

Building Clean-Energy Industries and Green Jobs

*Policy Innovations at the State
and Local Government Level*

By David J. Hess, David A. Banks, Bob Darrow, Joseph Datko,
Jaime D. Ewalt, Rebecca Gresh, Matthew Hoffmann,
Anthony Sarkis, and Logan D.A. Williams

Department of Science and Technology Studies | Rensselaer Polytechnic Institute



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Corrections

If you find inaccuracies or have corrections, please email them to David Hess at hessd@rpi.edu.

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Executive Summary

State and local governments have increasingly expanded their environmental and energy policies to become more integrated with job creation and economic development. The changes occurred before 2008, but they have been spurred by funding opportunities from the American Reinvestment and Recovery Act (ARRA) and the loss of manufacturing and other jobs that has occurred during the recession that began after the financial crisis of 2008. Policymakers are increasingly driven by a new, synthetic question: how can environmental and energy policies be configured to create new businesses and generate green jobs with the maximum impact and minimum expenditure?

Many states have a strong suite of “demand-side” policies for energy, that is, policies that encourage demand for renewable energy and energy-efficiency products. We argue that a successful state and local green-collar economy will require an equivalent suite of “supply-side,” that is, economic development policies that ensure that the green businesses are there to provide the jobs that are emerging in the green economy. In other words, state and local governments must carefully craft environmental and energy policies to coincide with economic development efforts so that both sets of policies work together to enhance the growth of clean-energy manufacturing companies and innovation clusters. If the policies succeed in creating a wide range of green jobs, from installation and service delivery to manufacturing to high-tech innovation and entrepreneurship, they will likely receive widespread and growing support from voters, industry, advocacy groups, and policymakers.

There are many existing reviews of state and local government “demand” policies for renewable energy, energy-efficiency, and related energy goals, but to date there has been no comprehensive overview of how those policies are connected with green business development and job creation at the state and local government level. Initiatives in American states and cities were analyzed in order to identify best practices that link environmental policies with the creation of clean-energy industries and jobs. The study tracked the following clean-energy industries: biofuels, smart-grid and building technologies, solar energy, electric/hybrid transportation and energy storage, and wind.



Our research then used the review of policy innovations to develop a composite for state and local governments to use as a benchmark to measure their own progress toward bridging sustainability and green job development policies. The policy recommendations emerged from our review of approximately thirty states and over twenty-two cities.

State Governments

A state government that is serious about creating green jobs must first have in place “demand-side” policies that create the underlying economic demand for renewable energy and energy-efficiency goods and services. The demand-side policies are all tracked in numerous reports, such as those of the National Renewable Energy Laboratory and the Database of State Incentives for Renewables and Energy Efficiency. We do not attempt to duplicate that work. Rather, we use that work as a starting point. To summarize, demand-side policies can be divided into two groups, general policies and building-related policies. Over half of the American states have a fairly well-developed suite of general policies that includes at least some of the following:

- a renewable electricity standard
- an energy-efficiency standard
- a renewable fuels standard
- a system benefits charge to support renewable energy and energy conservation programs
- net metering and interconnection policies
- decoupling of energy company profits from revenue growth
- greenhouse gas emissions reductions targets
- a feed-in tariff or related rate structure for renewable energy generation
- property-assessed clean-energy (PACE) bonds or (given that the fate of such programs has been restricted by national home-mortgage organizations) on-bill payment for energy-efficiency and renewable energy improvements

The second type of demand policy involves the greening of existing buildings and the construction of new buildings that meet standards such as those of the Leadership in Energy and Environmental Design (LEED) of the U.S. Green Building Council. The second set of demand policies are especially important because they create jobs in construction, retrofitting, and related building installation and maintenance industries, and the jobs can be tailored to the needs of cities and states with high levels of unemployment among relatively unskilled workers. (The term “retrofitting” is somewhat broader than “weatherization,” but we will use the two as synonyms.) There are at least five major types of demand policies at the state government level for green-buildings policies (beyond energy-efficiency goals and standards noted above):

- energy-efficiency building targets equivalent to LEED silver certification for new construction and major renovations of state-government buildings (e.g., New Jersey’s LEED silver requirements)
- system benefits funds oriented toward energy-efficiency and green-building changes (e.g., New York’s NYSERDA programs)

- requirements for commercial building owners to audit the energy efficiency of the buildings and reveal the results (e.g., Washington state's requirements for transparency)
- long-term mandates for the energy efficiency of private-sectors buildings through the building codes, including even zero-emissions codes for new buildings (e.g., California's zero-emissions building codes)

Our work reviews those two groups of demand policies, but our focus is on the other side of green jobs policies. We identify fifteen groups of “supply-side” policies for clean-energy business development, that is, policies to help spur research, manufacturing, technology innovation, business creation, and job training. The policies are also presented in the table at the end of the executive summary. The numbers in the list that follows correspond to the columns in Table One:

- (1) Identify, target, and roadmap specific clean-energy industries for development, based on existing research capacity and industrial strengths, and form industry-specific associations, programs, and initiatives to support the targeted industries (e.g., New York's Battery and Energy Storage Consortium).
- (2) Conduct supply-chain analyses and establish programs to help supply-chain manufacturers retool (e.g., Ohio's analysis of the wind industry).
- (3) Merge economic development policy (EDP) and energy policy (EP) functions into one department or set up an office and advisory group that coordinate economic development and energy programs (e.g., Michigan's Department of Energy, Labor, and Economic Growth).
- (4) Support with matching funds and grants clean-energy research institutes and programs in the state's universities, with technology transfer potential to targeted specific clean-energy industries (e.g., California's energy-related research institutes and programs).
- (5) Set up programs and consortia that facilitate communication on clean-energy research among the state's universities, national laboratories, and industry and that facilitate university-industry relations (UIRs, e.g., Colorado's Renewable Energy Collaboratory).
- (6) Support competitions that identify and support clean-energy entrepreneurship and that link potential businesses with investors (e.g., Massachusetts Ignite Clean Energy Competition).
- (7) Set up a technology park, incubator, test facilities, and other support structures focused on clean-energy business creation and development (e.g., Colorado's Clean Tech Incubator).
- (8) Dedicate tax credits, enterprise zones, and other incentives specifically for the attraction, retention, and creation of clean-energy companies that engage in manufacturing, refining, software development, and other clean-technology (e.g., Oregon's BETC).
- (9) Dedicate a single state-level organization (or a specified clean-energy staff and program within the state's economic development department) that assists in new clean-energy business growth and provides funding support from initial stages to scaling up stages (e.g., Massachusetts Clean Energy Center).
- (10) Allocate a portion of the state government's pension fund to in-state green business development, including new companies (e.g., New York's pension fund set-aside).

- (11) Establish standards or policies that require in-state production, such as in-state manufacturing for wind-turbine components and biorefining for in-state consumption of biofuels (e.g., California's in-state biofuels targets).
- (12) Target and set-aside state government economic development funds for programs that specifically support new business creation in specified clean-energy industries and use the funds to leverage federal government support (e.g., Michigan's NextEnergy and 21st Century Jobs Fund).
- (13) Project green jobs growth by industry, either by the state government or by an associated organization, so that training programs in the state are connected to the industry demand for green jobs (e.g., the Pennsylvania Department of Labor and Industry's 2010 Green Jobs Report)
- (14) Coordinate training programs and provide information that connects job seekers with green-jobs training programs (e.g., Ohio's Green Pathways program).
- (15) Ensure that green jobs are inclusive, provide pathways out of poverty, and provide training opportunities for persons with employment barriers (e.g., California's green jobs programs).

City Governments

For city governments, the general demand policies are less prominent than at the state-government level, but many cities have climate action plans with overall goals for greenhouse-gas reduction, energy efficiency, and renewable energy. Several cities have also established an office of sustainability to coordinate policies. In addition, cities often have a suite of policies that will spur the demand for services in the weatherization, retrofitting, building auditing, and construction industries:

- Establish LEED silver or gold standards for new construction and renovations of public buildings (e.g., Portland's LEED gold standards).
- Set a goal to power the city government's electricity completely from renewable energy (e.g., the city of Grand Rapid's 100-percent renewable energy goal).
- Develop green-building guidebooks and weatherization manuals (e.g., Philadelphia's manuals).
- Establish financial incentives through local electricity service providers to motivate green-building improvements (e.g., Austin Energy's programs).
- Establish a Property Assessed Clean Energy (PACE) bonds program, but given the delays as a result of federal policy, establish alternative financing mechanisms such as a revolving loan fund with on-bill payment (e.g., Portland's on-bill payment program).
- Facilitate a building deconstruction program for unused and abandoned buildings (e.g., Cleveland's deconstruction program).
- Establish a greening program for the port and other industrial districts (e.g., the Los Angeles program for greening the port).
- Establish a green impact zone for low-income neighborhoods (e.g., the Kansas City green-impact zone)
- Make available a free or inexpensive energy audit program (e.g., Austin's home energy program).

- Require residential buildings to have an energy audit before sale and commercial buildings to have an energy rating (e.g., Austin’s requirement).

As with the state-level analysis, we identified fifteen groups of “supply-side” policies that cities are using to encourage green business development and creation. Again, the numbers listed here represent columns in the table (see Table Two):

- (1) Develop a city sustainability plan or climate action plan that goes beyond urban greening and emissions goals to establish goals for green job development (e.g., San José’s green jobs goals).
- (2) Undertake a self-assessment of industrial strengths and set goals for clean-energy or clean-tech business development that are a realistic match with the regional economy (e.g., the Portland plan for industrial cluster development).
- (3) Develop a web site that identifies local green businesses for purchasing decisions (e.g., New York’s web site for green manufacturing that is “made in New York”).
- (4) Help to establish a strong local sustainable business association that has programs for local and small business greening (e.g., the Sustainable Business Network of Greater Philadelphia).
- (5) Host a national umbrella organization in a targeted clean-energy industry and/or regularly host national or international events for one or more clean-energy industries (e.g., Austin’s recruitment of Clean Technology and Sustainable Industries Association).
- (6) Facilitate systematic connections among local universities, government representatives, business leaders, and nonprofit organizations (e.g., San Diego’s Clean Tech Alliance).
- (7) Host an annual sustainability summit or advisory council that engages all stakeholders to link diverse urban constituencies for clean-energy business development (e.g., Cleveland’s sustainability summit).
- (8) Establish a clean-tech corridor or industrial park (e.g., the Boston clean-tech district).
- (9) Develop accelerated permitting and new zoning for clean-energy businesses (e.g., Seattle’s accelerated permitting).
- (10) Develop one-stop shopping for green business assistance, including marketing (e.g., Boston’s one-stop shopping).
- (11) Create links between new business ventures and capital (e.g., San José’s incubator and other programs).
- (12) Link local rail or renewable energy development to local manufacturing (e.g., Portland’s Oregon Iron Works).
- (13) Gather and disseminate information on diverse green job training options in the region, including outreach into high schools (e.g., New York’s information program).
- (14) Establish partnerships for green jobs training among the city government, community organizations, unions, high schools, and local educational institutions (e.g., the East Bay Green Corridor Partnership).
- (15) Work with local organizations to ensure that green-jobs programs include multiskill training for persons with employment barriers and youth at risk (e.g., Chicago’s multiskill training programs).

In summary, our research finds that in addition to the widely studied demand-side policies there is also a less well-recognized suite of policies that state and local governments can develop that help to strengthen local businesses that create green jobs. This report brings together

in one location the best practices of state and local governments in order to facilitate goal-setting and planning for a clean-energy transition that includes business development and job creation. Although not all of the policies can be applied in every state and local government context, the survey of policies provides many good ideas, often at a relatively low cost, for the greening of regional economies.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Roadmaps & targets	Retool supply chain	Coordinate EDP & EP	CE research programs	UIR consortia	Develop VC relations	Incubator, testing	CE manufacturing incentives	One-stop assistance	Pension fund set-aside	In-state manufacturing/ refining	Econ. Development CE set-aside	Plan & project training	Coordinate training	Make training inclusive
CA	X		X	X	X	X	X	X		X	X	X	X	X	X
CO			X	X	X		X								
FL	X			X	X	X	X			X	X	X			
IA	X		X	X	X			X				X			
IL			X	X	X										
MA			X	X	X	X	X		X					X	
MI	X	X	X	X	X	X	X	X	X		X	X	X	X	
MN	X		X	X		X									
NJ			X	X	X			X			X	X	X	X	X
NM	X		X		X			X			X		X	X	
NY	X		X	X	X		X	X	X	X	X	X	X	X	X
OH	X	X		X	X	X	X	X	X			X	X	X	
OR	X		X	X	X			X					X	X	
PA		X		X							X		X		
TX					X		X						X	X	X
WA	X				X			X			X	X	X		X
WI	X	X	X	X	X	X			X						

Table One: Fifteen Leading Supply-Side Policies for State Governments

Key:
 CE is “clean energy”
 EDP is “economic development policy”
 EP is “energy policy”
 VC is “venture capital”

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	<i>Green jobs in plan</i>	<i>Targeted CE Industry</i>	<i>Purchasing Policy</i>	<i>Local sustainable business association</i>	<i>Host events & organizations</i>	<i>University-industry relations</i>	<i>Engage stakeholders</i>	<i>Corridor and/or park</i>	<i>Accelerated Permitting</i>	<i>One-stop shopping</i>	<i>Business & capital link</i>	<i>Local manufacturing</i>	<i>Publicize job training</i>	<i>Training partnerships</i>	<i>Inclusive training</i>
ALBU	X										X		X	X	
AUST			X	X		X	X						X	X	
BOST	X		X	X			X		X	X					X
BOUL	X			X	X	X							X		
CHIC	X		X									X	X	X	
CLEV	X				X	X				X					X
DENV				X			X		X		X		X	X	X
GRR	X	X	X	X	X		X		X	X					X
LA	X			X	X	X	X	X		X	X	X	X	X	X
MILW	X				X	X	X	X			X		X	X	X
MSP	X	X	X		X		X	X	X	X		X			X
NWK	X	X			X				X	X	X	X	X	X	X
NYC	X	X	X	X	X		X				X	X	X	X	X
OAK	X		X	X		X	X	X		X	X	X	X	X	X
ORLN	X						X				X				
PHIL	X	X	X	X		X	X					X	X	X	X
PORT	X	X		X			X				X		X	X	X
SAND	X	X			X	X		X		X		X	X	X	X
SJSE	X			X	X		X			X		X	X	X	X
SACR					X	X							X	X	
SEAT							X						X		
SANF	X		X	X	X	X		X		X	X	X	X	X	X

Table Two: Fifteen Leading Supply-Side Policies for City Governments

Key:
CE is “clean energy”

Key to cities:
ALBU=Albuquerque, AUST=Austin, BOST=Boston, BOUL=Boulder, CHIC=Chicago, CLEV=Cleveland, DENV=Denver, GRR=Grand Rapids, LA=Los Angeles, MILW=Milwaukee, MSP=Minneapolis-St. Paul, NWK=Newark, NYC=New York City, OAK=Oakland, ORLN=Orlando, PHIL=Philadelphia, PORT=Portland, SAND=San Diego, SJSE=San Jose, SACR=Sacramento, SEAT=Seattle, SANF=San Francisco

Introduction

Consider two state government strategies. State government A designs energy policies that lead to high levels of long-term renewable energy production, but it does so by importing from other states and other countries most of its wind turbines, solar photovoltaics, electric and hybrid vehicles, biofuels, fuel cells, energy-storage technologies, smart-grid appliances, building-control technologies, light-rail and bus vehicles, and other clean-energy or green technologies. State government B has similar policies, but it also attends to the development of manufacturing companies that connect research strengths, technological innovation, and business development. By 2050, both states have achieved the laudable goal of an 80 percent greenhouse gas emissions reduction below 1990 levels. But State B has a sizzling innovation economy with high wages and a vibrant culture of innovation, whereas State A imports most of its green technology and ends up, in effect, as a green colony of states like State B. In short, State A has failed to reap the benefits of high-wage innovation jobs and profit retention from new business development.

It is no longer enough for a state or local government (let alone a federal government) to have a plan for clean-energy, climate change, or sustainability. Initiatives with an environmental goal must also be connected with plans to develop the regional economy in order to ensure that it prospers in the transition to a low-carbon economy. To do so, the state government must go beyond policies that support energy-efficiency and clean-energy generation to the creation of high-technology businesses that generate jobs that produce the underlying technology. One way to do so is to recruit manufacturers of clean-energy technology to locate in the state. The recruitment of manufacturers is widespread among some state governments, especially for the wind turbine industry. However, it is not enough to attract a group of manufacturers in the state. When demand conditions and incentives change, the companies will consider locating elsewhere or reducing production in their host state. Instead, states and cities need to develop the clusters of research, industrial networks, capital pools, and business services that make a region an attractive place to stay.

Manufacturing is a crucial piece in an overall green jobs framework. Manufacturing jobs highly desirable for workers, but they also are essential for an innovation economy because they enable the upstream work of design and innovation to connect with problems of cost, scale, and customer needs. However, in some clean-energy industries there is already formidable competition from abroad. For example, 75 percent of the components of photovoltaics and 50 percent of the components of wind turbines are estimated to be produced abroad (Mayrl et al. 2010). For that reason, strong policies are needed to overcome hurdles to domestic manufacturing and to make manufacturing in the U.S. attractive to companies. Those policies have already made some progress in the manufacturing of batteries and wind turbines. Likewise, domestic manufacturing remains strong in the biofuels, electric vehicles, fuel cells, and building materials industries.



As organizations such as the Apollo Alliance have argued, a green-jobs framework should include not only the construction, weatherization, and maintenance positions but also the often better-paying jobs in manufacturing, refining, and technology innovation. By thinking about energy and economic development policy together, cities and states can ensure that regional economies are centers of clean-tech innovation, so that there are career ladders from the lower-skill and lower-wage jobs to the better green jobs. This report explores how to do that: to think about both energy policy and economic development policy in ways that create a full range of green jobs.

The “Green Jobs” Frame for Policy Innovation

The levels of unemployment and government budget deficits since the onset of the Great Recession in 2008 have spurred state and city governments to become deeply concerned with finding jobs for the unemployed and helping to develop new businesses in their regions. Those concerns intersected with growing awareness that reliance on fossil fuels is generating both environmental risk for the planet and (in the case of foreign oil) security risks for the country. Political, business, and civil society leaders have responded to the intersection of concerns by rallying in favor of green job creation, especially in industries that produce domestic, clean energy or lead to new energy-efficient designs. As a result, cities and states that had previously developed sustainability initiatives are expanding their efforts to include green business development, job training, and job creation. At the federal government level the American Recovery and Reinvestment Act of 2009 (ARRA, also known as the “stimulus” package) included significant investments in clean technology and green jobs development that helped spur local programs through competitive grants.

By framing the promise of green economy transition as an opportunity to create good, green jobs, new political coalitions can be forged and sources of support to be tapped from diverse constituencies:

- For elected political leaders during a recession, it addresses the problem of unemployment and popular demand from voters for job development.
- For environmentalists, it diversifies political support for environmental policy reforms.
- For educational and research organizations, it offers new opportunities for research funding and curriculum development.
- For advocates of low-income neighborhoods, it offers the potential of job training, new jobs, and cost reductions on home energy bills.
- For business leaders and entrepreneurs, it offers new areas of investment in a rapidly growing industry.
- For labor and hourly workers, it offers new opportunities for work, including potential jobs in manufacturing and the skilled service sectors.
- For the small business community, it offers new prospects for service-sector employment and energy-based cost reductions.

Part of the political attractiveness of “green jobs” is that it is a wide tent where many constituencies can gather, ranging from antipoverty constituencies that want job training for

persons with employment barriers to high-tech venture capitalists and entrepreneurs. Although significant differences exist among the various constituencies over what the clean-energy transition should and should not entail, there are also opportunities for new areas of consensus to be forged, and the frame of “green jobs” provides one such opportunity.

If “green jobs” is the frame that enables successful new policies to be forged, what exactly does that frame entail? There are many definitions of green jobs, and those definitions change according to circumstance. One broad approach noted that green jobs range from entry-level to advanced positions in at least ten sectors: energy, water, green building, woodworking, green space, food, transportation, nontoxic printing, nontoxic cleaning, and waste stream diversion (Pinderhughes 2007). Entry-level jobs include construction and installation, whereas more advanced jobs include the work of electricians, engineers, managers, and even business founders. To give an example from the green-building sector, jobs such as building weatherization have been linked to longstanding programs of job training for persons with employment barriers, whereas at the high-tech end of the job spectrum, there are opportunities for new technology companies that address building system controls and appliance connections with emergent smart-grid technologies.

Another way to break down the category of green jobs is by type of occupation rather than industrial sector. A study of green jobs in California broke them down into fifteen categories, with most jobs in services (54 percent), manufacturing (20 percent), and supplier and installation businesses (16 percent). There were smaller numbers in research, development, and education, but those jobs were often higher paying (Next10 2009a). In the state of California for the years between 1995 and 2008, green jobs grew at a rate of nearly three times the average growth rate for all jobs in the state, and the industry of “core” green jobs was estimated to be 159,000 people in 2008. Benchmark comparisons included 52,000 jobs for the biotech industry and 220,000 jobs for the software industry (Next10 2009b). The largest sectors of green jobs were green transportation (including biofuels), energy generation, and air and environment (environmental consulting and emissions monitoring)

A study at the national level by the Pew Charitable Trusts (2009) focused on the subset of green jobs known in the “clean-energy” sector. The report use relatively narrow criteria that resulted in a definition of 770,000 jobs at the national level, which compared with about 1.2 million jobs in the fossil-fuel industries. As for the California data, the statistics showed that overall green jobs were growing at a rate of 9.1 percent per year between 1998 and 2007, in comparison with 3.7 percent for other jobs. The Pew Charitable Trusts researchers broke down the jobs into five categories for the period 1998 to 2007: clean-energy generation and maintenance (11.6 percent of the total of clean-energy jobs and growing at a rate of 23 percent); energy efficiency (9.5 percent with an 18 percent growth rate); environmentally friendly production, including biofuels, hybrid-vehicle manufacturing, and construction (7 percent and growth with a 67 percent growth rate); conservation and pollution mitigation, including remediation, recycling, and waste and water treatment (65.1 percent and growing at a rate of only 3 percent); and training and support (6.8 percent, and growing at a rate of -.3 percent). The general result was that clean-energy jobs were growing rapidly but unevenly, and growth in the sector was driven primarily by clean-energy, energy efficiency, biofuels, and manufacturing.

Those jobs were growing much more rapidly than the larger sector of conservation and pollution mitigation jobs.

Our primary focus in this study is on the rapidly growing sectors of clean-energy jobs. Specifically, we focus on the five industry groups of biofuels, smart-grid and building technologies, solar-energy design and manufacturing, transportation manufacturing and energy storage, and wind turbine manufacturing. The green jobs reports by Next10 and Pew Charitable Trusts suggest that the five industry groups have the potential for ongoing rapid growth, but they are also of interest because they are sources of industries that combine the potential for technological innovation, domestic manufacturing, and potentially also export revenue. Our choice is based on the assumption that a good state government policy will ensure that there is a wide range of green-collar jobs and that potential career ladders exist from low-skilled, entry positions to the more highly paid positions in manufacturing and technology development.

A Broad Economic Development Approach

This study builds on an excellent base of existing studies and databases that track state and local government policies for clean energy, energy efficiency, and related environmental reforms. There are web sites maintained by the U.S. Department of Energy, Environmental Protection Agency, Database of State Incentives for Renewables and Energy Efficiency, and National Renewable Energy Laboratory. There are also very well-researched reports by the Apollo Alliance, Network for New Energy Choices, Pew Charitable Trusts, and other organizations. Together, the reports point to the base of environmental and energy policies that should be in place to ensure that state and local economies are well-positioned for success in the green economy transition. Examples include the many “demand-side” policies that create the conditions for steady demand growth in renewable energy, clean-energy, and energy-efficiency technologies and products. We suggest that the base is necessary but not sufficient. As with some of the more specific Apollo Alliance reports, our report explores the next level of policies and programs that should be in place as well.

The broad economic development strategy suggested here involves creating innovation clusters. A cluster is a group of related businesses and research organizations (such as universities) that are connected with associated service organizations, capital pools, and government agencies, often through a trade association or government initiative. There is no general agreement on the geographical scale of a regional cluster, but one common definition is that businesses need to be within commuting distance of each other in order to enable people to shift jobs and have frequent contact. The information-technology industry of Silicon Valley is probably the most famous example of a cluster. We tend to focus more on a related concept of in-state industries, which sometimes are more geographically dispersed within the state. Businesses that are headquartered in the state are very valuable because they retain essential, high-end functions in the state (such as research, development, design, and marketing). We recognize that manufacturing is often global in scale and that costs are often lower in other countries, but companies also likely to retain some manufacturing close to their research and development facilities. Successful clusters require a vibrant base of research, adequate sources of capital (including state government funds), related industries that can be transformed into the

new industry, an adequately trained workforce, supporting service industries, local demand, testing facilities, adequate capital, and many other features that are discussed in the regional innovation literature. When clusters are successful, it is easier to recruit not only manufacturing facilities but also corporate headquarters, and it is easier to retain existing companies because of their location as part of a vibrant network of innovation.

In many cases state governments have played an active role in facilitating the development of new clean-energy businesses. They have also leveraged existing industrial strengths, such as the following:

- automotive manufacturing for energy storage, electric and hybrid vehicles, fuel cells, and wind-energy components (especially in Michigan, Ohio, and South Carolina)
- biotechnology for next-generation biodiesel and ethanol (especially in California, the upper Midwest, and Massachusetts)
- information technology for smart-grid technologies (in California and Washington)
- semiconductors and advanced materials for photovoltaics and fuel cells (in California, Ohio, and the Northeast)

Although California is strong in most industries, there are also significant innovation clusters emerging in many other states. States with more limited resources but a good base of related-industry strength have also done exceptionally well by targeting specific industries for development, such as the photovoltaic cluster in northwestern Ohio.

Demand-side policies can also be configured to help the local innovation clusters. For example, some states are already establishing incentives and goals for in-state or regional production of biofuels. State government policies can also create favorable demand characteristics by establishing preferences for procurement policies for in-state companies. Likewise, tax credits and other policy instruments associated with renewable energy goals can be used to favor wind farms that utilize in-state manufacturing components, as has occurred in Michigan.

By thinking through the connections among long-term energy policies, the development of clean-energy innovation clusters, and the potential for the vertical integration of good green jobs from energy production to manufacturing and innovation, opportunities can be recognized and policies can be designed with multiple objectives in mind. If the policies succeed in creating a wide range of green jobs, from those of the high-tech innovation clusters through service-delivery positions, they will likely receive widespread and growing support from voters and their representatives.

Method

This report provides an overview of some of the best-practice initiatives at the state and local government level in the U.S. as of 2010. The goal was to develop a composite “best practice” model of state and city government initiatives that can serve as a benchmark. Although we understand that each state and city is unique, this report provides the first comprehensive look at what the leading states and cities are doing to build green businesses.

To begin, the lead author surveyed policies in all fifty states and made a selection of thirty states with the most advanced supply-side policies for clean-energy industries. As the project developed, seventeen states were studied in more detail and fourteen states were reviewed in a summary way based on Internet sources (covered in a section called “other states” for each region). Over twenty metropolitan regions (about twenty-five cities) were also selected for more detailed analysis.

States and cities were selected on the basis of evidence for high levels of policy innovation oriented toward the creation of clean-energy industries and green jobs. Attention was given to regional diversity so that there was some discussion of efforts in each of the four major geographical regions of the U.S.: the Midwest, Northeast, South, and West. Some of the cities that routinely are listed at the top of urban sustainability rankings do not appear, because they had not developed significant or innovative policies associated with green jobs in clean-energy industries. For example, Washington, D.C., is well-known for its many green buildings and its green jobs training programs, but it is not a center of clean-energy manufacturing or technology innovation.

There are various definitions of clean, green, renewable, and other terms associated with the topics covered here, and there are also many debates and criticisms about what should or should not be included as “green” versus “green-washing.” The weatherization and building efficiency initiatives are probably the least controversial for designation as “green” technologies, because they result in a reduction of emissions and energy use, and they also can be configured to address issues of low-income energy and job needs. At the other extreme, the corn-based ethanol industry is probably the most controversial, because the corn-based technologies currently in use have a low energy return on investment and have impacts on local environments and food prices. However, future technologies such as cellulosic ethanol may address some of the concerns, and it is clear to almost everyone that corn-based ethanol is a bridge technology. We decided not to limit prematurely what would or would not be included as a “clean” or “green” industry; rather, we follow the usages and frames as developed by policymakers. Our focus is less on the complex technological issues such as ecological footprints, rebound effects, and overall sustainability than on the efforts to connect green jobs with new industrial development. However, within the broader clean-tech sector we did focus on clean-energy industries, and within that category we looked at industries that have the potential to generate good jobs in manufacturing, technology innovation, and biorefining. As a result, our coverage of industries for each state was focused on biofuels, smart-grid and building technologies, solar, transportation and energy storage, and wind.

The research method is based on the qualitative analysis of case studies. We refer to quantitative indicators frequently and build on the many studies with quantitative analysis, but our method enabled us to focus more on the institutional constraints and practical problems of developing policies that create green jobs. Our goal was to develop a holistic picture of policies in specific states and cities, and to use that picture to identify policy innovations. The inventory is intended to be of use for policymakers and advocates in the private sector and civil society. Because civil society advocacy (from labor, environmental, social justice, and other organizations) sometimes plays an important role in developing the political will for policy

reforms, we have also tracked the role of civil society organizations in the policies. Likewise, at the city level we have also tracked cases where civil rights, urban poverty, and related concerns have fed into green-jobs policy initiatives.

Cases were assembled based on preliminary reading of information available from state and local governments, business associations, press accounts, civil society reports, and other reports. The preliminary cases were then fleshed out by interviews conducted by graduate students during a summer training session that provided them with background readings in related social science topics and hands-on experience in conducting semi-structured interviews. Interviews involved people in government, civil society, or other organizations who were knowledgeable about the green jobs initiatives in their region. Each student research assistant was responsible for two of the main case studies (a state and a city). One student was assigned entirely to cities California, with assistance on state-government policies from the lead author. Six cities from California were selected (four for detailed analysis with interviews) because of the high level of achievement by California cities in developing clean-energy industries. After developing preliminary case studies based on publicly available sources, the researchers followed up with a total of about fifty interviews and email contacts. In addition, we attended over fifty conference presentations related to the case studies.

Our overarching research question is the following: how can energy and environmental policies be coordinated with policies that also create businesses that produce green jobs? The interviews focused on five main questions, which were made more specific for each interviewee:

- With respect to green jobs and green industry, what unique laws or programs in your city and state are models for the rest of the country?
- What additional policies would you like to see at the state, federal, and local government levels to facilitate the growth of green jobs?
- What problems of financing do existing and proposed programs face, and what kinds of innovation have you seen in the structuring of financing for the policies and programs?
- What would you say is the source of the strongest opposition or greatest hurdle to developing more green jobs?
- How important have problems of urban poverty and unemployment been for green jobs policies in your state and city?
- For civil society organizations, what role has your organization played in developing green jobs legislation and initiatives in your state and city?

Overview of the Case Study Categories

Although the primary focus of this study is policies directed toward generating clean-energy industries and jobs, some background information on demand policies and green jobs training programs is provided. For state governments, we collected background policy information on four general areas: energy policy goals, public benefits funds, green-buildings policies, and green jobs training. Then we tracked policies oriented toward general green business development and development in the five selected industries. For city governments, we

collected background policy information on four areas: sustainability plans, green-buildings policies, green jobs training, and green business initiatives.

With respect to the background policies, a few definitions may be helpful. A renewable portfolio standard is a percentage of energy, generally electricity, that is produced with renewable energy. The definitions of renewable energy vary by state, and some standards include a “set-aside” that specifies subcategories such as solar energy. Some states also have a broader category such as “advanced energy.” A public benefits fund is a general fund that supports energy efficiency, renewable energy, and/or low-income energy assistance. The funds generate demand for clean-energy industries, and occasionally they provide financial support for businesses and researchers. They are generally supported by a surcharge on ratepayers’ utility bills, and in the Northeast some are also supported with funds from the Regional Greenhouse Gas Initiative. With respect to building policy, most states have building codes, but they are not reviewed here. Instead, the focus is on innovative policies that support green building job creation, such as energy-efficiency standards for buildings. With respect to green jobs programs, nearly all states received \$5-6 million dollars of federal funding for green jobs training programs in 2009 and 2010 under the American Recovery and Reinvestment Act (ARRA, State Energy Sector Partnership and Training Grants, U.S. Department of Labor), and some states received more.

The result of our research is the first comprehensive guide at the state and local government level for policymakers, industry leaders, and civil society leaders who wish to build a green-economy transition that creates a full range of new green jobs. We hope that this study will provide policy advocates and leaders with a valuable resource that enables them to compare their policies to those in other cities and states.

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State Governments and Green Jobs

State governments have played an increasingly prominent role primarily in creating and supporting industries that provide green jobs. Often their new policies build on previous generations of environmental policy, but increasingly environmental and energy policy is being connected with business development and job creation. Although there are many surveys of environmental policies at the state government level, the existing literature has not explored systematically policies that have the goal of the creation of clean-energy industries and green jobs. This chapter presents a summary of our results for the state governments by reviewing policies with four main goals: to create or spur demand for clean-energy industries, to encourage the greening of buildings, to develop clean-energy industries, and to train people for green jobs.

General Demand Policies

State governments have access to a fairly well developed suite of policies that can be used to develop clean-energy generation. The policies generally emerged after the wave of environmental policies that began with environmental remediation during the 1960s and 1970s. By the 1990s state governments had become increasingly concerned with climate change and greenhouse gas emissions. Thus, the general policies are not directly aimed at economic development, but they do create general demand that leads to green job creation.

Foremost among the demand policies is the renewable portfolio standard or renewable electricity standard, which as of 2010 could be found in twenty-seven states. The standards vary considerably, and at the weaker end they are little more than voluntary targets, but in states that have a renewable electricity standard the policy generally involves a requirement that the state's utilities must generate a percentage of their electricity from renewable energy. Sometimes the standard is more openly defined to include "alternative" or "advanced" sources of energy, and some of the inclusions are environmentally controversial. For example, the second tier of Pennsylvania's "alternative" fuel standard includes waste coal.

The more aggressive standards have a short-term goal coupled to a longer term goal of about 20 percent renewable energy by 2020 and 25 percent by 2025. There is also some competition among states to set the most aggressive renewable portfolio standard. For example, in 2008 California's Governor Arnold Schwarzenegger increased the renewable portfolio standard with an executive order (S-14-08) that required 33 percent renewable energy sources by 2020, and in 2010 Colorado boosted its renewable energy standard to 30 percent by 2020. The highest levels are projected into the more distant future. For example, in 2010 the State of New York was engaged in an extensive climate action planning process based on the goal of 80 percent renewable energy by 2050. Although long-term planning has significant value, to be effective it must be connected with more proximate goals. Of those, the 2020 goals may create an appropriate mix of pressure and planning.

Some states also include a set-aside for particular types of energy. For example, Nevada requires 5 percent of its electricity to be generated from solar energy, and New Jersey has a 2.5 percent solar set-aside. Although the energy produced from solar could come from outside the state, the set-aside provides an additional boost to the state economy because it tends to stimulate the local service installation and maintenance industry for distributed generation and local solar farms. Michigan's state government has expanded on the idea by providing an additional incentive in its renewable energy portfolio that rewards renewable energy producers who utilize equipment manufactured within the state. Because much of the new renewable energy produced from the state's 2008 renewable portfolio standard is from wind energy, the goal is to utilize the development of wind farms to stimulate the state's wind manufacturing industry. The hope is also to convert some of the automotive supply-chain manufacturers to manufacturing for wind-turbine components.

A similar approach has been taken for biofuels. Several states have introduced renewable fuels standards that enhance the national standard, and some governors have pushed for an increase in the national renewable fuels standard to 15 percent ethanol. Minnesota has led the country with a 10 percent minimum of ethanol in gasoline in 1997 and then a 20 percent minimum in 2005. In 2007 the Midwestern governors joined in an effort to coordinate their energy goals under the Energy Security and Climate Stewardship Platform. The policy goals included expanding the availability of E85 ethanol (a blend of 85 percent ethanol), accelerating the conversion to cellulosic ethanol, reducing the level of fossil fuel used in the production of biofuels by 50 percent by 2025, and having 50 percent of all transportation fuels in the Midwest based on regionally produced biofuels by 2025. If enacted, the policies would provide ongoing demand for biofuel production that would be mostly produced in the region. By replacing purchases of foreign oil with regionally produced ethanol, local jobs are created in both the agricultural and refining industries. Although corn-based ethanol has many environmental and social problems, the next generation of cellulosic ethanol will address many of the problems.

Another state-level policy that enhances demand for clean energy is based on caps for carbon emissions limits and a trading scheme for rights to produce carbon. As of 2010 only the Northeastern states had implemented a regional trading scheme. Known as the Regional Greenhouse Gas Initiative, the policy consisted of a cap-and-trade system for carbon dioxide emissions for the six New England states, Delaware, Maryland, New Jersey, and New York, with Pennsylvania as an observer. The implementation began in 2009 and was predicted to result in a 10 percent decrease in carbon dioxide emissions by 2018. Although the environmental impact of cap-and-trade systems is questionable due to the many loopholes, the system is effective at generating revenue for the state governments, and the states must invest 25 percent of the revenue in energy-efficiency and related energy programs. After one year, the program had raised \$433 million of badly needed revenue in the midst of the Great Recession that began in 2008. Unfortunately, due to the budget crises of the Great Recession, in some cases money has been siphoned from the greenhouse gas auctions to cover state government budget deficits.

By 2010 other regions and states were also planning carbon trading schemes. California developed a general policy framework for reducing greenhouse gas emissions and shifting electricity production to greener sources. Under the 2006 Global Warming Solutions Act (AB 32), the state government established a timetable for bringing greenhouse gas emissions to 1990

levels and charged the California Air Resources Board with preparing plans for its implementation. Under the Western Climate Initiative, California planned to join with other Western states and some Canadian provinces to implement a cap-and-trade system for carbon dioxide emissions that was scheduled to begin in 2012. In the Midwest in 2007, the governors and premier of Manitoba signed the Midwestern Greenhouse Gas Accord, which was a first step to a regional cap-and-trade system. In 2008 the state of Florida approved HB 7135, which authorized the state's Department of Environmental Protection to develop a cap-and-trade program and a plan to reduce greenhouse gas emissions in the electricity sector to 1990 levels by 2025. The proliferation of regional and state-level systems was likely to motivate carbon producers to support a national system, which would standardize the rules but potentially also weaken the state and regional policies.

To support the policies that favor greater renewable energy consumption, states often launched a series of other policies that more directly supported renewable energy production. By 2010 there was a wide range of grants, tax credits, rebates, and other incentives available. In addition to policies that favor renewable energy production, a significant area of state government policy was focused on developing building efficiency and alternative transportation. A few states have also passed legislation that supports the decoupling of utility profits from energy-efficiency goals. Some of the policies involved changes in state government purchasing, such as goals for increased levels of alternative-fuel vehicles in state government fleets and for energy-efficiency improvements to public buildings. Another group of state government policies involved information provisioning and technical requirements. The following list of technical and informational policies provides a sense of the range of initiatives that increase demand for renewable energy:

- contractor licensing, which ensures the qualifications of installers;
- renewable energy equipment certification, which ensures the quality of the equipment, such as photovoltaic panels;
- utility disclosure policies, which require utilities to inform customers of the fuel source mix and emissions;
- interconnection standards, to facilitate distributed energy connection to the grid;
- line extension analysis, which requires utilities to analyze on-site energy production as an alternative when a customer requests service for a facility that is not connected to the grid;
- requirements that utilities offer customers a green-power pricing option;
- net metering, or the use of a bidirectional meter that allows customers who produce electricity to add it to the grid when they have an excess and to withdraw electricity from the grid when they have a deficit;
- minimum appliance efficiency standards for appliances not covered by federal standards; and
- renewable energy access laws, which prohibit new construction from blocking sunlight and allow customers to install distributed wind and solar facilities.

This group of policies helps utilities, energy producers, and customers to overcome the many technical and informational hurdles that they can face. States that had managed to put most of the policies in place and to establish leadership as the first to implement the policies developed a reputation that was helpful in recruiting and retaining clean-energy businesses. The most

comprehensive record of demand-side policies at the state government level is available at the Database of State Incentives for Renewables and Energy Efficiency.

It should be noted that many demand-side policies do not represent a direct drain on state-government revenues. The issue became especially important as the impact of the Great Recession hit state-government budgets in 2009 and 2010. Some policies, such as net metering and building codes, involve setting standards. Others can be funded with a system benefits charge on ratepayers' utility bills or with revenues from regional carbon-trading systems. Direct-incentive programs paid with general funds are the most vulnerable to budget cuts. Increasingly, state governments have turned from grants to tax credits or revolving loan funds. (A revolving loan fund has a pool of capital that is replenished from loan payments and then loaned out for future loans.)

A significant policy innovation is the property-assessed clean-energy (PACE) bond. Over two-dozen states have enacted legislation, but it is generally up to cities to implement the programs with revenue bonds. PACE financing enables building owners who want to invest in energy efficiency or distributed renewable energy to reduce risk in the event that they must move, because the investment stays with the building until it is paid off. With utility rebates and rebates from the state and federal governments, building owners end up paying a price over a twenty-year period that approximates the cost of buying electricity from the grid, but in the long-term they own the energy improvements for their buildings. A similar approach involves an up-front investment from the utility that is then paid off over time with an incremental increase on the monthly utility bill. Although PACE financing was held up as we went to press due to restrictions initiated by Fannie Mae and Freddie Mac, on-bill financing was going ahead.

Green-Buildings Policies

Policies for green buildings represent another aspect of demand-side policies that are particularly popular because they are considered the “low-hanging fruit” of demand policies. Improvements such as weatherization, energy-efficient light bulbs, and small changes in building temperatures can result in rapid savings that often pay back any investments in a relatively short period of time. Weatherization programs are especially attractive because they can generate jobs for the unemployed who lack a broad skill set that could enable them to transition to high-tech jobs. Training for jobs in weatherization and the somewhat broader category of retrofitting are valuable because they can provide employment to the unemployed and a step toward a pathway out of poverty. In 2009 and 2010 there was federal funding for the programs through the American Reinvestment and Recovery Act. Used widely and with revolving loan funds, a limited up-front pool of capital can be made to last over a long period of time.

State government policies with respect to building efficiency can be divided into those for state government buildings and those for residential and commercial buildings. With respect to the former, since 2000 several governors have issued executive orders that mandated energy efficiency in state government buildings. Examples include a 20 percent reduction in energy use in California and Colorado, 10 percent reduction in Minnesota together with requirements to purchase energy-efficient office equipment, and a 35 percent reduction in building energy

consumption in New York. In addition to building efficiency targets, many states also have guidelines for major renovations and new construction of state government buildings. The guidelines vary, but the most aggressive ones are generally set at the level of a “silver” rating—that is, a rating below gold or platinum—using the “LEED” (Leadership in Energy and Environmental Design) standard of the U.S. Green Building Council.

In addition to setting standards for public buildings, state governments have also developed programs for assisting in the financing of building improvements. For example, in 2005 New Mexico passed the Energy Efficiency and Renewable Energy Bonding Act, which enabled state agencies and public schools and colleges to fund building improvements and repay them with savings. In the same year the state also passed the Renewable Energy Bond Act, which finances schools and universities that add renewable energy installations.

Whereas the programs and policies for government buildings often involve hard targets with mandates, those for residential and commercial buildings generally provide incentives for building efficiency programs or distributed energy installations such as rooftop solar energy. Over half of the states have a system benefits charge on utility bills that funds programs for residential and commercial buildings. Some funds are quite substantial, such as the initiative developed in Massachusetts to employ \$1.6 billion for weatherization and energy-efficiency programs.

The states of Washington and California have developed policies of note in this area. In 2009 the state of Washington passed the “Efficiency First” legislation, which required that the utility companies keep records of the energy consumption of commercial buildings. Although the legislation did not involve a hard mandate that required owners of commercial buildings to install energy-efficiency improvements, it created the conditions of reporting that motivate and reward such improvements. The law also tightened building codes to require buildings to shift gradually from 2013 to 2031 to achieve a 70 percent improvement in energy efficiency. California has a goal of net zero energy for new residential homes by 2020 and for commercial buildings by 2030. Although the definition of “net zero energy” is not straightforward, the goal is to have enough rooftop solar and energy-efficiency measures to enable the house to contribute as much electricity to the grid as it withdraws.

To summarize, state government policies for green buildings generally begin with targets for state government buildings. However, several states have also extended the policies to include residential and commercial buildings. It is difficult to utilize mandates for residential and commercial buildings, because unfunded mandates trigger a backlash, but the California regulations suggest that they are politically possible for new home construction, and the Washington mandates suggest that building codes can be tightened over the long term. In general, one of the primary policy instruments is an incentive program, which can be funded from system benefits charges and revolving loan funds. Private-sector policies can meet with stiff resistance if they require energy-efficiency improvements in existing buildings but do not provide funds to support the improvements. As a result, the policies tend to move in the direction of transparency rules, which do not require but motivate building owners to improve efficiency, and long-term codes for new construction.

There is potential to connect the service sector of weatherization, green building construction, and building efficiency improvements with local manufacturing, and the potential is significant because manufacturing for some of the building-related industries (windows, doors, insulation, caulking, and so on) tends to be domestic, in contrast with other clean-energy industries such as photovoltaic manufacturing. However, to date there is very little in the way of state government policies intended to promote a building materials manufacturing industry. There is an emergent green-building cluster in Oregon, New York has strengths in the building systems controls industry, Pennsylvania has an inventory of green-building manufacturing, and the states of California and Washington are home to many of the new smart-grid companies. In other words, there is considerable potential to develop the building efficiency industry from a service-and-construction sector to a manufacturing cluster via comprehensive policies that link the local manufacturing industry with green-building initiatives. However, as of 2010 that potential was largely unrealized.

Manufacturing and Business Development

From a green-jobs perspective, both the general demand-side policies and the green-buildings policies generate green jobs in construction, installation, and maintenance for renewable energy generation (such as wind farms) and building construction and renovation. From the statistics cited in the introduction, it is likely that there will be more jobs in this sector than in manufacturing and technology. As a result, we do not want to underestimate the importance of demand-side policies in generating green jobs. However, our study also points to opportunities to develop green jobs in the related manufacturing, refining, and high-technology industries. Examples of this second type of green job include wind turbine and solar panel manufacturing, rail and vehicle manufacturing, green building materials manufacturing, biofuel refining, and businesses associated with clean-energy funding and start-ups. Although a state government may import its photovoltaics, wind turbines, steel rails, electric vehicles, building materials, and even its biofuels from other states or other countries, the state can also use the green transition as an opportunity to generate the often better-paying positions that have higher economic multiplier effects.

Some might argue that green manufacturing jobs are not that important. At about 13 million of 150 million total jobs, manufacturing represents a relatively small proportion of the American economy today. The sector employs fewer people than health care (16 million jobs), state and local government (20 million jobs), and business and professional services (18 million jobs). Likewise, manufacturing is also a relatively small proportion of green jobs (about 20 percent in the California green jobs study discussed above; Next10 2009).

However, manufacturing is important for several reasons. First, it is a fast growing part of the clean-energy jobs sector. Second, although the manufacturing sector only represents about 12 percent of the gross domestic product of the U.S., each manufacturing job generates over two additional jobs and four additional jobs in some industries. In contrast, a job in the retail sector generally generates only one additional job, and a job in the service sector generates 1.5 additional jobs. The powerful multiplier effects for job creation through manufacturing lead some to argue that it is the motor of the economy. Third, manufacturing is also a source of export

revenue. Even when some manufacturing is shifted to foreign countries, profits return to the headquarters of the company in the U.S., where high-end jobs in marketing, finance, engineering, design, and research are often retained. Of course, the older forms of labor-intensive, low-tech, assembly-line manufacturing, such as for mass-produced clothing, are no longer viable in the U.S. As a result, manufacturing is increasingly tied to high-tech, capital-intensive industries that must continually innovate to retain a competitive edge. To maintain that competitive edge, it may be a bad idea to assume that research and development can be located in the U.S., and manufacturing located abroad. The issue leads to the fourth main reason why manufacturing is important: having at least some manufacturing close to research and development teams strengthens that upstream work because it provides opportunities to link design innovation to cost, scale, and markets.

All of the states that we studied had programs of incentives and tax exemptions to support business recruitment and retention, but programs specifically directed toward clean-energy business development and especially manufacturing were not as widespread. This section will focus on specific state funds that have the goal of supporting the development of green or clean-energy businesses in manufacturing. More details can be found in the chapters that follow for each state. Most of the policies do not explicitly separate service businesses from manufacturing, but the primary target is generally high-technology clean-energy businesses in manufacturing, software, or biofuels refining.

Overall, the U.S. lost an estimated five million manufacturing jobs between 2000 and 2010, and ground zero has been the automotive industry and other manufacturing in Michigan and neighboring Midwestern states. As a result, the states have moved especially aggressively to develop new businesses. For example, the state government of Michigan founded the nonprofit organization NextEnergy, capitalized with \$30 million in seed funding from the Michigan Economic Development Corporation. In turn the clean-energy efforts are part of the larger, \$1 billion 21st Century Jobs Fund. The organization facilitates the commercialization of new energy technologies and has supported business development in the biofuels and electric vehicle industries. Like Michigan, Ohio has also moved aggressively to support its manufacturing sector. The state established Ohio Third Frontier to spur the high-tech sector and stimulate cluster developments. The program was part of the state's Department of Development and had a budget of \$1.6 billion over ten years (funded by a bond issue) that included support for clean-tech industries, with an emphasis on fuel cells and other advanced energy projects. One of the program's great success stories has been its support of Toledo's transition from a window-glass manufacturer to a leader in the photovoltaics industry. Ohio Third Frontier also supports the use of the automotive supply chain to develop wind turbine component manufacturing and battery technology. The program has been so successful that a voter referendum recently reauthorized the program for another four years and \$700 million.

The solar industry cluster in northwestern Ohio is a good example of how a targeted state-government investment that builds on an existing industry and strengthens research capacity can create new jobs in technology development and manufacturing. The states of Massachusetts and New York are especially interesting in this regard. In Massachusetts, the 2008 Green Jobs Act transferred various initiatives that supported the clean-energy sector to a single organization, the Massachusetts Clean Energy Center. The organization is a model of how a state

government can integrate initiatives that involve energy generation projects, business development, and green jobs training. In New York the efforts to support the state's clean-energy industries are divided largely between the New York State Foundation for Science, Technology, and Innovation (NYSTAR), which supports high-technology economic development in the state, and the New York State Energy Research and Development Authority (NYSERDA), which is funded mainly by a system benefits charge and regional greenhouse gas initiative revenues. Although NYSEDA's programs are mainly demand-side programs for renewable energy and energy efficiency, the organization also has formed partnerships to help spur clean-energy business development. For example, in 2009, one of the NYSTAR centers, the Center for Economic Growth, entered into partnership with NYSEDA and the University at Albany to fund clean-energy and other environmental-technology companies throughout the state. Of particular note is NYSEDA's work in 2009 and 2010 to launch business associations to support two industries, the smart-grid industry and the battery and energy-storage industry. Here, the state agency helped connect the businesses and create the conditions for successful competition for federal grants.

Many states, especially the larger ones, have programs that provide support for the recruitment and development of firms in targeted industries, usually in the high-tech sector. Some of those funds end up supporting clean-energy companies, but often there are no separate programs and funds that particularly target those industries. One of our conclusions is that a state government benefits by having dedicated economic development funds for the clean-energy sector, such as those in Massachusetts.

In addition to direct support of clean-energy business development, state governments have also provided indirect support through research funding. Populous states with strong networks of research universities, such as New York and California, have a clear advantage, but the research programs have to be connected with technology transfer in order to generate green jobs in the manufacturing sector. In New York NYSTAR funded fifteen centers for advanced technology, which specialized in university-industry collaboration and technology transfer. The centers included work in photonics, advanced materials, and future energy systems, and NYSTAR also supported five other major research centers in energy and environmental research. California has supported energy research since 1982, but its research commitment increased after 2000, when the state provided \$100 million to start the California Institutes of Science and Innovation in the state's university system. In 2006 the state also provided \$30 million to support the Helios Laboratory at the Lawrence Berkeley National Laboratory, a research center that studies carbon-neutral energy. The state also promised \$40 million in matching funds for the Energy Biosciences Institute, which was supported with \$500 million from British Petroleum, in partnership with the Lawrence Berkeley National Laboratory and the University of Illinois at Urbana-Champaign.

Most states do not have the number of high-quality research universities found in New York and California; nevertheless, the states have developed programs that show how existing research universities can be strengthened. For example, in 2008 the state government of Michigan developed a program to support clean-energy research. Explicitly drawing on economic base and cluster theory, the Centers of Energy Excellence program encouraged "the development, growth, and sustainability of alternative energy industry clusters in Michigan by

identifying and/or locating a base company in a geographic region with the necessary business and supply-chain infrastructure” (Brown 2008). Colorado leveraged existing resources well by developing the Colorado Renewable Energy Collaboratory, which links the state’s major research universities with the private sector and the National Renewable Energy Laboratory. In 2004 Oregon’s state legislature established in the Oregon Built Environment and Sustainable Technologies Center, which links clean-tech researchers with each other and with industry.

Although dedicated funds for clean-energy business development and research are the cornerstones of state government policies, there were some other policies and programs that could be added to the two cornerstones. The remainder of this section will review briefly four other policies and programs: the use of pension funds, tax credits, targeted business development sites, and business competitions.

One mechanism found in a few states is the use of a dedicated portion of the state’s pension fund for green business development. An example of the strategy was the decision by the New York State Common Retirement Fund to invest about \$500 million of the \$155 billion fund in green technology and a smaller amount (about \$40 million) in clean-tech private equity. Likewise, under the Green Wave Initiative of CalPERS and Cal STRS, the public pension funds of the state of California invested \$450 million in private equity for clean-tech companies in 2004. Florida also established a 1.5 percent (of \$130 billion) earmark from the state pension fund for high-technology companies. Although the mechanism is available to most states, the severe pressure that pension funds faced after the collapse of equity values in 2008 may have reduced the viability of the option today (Angelides 2004, DiNapoli 2009).

Another policy is the use of tax credits for the recruitment of clean-energy companies. The mechanism is widespread, and only two of the leading examples will be given here. Oregon has aggressively recruited clean-tech industries with a 50 percent tax credit for new renewable energy facilities up to \$20 million. Between 2006 and 2009, the state spend nearly \$400 million in tax credits, and the tax credit has been a significant factor in Oregon’s status as one of the leading states for clean-tech industry growth (Knutson 2009). The credits were so successful that funds were depleted, and the programs had to be recalibrated. Another example is legislation passed in Michigan in 2006 and 2008 that allowed for the establishment of up to fifteen Renewable Energy Renaissance Zones, in which companies that produce renewable energy are exempted from most state taxes.

Some states also create funds for public-private partnerships that enable specific sites to be redeveloped or developed. For example, in Wixom, Michigan, the Michigan Economic Growth Authority helped Ford to repurpose an automotive plant, which at its height employed 5,000 workers, to house renewable energy companies. In another prominent example, NYSERDA spent about \$14 million annually on the Saratoga Technology + Energy Park, which is located next to a technology campus that houses a new chip manufacturing plant in New York’s Capital District region.

State governments have also attempted to spur entrepreneurial activities with business plan competitions. For example, the Minnesota Cup, a competition for entrepreneurs, includes a “clean and green division.” In Massachusetts, the Clean Energy Center also cosponsored the

Ignite Clean Energy Competition, a business plan competition hosted by the MIT Enterprise Forum.

Finally, in some cases governors have made organizational changes in the state government to help bring together various initiatives. The Massachusetts Clean-Energy Center is one example, and the state of Iowa has an Office of Energy Independence. In Michigan Governor Granholm reorganized the state's Department of Labor and Economic Growth into the Department of Energy, Labor, and Economic Growth to bring together economic development efforts with energy policy, clean-tech industry development, and green jobs training initiatives. In New Mexico Governor Richardson developed a Green Jobs Cabinet to review and coordinate policies.

To summarize, state governments have gone beyond the energy and environmental policies that have spurred the development of renewable and clean energy to another set of policies aimed at green business development. Although the demand-side policies are very important, it is also clear that if states want to develop clean-energy industries, they must put in place the basic infrastructure of financial, technical, and research support. A state investment fund (either as a separate entity or part of a broader high-technology research fund) that invests in technology transfer and new clean-energy ventures is central, as are investments in university research and development. The manufacturing cluster in several clean-energy industries is inherently fragile; it is highly dependent on ongoing local demand and tax incentives. The goal is to build an innovation cluster that constantly creates new companies, where research, development, and some manufacturing are located close to each other.

Green Jobs Programs

In addition to demand-side policies and business development policies, a third major category of state-government policies for green jobs involves training. In many cases, the problem of training for green jobs has been left to community colleges, universities, unions, and nonprofit training-and-development organizations. There are also programs offered by local governments, often in partnership with nonprofit organizations, and often those programs provide green jobs training for persons with employment barriers. Although the ecology of organizations may provide adequate resources for green job training in most states, state governments can also play several essential roles. One role is to conduct the studies that identify which sectors of clean-energy industry are prominent in the state, what their needs are, and how those needs can be matched with job training programs in order to avoid both shortages and surpluses in the supply of labor.

In some cases state governments also support job training more directly. For example, Michigan has developed a substantial job training program, called No Worker Left Behind, to provide tuition support to retrain laid-off workers for future employment in high-demand industries. Since its launch in 2007, more than 130,000 people have enrolled in No Worker Left Behind, and in 2008 the training program expanded to include the Green Jobs Initiative.

Green jobs training programs can be funded through the system benefits charge on ratepayers' utility bills, greenhouse gas auction funds, and federal funds. For example, in New Jersey, the societal benefits charge on the utility bill funded the Board of Public Utilities Clean Energy Program, which in turn provided \$1 million for green jobs training. In New York, NYSERDA's training programs operate through a network of training centers located in community colleges, four-year colleges, BOCES, and building trades organizations. In 2009 Governor Paterson of New York also announced a program for a Green Jobs Corps that was financed partly by the federal program of Temporary Assistance for Needy Families.

California has been the national leader in legislation and programs that support green jobs training. The Green Collar Jobs Act of 2008 authorized the formation of the Green Jobs Council to assess training and resource needs for the state, develop public-private partnerships, and establish guidelines for green jobs training programs. In 2009 California announced two green jobs programs. The California Green Corps, funded with \$10 million of federal stimulus money and matching funds from public-private partnerships, offered twenty-month training sessions for green-collar jobs for 1,500 at-risk youth and was administered via ten regional green corps centers operated by colleges, local governments, and workforce training centers. Later in 2009 the state announced a second, much larger program: the \$75 million California Clean Energy Workforce Training Program, which was planned to train 20,000 people for green jobs.

In Iowa, the state does not fund green jobs training programs directly, but it created legislation to enable community colleges to fund additional programs. Iowa's New Jobs Training Program allowed community colleges to issue bonds to pay for programs for students who will find jobs in growing industries, such as wind and biofuels. The bonds are repaid by diverting a small percentage of the payroll tax of the student's wages when the new job is obtained.

Another important function of state governments is to provide information. Several states had green jobs roadmaps and guidebooks. A program of note is Ohio Green Pathways, which produced a catalog of green jobs training programs at community colleges and adult career centers. Environmental Defense has worked with the Ella Baker Center in California, the Texas Workforce Commission in Texas, and the Governor's Energy Office in Colorado to develop a green jobs guidebook for each state. For example, the Colorado green jobs guidebook outlines job categories, salaries, and sample employers in the state (State of Colorado 2009). The approach is complementary to the Ohio guidebook, which catalogs educational programs available. In 2010 New Mexico also released its *Green Jobs Guidebook*, which covers both occupations and educational resources in the state (and is modeled in part on Environmental Defense's California guidebook). An innovation in the Northeast is the regional "Green Jobs Bank," which charts emerging green-collar careers and training opportunities for the northeastern states (State of Connecticut 2009).

To summarize, there are three main elements necessary for the labor side of state government policies for green job development. First, there is funding of green jobs training programs. In 2009 and 2010 there was about \$500 million available in federal government funding through the ARRA, but some state governments also found local resources to support the programs. The Northeastern states had an advantage due to the regional greenhouse gas initiative funding, but other states managed to support the programs with general funds, system

benefit charges, and even bond issues. Second, there is the information-providing role of developing career guidebooks, catalogs of training programs, a green jobs bank, and roadmaps of likely green job growth in the state. Several states have one of the elements in place, but no state has a comprehensive set of information tools. Third, as the green jobs programs are defined, they can be set up to provide assistance to persons with historic employment barriers and hence address issues of poverty as well as matching skills to employer needs. California, New York, and Texas are among the states that have special programs that target persons with employment barriers. Many of the green jobs programs, especially ones for persons with employment barriers, represent a continuation of longstanding workforce development and training programs. Fourth, the training programs must be carefully calibrated with business demand for jobs and skills, so that workers can expect to have a job at the end of the training period.

Conclusion

This introduction to our survey of state government policies provides evidence in support of our claim that there has been a transition from demand-side energy policies that emerge out of environmental goals to those that combine environmental, business development, and job creation goals. By combining demand policies with business development and green jobs training, the state green jobs initiatives are broadened to include more of the upper-end jobs of the career ladder, especially manufacturing and innovation jobs. The strategy prevents green jobs policies from becoming a dead-end to low-paying service-sector jobs.

One way to ensure the growth of clean-energy businesses in the manufacturing and high-technology sector is to recruit manufacturers of clean-energy technology to locate in the state. The recruitment of manufacturers is the oldest and most traditional of economic development policy tools, and it is widespread among some state governments, especially for the wind turbine and solar photovoltaic industries. However, it is not enough to recruit a single business or even a few businesses to the state. Although the opening of a new factory with hundreds of jobs is a cause for celebration and an occasion for political leaders to gather in the media spotlight and gain public appreciation, it can be a mirage. When demand conditions and incentives change, the companies will consider locating elsewhere or reducing production in their host state. Furthermore, growing industrial strength in China and other Asian countries, as well as heavy government investment in clean-energy industries in Europe, make global competition in the manufacturing sector formidable. For the final assembly of large and heavy technologies such as wind turbines and rail vehicles, there are some advantages to local manufacturing. Likewise, refining for domestically produced biofuel feedstocks is likely to remain close to agricultural sources. However, in general the recruitment of manufacturers in the clean-energy industry affords precarious long-term green job prospects unless recruitment is embedded in a broader economic development strategy that anchors firms to a regional economy.

The broader economic development strategy involves creating innovation clusters so that businesses are headquartered in the state and retain essential, high-end functions in the state even if some manufacturing is shifted to other states and countries. The creation of innovation clusters is a long-term process that fits well with other long-term planning exercises. Successful clusters require a vibrant base of research, adequate sources of capital (including state government

funds), related industries that provide positive spillover effects, supporting service industries, local demand, testing facilities, an adequately trained workforce, and many other features that are discussed in the regional innovation literature. When clusters are successful, it is easier to recruit not only manufacturing facilities but also corporate headquarters, and it is easier to retain existing companies because of the benefits that accrue from colocation.

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For more detailed references on specific states and cities, see the case studies that follow.

2

Bringing Green Jobs to Cities

A city government in the U.S. in the early twenty-first century does not have much room for maneuvering. Costs are continually rising, revenue sources are tight and often in decline, and much of the city budget is dedicated to necessary services. Nevertheless, many American cities have developed climate action plans and other green plans that establish goals for the improvement of green spaces, carbon emissions, air and water quality, transportation, buildings, and other areas of metropolitan life that serve as indicators of sustainability. To some degree the action of American cities has been a response to inaction at the federal government level. Because the U.S. Congress failed to ratify the Kyoto Protocol and assume a position of international leadership in the transition to a more sustainable global energy infrastructure, the task fell to state and local governments.

As we reviewed the city sustainability and climate action plans (or, where those plans are absent, the sustainability component of general plans), we found an emerging pattern. Many plans were examples of what we came to think of the “first generation” of greening efforts, which focus on issues of energy efficiency, transportation, urban spaces, and overall greening. However, we also found some city plans that had moved to a second-generation phase that included goals for the creation of green jobs and building local green businesses. In some cases the older green plans were extended and amended, but often a mayor simply announced one or more new initiatives that went beyond the existing sustainability plan. The clean-energy and green-jobs initiatives became much more visible in the wake of job losses of the Great Recession, and they have also grown in response to new levels of federal funding to support green jobs training programs and green business development efforts that became available under the American Recovery and Reinvestment Act. In other words, there was both an internal evolution, as cities moved beyond green plans to economic development initiatives, and a change in the opportunity structure as new funding pools became available from higher levels of government. In this respect, our work builds on that of Joan Fitzgerald (2010), who has also studied the emerging convergence of urban sustainability efforts and economic development goals.

This chapter charts out the main features of this second wave of green policy initiatives at the urban and metropolitan scale. Leading efforts by the cities will be discussed by region in three sections: green building programs, developing clean-energy businesses, and green jobs training programs.

Green Buildings Programs

One of the primary mechanisms that city governments use to achieve energy goals is through demand policies that focus on buildings, which consume an average of 40 percent of all energy. The policies are important because they often are linked to community development

initiatives that provide access to job training and new employment opportunities for persons with employment barriers.

Of the various ways to spur the local green building and retrofit industry, one strategy is to develop short- and long-term standards for building efficiency. There are three main targets of standards: city-owned buildings, private commercial buildings, and residential buildings. Many of the cities discussed below have standards for public buildings, but fewer cities have mandatory standards for private commercial and residential buildings. The latter can be difficult to support. For example, in 2009 New York Mayor Michael Bloomberg announced that existing buildings of 50,000 square feet or more would be required to undergo an energy audit and then to pay for many of the designated changes. However, when faced with vehement opposition from building owners, the mayor backed off the plan and said he would only seek mandatory energy audits. At the state-government level, we have seen some successes, but only for long-term codes that are for new construction.

Because there are other reviews of urban green building standards and mandates, they will not be discussed here. Instead, this section will focus on programs to weatherize and retrofit buildings, including both city-owned and privately-owned buildings. The programs became especially prominent in 2009 as state governments began to receive \$5 billion in ARRA weatherization assistance funding and \$3.1 billion in ARRA state energy program funds that could be used for energy-efficiency programs. Although the funds were spent slowly and were plagued by implementation difficulties, they did help spur the growth of many weatherization jobs.

The first type of initiative involves goals for city-owned, public buildings. Buildings play an important role in urban sustainability plans that have set targets for greenhouse gas emissions, and energy-efficiency programs lead to cost reductions for the city government while also creating local, green jobs. An example is the Green Building and Retrofit Ordinance, which the city of Los Angeles approved in 2009. The law established the goal of retrofitting over 1,000 city buildings and developing workforce training programs. Another element of the city's greening plan, the goal of greening the city's port, including its trucks, resulted in improved air quality and led to over \$500 million in private investment. In San Francisco, for city government buildings, all new construction and renovations over 5,000 square feet must meet LEED silver standards as defined by the U.S. Green Building Council.

Although establishing a standard for new buildings or energy conservation goals is one approach to greening public buildings, other approaches focus less on building standards and more on targets based on expenditures or square feet. For example, the San José Green Vision plan included the goal of building or retrofitting 50,000 square feet of green building space, and the city of Sacramento set the target of investing \$5 million in retrofitting city buildings with a goal of saving \$500,000 per year. The city of San Diego established a goal of fifty megawatts of solar energy production by 2013, and as a result of its incentive programs it became the leading city in California for solar energy installations. In 2008 Mayor Villaraigosa launched the Solar LA initiative, a plan to leverage the city's public power department to develop 1.3 gigawatts of solar energy by 2020 via roof-top solar, local projects owned by the department, and large-scale projects outside the city. Although in 2009 the voters defeated the ballot initiative, Proposition B,

that would have implemented the solar plan, the city's Department of Water and Power moved forward with solar and energy-efficiency programs.

For commercial and residential buildings, city governments generally adopt incentives rather than mandates. Where mandates appear, they are for new buildings and renovations rather than existing buildings. For example, the city of San Francisco requires that all new residential and commercial buildings and some large renovations reach a level of LEED certification or its equivalent (but not the higher levels of silver, gold, or platinum). The programs are supported by financing opportunities. The city of Chicago is more typical with its incentive programs. For example, under the Industrial Rebuild Program, the city of Chicago provides free energy audits in one industry per year and offers zero-percent financing for energy improvements based on the audits. A third example is the Boston Energy Alliance, which was announced in 2009 as a revolving loan fund that would mobilize up to \$500 million to support retrofits of buildings. Increasingly, as property-assessed community energy bonds and on-bill payment programs become more widely available, city governments can serve as the facilitators and motivators rather than direct funders.

One of the more comprehensive programs for on-bill payment is found in Portland, Oregon. In 2009 the mayor and city council approved the Community Workforce Agreement, which is a plan to develop weatherization for up to 100,000 homes and simultaneously to create green jobs for low-income and historically underserved workers. A multistakeholder program called Clean Energy Works Portland was established to oversee training, weatherization, and heating improvements in homes. The program was financed initially with ARRA funds, and payment was made via a line on the homeowners' utility bill that is paid into a revolving loan fund (City of Portland 2009b).

Some cities have supplemented voluntary weatherization programs and financial incentives with educational materials and manuals. For example, the city of Philadelphia has a guidebook for renovation of existing city buildings, a weatherization manual, and a low-income weatherization program supported mostly by federal funds.

The case of Boulder, Colorado, is interesting, because it shows that even when financial incentives and educational programs are in place, they may not be enough to spur demand for weatherization. In 2006 the city went beyond the voluntary loan programs of other cities to inaugurate the country's first carbon tax. The goal was to lower carbon emissions to 95 percent of the levels established by the Kyoto Protocol. The tax generated about \$1 million in revenue per year for the city, and it cost ratepayers an average of about two dollars per year for homes based on electricity consumption. The revenue allowed the city to assist in energy audits, but because customers had to pay an additional \$200, there were only about 750 home energy audits and seventy-five business audits during the first three years of the program. Furthermore, customers often failed to implement the proposals, even when tax credits were available. In 2009 the city council increased the tax in order to support energy-efficiency teams that visit homes and businesses to provide free upgrades. For example, the teams caulk windows, change light bulbs, install low-flow showerheads, add programmable thermostats, and set up drying racks near clothes dryers. The "Two Techs and a Truck" initiative has been more successful in low-income neighborhoods in the city. Overall, the tax has the potential to stimulate local jobs by

encouraging building owners to engage in more extensive improvements. In 2010 the city council was considering mandates for energy-efficiency improvements in apartments and businesses (Simon 2010).

Another strategy to spur demand that goes beyond financial incentives and educational programs involves transparency and reporting requirements. The requirements stop short of a complete mandate, which can provoke resistance and voter backlash, but they tend to motivate private owners of homes and commercial buildings to attend to the results of energy audits. The city of Austin is notable in this regard. The city's Climate Action Plan set the target of powering all of the city's buildings by renewable energy by 2020, and the city's public electricity organization, Austin Energy, was charged with developing a broader set of energy-efficiency programs. The programs included rebates for energy-efficiency improvements and free home energy improvements for low- and moderate-income customers. The programs were supported by the city's Energy Conservation Audit and Disclosure Ordinance, which required homeowners to have an energy audit completed before the sale of a home. Likewise, owners of a commercial building that received energy from Austin Energy were required to receive an energy rating. Austin Energy also pioneered a shift in its solar energy policy from rebates to a guaranteed, ten-year payment for solar energy produced from homes and businesses. The shift in the incentive structure provided a better picture of long-term financial payback (about six to eight years), and it also motivated owners to maintain their systems properly.

The city of Seattle is another example of a city that has motivated energy-efficiency improvements by passing a disclosure ordinance. In 2008 Mayor Greg Nickels announced plans to make the city the country's "green building capital" based on energy-efficiency improvements, and he formed the Green Building Task Force. A year later the task force issued a report with a variety of goals, including a plan for financing residential energy-efficiency improvements as a source of green jobs. In 2009 Seattle launched the Green Building Capital Initiative, which provided inexpensive home energy audits and incentives to improve building efficiency. The program's goal was to audit 5,000 homes within eighteen months. The following year the city passed the Energy Disclosure Ordinance, which required owners of large buildings to report on energy use and ratings for tenants, buyers, and lenders.

To summarize the diverse policies, a starting point is to have an overall sustainability plan that includes goals for the greening of existing and new buildings. The second step is to have a program for city-owned buildings that sets goals and funding levels for energy-efficiency improvements and rooftop photovoltaic installations, preferably with some link to green-jobs training programs. The next step involves putting together energy weatherization and retrofitting programs for residential and commercial buildings. The programs can also designate certain industrial zones of the city, such as the port, for improvement. In 2009 and 2010 the programs were receiving a substantial boost from the ARRA funds, but funds were also available from community development organizations, foundations, and utilities. Rather than spend available funds once, the better plans set up a revolving loan fund with low interest financing to enable an ongoing stream of income. PACE bonds and on-bill payment systems were becoming increasingly common, but as mentioned above the PACE programs were on hold pending federal policy.

Once the funding arrangements are in place, cities can utilize informational workshops, guidebooks, and inexpensive or free building auditing services to motivate building owners to explore their energy-efficiency needs and become aware of the financial incentives. However, the case of Boulder indicates that voluntary programs for homeowners and small businesses may face considerable inertia. Even free home energy audits may be inadequate, because they often tell building owners about inefficiencies that they already know exist. The plan to provide free weatherization assistance funded by a ratepayer tax may solve the problem. Likewise, regulations in Austin and Seattle that require reporting of building efficiency ratings may also help motivate changes.

Developing Clean-Energy Businesses

The need to recruit, retain, and incubate green industries often requires the resources of a state government, but city governments have also undertaken local initiatives as well. As Joan Fitzgerald (2010) noted, the initiatives are likely to be most successful where the state government has well-developed programs. Still, there are some cities that have not done much even when state governments are very active. For example, in Michigan the state government is leading efforts to create green jobs, whereas the city of Detroit has done relatively little. In contrast, in Texas the city of Austin has been a national leader in urban sustainability efforts, whereas the state has been less supportive of green-job development than other states.

One important strategy that cities can undertake at relatively low cost is the planning and coordination to target clean-energy and clean-tech industries for development. Noteworthy examples can be found in Portland, Minneapolis-St. Paul, and Cleveland. In an economic development plan released in 2009, the city of Portland noted that it had lost 44,000 jobs during the preceding twelve months (City of Portland 2009a). As in many other cities across the world at that time, job creation had become a top priority. The report identified four “clusters” on which the city would focus its limited resources: clean-tech and sustainable industries, activewear and design, software, and advanced manufacturing. In defense of the strategy, the report noted the relatively small size of the city and the need to be selective in its planning for new industries that would be competitive. With respect to the clean-tech and sustainable-industries cluster, the report noted that the city had strengths in several industries, including wind, solar, and green buildings. Previous recruitment efforts had enabled the city to capture the North American headquarters of two large wind manufacturing companies, Vestas and Iberdrola. The plan included various strategies and actions to build on existing strengths: mapping the regional supply chain, recruiting new firms, developing a coordinating body that links industry to the research infrastructure, and promoting demand with the Clean Energy Investment Fund. In addition, the city planned to promote synergies among the four main industrial clusters and to promote all four clusters via international trade shows, linkages with universities, and workforce development.

A somewhat more focused industrial plan can be found in Minnesota, where Minneapolis Mayor R.T. Rybak and St. Paul Mayor Christopher Coleman launched the Mayors’ Green Manufacturing Initiative in 2006. Their goal was to make the twin cities a national hub of green manufacturing. The initiative identified buildings, transportation, and energy for future

development. Of general interest is the inventory that the cities conducted to determine what businesses already exist and what the strengths were within each industry. Specific areas included manufacturers of windows and doors and suppliers for wind manufacturing. The report also identified research centers at the University of Minnesota that were relevant to each of the three industries. The region's Blue-Green Alliance contributed to the effort by conducting benchmarking exercises to determine what else could be learned from the efforts of other cities (Mitchell 2009). The Blue-Green Alliance helped the city implement those goals, and the project was rebranded Thinc.Green^{MSP}.

Cleveland provides an example of another element of a planning initiative that took the form of a "summit" of major stakeholders. In 2009, the 700 participants in the Sustainable Cleveland 2019 summit produced twenty-eight recommendations for future projects, a number of which aim to develop local clean-energy industries. For example, the proposed Laboratories for Advanced Energy Commercialization and Global Center for Sustainable Design and Manufacturing would support clean-energy business development, including the proposed off-shore wind-farm. There was also a proposal to develop a Regional Sustainability Fund for clean-energy business start-ups. As in Minneapolis and St. Paul, the planning process included an appraisal of existing strengths, but the Cleveland process has shown how to use the mechanism of a sustainability summit to embed its clean-energy policy in an overall sustainability effort that includes local environmental, neighborhood, and other civil society organizations. The city also completed a sustainability strategic plan, an outgrowth of the summit process, which explicitly framed the proposed initiatives as economic development opportunities.

To institutionalize the plans and integrate efforts across city government departments, some cities have established a separate office for sustainability functions. In Portland, the city government merged its sustainable development and planning functions into the single Bureau of Planning and Sustainable Development. The bureau subsequently became the fiscal agent of the nationally recognized Clean Energy Works Portland program. Another strategy is to convene an ongoing network of organizations to review initiatives and plan for new ones. For example, in 2007 Oakland Mayor Ron Dellums launched the Oakland Partnership, a public-private partnership for economic development that includes representatives from government, business, education, labor, and community organizations. "Green tech" was one of the four major industry clusters that the partnership targeted, and late in 2007 Dellums joined with other East Bay mayors and representatives from the universities to launch the East Bay Green Corridor Partnership.

In addition to planning and partnership formation, there are many other initiatives that city governments have undertaken to promote clean-energy businesses. One strategy has been to develop local and green purchasing preferences policies for the city government. For example, the city of Portland has an environmentally oriented purchasing preferences program, which supports local businesses that meet its standards. At a larger scale, the city used federal-government ARRA (American Recovery and Reinvestment Act) funds that enabled a subsidiary of Oregon Iron Works to build the country's first streetcar made by an American firm in over fifty years. The development attracted national attention as an example of unionized, green manufacturing. In Los Angeles, Mayor Villaraigosa also attempted to bring an Italian

manufacturer to the city to anchor his planned Clean Tech Corridor. The mayor's goal includes a twenty-acre Clean Tech Manufacturing Center and a Clean Innovations Research Center.

The Clean-Tech Corridor in Los Angeles is an example of another strategy to develop clean-energy industries. Many of the cities that we studied had developed plans for a clean-tech or clean-energy district or an incubator for clean-energy firms. As we looked more closely, the districts were often older manufacturing districts that were not necessarily homes to clean-energy firms but instead were homes to light manufacturing that included some greening of their buildings and manufacturing processes. The clean-energy business incubators in San José, Denver, and Austin were more specifically targeted to business development. Cities may also work with local universities, as Los Angeles does with CalTech, to facilitate clean-energy business develop from university-based incubators.

To attract and assist businesses, some cities developed programs that made it easy for businesses to take advantage of city economic development services. For example, in 2008 the Boston Redevelopment Authority developed the Green-Tech Initiative, which provides “one-stop shopping” to assist green businesses that choose to relocate to Boston. Services include site selection, financing assistance, workforce training, and assistance with contacts in the city government. In Portland, the Businesses for an Environmentally Sustainable Tomorrow Program also provides a single source of financial and technical assistance. Another city initiative is to offer accelerated permitting for green or clean-energy businesses. For example, in 2007 Seattle Mayor Greg Nickles led a shift toward green jobs with the “industrial jobs initiative.” The initiative included easier permitting and other efforts to recruit and retain businesses in a wide range of industries, including clean tech. For example, in 2009 the engineering and construction firm McKinstry Company received a permit from the city to allow an expansion that would create 500 new jobs in the energy-efficiency industry. In Portland, the city also offers services by helping to promote local businesses in distant markets through the PBX Lounge.

Cities have also strengthened their clean-energy businesses by recruiting, forming, or supporting existing business associations. For example, in 2009 the Clean Energy Council of Austin's Chamber of Commerce announced that the leading industry association, the Clean Technology and Sustainable Industries Association, would move from Massachusetts to Austin. Sometimes business associations support events that bring global attention to the city's clean-tech businesses. The city of San José hosts the Clean Tech Open, the largest annual clean tech business competition in the country, is sponsored by a partnership with a nonprofit organization located in nearby Palo Alto. Even where cities do not have national organizations and events, some have done very well by sponsoring local organizations. For example, in 2007 the city of San Diego launched the San Diego Cleantech Initiative and helped to form the San Diego Clean Tech Alliance to promote the industrial sector. In Boston and Philadelphia, there are large, local sustainable business associations that have worked with the city government to develop initiatives for the small-business sector.

Some cities also form partnerships with electricity utilities. Cities that have public power have been able to work closely with the organizations to promote a variety of clean-energy initiatives, including energy-efficiency projects, smart-grid development, plug-in vehicle charging stations, and rooftop solar. Although local political control over energy generation and

distribution makes it easier for city governments to develop such initiatives, it is also possible to pursue partnerships with investor-owned utilities. For example, the city of Chicago has worked with the local utility to develop a program to provide solar installations on the city's schools, and it partnered with Exelon to build the country's largest urban solar power plant.

As one can see from this overview, many of the initiatives can be undertaken with limited resources. The city government needs to look for places where it can play the role of catalyst and convener rather than the funder of new projects. Where more funding is needed, such as in recruitment efforts, the state government may be helpful. There were several examples of mayors who successfully helped to recruit new clean-tech businesses to their region, but those efforts generally involve close coordination with the state government, which generally has more resources.

To attract new businesses and create an environment to incubate local businesses, many other elements need to be in place. One is a general sustainability plan, but more specifically cities need to move beyond the "green spaces" framework of sustainability plans to integrate job development and business development into the plan. The plans need to make a realistic assessment of existing, related industries in the region that can serve as a basis for building more extensive networks. Only a few cities, such as Portland, Cleveland, Oakland, and the twin cities of Minnesota, have gone through the exercise at a detailed level. Once the basic goals are in place, another dimension that cities can develop is networking, such as by helping to form sustainable business associations and working with the local chambers of commerce to develop initiatives. In the case of Cleveland, the sustainability summit created a broad tent that linked the economic development concerns with community development issues and participation from the local civil society. Some cities have also hosted national events that bring attention to the city's strengths and connect local businesses with global industries.

Some cities also help to form clean-tech businesses and the greening of existing businesses. Some cities have used their procurement policies to increase demand and strengthen local businesses, and others were developing a one-stop shopping facility to provide business assistance. Accelerated permitting, the creation of specific industrial districts, incubators, industrial parks, and partnerships with local utilities and universities can also make the city attractive. The use of tax increment financing programs can help to fund the programs. Furthermore, cities can help the local businesses with their global marketing, as Portland did with the PDX Lounge.

Although the price tag for this range of programs is variable, if one looks carefully, most of the policy initiatives discussed in this section can be achieved with limited resources. City governments that have established an office of sustainability and combined their sustainability efforts with their economic and community development efforts may even save some money by reducing organizational barriers and inefficiencies. By using the city government and its policy instruments as a catalyst, it is possible to help establish new organizations and transform existing ones with limited resources.

Green-Jobs Training Programs

Green-jobs training programs have emerged to accompany the efforts at green economic development. At the higher levels of skill, training programs take place in universities, community colleges, and technical institutes, and cities can play a role in promoting the programs and connecting them with potential students and employers. At the lower levels of skill, cities have broadened their job training opportunities for persons with employment barriers, such as “at-risk” youth, to include green-job training. As will be seen in the section that follows, such programs can be provided directly through the city government or indirectly through partnerships between the city government and nonprofit organizations. Some of the oldest city programs, such as the Chicago Greencorps, and some of the partnerships with nonprofit organizations were established well before the Great Recession. Those programs provided one set of models for some of the spending priorities associated with low-income weatherization and green jobs training that were targeted in the ARRA. Many of the other city and nonprofit job training programs were not historically focused on green jobs but expanded into that field after ARRA funding became available. This section will survey some of the more notable green jobs programs offered by city governments, either on their own or in partnership with other organizations.

Before discussing the programs, it is worth clarifying the different streams of training that are available. Many of the local green-jobs training programs offered by city governments and their partners have very small numbers of people undergoing training in comparison with the sometimes bloated promises of public officials, who estimate that a new law or initiative will create thousands of green jobs. The disjuncture requires some explanation. Many of the urban-level green-jobs programs address social disparities and provide pathways out of poverty. The funding levels are sometimes limited in comparison with general green jobs training funds, and the poverty-oriented training programs need to be coordinated with demand for jobs in weatherization, building auditing, and rooftop solar installation. In the event that a city or metropolitan region gains a new manufacturing facility or large energy-generation facility, then many more jobs become available than the small numbers represented by most of the green-jobs training programs. Training for manufacturing jobs often involves a higher skill set and must take place through the company’s department of training and development and also local community colleges, trade unions, and technical institutes. As a result, when one speaks of “green jobs” training, there are very different types and purposes. The focus here is on the training programs offered by city governments and their partners.

There are various organizational strategies for a city government that wishes to initiate a green-jobs training program. An example of the public form of green-jobs training programs is the Greencorps Program of Chicago. Launched in 1994 and managed by the city’s Department of the Environment, the program hires about fifty people each year for a nine-month training session for jobs in landscaping and horticulture, electronics recycling, and weatherization. During the period the trainees also assist the community gardens program and work in a recycling center. This program is of note for several reasons. It offers a mixture of skills obtained over nine months, so that graduates have flexibility on the job market. Furthermore, many of the members of the Greencorps training program are ex-offenders, and it offers them an opportunity to live up to the promise of “jobs not jail.” The program is also housed in the Chicago Center for

Green Technology, a LEED-certified building located on a seventeen-acre site that was occupied by a company that violated permits and left significant solid waste. The city's Department of Environment closed down the site and, after taking the company to court, became its owner in 1996. As a result, trainees get hands-on experience working in a model green building and can see some of the features that they may help to create in their future employment.

A second type of program is offered by a nonprofit organization. Some of the nonprofit organizations have historically offered job training for the unemployed and for persons with employment barriers, and they have diversified into green jobs training. In Austin, the model of green jobs training is in some ways the opposite of that of Chicago. In Austin, the nonprofit organization American Youth Works was founded in 1976 to help youth and adults who had dropped out of high school to get job training. In partnership with the City of Austin and the federal government, the organization has run two green jobs programs since the mid-1990s: Casa Verde Builders, a green building training program, and Environmental Corps, a parks and public lands preservation program that was founded. In 2009 the organization won a \$750,000 grant from the U.S. Department of Commerce to launch a Green Jobs Training Center. Austin Community College also received grants to start up weatherization and solar energy training programs.

Another type of partnership involves nonprofit organizations that do not have an historic jobs-training mission but have diversified into green-jobs training. Two examples involve the cities of Boston and Newark. In 2009 Boston Mayor Menino announced green jobs training programs based on a grant to Boston's Empowerment Zone from the U.S. Department of Housing and Development. The youth training programs, also called the Green Youth Corps, took place in partnership with various community organizations, including Bikes Not Bombs and Alternatives for Community Environment. In Newark, the city government developed a job training program for the city's youth in the Mildred Helms Park through a coalition with the nonprofit organizations Project U.S.E. (Urban Suburban Environment) and Trust for Public Land. The city government also has worked with the Laborers Union International of North America (Local 55) and the Garden State Alliance for a New Economy to launch a green-collar job training program. The program provided general training with practical experience for twenty-five Newark residents who weatherized homes for senior citizens. Funding came from a grant from the U.S. National Institute of Environmental Sciences to the national Laborers Union.

Occasionally community development corporations and local foundations have played a role in supporting green-jobs training programs. In Newark, the Lincoln Park Coast Cultural District, a community-development corporation, diversified its mission from arts and cultural development to green building construction and green job development. The organization has two green-collar jobs programs: GreenCAP, which trains 100 at-risk youth, parolees, and veterans in the building and solar construction trades; and the Green Collar Job Training Program, which trains about sixty residents mostly for green construction jobs. The Cleveland Foundation has supported the interesting "Mondragon" model of green-jobs cooperatives that is emerging in the city. The employee-owned cooperatives are located in low-income neighborhoods and provide jobs to the unemployed in those neighborhoods. In Philadelphia, the John S. and James L. Knight Foundation supported the Energy Coordinating Agency of Philadelphia, which administers federally funded weatherization programs, to train lower-skilled

workers for green-collar jobs. The foundation also gave the Sustainable Business Network of Greater Philadelphia a planning grant to develop a green corps program. In April 2009 Mayor Nutter and the Energy Coordinating Agency welcomed the first class of twenty students, who began their four-week training program in weatherization.

Sometimes the programs involve a network of organizations, each of which can bring a special set of training skills to the partnership. The Green Jobs Institute in Minnesota's twin cities provides training in home weatherization, energy audits, and green buildings in collaboration with the Minneapolis Community and Technical College, Dunwoody College of Technology, and the Summit Academy Opportunities Industrialization Center. The city also added green jobs to its program of measuring progress through sustainability indicators. A similar network of partners can be found in Oakland. The mayor's office worked with the Ella Baker Center and the Apollo Alliance to secure seed funding that resulted in the designation of three partners for green jobs training: Laney College; the Cypress Mandela Training Center, a construction training center; and Growth Sector, a workforce development organization. In June, 2009, the Oakland Green Jobs Corps graduated its first class of 40 students, who received jobs in solar and construction companies

In California, green jobs training programs at the city level benefit from the comparatively high levels of support from the state government. The State of California has supported green jobs training programs at eleven "green jobs corps" locations throughout the state. In addition to the state programs, the major California cities surveyed have an independent, local "conservation corps" that provide education, community services, and conservation work opportunities for at-risk youth. Increasingly, those organizations have developed more specific green jobs training programs. In addition to the state-sponsored green jobs corps and the local conservation corps, there are several unique green jobs programs in San Francisco and the East Bay. For example, in 2009 the city of San Francisco launched the Green Skills Academy (now TrainGreenSF) to provide training programs in the green industry. The program currently includes vocational training for positions in energy efficiency, solar installations, recycling, transportation, and non-installation positions such as clerical and administrative employment in green-industry firms. The programs utilize ARRA funds and involve partnerships between the city's Office of Economic and Workforce Development and local colleges, labor unions, and nonprofit organizations.

In summary, there is a variety of organizational strategies that can be used as a basis for planning an improvement in a city's current green jobs training programs. Before deciding on an organizational strategy, the first task of a city government is to determine if the supply of newly trained workers will find jobs. Green jobs training programs must be coordinated with clean-tech and green-buildings initiatives discussed in previous sections; otherwise, there is a risk of training people for jobs that do not exist. To minimize the risk, it is a good idea to base the programs on a clear assessment of employment opportunities that includes partnerships with local businesses and even commitments from them to hire graduates of the programs.

A second step is to develop an overall strategy that addresses the various types of green jobs needed, the organizations that can provide the training, and categories of people served. This step involves making a realistic assessment about the capacity of a city to use green-jobs in

areas such as weatherization to address low-income poverty issues. The potential for new businesses to generate green jobs in fields that require higher skill sets should be matched with initiatives that involve the participation of technical institutions, unions, and community colleges. City governments that do not already have established job training programs for persons with employment barriers may be able to expand existing programs that provide summer jobs for youth at risk. However, if there are no pre-existing programs that can be expanded into green-jobs training, the city government may not want to get into the business. Programs serving youth at risk and other persons with employment barriers will tend to require a broad base of training in life skills that goes beyond the occupational training offered at community colleges, technical institutes, and universities. Those programs may be best developed by working with existing nonprofit organizations that have ample experience. Cities can also reach into high schools, as is occurring in New York, to publicize the programs and options and even to establish green jobs vocational training programs.

Conclusion

Our research suggests that by 2010 many American cities had shifted into the next generation of urban sustainability efforts; that is, they had made the transition from urban greening to the development of green jobs. Increasingly their climate change and sustainability plans reflected the change by including sections devoted to green jobs. Although there is evidence that some of the initiatives were in place before the onset of the Great Recession, the rising levels of unemployment and the ARRA stimulus funding greatly increased the speed with which initiatives were developed. In this sense, the politics of urban sustainability may have crossed an historic watershed from general greening efforts—concern with carbon emissions, pollution, green spaces, transportation, and so on—to efforts to create green jobs through business development, the greening of buildings, and training programs.

The comparison of the sample of cities reveals evidence of different models of public participation and different strategies for green job development. In some cities, the emphasis is on building clean-tech industries, and the initiatives are driven by partnerships between city government leaders and the business community. The approach is particularly prominent in some of the California cities with strong clean-tech industrial clusters, such as San Diego and San José. At the other extreme are cities that have focused mainly on green jobs as a mechanism of community development and poverty alleviation for persons with employment barriers, such as Chicago and Newark. The second approach can also be found in some of the civil society organizations in other cities, such as the Ella Baker Center in Oakland. Cities that have developed programs oriented toward the unemployed and low-income housing needs, such as weatherization programs, tend to also have greater bottom-up participation from neighborhood groups.

Many cities have a mixture of the two strategies, and there is probably a trend for cities to diversify into both. For example, Los Angeles has a longstanding program to train persons with employment barriers for green jobs, and it creates demand for their job skills with programs that promote building weatherization and solar energy installations, but it has increasingly added programs oriented toward attracting and building clean-tech industries. Likewise, Oakland,

California, has substantial bottom-up participation under the Dellums administration, but it also have sought out partnerships with the business community and targeted clean-energy businesses for further development.

Civil society organizations—including environmental, labor, neighborhood, and localist organizations—have played an advocacy role and in some cases a leadership role in formulating economic development policies and green jobs training programs. The Apollo Alliance in several cities, Green for All in Portland, the Blue-Green Alliance in Minneapolis, the Sustainable Business Network of Greater Philadelphia, and the Ella Baker Center in the East Bay and California have all played an influential role in urban policy development. In Grand Rapids, Michigan, the initial push for sustainable development came from the business community and nonprofit organizations through partnerships such as the West Michigan Sustainable Business Forum. In other cases, the mayor and city council were leading on the sustainability issue. For example, the Chicagoland Green Jobs Initiative, a coalition of grassroots organizations, emerged after Mayor Daley’s initiatives had been in place for some time. In most cases, there appears to be willingness of government, business, and civil society leaders to work together, and Cleveland’s sustainability summits provide a model for encouraging ongoing conversations among a broad coalition of stakeholders. Although civil society leaders may advocate more for job creation for low-income neighborhoods, the three approaches to green development are not necessarily contradictory, and it is likely that city governments will increasingly pursue integrated development policies.

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For more detailed references on specific states and cities, see the case studies that follow.

The Midwest

The Midwest is characterized by several distinctive features. First, agriculture is strong, and there is widespread support for the biofuels and broader “bioeconomy” industries. Second, there is interest in wind energy both in the Great Lakes and on farmland. Third, the automotive and manufacturing heartland of the country has suffered severe job losses, and some Midwestern states have latched onto green manufacturing as a solution to manufacturing job loss. That can include the diversification of the automotive supply-chain to include wind and rail manufacturing.



Illinois

Summary and Analysis

As a result of the basic demand policies, Illinois is positioned to be a leader in clean-energy industry development and green-job creation. However, many of the supply-side policies oriented toward green business development and innovation are missing. In our conversations with advocates in Illinois, explanations included the general paralysis of the state legislature, the influence of the state's coal industry, and the high levels of corruption involved in locating and building in the state, especially in the city of Chicago. As a result, Illinois generally lacks the integration of research, innovation, and new business development found in some of the other states. Likewise, although Chicago has a reputation as a sustainable city, its record is based primarily on urban greening policies and its climate action plan. The next-stage attempts to build a diverse range of green jobs from weatherization to manufacturing and technology innovation is much less developed. Nevertheless, there were some policies and programs worthy of additional study and potential emulation:

- The state has a strong suite of biofuels companies as well as research at Energy Biosciences Institute at the University of Illinois at Urbana-Champaign underscores Illinois' leadership in biofuels research and processing.
- Chicago is a leader in low-end green jobs training, particularly weatherization and horticulture, but it also offers multiskill training in the Greencorps Program.

General Background Policy

Energy Goals. In 2006 an executive order from Governor Blagojevich (2006-09) announced a goal of reducing greenhouse gas emissions from state government sources by 6 percent by 2010 (EPA 2008). In 2007 the state joined the Midwestern Greenhouse Gas Reduction Accord, which committed the state to 10 percent renewable energy by 2015. The state also announced a long-term plan of 25 percent renewable energy by 2025, and in 2007 the governor announced greenhouse gas emissions targets for the state of 1990 levels by 2020 and 60 percent below those levels by 2050 (State of Illinois 2007a). The Climate Action Plan developed in 2007 called for a range of vehicle efficiency standards in line with those of California, as well as renewable energy and energy-efficiency measures (State of Illinois 2007b). State agencies have a goal of purchasing about 5 percent of their power from renewable sources, and the state has steadily increased its percentage of flex-fuel vehicles (EPA 2008). The state has an energy-efficiency standard of 1 percent of sales in 2012 and 2 percent in 2015 (SB 1597 of 2007).

Public Benefits Fund. There is a public benefits charge that supports two funds, the Renewable Energy Resources Trust Fund, the Coal Technology Development Assistance Fund,

and the Energy Efficiency Trust Fund. The first two receive about \$5 million per year, and the third receives about \$3 million per year. The Renewable Energy Resources Trust Fund supports renewable energy projects, and the Energy Efficiency Trust Fund supports energy-efficiency projects, including for low-income homes. The latter is administered by the state's Department of Commerce and Economic Opportunity. A separate fund, the Illinois Clean Energy Trust, was developed after a settlement with ComEd and the state in 1999. The initial funding was \$250 million, which supports energy-efficiency and renewable-energy projects, as well as habitat restoration (DSIRE 2010).

Green-Buildings Policy. In 2001, Governor Ryan's Executive Order 11 encouraged energy-efficiency practices for the state's buildings (State of Illinois 2001). Legislation passed in 2005 (SB 0250) required that new construction of state government facilities use the "best available" energy conservation technologies. Legislation in 2007 required that all executive branch agencies reduce energy consumption by 10 percent within ten years. In 2009 Governor Quinn issued an executive order (No. 7) to establish an energy-efficiency committee to track changes and make recommendations. That year the state also approved the Green Buildings Act. Under the law, all new buildings and renovations over 10,000 square feet that receive state funding are required to have LEED silver or equivalent certification. (DSIRE 2010).

Green Jobs Training. The Department of Commerce and Economic Opportunity received \$6 million in ARRA funding in 2010 for green jobs training. In April of that same year, the Illinois Institute of Technology (IIT), a private research university in Chicago, received a grant of \$5 million of ARRA funding from the Department of Energy to launch the Smart Grid Education and Workforce Training Center. An additional \$7.6 million will be supplied by the state and other partners within three years. The project anticipates training 49,000 people in a smart-grid curriculum over a three-year period. IIT will be partnering with Operation Green Jobs—a collaboration between the Chicago Staffing Alliance, the Illinois Department of Veterans' Affairs, and the Illinois Department of Employment Security—to conduct recruitment and placement of trainees (Illinois Institute of Technology 2010a).

In January of 2010, Governor Quinn announced a \$1.7 million grant to the Illinois Community College Sustainability Network, a consortium of forty-eight community colleges. The grant will be used to fund green job training centers at Southwestern Illinois College in Belleville, College of Lake County, and Wilbur Wright College in Chicago (Illinois Department of Commerce and Economic Opportunity 2010).

Clean-Energy Industry Development

General Policy. The Illinois Department of Commerce and Economic Opportunity supports business development efforts, including some for green businesses. The department also administers various energy programs, and with funding from the American Recovery and Reinvestment Act (ARRA) it made some grants for the Green Industry Business Development Program. For example, \$5 million was given to Ingersoll Machine Tools, a company in Rockford that manufactures wind-turbine components (State of Illinois 2010). However, other than for biofuels, Illinois lacks targeted programs to develop the state's clean-energy industries. The state

has strong research universities, a relatively large population, ample resources for renewable energy, and a large city with a manufacturing base, but the state government has not utilized the resources to develop its clean-energy industries.

Biofuels. Illinois is home to Archer Daniels Midland and has a large number of ethanol refineries due to an early commitment to biofuel production and commercialization. The state has also supported the industry through a series of demand policies. For example, in June, 2003, the Renewable Fuels Development Program was initiated (Public Act 93-51) through the Department of Commerce and Economic Opportunity, offering up to \$5.5 million in construction grants per biofuel production facility with a capacity of at least thirty million gallons per year (Illinois Department of Commerce and Economic Opportunity n.d.). The state government has supported the industry in other ways, including campaigns to increase the level of biofuels in the state's vehicle fleet (State of Illinois 2001). A statute (30 ILCS 500/45-60) also requires that state government contracts favor suppliers who use vehicles with biofuels powered by ethanol or biodiesel from in-state sources (EPA 2008).

In addition to policies that support biorefining facilities and general demand for biofuels, the state has also supported research. In 2004 the state government provided \$6 million to match \$15 million in federal funds to launch the National Corn-to-Ethanol Research Center at Southern Illinois University Edwardsville (State of Illinois 2005). In November of 2007, the University of Illinois received a share in the Energy Biosciences Institute (EBI), which is supported by British Petroleum's \$500 million, ten-year commitment and involves a partnership with the University of California at Berkeley and Lawrence Berkeley National Laboratory. The EBI consists of sixty-eight funded projects dedicated to the production and commercialization of cellulosic biofuels, including a 320-acre "energy farm" at the University of Illinois (Energy Biosciences Institute 2010). There is also biofuels research at the Wanger Institute for Sustainable Energy Research at the Illinois Institute of Technology and at other universities in the state.

As a result, the state has the research infrastructure to support a biofuels innovation cluster, and it has a biofuels industry. In addition to Archer-Daniels Midland, the state is also home to Coskata, DuPont Danisco, UOP Honeywell, and IneosBio. Those companies enabled Illinois to be listed second, well behind California but tied with Colorado, in the number of companies listed as the fifty "hottest" biofuels companies for 2009-2010 for *Biofuels Digest*. As a result, the state has all of the elements in place for not only a biofuels production industry but a biofuels innovation industry: demand policies, research centers, and a critical mass of innovating companies. But the state government has not stepped in to target the industry and provide it with the support to move on to the next step.

Smart Grid. In February of 2010, the Illinois Institute of Technology announced the completion of the first high-reliability distribution system loop in its plan to develop a campus-wide system of smart microgrids. Referred to as the Perfect Power Project, partners include the Galvin Electricity Initiative, the local utility company, and private electricity distribution and delivery firms. The Perfect Power Project anticipates the whole campus to be online in four years. At a cost of \$12 million—\$7 million from a Department of Energy grant and \$5 million from IIT—the Institute anticipates a savings of \$10 million over a ten-year period (Illinois Institute of Technology 2010b). Although the state has received federal funding for a smart-grid

installation project in Naperville, it missed out on the \$620 million allotment from the Department of Energy in 2009.

Solar. In May of 2010, the Illinois General Assembly passed two bills related to solar energy that were part of a package called Rebuild Our Economy with New Energy Work (RENEW Illinois; Sierra Club, Illinois Chapter 2010). The Solar Ramp Up Bill (HB 6202) requires that 6 percent of the state's renewable energy comes from solar power by 2015. The other bill, the Homeowners' Solar Rights Act, clarifies the rights of homeowners and provides a process for homeowners in homeowner or condominium associations who want to erect solar panels. If the legislation is signed by Governor Quinn, it will result in the creation of as many as 5,000 new jobs and the generation of three million kilowatt-hours by 2015 (Environmental Law & Policy Center 2010).

Transportation and Energy Storage. Under President George W. Bush's hydrogen fuel initiative, Illinois was poised to be a leader in energy storage technology. The Illinois Department of Commerce and Economic Opportunity sponsored the Illinois 2H2 Partnership which connected Argonne National Laboratory's fuel-cell research facility with Illinois universities and the hydrogen industry. However, with practical applications twenty years away, the Obama administration moved away from funding research related to vehicular hydrogen fuel cells, opting instead to fund the development of technologies that promise a more immediate impact. Today, the Illinois 2H2 Initiative is defunct and that research infrastructure has not successfully transitioned to other energy storage technologies in order to maintain the cluster.

Wind. With the 2010 addition of Iberdrola Renewables' 300-megawatt Cayuga Ridge project, the state of Illinois has the sixth highest level of installed wind capacity in the nation, with 1,848 megawatts (American Wind Energy Association 2010). Despite the demand for wind energy and Illinois' utility-scale wind resources (U.S. Department of Energy 2009), the state government has not moved as aggressively as some neighboring states to develop Illinois' wind manufacturing industry.

In November of 2009, the Department of Energy awarded the Illinois Institute of Technology's Wagner Institute for Sustainable Energy Research \$8 million to spearhead a wind energy research consortium. The consortium, made up of state and local governments, private industry, and other universities, has been charged with addressing the challenges outlined in the Department of Energy's "20% Wind Energy by 2030" report. The consortium will focus on improving wind turbine performance and studying wind turbine and wind farm interaction (Illinois Institute of Technology 2009; SustainableBusiness.com 2009).

On the municipal level, the city of Evanston, which shares its southern border with Chicago, is exploring off-shore wind energy to power its 30,000 homes. The original proposal, put forth by Citizens for a Greener Evanston, sought to reduce the city's greenhouse gas emissions by 13 percent by 2012. The plan includes forty wind turbines to be located seven miles off the coast of Lake Michigan, where wind speeds average 19 to 20 mph (Citizens for a Greener Evanston 2009). In April, 2010, the Evanston city council voted unanimously to issue a Request for Information to wind farm developers (Long 2010). The RFI closes on June 30, 2010, and city officials anticipate proposals from ten developers (Barrosse 2010).

Chicago

Sustainability Plans. Chicago is regularly applauded for its efforts to green its infrastructure and businesses. The city launched the Department of the Environment in 1992, and it gradually added new environmental initiatives over the years. The early initiatives focused on tree planting and landscaping, and over time the city has developed a wider series of efforts that includes the use of recycled materials in roads, green roofs, transit-oriented development, and alternative fuel vehicles. In 2008, the city introduced the Chicago Climate Action Plan, calling for a reduction in greenhouse gas emissions to 25 percent below 1990 levels in ten years and an 80 percent reduction by 2050. Heating, cooling, and powering buildings, followed by transportation were determined to be the most significant contributors to the city's greenhouse gas emissions (Walljasper 2010). Therefore, most of the plan's steps focus on improvements in energy efficiency and transportation. The plan does not articulate any strategies for developing clean technology or green energy industries, but instead focuses on an increased demand for tradespersons to retro-fitted buildings and low-skill work related to landscaping and recycling (Schrock and Sundquist 2009).

Green-Building Initiatives. In 2004 the city adopted the Chicago Standard, a guide for green building construction for new buildings and building renovations for city-owned buildings. The Climate Action Plan has identified energy-efficient buildings as a central strategy (City of Chicago 2009, Johnston 2005) and includes a section that is dedicated to greening buildings. Since 2001 the city retrofitted fifteen million square feet of municipal buildings and helped to weatherize 1000 residences (City of Chicago 2009e). The city also supported the Energy Savers Program, a low-income weatherization program that is an initiative of the MacArthur Foundation and the Cook County Community and Economic Development Foundation. The city has added rooftop gardens and plants to over thirty municipal buildings and provided subsidies to enable over 400 buildings throughout the city to add green roofs. It has also worked with the local utility to develop a program to provide solar installations on the city's schools (Martin and O'Toole 2002), and it partnered with Excelon to build the country's largest urban solar power plant (City of Chicago 2009a). Under its Industrial Rebuild Program, the city provides free energy audits in one industry per year and offers zero percent financing for energy improvements based on the audits. The city's Green Permitting Program offers developers an expedited permitting process, shortening the processing time the more green building elements are included in the project (City of Chicago 2010b). Taken together, the many programs were a major contributing factor behind the high score that Chicago gained on many of the sustainable cities rankings. ShoreBank, a community bank dedicated to the development of low-income neighborhoods, has a variety of loan programs for building renovation, and it received \$35 million from the U.S. Treasury for work on green building projects (Chicago Sustainable Business Alliance 2009).

Green Jobs Training. Chicago is also known for its green jobs training programs, especially the Greencorps Program of Chicago. Launched in 1994 and managed by the city's Department of the Environment, the program provides community gardening assistance and green jobs training. It hires about fifty people each year for a nine-month training session for future jobs in landscaping and horticulture, electronics recycling, and weatherization (Chicago Jobs Council 2007, City of Chicago 2009d). During the period the trainees also assist the

community gardens program and work in a recycling center. Many of the members of the Greencorps training program are ex-offenders, and the program offers them an opportunity to live up to the promise of “jobs not jail.” The program is located in the Chicago Center for Green Technology, a LEED-certified building located on a seventeen acre site that was occupied by a company that violated permits and left significant solid waste. The city’s Department of Environment closed down the site and, after taking the company to court, became its owner in 1996 (City of Chicago 2009b). With ARRA funds, the city was able to increase the number of jobs for the Chicago Green Corps and develop another initiative, the Community Green Jobs initiative, which involves training in partnership with nonprofit organizations (Merritt 2009).

Another program of the city’s Department of Environment is the Chicago Conservation Corps. Founded in 2006, the program provides training sessions and some financial assistance to citizens who wish to undertake environmental service projects in their neighborhoods. Examples of projects include ride sharing programs, home energy audits, community garden development, and plastic bottle clean-ups (Phillip 2006).

Green Business Initiatives. Although the city’s Climate Action Plan does not include a strategy to develop clean-energy industries, the city is the headquarters of many green or clean-tech companies, including fourteen wind energy companies (City of Chicago 2010a). Mayor Daly also recruited two solar firms, Spire Solar and SolarGenix, to locate in the city by providing incentives and using the city’s procurement policy to spur demand. With loan guarantees from the federal government’s stimulus program, Excelon has partnered with the city of Chicago to build a solar farm on an unused industrial site on Chicago’s South Side. The project will generate 200 jobs during construction but only an estimated one job when it is up and running (Dumke 2009). Although the efforts to attract solar-energy companies and develop solar installation projects are laudable, there is no evidence of a comprehensive plan to develop the city’s solar industry.

There is a plan from the Department of Community Development to develop a part of the Addison Industrial Corridor for green tech and other high-technology businesses (City of Chicago 2009c). The corridor would build on the “Green Exchange,” a refurbished building in an adjacent neighborhood that plans to house up to 100 green businesses and will be financed from the tax-increment financing district. The building would have 275,000 square feet and would be the largest of its kind in the country (City of Chicago 2009f). However, the developers have struggled to find private financing for the project (Gallun 2009). The city also played a role in founding the Chicago Climate Exchange, a carbon emissions trading system, and the city formed the Greentown Enterprise Zone, which it used to attract clean tech businesses like SolarGenix, but the city does not have a focused economic development strategy that has assessed clean tech strengths and targeted industrial clusters for development.

Civil Society Organizations and Policy

Civil society organizations have increasingly rallied to the cause of green jobs. In 2002 Attorney Naomi Davis founded Daughter’s Trust/the Village Builders, and since then she has been trying to convert 1000 acres in Chicago’s South Side neighborhood of Riverdale into a mixed income, ecologically oriented village. Four years later she founded Blacks in Green,

which sponsors a weekly television show about African Americans and the environment and works to connect green jobs with the African American community (Olivesi 2009, Walker 2008). A broader coalition of organizations was formed in 2007 as the Chicagoland Green Jobs Initiative, which has hosted conferences of area organizations and developed research reports in support of green jobs (Green for All 2008). The Chicagoland Green Jobs Initiative has partnered with the city and the Partnership for Communities (a fund of The Chicago Community Trust) to obtain external foundation support for a program to train thirty to fifty public housing residents in weatherization (Partnership for Communities 2009).

The Local Economic and Employment Development Council (LEED Council) is a membership organization that includes over 100 businesses and institutions and promotes business and workforce development in the North River Industrial Corridor. Working with employers, LEED Council conducts customized recruitment, training, and job placement that seeks to increase access to jobs for low-income Chicago residents. Recently, LEED Council created training programs that develop weatherization, “green” maintenance, and solar panel installation skills.

The Chicago Sustainable Business Alliance (CSBA) connects sustainable businesses and eco-entrepreneurs throughout the city. In cooperation with the Illinois Institute of Technology’s Center for Sustainable Enterprise, CSBA regularly offers members nearly twenty workshops such as “Addressing Climate Change for Business” and “Anatomy of a Sustainable Enterprise Business Plan.”

The city is also home to the Center for Neighborhood Technology (CNT), a “think-and-do tank” that promotes urban sustainability with research and programs in transportation, community development, energy, and climate change. CNT Energy played a significant role in the development of the Chicago Climate Action Plan and is also the convener of the Illinois Smart Grid Initiative. CNT Energy has also been developing the Cook County Energy Savers program which provides proprietors of multi-family buildings with recommendations for becoming more energy efficient. CNT has been growing Energy Savers to serve the 7 county Chicago region and aims create a centralized way “to manage the financing, marketing, performance monitoring and certification, information provision, supply chain development, and customer assistance required to efficiently scale up the delivery of retrofit services for all types of buildings across the Chicago region” (Brookings Institute 2009). This project is 100 percent privately funded.

The Illinois chapter of the Sierra Club is a major player at the state level and was a significant force behind the recent RENEW Illinois legislation. The state chapter’s focus is on advocating for or against legislation proposed at the state level. The organization’s website explains their policy positions and members also maintain an active blog and YouTube channel documenting each legislative session.

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Iowa

Summary and Analysis

For a state with a relatively small population and gross state product, Iowa has developed impressive leadership in two clean-energy industries, biofuels and wind. Among the innovative programs are the following:

- the Bioeconomy Institute, which provides a research basis for innovation in the state's biofuels industry
- the Iowa Alliance for Wind Innovation and Novel Development, which will help the state transition from wind-energy production and manufacturing to technology innovation;
- the New Jobs Training Program, which enables community colleges to sponsor new programs through revenue bonds; and
- the Grow Iowa Values Fund and Iowa Power Fund, which can support clean-energy business development.

General Background Policy

Energy Goals. In 2005 Executive Order 41 established a target that state agencies receive 10 percent of their electricity from renewable sources by 2010. In 2007 Iowa joined the Midwestern Regional Greenhouse Gas Reduction Accord, which established a 10 percent renewable energy standard by 2015. The state also has a target of 105 megawatts of electricity from renewable energy sources for the two main investor-owned utilities (about half of the 1990 peak load for the utilities). The state has an energy-efficiency resource standard of 1.5 percent per year for electricity and natural gas (SF 2386). Legislation passed in 2007 (SF 485) also established the Iowa Climate Change Advisory Council, which developed plans for greenhouse gas reductions under scenarios of 50 percent and 90 percent by 2050. In 2007 the state also approved legislation (HF 918) that created the Office of Energy Independence to coordinate state government initiatives (EPA 2008).

Public Benefits Fund. Iowa does not have a public benefits fund (DSIRE 2010).

Green-Buildings Policy. In 2005, Governor Vilsack issued the executive order (41) to have state government buildings reduce electricity and natural gas consumption by 15 percent by 2010. In 2007 the state's energy independence plan mandated audits for all state buildings and energy retrofits. In 2008, Governor Chet Culver issued a new executive order (No. 6) that established green building goals for the state government's buildings and led to the creation of the state government's Green Government Master Plan (State of Iowa 2009). The Energy Excellent Buildings Task Force was charged with reducing energy and water consumption in state buildings by an additional 15 percent by 2013 (DSIRE 2010).

Green Jobs Training. An innovative program is Iowa's New Jobs Training Program, which allows community colleges to issue bonds to pay for programs for students who will find jobs in growing industries, such as wind and biofuels. The bonds are retired through a diversion of 1.5 to 3 percent of the state withholding taxes from wages of the new positions. Funding for green jobs training from the ARRA (\$6 million in 2010) went to Iowa Workforce Development. The state is also developing a green workforce development plan (State of Iowa 2010a)..

Clean-Energy Industries

General Policy. In 2005 Iowa approved the Grow Iowa Values Fund for \$500 million over ten years (HF 809, 868). The fund provides support for the state's Department of Economic Development for start-ups, recruitment, and retention. Some of the fund has supported biofuels and wind power development (State of Iowa 2010b). In 2007 Iowa passed HF 927, which provided the basis for General Iowa Power Fund of \$100 million over four years. As of 2010 the fund had supported about \$37 million in direct investments in the wind, biofuels, and renewable energy sectors. The state also offers a research activities credit for companies and other business credits for renewable-energy production. Less directly relevant to support for clean-energy industries is the I-Jobs legislation, which was passed in 2010 and provides \$875 million in bond-supported funding. Most of the funding is for infrastructure, but some of it is for economic development programs. With respect to clean-energy industries, Iowa is known mostly for biofuels and wind energy.

Biofuels. Iowa is the national leader of biofuels production (first in ethanol and second in biodiesel), and the state government has supported the industry through the General Iowa Power Fund and a renewable fuels standard of 25 percent by 2019. In 2008 Governor Chester Culver's Executive Order 6 established the Biofuels Task Force to develop state government use of biofuels in its fleets (EPA 2008). In 2009 Governor Culver also supported an increase in the federal mandate for ethanol to 15 percent, a change that he claimed would create about \$24 billion in import substitution revenue for the country (State of Iowa 2009). In the same year the governor signed Executive Order 3, which set a goal of shifting the state's vehicle fleet to flex-fuel vehicles that could use the E85 ethanol blend. Iowa State University also has impressive research resources that are brought together in the Bioeconomy Institute (2009), which has over 150 affiliated faculty and over \$50 million in research funding spread across various programs. The research is helping the industry to expand not only for biofuels production but also for coproducts. Among the large grants to the university is a \$22.5 million partnership with Conoco-Phillips and the National Renewable Energy Laboratory for cellulosic ethanol research. The company POET also received an \$80 million grant from the U.S. Department of Energy to create a commercially viable cellulosic ethanol facility, and the state is home to the Renewable Energy Group, which is among the fifty "hottest" biofuels firms in the country.

Wind. Iowa has the second highest level of wind energy production in the country, due largely to its decision to become one of the first states to develop a renewable electricity standard. The state has won some large wind manufacturing contracts, and it is home to 200 companies that either manufacture or provide services in the wind industry (Trabish 2010). The

manufacturing industry employs about 2300 people (Culver 2010). There is no single geographical cluster of major manufacturers in the state, but most are located in the area around Des Moines and Cedar Rapids, as well as in the southeastern corner of the state. The state's General Iowa Power Fund has provided funding for wind energy at the University of Iowa and a plan to store wind energy in a compressed air facility. In 2009 the state government also improved the use of tax credits for small wind projects and incentives for wind manufacturers.

The Iowa Alliance for Wind Innovation and Novel Development is a state government initiative intended to promote wind energy research, testing, training, and education across the state's research universities, community colleges, and businesses. The organization's web site includes a detailed summary of intrastate research resources relevant to the wind industry. The organization also hosted a conference with the Iowa Wind Energy Association in 2010, and other conferences have been held in previous years. The University of Iowa has a Wind Energy Working Group. One negative point in a generally positive series of developments is that the state lost the 2009 competition for the \$45 million wind energy test bed facility to South Carolina.

Des Moines

Iowa does not have a large city with a politically powerful constituency of low-income neighborhoods that are pushing for green jobs from the grassroots. The largest city, Des Moines, has a low unemployment rate similar to that of some other small cities in the Midwest. As a result, sustainability initiatives at the urban level tend to be disconnected from national efforts to build low-income green jobs programs, such as weatherization. Likewise, the city's sectoral strengths are in insurance, finance, publishing, and government rather than the ethanol and wind industry. Consequently, the high-tech side of green jobs development is also not a major part of the economic development picture at the urban level. The connection with the state's ethanol industry is primarily through the biotechnology corridor that runs between Des Moines and Iowa State University to the north (Greater Des Moines Partnership 2010). Attempts to build an ethanol plant in the Agrimergent Technology Park failed due to credit problems (Eckhoff 2008).

The city is concerned with sustainability issues in the more traditional sense of urban design, greening, and quality of life. The mayor, Frank Cownie, established the Des Moines Energy and Environmental Task Force, and the city has been selected as one of four sites for measuring environmental and sustainability factors associated with the International Council for Local Government Initiatives (2006). Based on recommendations from the task force, in 2007 the city council approved the Energy Conservation and Environmental Enhancement Policy. In response, the mayor created a sustainability team composed of seven members from across different departments (Green Des Moines 2010).

Civil Society Organizations and Policy

Iowa's developments in the biofuels and wind-energy industries appear to be driven by policymakers who are responding to needs of the state's agricultural sector as well as the loss of

manufacturing jobs. The state does not have active Blue-Green Alliance and Apollo Alliance chapters, and there is not the same level of grassroots advocacy for green jobs found in the cities of other states. The state's Sierra Club chapter has information on legislative activity and advocacy, but here the emphasis is on energy demand policies. In 2010 the chapter's legislative priorities include the following: "renewable energy solutions, distributed generation through feed-in tariffs, property-assessed clean-energy bills (PACE), and a bill that requires disclosure to utility customers of the percent electricity derived from alternative and renewable energy sources" (Sierra Club 2010). The chapter is also supporting green building codes and opposing legislation that supports nuclear power.

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Michigan

Summary and Analysis

Michigan policymakers envision the development of green industries as a potential solution to the state's ongoing economic woes. Those hopes, coupled with significant investment during the last five years at the state and local levels, are beginning to produce some significant results.

With the Big Three automakers based in Detroit, Michigan has a head start over other states in developing clean fuels and cars, because it can piggyback off existing automotive research, manufacturing, and supply capacities. At present, more than 40 percent of the state's green jobs are in the transportation and fuel sector. Governor Jennifer Granholm has successfully pursued billions of dollars in federal support for green and energy efficient vehicles for Michigan. The state is positioned to become a global leader in the production of electric vehicles and batteries. Michigan has also targeted wind energy manufacturing as an area of potential strength. Multiple wind farms may eventually be built off the shores of the Great Lakes, though existing proposals are meeting with stiff local resistance. Some sources have cautioned that without a stronger renewable portfolio standard, lack of demand may cause Michigan to lose the competition for wind manufacturing to states, like Ohio, with more progressive energy goals. State and local officials agree there is a need to raise Michigan's standard above 10 percent moving forward. Michigan stills gets most of its electricity from coal, and unemployment remains staggering, but state and local leaders have implemented a number of innovative programs aimed at promoting green development, including:

- The statewide No Worker Left Behind program provides up to \$10,000 in tuition support for laid-off workers and has trained over 130,000 workers since 2007.
- The governor has linked economic development and environmental policy in the Department of Energy, Labor, and Economic Growth.
- Massive public investments are being made in tax credits to attract green energy manufacturers, including portions of the \$1 billion 21st Century Jobs Fund and the \$800 million Michigan Advanced Battery Credits.
- In Grand Rapids, city officials have pledged to obtain 100 percent of municipal electricity needs from renewable sources by 2020.

Grand Rapids is emerging as a national leader in green building, education, and business development. The greening of the city's image and economy is in large part thanks to strong regional organization and collaboration. Local companies have banded together in the West Michigan Sustainable Purchasing Consortium to bid down prices for green supplies. The Community Sustainability Partnership has allied more than 190 local governments, educational institutions, businesses and nonprofits to promote sustainable growth.

General Background Policy

Energy Goals. In 2007, Michigan joined the Midwestern Regional Greenhouse Gas Reduction Accord, which commits the state to 10 percent renewable energy by 2015. That benchmark was codified as part of a comprehensive energy plan passed in 2008 (SB 213, HB 55214). In addition to establishing the state's Renewable Portfolio Standard, the legislation includes a net metering provision, consumer tax credits for energy-efficiency and renewable-energy projects, and a requirement that the state's two large electric utilities increase efficiency 5.5 percent by 2015. Those utility companies are also required to invest in renewable electricity generation. Consumers Energy must add 200 megawatts from renewable sources by 2013 and a total of 500 megawatts by 2015, and DTE Energy must build or buy 600 megawatts by the same date (NextEnergy 2008). Those investments are being funded by a monthly surcharge on consumer electric bills. Finally, the package of bills called for state government buildings to reduce their electricity consumption 25 percent by 2015 (DSIRE 2010). Investments in energy efficiency are expected to save the state \$3 billion over twenty years (BLMISI 2009). Governor Jennifer Granholm has been pushing the legislature to adopt the aggressive goal of a 45 percent reduction in the use of imported fossil fuels (which would include all coal burnt in the state) by 2020. The Michigan Climate Action Council, a planning group formed at the governor's behest, recommended in their 2009 final report that the state enact policies to reduce greenhouse gas emissions 20 percent below 2005 levels by 2020 and 80 percent by 2050.

Many in policy circles feel Michigan's 10 percent renewable energy goal is not aggressive enough, especially because the state's major utility companies had already achieved about half of that goal before the legislation was passed. "The RPS is a modest commitment to renewable energy at best," said Arn Boezaart, Director of the Michigan Alternative and Renewable Energy Center at Grand Valley State University. "Michigan was twenty-eighth in the nation to develop a renewable portfolio standard, so we didn't exactly lead the pack" (Boezaart 2010). Greg Main, president and CEO of the Michigan Economic Development, admitted that the existing renewable portfolio standard is insufficient, but said he has been in talks with the governor about trying to increase those targets (Main 2010).

The state's investor-owned utility companies get paid by the kilowatt-hour, so they have little incentive to invest in clean energy or efficiency. Unlike California and a few other states, Michigan does not have decoupling of utility revenue from efficiency gains. While the utilities have been accused of dragging their feet on renewable energy, they have not been entirely unresponsive to state demand. Consumers Energy has launched an experimental program to buy electricity from small residential solar installations. Under the new program, the utility would purchase all of the electricity produced by the residential system, and the residence would continue to receive its electricity from the grid. In order to be eligible for the program, the solar equipment used must have been manufactured or assembled in Michigan, and participants are not eligible for net metering. Grand Rapids sustainability director Haris Alibasic said he would like to see greater support for feed-in tariffs at the state level. The existing Consumers' program is capped at 2 megawatts and is already 300 percent oversubscribed (Alibasic 2010).

Public Benefits Fund. Michigan electric consumers pay a system benefits charge that supports the Low-Income and Energy Efficiency Fund, which is administered by the state's

Public Service Commission. The fund receives about \$84 million annually for projects, and a total of more than \$488 million in grants had been awarded by the end of 2009. Although the focus is on low-income customers, the fund supports general energy-efficiency projects and has even supported feasibility studies for off-shore wind generation (DSIRE 2010).

Green Building Policy. In 2005, Governor Granholm signed Executive Order #2005-04, which required new and renovated state government buildings, including those at universities, above \$1,000,000 to be LEED-certified at the minimum level. The order also mandated a reduction in energy consumption by executive branch buildings of 10 percent by 2008 and 20 percent by 2015, with both goals using 2002 as the baseline year. Additional executive orders in 2007 (#2007-06, #2007-22) increased the reduction in energy consumption by an additional 10 percent. Legislation passed in 2008 (PA 295) increased the reduction in purchases from the grid to 25 percent (DSIRE 2010). The state legislature (SB 1111-1114) is considering bills that would provide tax breaks to construction or renovation projects that meet LEED standards.

Green Jobs Training. Faced with an army of unemployed workers, Michigan has taken a unique approach to jobs training, investing heavily in several marquee programs such as No Worker Left Behind and the Michigan Skills Alliances. Since its launch in August 2007, the \$500 million No Worker Left Behind program has helped more than 130,000 laid-off or impoverished Michiganders receive additional training in high-demand professions. The program provides up to \$10,000 in tuition support for each participant. Twenty-five regional Michigan Works! agencies determine what kinds of jobs are in high demand in their area, and they compile a list of eligible training programs. Individuals receiving unemployment benefits are steered to No Worker Left Behind through local Michigan Works! service centers, and the workers can choose to enroll in any of the approved training programs, which range from associate's degrees and certificates to post-graduate studies at four-year universities. Nearly 60 percent of unemployed workers who finished their training were able to find a new job — three times the national average (State of Michigan 2010). Unfortunately, federal spending cuts are drying up the stream of funds to the program, and local Michigan Works! offices have begun limiting the number of new applicants. Some observers have also complained that the program needs to put greater emphasis on training workers in emerging sectors, such as advanced energy, rather than focusing on existing areas of high demand. To address the need for more training in green industries, No Worker Left Behind was expanded in 2008 with the creation of the Green Jobs Initiative. The initiative earmarked \$6 million for green education and training programs, \$3 million of which went to tuition support for individual trainees.

State officials increasingly attempt to partner with industry in order to identify skills gaps and worker training needs. This new approach led in 2004 to the establishment of the first Michigan Skills Alliances, regional working groups that connect employers with educational institutions to address the workforce needs of a particular industry. The state provides seed money of \$250,000 over four years to help establish new alliances. To date, about forty alliances have been created throughout Michigan, with greater attention being paid to green industries in recent years. One success story has been the Michigan Academy for Green Mobility, which in 2008 brought together representatives of the auto industry to discuss strategies for training their engineers to build greener cars. After identifying their training needs, the alliance solicited proposals for training programs from state universities, and eventually settled on short courses in

advanced battery technology developed by Wayne State University and Michigan Technological University. In 2009, the state Department of Energy, Labor and Economic Growth secured funds from the Green Jobs Initiative for the first 200 engineers to complete the courses. For their part, companies like General Motors pitched in with equipment and facilities, such as vehicles and test tracks, for use in the courses, and covered some of the cost for a second cohort of trainees. The alliance is now looking at expanding the course offerings to a full certificate program.

A variety of other training programs in clean-energy industries has been started at state universities and community colleges. Weatherization certificate programs such as those at Henry Ford Community College in Dearborn and the WARM Training Center in Detroit have been attracting unemployed residents, but graduates are having a hard time finding work. Although Michigan secured \$234 million in ARRA funds to weatherize low-income homes, those funds have been slow to materialize, and as a result weatherizing businesses have not been hiring (Rogers 2010).

Clean-Energy Industries

General Policy. Between 2000 and 2010 Michigan lost about one million out of five million jobs, and it became the fiftieth state in the country for unemployment. The desperate employment situation set the stage for government investment in the high-technology sector, which soon broadened into the clean-energy industries. A 2009 report claims that Michigan already has more than 100,000 “green” jobs in the private sector, with ample opportunity for growth. The state’s Department of Energy, Labor, and Economic Growth projected jobs in green industries to grow by 6.4 percent annually from 2006-2016. Renewable energy jobs grew 30 percent between 2005 and 2008 (State of Michigan 2009). A Pew study recorded more modest gains (22,674 “clean” jobs in 2007 at 1,932 businesses) but still found that clean jobs were growing at more than 10 percent a year while the rest of the state’s economy is in decline (Pew 2009).

The Department of Energy, Labor, and Economic Growth distributes funds to industry for jobs training, but the first stop for most businesses looking to expand is the Michigan Economic Development Corporation (MEDC). An arm of state government, the MEDC has a hat full of tax incentives that can be used to lure green businesses — the decades-old Michigan Economic Growth Authority tax credits, Renaissance Zones for renewable energy, and brownfield redevelopment tax credits among them. The state has also been awash in federal stimulus funds. The MEDC recently selected the growth of alternative energy clusters as a focus of its business recruitment activities. Wind energy, photovoltaics, and cellulosic biofuels have been identified as target areas for investment. In addition to making green businesses eligible for various pots of government honey, the agency now employs dedicated business development managers to work with companies in sectors such as wind and solar energy, and it is even airing a new commercial in which actor and native son Jeff Daniels pitches Michigan as the “Eco-Peninsula.”

At the heart of Michigan’s economic development efforts is the 21st Century Jobs Fund, authorized by the state legislature in 2005. The 10-year, \$1 billion fund invests tobacco

settlement dollars in the state's high-tech economy, with alternative energy as an area of special emphasis. MEDC President Greg Main called the fund an essential aspect of the state's economic development strategy, but other sources have been more critical of the program's performance. For example, *The Detroit Free Press* recently reported that the hundreds of millions already spent under the program have only netted about 1,000 direct jobs, about one-third of the number initially predicted by the state (Yung 2010).

The state government has also created a program to develop further Michigan's research infrastructure. The Centers of Energy Excellence program was launched in 2008 to encourage "the development, growth, and sustainability of alternative energy industry clusters in Michigan by identifying and/or locating a base company in a geographic region with the necessary business and supply-chain infrastructure" (Brown 2008). The program utilized up to \$45 million over three years from the 21st Century Jobs Fund to support research and development clusters. One of the first centers steered \$3 million to a University of Michigan professor to fund both research and her Ann Arbor startup. A related law passed in 2006 and amended in 2008 enabled the state to establish up to fifteen Renewable Energy Renaissance Zones, in which companies that produce renewable energy are exempted from most state taxes. As of August 2009, four such zones had been approved (DSIRE 2010).

The state is using some of the ARRA funding it received to support clean-energy manufacturing. In 2009 the state awarded five grants to help small manufacturers retool for production in renewable energy or components, and in 2010 the state gave another \$20 million to nine businesses. Applicants had to show demand, local sourcing (within Michigan), proof of contribution to the state's renewable portfolio standards goals, recycling of waste, and compliance with the prevailing wage laws (Foshay 2010). One well-known example of the retooling of Michigan's industrial base is a factory in Wixom, where the Michigan Economic Growth Authority helped Ford to repurpose an automotive plant, which at its height employed 5,000 workers, to house renewable energy companies (Donoghue 2009).

Several other tax incentives have been put in place to attract businesses in clean-energy industries, and a variety of incentives exist for residential property owners to pursue renewable energy or efficiency projects as well. The Michigan House of Representatives recently passed a bill that would allow communities to issue PACE bonds for residential projects, which homeowners would slowly repay through additional property taxes.

Governor Granholm also reorganized the state's Department of Labor and Economic Growth into the Department of Energy, Labor, and Economic Growth (DELEG) to link the state's economic development efforts with energy policy. The new department's activities include clean-tech industry development, and green jobs training initiatives. Prior to the reorganization, work to promote sustainable development had been underway in a handful of state departments with little inter-departmental cooperation. According to DELEG staff, gathering all of these resources under one banner has improved communication among state officials and allowed for greater coordination of their activities.

The state government in 2007 founded the nonprofit organization NextEnergy and capitalized it with \$30 million in seed funding from the MEDC. The organization both funds

research on advanced energy technologies and facilitates their commercialization. It supports business development in the biofuels and electric motor vehicle industries, as well as the use of the automotive supply chain to develop wind turbine component manufacturing and battery technology.

In 2007, the state's three large research universities received almost \$80 million in grants to conduct alternative energy research. More than half of the funded projects concerned transportation and fuel technologies. Michigan universities have established a variety of offices and centers for coordinating clean-energy research and facilitating technology transfer, including the Michigan Memorial Phoenix Energy Institute at the University of Michigan, Michigan State University's Office of Biobased Technologies, and Wayne State University's Center for Automotive Research (Anderson Economic Group 2008).

Biofuels. Michigan has targeted biofuels production through its Renewable Energy Renaissance Zones program, which stipulates that five of the fifteen zones to be established focus on producing cellulosic fuels (DSIRE 2010). In 2005 an executive order from the governor (2005-4) required state agencies to purchase hybrid and alternative fuel vehicles (EPA 2008). In 2006 Michigan developed a program to assist service station owners with converting their pumps to include biofuels, and in the same year NextEnergy established the National Biofuels Energy Laboratory at Wayne State University. The laboratory helped to develop the national standard for biodiesel that will enable a transition from a 5 percent to 20 percent blend. A year later Michigan State University shared a \$50 million grant to found the Great Lakes Bio-energy Research Center, in partnership with the University of Wisconsin-Madison, for advanced studies on cellulosic ethanol production. The creation of that center helped to forge an agreement with the Boston-based Mascoma Corporation to build a cellulosic ethanol plant in Michigan. In 2009, Michigan State University opened its Bioeconomy Institute at a 138,000 square foot facility in Holland, Michigan. The institute aims to facilitate technology transfers by providing space for business incubation and laboratory research on biofuels, materials and chemicals.

Michigan policymakers are also searching for ways to take advantage of the state's biomass resources. Waste from the paper and lumber industries and untapped stock in the state's vast northern forests have the potential to supply a large biomass industry, but the industry has so far been slow to develop.

Solar. Michigan has expanded in the solar industry, due to its demand side policies and its economic development efforts. The state has the natural resource of North America's largest silicon deposits near Saginaw. 2008 legislation set aside \$75 million for tax credits to companies creating jobs in photovoltaics manufacturing in hopes of strengthening the state's growing solar cluster. The state government's efforts have paid off to some degree, because Michigan is now home to a number of solar equipment manufacturers. Hemlock Semiconductor, a subsidiary of Dow Corning, is a leading producer of solar-grade polycrystalline silicon, and the company is investing \$2 billion into an expansion of its solar business. United Solar Ovonic (also called Uni-Solar) is a leading global photovoltaic firm that has its headquarters in Michigan. The company makes thin, flexible solar films and has four production plants in Michigan, two near Detroit and two near Grand Rapids. Though the company's cutting-edge technology has garnered significant media interest, production has outpaced sales during the current economic

downturn, and Uni-Solar's bottom line has suffered, even to the point of forcing temporary worker furloughs in 2009.

Transportation and Energy Storage. Given Michigan's historical position as the home of the automotive industry, it has built on that strength to establish leadership in the electric vehicle, battery technology, and fuel-cell industries. State officials are betting that the country's transition to cleaner energy sources will make advanced batteries ubiquitous, both for grid storage and electric vehicles. The Michigan Advanced Battery Credits Program was recently expanded to \$800 million in tax credits for battery manufacturing. According to Governor Granholm, this support for the industry will enable Michigan to be "the place to locate if you are a battery manufacturer" (Luke 2009).

Michigan's courtship of the battery industry appears to be paying dividends, because six new battery manufacturing facilities have located there, and state officials are currently in talks to bring in two more companies. This success is in part thanks to the governor's close relationship with the Obama administration. In just the last two years, the state has received about \$6 billion in both private and public funds for new battery manufacturing facilities, including sizeable allocations of federal stimulus money (Schneider 2010). In 2009 Michigan received more money than any other state from the \$2.4 billion Electric Drive and Vehicle Component Manufacturing Initiative (U.S. Department of Energy 2009), and \$1.35 billion in ARRA funds to support twelve projects in advanced battery and electric vehicle manufacturing (Brown 2009).

As of mid-2009, four companies — Johnson Controls, Dow Chemical, LG Chem, and A123Systems — had pledged to invest almost \$2 billion building four battery plants in Michigan. The facilities were expected to create 6,600 jobs (Environmental Leader 2010). The Massachusetts-based A123Systems has since opened a second factory and will begin construction on a third in 2010. Efforts are also being made to grow a supply chain for the battery industry within the state's borders.

Michigan now has one of the largest stakes in worldwide electric vehicle manufacturing, and the state's battery and energy storage industries are projected to employ 62,000 people by 2010. The state claims that the multiplier for an auto industry job is ten to one (ten indirect and induced jobs are created for every automotive job), and four to one for automotive supply chain jobs. At a conference presentation that Hess attended, a representative from the state government characterized Michigan's electric vehicle industry as "real," in contrast with California's electric vehicle industry, which he characterized as "toy cars" built in "garages." The Obama administration's implementation of tough new fuel efficiency standards is priming the market for the huge number of gas-sippers that will soon be churning out of Detroit. Both General Motors and Ford selected Michigan as the site for building their first electric vehicles. The much-hyped Chevy Volt is scheduled to hit showrooms by the end of the year, and Ford plans to release five different electric models by 2012.

Michigan also has some strengths in the related industry of hydrogen production. The state is home to the DTE Hydrogen Technology Park, which provides testing for on-site hydrogen use from production and storage to use, and to the NextEnergy Center, which has

conducted hydrogen vehicle testing. All three of the major U.S. automotive companies, as well as some of the suppliers, have some research and development in fuel-cell vehicles. Manufacturers include Delphi, Adaptive Materials, and Energy Conversion Devices. There is also a fuel-cell research center at Kettering University and a laboratory at the University of Michigan. Five of the state's leading research universities formed the Consortium for Advanced Manufacturing of Alternative and Renewable Energy Technologies to advance energy technology research collaborations.

Wind. Michigan has several advantages over other states in growing its wind energy design and manufacturing sector. In addition to being a windier-than-average state (the American Wind Energy Association ranks it seventeenth nationally), its more than 3,000 miles of Great Lakes shoreline makes it an ideal place for investment in offshore wind farms. The state already has about 150 megawatts of wind capacity operating onshore, mostly in its southeastern "thumb" region.

In 2009 Governor Granholm established the Great Lakes Wind Council to identify wind energy sites, including offshore sites in the Great Lakes. Because much of the renewable energy produced from the state's 2008 Renewable Portfolio Standard is from wind energy, the goal is to utilize the development of wind farms to stimulate the state's wind manufacturing industry (North Carolina Solar Center 2009). Some observers have criticized the state, which owns the bottoms of the lakes, for not taking a more aggressive approach to developing offshore wind.

While offshore farms are still three-to-five years away from operational status, a number of Michigan wind technology firms are ramping up production in the anticipation of increased demand. A report by the MEDC counted at least twenty-five companies in the state involved in the manufacturing of wind turbines or turbine components, and another 900 firms are dedicated to designing, assembling, or providing other services related to the production of turbines. Michigan's economic development organizations hope that as automobile production continues to shrink, the state's many parts suppliers will be able to replace their disappearing business with contracts to make components for wind turbines, which require many of same building blocks as cars, such as gears, bearings and engines. In 2009, twenty-nine different parts suppliers successfully competed for \$377 million in new business (NextEnergy 2010).

Existing businesses include Danotek Motion Technologies, which makes generators for wind turbines; Ventower, which builds wind towers; and Loc Performance Products, which manufactures the systems that control the direction a windmill is facing. Each firm expects to add dozens of jobs in the coming years (Greene 2010). Because manufacturing quality remains a problem area for the turbine industry, Michigan businesses hope to trade on their expertise with casting technologies to manufacture more reliable turbine parts, and state officials have been courting a leading Swedish casting firm.

In 2008 Michigan was ranked as a top state, along with Iowa and Wisconsin, for expanded or new wind manufacturing operations (American Wind Energy Association 2009). Global Wind Systems is planning a \$30 million turbine manufacturing plant in Novi that will employ more than 400 people, and GE has announced it will add a design center in Detroit (Sanchez 2010). Michigan has established an incentive that rewards renewable-energy producers

who use equipment manufactured within the state. The state energy office has prepared model zoning guidelines to assist municipalities with the development of codes for commercial wind farms and residential installations (DSIRE 2010).

Grand Rapids

The West Michigan region, anchored by the city of Grand Rapids, is one of the few bright spots on Michigan's economic map, as the prospects for Detroit and much of the rest of the state continue to sag from dependence on the flailing auto industry. Investment in the Grand Rapids area has taken off, and the budding metropolis has increasingly been able to attract green industry. Green building throughout the region has gone, in some cases quite literally, through the roof. These successes have in part been stimulated by the forward-thinking policies of local leaders. In May, the U.S. Chamber of Commerce Civic Leadership Center named Grand Rapids the most sustainable mid-sized city in the U.S.. "We're at a tipping point of behavioral change," said Norm Christopher, executive director of the Sustainable Community Development Initiative at Grand Valley State University (Christopher 2010).

But the city government's impressive commitment to sustainability is almost certainly not the root cause of the accelerated greening of Grand Rapids in recent years. Rather, it is the effect of a community-oriented culture unique to the region. Local leaders like to say that the conservation ethic has a long history in Grand Rapids; a Protestant ethic has probably been equally operative. The region has traditionally been home to a large Dutch Protestant population, and that heritage has infused the captains of Grand Rapids industry with an uncommonly strong sense of civic and environmental responsibility. Local billionaires have invested heavily in the city and surrounding area, and today's sustainability initiatives can trace their origins back to environmental organizing begun by members of the business community in the late 1960s.

Government, business, and educational leaders have displayed a remarkable aptitude for bringing people together and generating consensus. The formation of public-private partnerships, large stakeholders' groups, and voluntary collaborations between business competitors is almost old hat here. "We collaborate and work together like we're a community of 10,000, yet we're a metro area of nearly 800,000. That is something very different about West Michigan," said Tim Mroz, vice president of marketing and communications at The Right Place, Inc. "The level of collaboration around sustainability is unlike anywhere else in the nation – I challenge you to find another community that brings citizens, government, and private business together like we do" (Mroz 2010).

Sustainability Plans. Grand Rapids has some of the most aggressive renewable energy goals in the nation. By late 2007, a 2005 benchmark of obtaining 20 percent of municipal government power needs from renewable sources had already been met. The city commission has embraced Mayor George Heartwell's new goal of obtaining 100 percent of the city government's energy from renewables by 2020. The city remains in the exploratory phases of determining how to meet this goal. The 20 percent mark was reached by simply buying renewable energy from Consumers Energy, the region's dominant utility. The increased cost of that electricity was offset by improvements in energy efficiency at a water filtration plant near

Lake Michigan, which by itself accounts for a quarter of the city's electricity use. Other solutions will have to be devised in order to meet the remainder of the goal, since Grand Rapids has already bought up most of Consumers Energy's existing renewable energy capacity. City officials have been in talks with two developers to build wind farms in West Michigan, and they have been trying to install two 2.2 megawatt turbines at the Lake Michigan filtration plant, but those plans have so far been stymied by opposition from lakeshore residents who do not want turbines obstructing their views.

Energy conservation is a central aspect of the city's sustainability plans. From 2008-2009, city government reduced its energy consumption by 3.8 percent. A goal has been set of making city facilities 10 percent more efficient by June 2015. As a signatory of the Great Lakes and St. Lawrence Cities Initiative, the only inland city so far to sign the agreement, Grand Rapids has committed to reducing its water usage by 15 percent below 2000 levels. In 2009 city officials developed a comprehensive energy-efficiency and conservation plan, which took a detailed account of current energy use by the city government and laid out strategies for reducing consumption. The plan recommended spending approximately \$2 million on mostly simple fixes, such as replacing windows and thermostats. The projects would largely be paid for with federal block grants awarded through the stimulus, and would save the city almost \$150,000 annually in energy costs.

Grand Rapids has also created an Office of Energy and Sustainability, hired a sustainability director, and formed a Renewable Energy Team on the city commission. The city's five-year sustainability plan, released this June, identifies numerous targets such as reducing carbon emissions by 10,000 metric tons no later than 2013, building 100 miles of bike lanes by 2014, and increasing green and local purchasing 25 percent by 2015 (city of Grand Rapids 2010).

Green-Building Initiatives. Grand Rapids boasts the most LEED-certified buildings per capita of any city in the country and the fourth highest number of LEED certifications overall, more than cities like Chicago and New York (Amway Insider 2010). That the West Michigan region has become a national leader in green building should perhaps come as no surprise; local furniture manufacturer Herman Miller was a founding member of the U.S. Green Building Council, and its "GreenHouse" building in Holland was used in 1995 as a model to help develop LEED certification standards.

Building to LEED standards has become the norm for new developments in Grand Rapids. According to Renae Hesselink, chair of the West Michigan chapter of the U.S. Green Building Council, the ongoing recession has not been able to slow the pace of green building in the region (Hesselink 2010). In 2006, the city adopted a requirement that all newly-constructed or renovated municipal buildings must qualify for LEED certification, so long as the buildings are 10,000 square feet or larger and the project's budget is at least \$1 million. The principles of LEED Neighborhood Development were also built into a new city zoning ordinance in 2008.

Mayor Heartwell has seen firsthand a shift in attitudes toward green building among local developers. Five years ago, those developers would more likely than not plead that meeting LEED standards was too expensive. Today, Heartwell says, proposals for new developments that

come before the city commission almost invariably include a commitment to obtain LEED certification (Heartwell 2010). Green building principles have permeated the development culture, and West Michigan benefits from an extensive talent pool of architects, builders and interior designers trained in applying LEED-friendly practices. All students enrolled in the construction trades program at Grand Rapids Community College are trained in green-building techniques. The greater Grand Rapids region has been reaping the rewards of this knowledge base, with a number of high-profile green buildings now completed or in development. A flashy new art museum opened in 2007 became the first in the world to achieve a LEED Gold certification. The museum's many energy-efficient features include significant use of natural lighting and a water collection and recycling system. Grand Valley State University will begin construction on a new \$70 million library, to be built to LEED Platinum standards, in 2011. Even employees of the local zoo have put their heads together in an effort to develop LEED-style standards for animal facilities.

Green Jobs Training. As discussed above with respect to green building, much of Grand Rapids' success in pursuing sustainability initiatives can be linked to the knowledge base that has been built there. In 2005, the United Nations University named Grand Rapids a Regional Center for Expertise on Education for Sustainable Development, making it the first city in the U.S. to receive such a designation. All of Grand Rapids' major institutions of higher education have made significant commitments to teaching sustainability and preparing students for jobs in the green economy. Aquinas College in Grand Rapids, where a LEED-certified library and the Center for Sustainability recently opened their doors, developed the country's first undergraduate program in Sustainable Business, and now offers a Master's Degree as well. The Center for Sustainability also offers professional certificates to local business managers and executives as one of its many community outreach programs. Although those efforts were spurred by donations from Steelcase and the Wege Foundation, center director Deborah Steketee says the campus has taken its newfound sustainability focus to heart, reducing energy consumption 19 percent, decreasing fertilizer use by 60 percent and pesticide use by 98 percent, and kicking off a number of student-led green initiatives (Steketee 2010b).

Grand Rapids Community College is using a \$4 million Pathways Out of Poverty grant to train at-risk individuals in personal energy-efficiency practices and the sorts of basic science skills needed for many green jobs. According to Julie Parks, director of workforce training at GRCC, the teaching of sustainability principles is now pervasive throughout the college's curriculum (Parks 2010). The same might be said about Grand Valley State University, where 13 percent of all student credit hours contain sustainability subject matter. GVSU was also one of the first schools in the nation to develop an undergraduate certificate program in green chemistry. The university has formed the departmental-level Sustainable Community Development Initiative to assess campus-wide practices, and has set the goal of becoming carbon neutral by 2037.

Green Business Initiatives. The Grand Rapids area is somewhat unique in that sustainability efforts have not just targeted local businesses; they started with business. Leadership came initially from the furniture industry, which organized to reduce the environmental impacts of their manufacturing practices and those of their suppliers. Such early

sustainability efforts culminated in the formation of the West Michigan Sustainable Business Forum in 1994, which now boasts around 100 area companies as members.

The “triple bottom line” model of measuring performance has gained widespread cachet in the Grand Rapids business community. Many firms have adopted the goal of improving environmental quality and social equity while growing profits, and go so far as to produce annual reports and web pages professing their commitment to “people, planet, profit” and documenting their progress. Community leaders will admit that while West Michigan has seen marked improvements on the economic and environmental fronts, the social equity piece of the puzzle remains a challenge. Unemployment remains high among poor and minority residents, as do dropout rates at city high schools. The region has witnessed some social justice successes; for example, reducing toxic pollution alone has social benefits. Plastics manufacturer Cascade Engineering has emerged as a standout in fulfilling triple-bottom-line principles through initiatives like its Welfare-to-Work program, which does just what it says, and its LEED-platinum corporate headquarters in Grand Rapids. Employee accidents, greenhouse gas emissions and costs are all down at the company (Cascade Engineering 2009). Nichols, a distributor of janitorial supplies, has also made triple-bottom-line inroads, achieving a LEED Gold certification for their Muskegon facility, diverting 148,000 tons of solid waste from landfills, and working in the community to build respect for custodial teams.

Decades after kicking off the sustainability movement in West Michigan, office furniture giants Steelcase and Herman Miller continue to set the bar high for other area businesses. Environmental stewardship is ingrained in the corporate cultures of both manufacturers. Herman Miller founder D.J. Depree first made it a company priority in the 1950s (Steketee 2010). The firm has had an Environmental Quality Action Team in-house since 1989, evaluating the companies’ environmental performance and producing monthly progress reports. Steelcase scion Peter M. Wege II has been preaching the gospel of “economicology” since the 1990s. Wege, now 90, has been a major driver of green building in Grand Rapids through his philanthropic foundation. Steelcase has switched to using more environmentally-friendly materials in products that account for about 80 percent of the company’s sales, which makes the furniture more attractive to offices seeking LEED certifications (Sanchez 2010b). Herman Miller recently reached its goal of obtaining 100 percent of the electricity the company uses, worldwide, from renewable sources. For competitors, the two companies have a remarkable history of partnering to work on sustainability initiatives and share best practices. In 2008, they teamed up with the Business and Institutional Furniture Manufacturers Association to create standards and a certification program for sustainable furniture products.

The region’s furniture manufacturers are not the only ones working together. As of April, the Community Sustainability Partnership has signed on more than 190 local governments, schools, businesses, and nonprofits in West Michigan to facilitate the flow of information and resources. The group has exhausted its planned three-year run, and will be meeting in the next year to decide whether the continuation of the forum or some new incarnation should be pursued. An outgrowth of the partnership has been the creation of the West Michigan Sustainable Purchasing Consortium, which allies area businesses to collectively negotiate with vendors for better prices on environmentally-friendly products.

Much of the push for sustainable development in West Michigan has been homegrown, but area leaders have also shown a talent for attracting new green firms of late. The region scored a major coup recently with the announcement of two new battery plants to be built in Holland, a short drive from downtown Grand Rapids. One plant will make power packs for the Chevy Volt, and combined the two facilities will cost more than \$600 million and generate almost 1,000 jobs (Schneider 2010).

Grand Valley State University has attempted to jump-start technology transfers in West Michigan with the founding of the Michigan Alternative and Renewable Energy Center in 2003. The Muskegon facility serves as a business incubator, research laboratory and distributed generation demonstration center. In typical West Michigan fashion, the 25,000 square foot building was constructed to LEED Gold standards and produces its own energy from wind turbines on the premises and photovoltaic roof tiles.

Other Cities

The Environmental Protection Agency recognized the City of Ann Arbor as one of the nation's top renewable energy users in 2009, with about 20 percent of the electricity usage at municipal facilities coming from renewable sources. This achievement is the result of the city council's 2006 goal of transitioning 30 percent of local government energy consumption to renewables by 2010 (DSIRE 2010).

Very little has been done at the local level to promote green investment in Detroit. The auto industry is showing signs of life and has been making massive investments in clean technologies, and numerous research and start-up ventures are located in the Greater Detroit area. But the developments are occurring without organized government support, and the city itself lags behind on most sustainability indices. A number of civil society organizations dedicated to sustainability, Detroiters Working for Environmental Justice and Greening Detroit, are active in Detroit, but their accomplishments have so far been limited mostly to urban community gardening and local foods initiatives. Deconstruction and salvaging of building materials and green business incubation is being supported by nonprofits on a small scale.

Civil Society Organizations and Policy

Both the Apollo Alliance and Blue-Green Alliance are active in Michigan, and they have been advocates of many of the reform measures discussed above. The "ReEnergize Michigan" campaign calls for an increasing the renewable portfolio standard to 30 percent by 2025 and increasing the energy-efficiency standard to 2 percent per year. The campaign would also revise building codes for energy efficiency and enact a low-carbon fuel standard, and it calls for various protections for low-income households that are vulnerable to energy price increases and shut-offs (Progress Michigan 2010). The Michigan Sustainable Energy Coalition was formed in 2005 to push for the adoption of clean-energy production and sustainability measures, and the Michigan Environmental Council has been active on similar issues in addition to its broader conservation

and social justice efforts. Michigan organizations also support federal legislation that would provide tax credits and a revolving loan fund for companies that shift to clean-energy production.

The Grand Rapids business community has provided important leadership in developing the area's green consciousness, but not at the expense of grassroots involvement. Community engagement has long been one of West Michigan's strengths, and a number of civil society organizations have been active in organizing support for regional sustainability efforts. Founded in 1968 by environmental activist Joan Wolfe, the West Michigan Environmental Action Council remains heavily involved today, and through its Sustainable Communities programs the council is carrying out projects ranging from distributing energy-efficient light bulbs to promoting ecological values among religious groups. A group of about 400 individuals pulled together to form the West Michigan Strategic Alliance in 2000. The organization aims to promote collaboration throughout the region, with a significant emphasis on sustainability and green development. The alliance's many initiatives include efforts to increase the use of alternative fuels and to promote sustainable manufacturing practices. The Right Place, Inc, a regional economic development organization, recently hired two new staff members specializing in sustainability and advanced energy technology (Steketee 2010). Goodwill Industries International has an active branch in Grand Rapids, where the charity has built one of its first LEED-certified stores and is running a pilot green jobs training program.

For Additional Information

Green Jobs Michigan (<http://greenjobsmichigan.com>) provides up-to-date listings of job openings in green industries throughout the state. State news site [mlive.com](http://www.mlive.com) runs active sustainability and alternative energy sections under its West Michigan business section (<http://www.mlive.com/business/west-michigan/index.ssf/sustainability>), with regular updates on green developments in the greater Grand Rapids area. West Michigan business newspaper MiBiz publishes the online forum MiSustainable (<http://www.misustainable.com>), which features news articles, blogs, podcasts, white papers and a variety of other resources on sustainability initiatives throughout the region. State web sites tend to be poorly designed, but the "growth industries" section of the Michigan Economic Development Corporation's web site (<http://www.michiganadvantage.org/Targeted-Initiatives/Default.aspx>) provides useful summaries of government efforts to promote green economic development.

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Minnesota

Summary and Analysis

Minnesota positioned itself early-on to be a leader in the green economy, particularly in the biofuel and wind industries. Minnesota has never had any traditional fossil-fuel resources, thus reducing their relative value to the local economy. As a result, the state was one of the first to enter into the biofuels market in an aggressive manner. Minnesota is also a leader in wind development, but has fallen in the past few years to fifth place (Lee, 2010). As other states have begun their own green industry mandates, Minnesota is faced with stiff competition that threatens their positional dominance. In the past, state-led mandates have been instrumental in bringing public resources and private industry to bear. Historically, the emphasis has been on demand-side incentives (particularly on wind power and solar energy), but strikingly little has been done to encourage supply-side domestic manufacturing and jobs creation. This imbalance has enabled neighboring states with stronger supply-side incentives, such as Iowa, to attract businesses that produce solar panels and wind turbine parts to meet Minnesota's demand (Hinkle 2010). The following have been identified as models and best practices:

- The “Minnesota Cup” is a unique way of spurring entrepreneurship and competition within private industry by awarding capital and resources to firms that think outside the box.
- The state's Office of Energy Security “Green Economy Report” collects and consolidates all of the sustainable activities going on in the state.
- The state has a suite of policies designed to develop the biofuels industry that have consistently been national leaders.
- Minnesota Sustainable Building 2030 requires all state buildings (and all voluntarily participating private commercial or industrial building owners) to reduce their carbon emissions by 60 percent of an established baseline, and subsequently reduce emissions by 10 percent every five years. All buildings are expected to be carbon-neutral by 2030.
- Community-Based Energy Development (C-BED) programs provide a unique model of community-based wind energy and were recently expanded to include other forms of renewable energy.

General Background Policy

Energy Goals. In 2007 the state joined the Midwestern Greenhouse Gas Reduction Accord, which set a goal of 10 percent renewable energy by 2015. That year the state went even further by approving the Next Generation Energy Act, which established a renewable-energy portfolio standard. The portfolio standard 25 percent of electricity must be produced from renewable fuels by 2025 and 30 percent by 2020 for Xcel Energy, the largest utility in the state. The act included energy-efficiency goals as well as a goal of strengthening locally owned

renewable-energy projects (EPA 2008). Minnesota has also instituted an aggressive Energy Efficiency Resource Standard (EERS) of 1.5 percent of retail sales (from electric and natural gas) per year (Minnesota Sustainable Communities Network: NextStep 2008). They were also one of many states to enact PACE financing regulations.

Public Benefits Fund. Minnesota's Renewable Development Fund receives about \$20 million per year from Xcel Energy largely in exchange for the right to store spent nuclear fuel at plants in the state. About \$10 million supports wind-energy development, and \$5 million supports the Initiative for Renewable Energy and the Environment at the University of Minnesota. The fund went through three funding waves in 2007 and 2008. A fourth cycle has been delayed due to restructuring of the funding process (Hinkle, 2010; Xcel Energy, 2010). In its two years of project funding, the fund created 1,750 kilowatts of renewable energy capacity (DSIRE 2010a, Hinckle 2010, Xcel Energy 2010).

Green-Buildings Policy. State-bonded facilities are subject to several executive orders and legislative guidelines. In 2004 Minnesota implemented guidelines that required that new state-funded building projects exceed the state's energy code by 30 percent, and in 2009 the guidelines were extended to major renovation projects (DSIRE 2010a). In 2005 Governor Pawlenty signed Executive Order 05-16, which required state government buildings to reduce energy consumption by 10 percent in the following year. The Next Generation Energy Act of 2007 established goals of developing Energy Star labels for 1,000 commercial buildings. (DSIRE 2010b, Energy Star 2008).

In the following year, the Legislature passed Sustainable Buildings 2030, a campaign to reduce carbon emissions over the course of twenty years. Starting in 2010, all state-bonded buildings must reduce their carbon emissions by 60 percent of a set "standard baseline of the same building type." Every five years after 2010, carbon emissions must be reduced by another 10 percent. By 2030, all participating buildings would have to be carbon-neutral. This is also open to industrial and commercial building owners who wish to voluntarily participate (Sustainable Building 2030 2010).

In addition to this standard, in 2009, the Minnesota Statute 16B.32 required all new state building construction to meet two percent of its power needs onsite from renewable resources. If the two percent is deemed unfeasible, the contractor must provide explicit reasons why and may not be eligible for additional construction funding for the project unless the commissioner of administration supports the explanation (Minnesota Office of the Revisor of Statutes 2009).

Back in 2007, Minnesota took a unique approach to green building standards. Although some states have opted for LEED requirements, Minnesota set up its own "Minnesota GreenStar" standard to act as a stepping stone towards more sustainable building practices. As Lynn Hinkle, Policy Director for the Minnesota Solar Industry Association said, "What I think it's attempting to do, at a state level, is to have a category that is more attainable. You don't set the situation up where [you] go to LEED-NC or LEED-EB, which is too high for many building owners to achieve, so they just absent themselves from the discussion completely. Rather than have that happen, you've got something like EnergyStar, for example... This gives you a platform that is achievable but also a platform from which you can then do more to achieve

LEED-EB, because a lot of LEED... embeds a lot of the EnergyStar requirements and that's the same intent with GreenStar" (Hinkle 2010).

Minnesota offers significant rebates to homeowners for installing geothermal, small-scale wind, photovoltaics, or thermal solar heating and electricity (DSIRE 2010b). Most of Minnesota's utility companies offer rebate programs for home installation of energy-efficiency and weatherization technologies (DSIRE 2010b). Alliant Energy provides electricity along the southern border of Minnesota, and offers significant rebates for high-efficiency farm equipment installation and offers free Farm Energy Audits (Alliant Energy 2010). Minnesota, along with Wisconsin, is also one of two states that require utility companies to compensate net producers of electricity. Any net producer under 40 kilowatts of capacity is guaranteed compensation for their energy production. Net excess generation (NEG) can be credited to a user's account—like Wisconsin's—but Minnesota's goes a step further and will compensate producers with a check if it exceeds their monthly balance. NEG rates are tied to the same retail prices offered by the utility (DSIRE 2010b).

Green Jobs Training. Funding for green jobs training from the ARRA (\$6 million in 2010) went to the Department of Employment and Economic Development. Minnesota legislation made green projects eligible for redevelopment funding, created a green jobs task force and green energy loan programs, and required state agencies to assess the green impact of grants and loans in reports that would become part of the state's "Green Economy Report" (Green for All 2007, Minnesota Senate 2008). This report goes a long way in providing a deeper understanding of the impact of Minnesota's various state departments impact on the environment, even if a project may not be readily considered "green."

The Minnesota GreenStar program mentioned in the previous section also acts as an awareness campaign, with the state offering classes to both homeowners and builders in green building practices. Homeowner and "Do-It-Yourself" classes can cost as low as \$39, and professional certification classes cost about \$350 (Locke 2010). The Minnesota Sustainable Design Guide is not just a standards guide but also provides possible solutions to meet the guidelines and make calculations (Hinkle, 2010).

Another program of note is the Communities for Responsible Energy Environmental Demonstration Project, which trains teachers in sustainable energy technology to use in the classroom. Students learn about alternative energy systems and apply classroom lessons to real-world problems related to energy production (CREED Project 2009).

Clean-Energy Industries

General Policy. In 2008 Governor Pawlenty created the Clean Energy Technology Collaborative to develop a roadmap with a research and development vision, and he also created the Office of Energy Security within the Department of Commerce. During the same year the governor announced an initiative that channeled revenue from various state economic development programs into industries that generate "green jobs." The "Green Jobs Investment Initiative" built on existing job incentive programs to create a collection of competitive grants

from the state and tax incentives for small businesses. Under the Green Jobs Investment Initiative, two of the state's tax credit incentive programs, the Job Growth Investment Tax Credit and the Small Business Investment Tax Credit, were altered so that half of the funds would be dedicated to green jobs (State of Minnesota 2008a). Although the state does not have a specific venture investment fund for clean-energy businesses, the tax credits provide capital managed by state-sanctioned venture capital firms, who invest in small and medium-sized businesses, and the Renewable Development Fund has also supported business development.

Governor Pawlenty also extended the tax exemptions to green businesses under the state's Job Opportunity Building Zone (JOBZ) program (State of Minnesota 2008a). The JOBZ program supports green businesses with exemptions on corporate franchise taxes, income taxes for operators or investors of green industries, capital gains taxes, sales taxes for transactions within the JOBZ, commercial and industrial property improvement taxes (not land taxes), and wind energy production taxes (State of Minnesota 2008a). The initiative also added a "clean and green division" to the Minnesota Cup, a competition for entrepreneurs that offers investment capital and training services to competition winners (Taylor 2008).

The state has built clean-energy strengths especially in biofuels and wind energy. However, a majority of the state's energy fuels are imported, and over eighty percent of wind energy is owned by entities outside of the state (Hinkle, 2010). Existing clean-energy industries have moved to neighboring states that have instituted investment tax credits to attract clean-energy investment (National Angel Capital Organization 2010). Minnesota has begun to react to this trend by providing strong incentives to investment firms who provide funding to green small businesses. The Minnesota Angel Tax Credit provides a twenty five percent tax credit to any state-certified investors or funds. Program funding is set at \$11 million (National Angel Capital Organization 2010).

The University of Minnesota has decided to centralize its renewable energy efforts by creating the Institute on the Environment. The program includes interdisciplinary studies on everything from demography and business to freshwater conservation and food production. Alternative energy projects are organized under the Institute of Renewable Energy and the Environment (IREE). By restructuring all of their renewable industry initiatives under one roof and under the direction of Dr. Jonathan Foley, the university encourages innovative, cross-disciplinary work. Dr. Foley had spent the previous fifteen years at the University of Wisconsin, where he founded the Center for Sustainability and the Global Environment.

Biofuels. Minnesota is the fourth highest producer of ethanol, and it has the highest number of E85 filling station pumps. The industry has grown from next to nothing in 2000 to a \$3 billion dollar size that provides over 11,000 jobs and consumes a quarter of the state's corn crop (Way 2008). In 2002 the state government approved the country's first biodiesel mandate, which required two percent of all diesel in the state to be biodiesel by 2005. In 1997 Minnesota became the first state to require a 10 percent ethanol blend in all gasoline, and several states subsequently followed the lead. In 2005 Minnesota became the first state to require that 20 percent of all gasoline sales in the state come from ethanol by 2013 (Groschen 2009). In 2006 the governor signed Executive Order 06-03 to increase the use of biofuels in the state government's vehicle fleet (Pawlenty 2006). In 2007 the state appropriated \$15 million for biofuels and

renewable-energy projects, \$17 million for research, and \$3 million for more E85 pumps. The Institute for Renewable Energy and the Environment at the University of Minnesota, which is supported partially from funds from the state legislature, has also supported biofuels research.

Minnesota statute 239.791 requires 20 percent of fuel sales in the state to come from ethanol. While this could have been met by increasing E85 sales, the state requested that the EPA grant a waiver, making E20 legal fuel under the Clean Air Act. A year-long scoping study conducted by the State of Minnesota and the Renewable Fuels Association concluded that E20 had no significant effects on gasoline production, distribution infrastructure, and vehicle performance. The report did not include any data on emissions levels (State of Minnesota 2008). To date, the EPA has not made a decision on E20 (U.S. Department of Energy 2010).

In 2008, the state also began recognizing the use of biomethane as a credit toward annual energy savings goals for natural gas utilities. Biomethane is derived from organic waste such as vegetable compost. The credits toward meeting state-mandated energy savings goals are expected to spur significant investment (State of Minnesota 2008a).

Smart-Grid and Building Technologies. Minnesota does not have leadership in the smart-grid industry, but it does have some strengths in the building technologies industry. Two large companies form the base for the state's industry. Minnesota Mining and Manufacturing Company (more commonly known as 3M) has been headquartered in the state for 108 years and is the state's largest manufacturing company (Fedor 2009). The company has won numerous awards for excellence in sustainability (What's New: Sustainability, 2009). The Company offers several catalogs that compile their sustainable building materials and provides notes on how their products help contribute to LEED building certification. 3M also offers commercial buyers with guides on how 3M's products can help meet LEED requirements. The other large company, Anderson Windows and Doors, is a major Minnesota employer that constructs prefabricated housing and commercial building materials for residential, commercial and industrial construction. They are a charter member of the United States Green Building Council and an active participant in Minnesota's sustainability initiatives. Anderson employs 3,500 people in Minnesota, but it has been hit hard by the slow down in home building (Alexander 2009).

Both 3M and Anderson are globally oriented firms that produce for national and global markets. As a result, it is difficult to speak in terms of state demand alone, because Minnesota does not have a large-enough market to absorb their products at a cost effective scale of production. 3M is looking to provide components to Chinese-made solar panels, for example, because they have the production capacity to buy large amounts of component materials, Minnesota (or most of the U.S. state markets) do not (Hinkle, 2010).

Minnesota is also home Econar, a thirty-year-old company that provides ground-source heat pump systems for homes and businesses in colder climates. The technology is relatively simple: connect a modified air conditioner with a pipe containing refrigerant that is buried eight or more feet below the ground. Soil temperatures at this depth are a constant 50°F, and the pipe acts as a super efficient heat exchanger (Mitha, 2010a). Heat pumps can cool *and* heat homes and buildings very efficiently. In March 2010, Econar benefited from the Angel Investment Tax

Credit, which provides a 25 percent tax credit to investors that lend money to small green companies. Econar currently has systems installed in 26,000 homes and businesses throughout the state (Hudson, 2010). Several small towns are in preliminary discussions to build centralized heating exchangers to defray the costs of installing the piping, which is the most expensive part of the system.

Wind. Minnesota is the fifth highest producer of wind energy in the country, and it is distinguished by the large number of community wind and cooperative projects. It also has several firms that manufacture wind turbines and turbine generators, including Ventera, Wind Turbine Industries Corporation, and Next Generation Power Systems. The state currently has 1800 megawatts of wind-power capacity, and the legislature has mandated that 20-25 percent of energy production must come from wind power by 2021 (Mitha 2010a). The University of Minnesota also conducts research via its West Central Research and Outreach Center, which has a large wind turbine for research. In 2009 the university, in a consortium with wind energy manufacturers, was one of three universities selected nationally for a grant of \$8 million from the U.S. Department of Energy. Minnesota has also achieved national prominence for its support of community-owned wind energy production.

A settlement in 1994 allowed Xcel, the state's largest private utility, to store nuclear waste at its Prairie Island facility in exchange for mandates for wind energy generation. The state's mandates increased over time, and after 2004 they began to include a set-aside for small wind production. In 2005 the state passed the Community-Based Energy Development (C-BED) legislation, which was designed to support increased community energy in the state. After the legislation was signed into law, Governor Pawlenty announced the goal of 800 megawatts of community wind by 2010, but partly because of the Great Recession, the developed occurred at a much slower rate than he had envisioned. Under C-BED, a public utility is required to file a twenty-year power purchase agreement (PPA) with the Public Utilities Commission. The first ten years of the PPA's rate must be higher than the second half, thus ensuring that community-owned renewable-energy products will be well funded for the first ten years and that costs to consumers decrease in the last ten. Ownership share of any given C-BED is capped at 15 percent to ensure community ownership and not local energy takeovers (Community-Based Energy Development 2010).

An amendment in 2007 expanded C-BED arrangements to other forms of renewable energy, including solar, hydroelectric (under 100 megawatts), biomass, or hydrogen that is not derived from fossil fuels (216B.1961). As of January 15, 2010, Minnesota had 131 megawatts of C-BED projects completed on twelve sites and an additional 282 megawatts under contract to be built, or in initial negotiation phases (Minnesota Department of Commerce: Office of Energy Security 2010). This expansion comes at an opportune time. The expansion of C-BED and other wind farms, may hit transmission bottlenecks, and slow down the construction of new turbines. Other forms of energy generation that are more decentralized may not meet the same problems that wind is currently facing (Hinkle, 2010).

There are several applications of wind power that do not run into transmission problems. The University of Minnesota's West Central Research and Outreach Center has begun research into ammonia production using on-site wind power. Through electrolysis, hydrogen from water

is mixed with nitrogen to create ammonia. Researchers are creating an industrial-scale ammonia facility using wind turbines that creates the same process Fritz Haber used when perfecting the Haber-Bosch process a century ago (Mitha 2010a).

In addition to the state's set-aside for community wind, the state government also offers a small wind production credit from the state government and streamlined permitting for qualified projects and tax exemptions on turbine sales. Minnesota has also pioneered the "flip" financing model, in which a corporate partner provides up-front financing and ownership for the first ten years, then the ownership is gradually transferred to the community or other local investors (Bolinger 2004, Mazza 2008, Minnesota Project 2009, Shoemaker and Brekken 2006). These economic incentive structures along with C-BEDs will increase the percentage of locally owned wind turbine facilities.

Minneapolis/St. Paul

The Twin Cities have followed their state counterparts in innovation. They were early adopters of many innovative sustainable practices, and they appear to continue to innovate and seek new ways of leading the pack in sustainable planning and clean energy. City officials in both Minneapolis and Saint Paul view comprehensive city planning as an exercise in creating a better society instead of merely a set of regulations and codes that govern land development and resources allocation. Minneapolis approaches city planning in a holistic manner reminiscent of the City Beautiful Movement. The city incorporates everything from transit ridership to obesity rates to water quality analysis within annual sustainability reports. Saint Paul is one of the only cities in North America to adopt centralized district heating and is currently looking at ways of reducing their carbon footprint even further by installing renewable heating sources. As a result of the innovations, the Twin Cities consistently win awards for livability standards and sustainability achievements. It is also worth noting that the Twin Cities account for only 25 percent of the total Minneapolis-St. Paul metropolitan area. The surrounding suburbs are working on their own sustainability initiatives as well.

Sustainability Plans. Minneapolis and St. Paul regularly receive high urban sustainability rankings. In 2003 Minneapolis launched its sustainability plan with twenty-four sustainability indicators. Both cities also have green building ordinances, and in 2008 Minneapolis added a sustainability indicator for green jobs. Support from the state government has also helped the efforts to link metropolitan greening with green job development.

The 2008 green jobs sustainability indicator was a product of the "Making It Green in Minneapolis and Saint Paul Report," which summarized best practices of other cities and outlined three major green industries that Minneapolis and St. Paul were most-prepared to develop: green buildings, transportation, and renewable energy. The plan suggested an aggressive marketing campaign to attract green businesses, retool existing economic development policies and procedures to focus on green industry, cultivate a local market for parts suppliers, integrate with existing and future state initiatives, and focus on long-term institutional partnerships (City of St. Paul 2009). Minneapolis defines green jobs as "activities in industries that reduce environmental impact and resource consumption" (Minneapolis Living

Well: 2009 Sustainability Report 2009). The city has identified 148 green businesses and is working on retaining them while attracting new business as well. The city has not, however, identified a particular jobs target number. (Minneapolis GreenPrint 2010 Environmental Report, 2010).

Both cities also have ordinances that encourage biking, transit, and efficient building standards. Minneapolis is aggressively reducing automobile independence by encouraging transit-based development. As of 2003, 55 percent of downtown visitors reach their destination by a means other than an automobile. City staff has set a goal to increase that percentage to 67 percent by 2013 through investment in transit infrastructure and increasing employer participation in the metropass discount program. The city also overhauled their zoning codes to include bicycle parking requirements while replacing automobile parking *minimums* with parking *maximums* (Minneapolis GreenPrint 2010 Environmental Report, 2010).

St. Paul's Comprehensive Plan has an implicit focus on conservation of resources and smart growth. Development (especially employment zones) is encouraged in places well-served by transit, and looks to provide a wide range of transportation choices for residents. The land use section reads much like an economic report, outlining the current housing market, the city's competitive advantages in America's economy, and employment statistics. Land use planning is driven and directed by three broad goals: target growth in unique neighborhoods, provide land for jobs, and promote aesthetic and development standards. Overall, this plan takes a comprehensive approach to land use by treating economic development, resource conservation, transportation, employment and housing as one large interconnected problem (City of Saint Paul Comprehensive Plan, 2010).

Green-Building Initiatives. With respect to building improvements, the annual GreenPrint reports of Minneapolis make some references to building efficiency, but the city does not include a broad category for building efficiency in its list of sustainability indicators (City of Minneapolis 2009). In St. Paul, the city has taken an energy audit of buildings, and it has green building standards for its own buildings and those of private developers (City of St. Paul 2009a, 2009b). However, the two cities do not have prominent weatherization and retrofitting programs similar to those of some of the other cities that we studied. Rather, they have relied on two other organizations, the utility Xcel Energy and the nonprofit Center for Energy and Environment, for support for building efficiency upgrades. Arguably the most notable program is St. Paul's district heating system, which centrally generates residential cooling and heating for over 185 buildings (District Energy St. Paul 2010). The centralized heating and cooling services have provided very stable rates for customers and has won numerous awards for energy conservation and workplace conditions (City of St. Paul 2010).

Green Jobs Training. In 2009 Minneapolis Mayor Rybak announced plans for the creation of the Green Jobs Institute, which provides training in home weatherization, energy audits and green buildings in collaboration with the Minneapolis Community and Technical College, Dunwoody College of Technology, and the Summit Academy Opportunities Industrialization Center (City of Minneapolis 2009). Minneapolis and Ramsey County Workforce Solutions received \$4 million from the U.S. Department of Labor to train residents of high-poverty neighborhoods through the Green Jobs-Pathways Out of Poverty grant program.

The grant is supplemented by a \$5 million state-wide program initiated by the Green-Blue Alliance (Minneapolis GreenPrint 2010 Environmental Report 2010)

Green Business Initiatives. In 2006 Minneapolis Mayor R.T. Rybak and St. Paul Mayor Christopher Coleman launched the Mayors' Green Manufacturing Initiative. A report issued two years later, titled "Making it Green In Minneapolis Saint Paul," identified three major industrial sectors—building, transportation, and energy—for existing strength and future potential (City of St. Paul 2009). Of general interest is the inventory that the cities conducted to determine what businesses already existed in the sectors and what the strengths were within each sector. Specific areas included windows and doors and suppliers for wind manufacturing. The report also identified research centers at the University of Minnesota that were relevant to each of the three industries. The region's Blue-Green Alliance has also conducted benchmarking exercises to determine what else could be learned from the efforts of other cities (Mitchell 2009).

The Mayors' Initiative on Green Manufacturing, as outlined in the "Making it Green in Minneapolis Saint Paul" report, prescribes a suite of comprehensive changes and planning strategies that put political and economic force behind a burgeoning market. It directs public procurement policies towards purchasing green products created locally. Government entities will help businesses find customers outside of Minnesota, through work already done by the Clinton Initiative and the U.S. Conference of Mayors. A comprehensive directory of green component suppliers and manufacturers will encourage local supply chains and business collaboration (City of St. Paul 2009). Most of the initiative has begun to take shape through the cities' partnership with the Blue-Green Alliance (see below; Institute for Sustainable Communities 2009). Plans for a downtown green industry research and development park are taking more time to materialize, as are the more comprehensive institutionalized relationships between private industry, the public sector, and local research universities. The Initiative also encourages sweeping reform of all economic development policies to focus on green energy product manufacturing and fast-track green development projects through the use of enabling language (City of St. Paul 2009, Institute for Sustainable Communities 2009).

Civil Society Organizations and Policy

The Blue-Green Alliance has its national headquarters in Minneapolis and has been particularly active in the state. The Minnesota chapter has several ongoing projects that aim to educate the general public about creating green jobs. The Thinc.Green^{MSP} is a five-part marketing campaign and economic partnership agreement between the Twin Cities and the BlueGreen Alliance. The plan will provide the following: 1) green-purchasing policies for government entities; 2) support for further initiatives that require green building standards; 3) a "green business recruitment strategy" that will bring green companies to the region and offer additional benefits if they support or compliment existing companies; 4) business start-up financing from private and public funds; and 5) a recognition program called "Thinc.Leader," meant to highlight business that leadership in green manufacturing (BlueGreen Alliance 2010). In the Twin Cities, the Blue-Green Alliance supported the Green Manufacturing Initiative and issued several reports that have helped define the goals and strategies of green industrial development in the region.

Another important nongovernmental organization is the Institute for Local Self-Reliance, which has an office in Minneapolis and has long promoted a focus on small, locally owned businesses and energy generation as a strategy of economic development. For example, in the 1980s the organization was the catalyst for the Homegrown Project in St. Paul, which supported economic development based on locally owned, independent businesses and led to the district heating system. Subsequently David Morris, president of the institute, supported statewide economic development strategies based on homegrown energy resources. In the 2009 State of the City address, Mayor Rybak invoked the term as he discussed the need to develop “homegrown” businesses and unveiled his plan for the Minneapolis Homegrown Initiative, which would support local food networks (City of Minneapolis 2009).

Minnesota 2020 is a policy think tank that works to promote new ideas in education, healthcare, transportation, and job creation. Instead of directly lobbying for specific legislation, MN2020 focuses on producing plain-language research reports, aimed at the informed reader, that promote new ideas. MN2020 Fellow Salman Mitha, a physicist by training, has begun advocating for “OpenSource” clean-energy information resources to help entrepreneurs access what would otherwise be hard-to-find information. Careful not to confuse the program with open-source software such as Firefox (the popular web browser), Dr. Mitha describes his vision as such: “An ‘open source green’ project would use community-wide resources to deliver *validated, coordinated* and *systemized* technical information to the public domain that is ready-for-use for *product development*” (Mitha, 2010b). He gives an example of what kinds of information would be made available: “It could be detailed design for an electric car drive-train that would be used by others to make innovative electric vehicles” (Mitha, 2010b). The aim of the project would be to provide entrepreneurs with a clearinghouse of key pieces of technology needed to build green businesses. He describes it as providing that key foundation to many new industries, “Many new ideas get stalled because there is a technical challenge where even though the technical knowledge is widely available, it is dispersed, and you need scarce technical skills to bring it together- and that is what the OpenSource green project would provide” (Mitha, 2010b).

Suggested Reading

For several reports on the state of Minnesota’s green energy policies, employment, and future opportunities, please see Minnesota 2020’s website: www.mn2020.org. The University of Minnesota’s Institute on the Environment’s *Momentum Magazine* covers many new and emerging science and technology reports in the areas of conservation, renewable energy, recycling, green policy, and building efficiency. It is available at <http://www.environment.umn.edu/momentum/>.

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Ohio

Summary and Analysis

If the U.S. is destined to undergo a green industrial revolution, few states are better positioned than Ohio to take advantage of the opportunities it will bring. The state has historically been a manufacturing hub, and it clearly wishes to remain so. But its leaders have no illusions about the return of low-skill, high-wage jobs in “dirty” industries. Instead, they are employing a mix of tax incentives, research support, and supply-chain organizing to aggressively pursue manufacturers in alternative-energy sectors—or “advanced energy,” as state politicians like to say, leaving room for clean coal and related technologies. Backed by supportive policies at the state and local levels, Ohio has emerged as a national leader in the development and production of wind, solar, and fuel-cell technologies, with active business clusters in each area. The state’s fifteen public universities have joined together to promote investment in clean energy. Research, technology transfer and skills training aimed at growing green businesses and employment are widespread throughout Ohio universities and community colleges.

The prevailing worry in Ohio is whether the state can muster the resources needed to sustain its current momentum. The governor has been a tireless advocate for green development, but if his reelection bid fails this fall, at least some of the state’s plans for growing clean industries could be in jeopardy. The legislature faces a \$7-\$8 billion budget deficit for FY 2012-2013, and while it is unlikely that economic development dollars will be significantly cut, the future availability of discretionary funds for new investments is a huge unknown. The passage of federal climate change legislation could be a major boon to Ohio. The state has proven adept at procuring federal stimulus funds for green projects, and new revenue streams will have to materialize if many of the programs launched under ARRA are to continue. On the list of Ohio’s more progressive initiatives:

- Ohio Third Frontier will have spent \$1.6 billion of taxpayer dollars by 2012 to encourage high-tech business growth, and it was recently reauthorized for another four years and \$700 million by voter referendum. In its more recent funding cycles, the program has placed increased emphasis on advanced energy and materials, fuel cells, and photovoltaics that build on its success in creating a solar and fuel-cell industry.
- The state has conducted analyses of the supply-chain of the fuel-cell and wind industries.
- Ohio’s leaders have excelled at bridging the gaps among government, business and research institutions. Ohio Green Pathways and the University Clean Energy Alliance provide two examples of programs that link disparate constituencies.
- The world’s first freshwater wind farm is poised to begin construction off the shores of Lake Erie in 2011, thanks to a partnership between a Cleveland group and General Electric.
- Evergreen Cooperatives is simultaneously encouraging green development, local buying, and urban renewal by opening a network of worker-owned cooperative businesses in some of Cleveland’s most distressed neighborhoods.
- In Cleveland there is a unique building deconstruction program.
- The City of Cleveland hosts a sustainability summit that brings together stakeholders to develop plans and initiatives.

General Background Policy

Energy Goals. In 2007 Ohio joined the Midwestern Greenhouse Gas Reduction Accord, which committed the state to a minimum of 10 percent renewable energy by 2015. A year later the state legislature raised the stakes with the approval of an Advanced Energy Portfolio Standard of 25 percent by 2025 (SB 221). That benchmark can be achieved through increases in nuclear energy, fuel cells, and clean coal, but a minimum of 12.5 percent of the goal must come from renewable sources — giving Ohio the third most aggressive renewables standard in the nation. The legislation included an energy-efficiency goal of 22 percent reduction in demand by 2025, with targets of 1 percent per year starting in 2014. With Ohio's large population and high energy use from its manufacturing base, the targets demand a more significant commitment to greenhouse gas reduction than similar goals would in a smaller state.

Public Benefits Fund. Ohio's public benefits fund was inaugurated in 1999 for an amount of about \$15 million per year, then reduced to \$5 million per year after 2005. Known today as the Advanced Energy Fund, it draws revenues from ratepayer charges to support a wide range of grants in energy efficiency and clean energy, including low-income energy projects and incentives for installing wind or solar generation on residential properties (DSIRE 2010). The fund is set to expire at the end of 2010, which exposes its renewal to the vagaries of gubernatorial campaign politics, but policy insiders are confident that the program will be reauthorized as a rider on some other piece of legislation before the clock runs out. It is unlikely, however, that the fund will be expanded anytime soon.

Green-Buildings Policy. In 2007 government legislation (HB 251) required a life-cycle analysis of buildings above a designated size, and it also set up energy consumption reduction goals for state university buildings. The same year Governor Strickland issued an executive order (2007-02S) that required the state government to conduct an energy audit of buildings and to reduce energy consumption by 15 percent within four years (EPA 2008, DSIRE 2010). Form-based zoning codes, which allow planning administrators greater control over the types of building projects approved for an area, are already in use in Columbus and are being considered in Cincinnati.

The U.S. Department of Energy provided another windfall for Ohio in the form of \$266 million in ARRA funds to weatherize homes for low-income residents. No other state received nearly as much support. The Ohio Office of Community Services is using the first \$106 million, awarded in June 2009, to weatherize 32,000 homes all over the state. Ohio also offers residents a variety of other incentives to improve their energy efficiency or switch to clean energy, including rebates for purchasing efficient appliances and rate reductions on loans for home upgrades. A diversity of similar programs exists at the municipal and county levels throughout the state.

Green Jobs Training. The state government received \$6 million in ARRA funds in 2010 for green jobs training. It also launched Ohio Green Pathways (2009), a partnership between the Ohio Board of Regents and the Ohio Environmental Council. The program produces a web tool and a catalog of green jobs training programs at community colleges and adult career centers. It has an advisory panel of twenty-five people from industry, academia, government, and labor. They provide advice on industry needs, new opportunities, and strategies for placing students.

The program provides a model of how to connect industry needs with higher education training programs for greater coordination and information sharing.

About half of Ohio's twenty-three community colleges currently offer some sort of green jobs training program. Degree programs that prepare students for careers in green industries are being created at institutions of higher learning throughout the state, including an associate's degree in advanced energy and fuels cells at Hocking College, and M.S. programs in renewable and clean energy sponsored by the engineering schools at both the University of Dayton and Wright State University. Some apprenticeship and pre-apprenticeship programs, such as the Orientation to Trade and Apprenticeship Program at Columbus State Community College, are also beginning to target green collar skills such as weatherizing homes (Van Lier et al. 2010). The state's Constructing Futures Initiative is dedicating \$4 million in ARRA funds to providing training in building trades to underrepresented groups, such as women and minorities.

Clean-Energy Industries

General Background. Ohio is the seventh most populous state in the country, and its central location and access to rivers and lakes has made it a hub for the country's industry. The state retains a strong manufacturing base, with estimates of about 45 percent of the economy in heavy industry. However, much of the manufacturing is tied to older industries, and as a result the state government has actively developed programs to help transition its Fordist industrial base to high-technology, including clean-energy industries. The potential for growth in green sectors is encouraging; a recent study by Pew Charitable Trusts found that clean-energy jobs in Ohio grew more than seven percent over the last decade, even while overall employment was shrinking (Pew 2009).

In 2002, the state government established Ohio Third Frontier to spur the state's high-tech sector and stimulate cluster developments by assisting with the commercialization of new technologies. The program was established within the state's Department of Development and has a budget of \$1.6 billion over ten years that includes support for clean-tech industries. Ohio Third Frontier offers funding opportunities through numerous programs, including the Innovation Ohio Loan Fund and the Ohio Research Commercialization Grant Program. In 2010, voters approved reauthorization of the program for an additional \$700 million through 2016. Some observers have expressed concern that since the program is debt-financed, the state has not yet faced its true cost.

In June, the governor signed legislation (SB 232) eliminating property taxes on renewable energy operations that come online by 2013 and replacing them with a flat tax of \$6,000-\$8,000 per megawatt of generation capacity. Wind and solar groups cheered the new law, which they believe will create significant cost savings for renewable-energy producers and will make Ohio more competitive in attracting renewable energy investment (Cartledge 2010). The law also makes facilities producing electricity from advanced nuclear, cogeneration, and "clean" coal technologies eligible for the tax exemptions. The state has long exempted facilities used for "energy conversion" — which has typically been taken to mean replacing fossil fuels with alternatives — from sales, use, and property taxes. The recently-signed law also expanded PACE

financing in Ohio by authorizing municipalities to create Special Improvement Districts where homeowners can borrow state funds for a wide range of renewable-energy and energy-efficiency projects. Previously, PACE financing had been restricted to photovoltaic and solar thermal installations. In June, the city of Cleveland and sixteen suburbs joined forces to create a first-of-its-kind renewable energy SID with \$100,000 in seed money from a regional economic development fund (Wendel 2010).

The Ohio Department of Development (ODOD) promotes economic growth in renewable energy industries through its Ohio Energy Resources Division, which uses federal stimulus dollars to fund a wide range of clean-energy and energy-efficiency projects. ODOD has identified advanced energy technologies as a target area for investment, giving such projects priority in the distribution of tax incentives and other funding opportunities.

In 2008, the state approved a \$1.5 billion job stimulus program (HB 554), which included \$150 million in funding for the Advanced Energy Job Stimulus Fund that is administered by the Ohio Air Quality Development Authority. The fund included \$66 million for clean-coal technology and \$84 million for non-clean-coal projects. The funding was available over a three-year period as loans especially to businesses that attracted new investment or involved technology commercialization (State of Ohio 2010). \$40 million from the jobs stimulus and ARRA was used to establish the Ohio Energy Gateway Fund, which will pair state dollars with private investment to accelerate growth in advanced energy sectors. Another large chunk of the jobs stimulus package went to the Clean Ohio Fund, reauthorized for \$400 million after the program spent an equal amount between 2000-2008 on brownfield redevelopment, farmland preservation, and green space conservation. Half of the total \$800 million either has been or will be spent to restore brownfield sites.

In late 2009, Governor Strickland announced \$14 million in grants to bankroll fifteen solar, eight wind, and two solar thermal projects. These awards marked the first phase of the \$96 million State Energy Program, paid for with ARRA funds from the U.S. Department of Energy. More recent funding opportunities have included \$18 million for energy efficiency and \$10 million for waste-to-fuel projects. Federal funds, state matching dollars and private donations will also create a more than \$80 million revolving loan fund for energy-efficiency and renewables ventures.

Ohio has a strong public and private research university system, with research strengths in the materials science fields. In 2007 the leaders of the state's fifteen large research universities formed the University Clean Energy Alliance of Ohio. The partnership organizes conversations and conferences on energy, and facilitates university-industry collaboration. It will also make it easier for university researchers and administrators to share information and resources among themselves. The state's public universities have numerous research centers dedicated to developing clean-energy technologies, among them the Great Lakes Energy Institute at Case Western Reserve University, the Dayton University Research Institute, and the Institute for Energy and the Environment at Ohio State University. Ohio Third Frontier also funds university research through its Wright Projects Program. In 2009, Governor Strickland named nine "Centers of Excellence" in advanced energy at eight state universities, and in 2010 the program allocated \$20 million to seven different research programs. The purpose of the designations was

to allow each university to focus on its specific strengths in advanced energy research. The University of Toledo's new Scott Park Campus of Energy and Innovation, opened in late 2009, will be used as a "hands-on alternative energy laboratory" (Lockwood 2009). The campus will produce its own energy from two solar arrays and a wind turbine, and beginning next year it will be home to a half-acre of algae ponds for biofuels research. The state also funds seven Edison Technology Centers around Ohio to foster technology transfer and business development. The Edison Materials Technology Center in Dayton has provided expertise in fuel cells and hydrogen technology to private companies for decades, and in the last two years expanded its efforts to include all major categories of renewable energy.

Biofuels. In 2006 Governor Robert Taft issued an "Energy Action Plan" that included \$80 million in investments in ethanol production. The plan called for the state to double its use of E85 in fleet vehicles, required all new vehicles purchased to be flex-fuel models, and tripled the number of E85 pumps available to consumers (NASDA 2006). In 2007 an executive order (2007-O2S) called on state agencies to install E85 pumps "where such pumps are not otherwise available," ensuring that the state fleet had access to alternative fuels, and to develop plans for 25 percent of diesel fuel used by state vehicles to come from biodiesel by the beginning of 2008. Currently, all four of Ohio's large electric utilities are developing methods to replace a portion of the coal they burn with solid biomass fuels. (Arnold 2010). Ohio's biomass industry has grown to more than sixty businesses and research institutions (Kruse and Gomberg 2009). The company SuGanit, out of Toledo, produces cellulosic ethanol from biomass waste. Quasar Energy Group, based in Cleveland, broke ground earlier this year on an anaerobic digester plant in Columbus with the capacity to turn 40,000 tons of municipal waste into one megawatt of electricity each year (Hallett and Gearino 2010).

Solar. Ohio has one of the fastest growing solar power industries in the nation, and much of the excitement is emanating from the northwestern part of the state, where Toledo is reinventing itself as a solar research and manufacturing mecca. The city was historically known as a glass manufacturing center, an industrial strength that was aided by its proximity to the Michigan automotive industry. As glassmaking declined along with much of the rest of the Midwestern auto industry, Toledo researchers and companies leveraged their expertise in glass to shift into thin-film solar panel manufacturing. As of 2008, Ohio Third Frontier had invested \$33 million in the northwestern Ohio solar energy cluster, and at least 6,000 people are now employed by the region's solar industry (Keen 2010, Ohio Third Frontier 2008).

This fledgling manufacturing renaissance has been built from a strong knowledge base. The region's most successful solar companies are spin-offs founded by University of Toledo professors. The university is home to the School of Solar and Advanced Renewable Energy, and in 2007 it received the largest chunk of an \$18.6 million award from Ohio Third Frontier to form the Wright Center for Photovoltaics Innovation and Commercialization, connecting researchers at the University of Toledo, Ohio State University, and Bowling Green State University. An additional \$8.9 million grant in 2009 went to the University of Toledo and nearby Bowling Green State University (Ramsey 2009). In an effort to build on the region's growing expertise in photovoltaics, the state's Ohio Research Scholars Program dedicated \$8 million to attract scientists to the University of Toledo.

In 2009, Ohio was home to 118 businesses and research institutions in the solar supply chain (Kruse and Gomberg 2009). Venture capital has flowed into the companies that are emerging in the area, including \$40 million into Xunlight (Ohio Third Frontier 2008). The company, which manufactures next-generation flexible solar films, put most of that startup capital into its production facility, which now employs more than 100 people and can produce enough photovoltaic film annually to power 25,000 homes. Xunlight has become a media darling; it hosted Sarah Palin for an energy policy speech during the 2008 presidential campaign and has been featured in the pages of *The New York Times* and *The Economist*. Toledo's other, larger thin-film solar manufacturer is First Solar, which today employs more than 1,000 people. The company expects to have 1.3 gigawatts of production capacity online by the end of the year, and has the lowest production costs in the industry, at around \$1 a watt. First Solar's stock is now trading for well over \$100 a share.

The state also supports the industry with a solar energy carve-out for its renewable portfolio standard (Calzonetti 2008, Fitzgerald 2010). Ohio has set a benchmark of developing 60 megawatts of solar capacity by 2012, about 30 times the amount currently installed (Schwartz 2009). The goal of generating 0.5 percent of the state's energy from solar by 2025 translates to 450-800 megawatts.

Transportation and Energy Storage. Ohio has developed a strong fuel-cell industry, which as of 2009 numbered 115 businesses and research centers (Kruse and Gomberg 2009). The state's Department of Development began a mapping process in 2004 for fuel-cell investment, and during the following four years it invested over \$73 million into the industry, of which about \$40 million came from the Ohio Third Frontier Fuel Cell Program. A cluster of firms is located in northeastern Ohio, but the state has also identified a fuel-cell "corridor" that includes Columbus and southwestern Ohio, but not northwestern Ohio, where the solar industry cluster is located. By 2008 the Ohio Department of Development reported the successful recruitment of several fuel-cell companies to the state and significant growth in the cluster. The state also has a fuel-cell supply-chain database developed by the Edison Materials Technology Center (Curtin et al. 2010). Fuel-cell research is conducted in many of the states universities, with over eighty-seven research projects underway in 2008 and significant research groups at Case Western Reserve University, Ohio State University, and Stark State College of Technology. Research is also conducted at the Wright Patterson Air Force Base and NASA Glenn Research Center. However, commercialization has been slow, and most jobs remained in the research and development segment of the industry (State of Ohio 2009). Rolls Royce chose Canton for the North American headquarters of its fuel-cell research division, citing the area's large base of potential suppliers as a reason for picking that location (Patton 2010). Nextech Materials in Lewis Center, Ohio has grown to thirty-five employees with the help of \$5.7 million in state funding. Owner Bill Dawson wants to someday open a manufacturing plant in Ohio (Hallett and Gearino 2010).

Lack of investment in rail and other forms of public transit remains a major sticking point in Ohio politics. Historically a major supplier to the automobile industry, the car culture is firmly embedded in Ohio. No passenger rail service has connected the state's major cities since the early 1970s. Plans to establish a "3C" corridor linking Cleveland, Columbus, Cincinnati and Dayton appear to be at a crucial stage. In early 2010, Governor Strickland announced that the

state had received \$400 million in ARRA funds to establish the corridor, enough to complete the entire project. For the moment, though, it remains unclear whether the state will even accept the federal stimulus money, despite Strickland's enthusiastic support. At least some Republicans in the state legislature are unconvinced the project can stay on budget, and a political fight appears imminent over the \$17 million in annual operating costs the state would have to provide. It is worth noting that those operating costs would represent only about one-half of one percent of the state's annual transportation budget (Freemark 2010).

Each of the last two years, only \$10 million has been set aside from the state's transportation budget for public transit, a 70 percent decrease from 2002 funding levels (Woodrum 2010). In a small gesture toward sustainability concerns, the Ohio Department of Transportation recently added an environmental category (evaluating the impacts that a project will have on air quality) to the scorecard it uses to determine funding priorities. A coalition of twenty citizen's groups and local transit authorities has formed under the banner "Save Transit Now, Move Ohio Forward!" to lobby for increased spending on public transit projects.

Wind. Ohio has become a hotbed of activity in the wind-energy sector, and in recent years has made significant strides toward become a national leader in wind technology manufacturing. The state's 2008 goal of obtaining 25 percent of its energy from advanced and renewable energy by 2025 requires that at least half of that total come from renewables like wind and solar (SB 221). The law set the stage for growth in the state's wind industry, and wind energy developers have shown considerable interest in the "wind belt" located in the state's northwestern region. Three large wind farms were recently approved for construction there. When completed, the combined capacity of those farms will top 400 megawatts (Sautter 2010).

Ohio's large manufacturing base gives it a significant advantage in developing its wind industry. Like Michigan, the state is home to many small automotive suppliers that could easily make parts for wind turbines. A 2005 report by Policy Matters Ohio projected that the state has the potential to add as many as 13,000 jobs by investing in wind energy (Hanauer 2005). The Cleveland-based manufacturers' organization WIRE-Net was responsible for creating the Great Lakes WIND Network, which is dedicated to developing the wind-energy supply chain throughout Ohio and the nation (Fitzgerald 2010). The network has made progress in organizing Ohio's wind supply chain and connecting suppliers with turbine manufacturers. Ohio now claims to have a very high, if not the highest number of companies located in the wind energy supply chain (Ohio Wind Energy Working Group 2009), and some of those companies are already producing wind energy components (Sterzinger and Svrcek 2004). American Tower Company in Shelby is making towers for small turbines up to 10 kilowatts. Cardinal Fastener & Specialty Company makes oversized screws and bolts, in the past for companies like John Deere and Caterpillar, but has now moved aggressively into supplying turbine manufacturers. Owner John Grabner predicts turbine manufacturing could account for 90 percent of Cardinal's business in the years to come, and unlike many businesses in Bedford Heights, he is hiring (Chu 2009).

Ohio's industry leadership in promoting wind energy has been impressive, and state government is also working to attract investment through its Ohio Wind Working Group, administered by the Department of Development. There is also freshwater wind energy research conducted at the University of Toledo and Case Western Reserve University's Great Lakes

Energy Institute. In 2010 Ohio Senator Sherrod Brown (2010) introduced federal legislation, the Program for Offshore Wind Energy Research and Development (POWERED) Act of 2010, that would fund additional research and support wind-energy sites.

Cleveland

Twenty-first century Cleveland is typical of large rust belt cities. Like its neighbor to the north, Detroit, the city's economy and infrastructure have been ravaged by fifty years of disinvestment and decline. The middle classes have largely fled to the sprawling suburbs, and the city center is now a shell of what it once was, home to impoverished minority communities and tens of thousands of empty lots. One of the biggest dilemmas facing city leaders today is what to do with all of the vacant land. The population has evaporated from more than 900,000 in the city's heyday to less than 450,000 today. But unlike Detroit, efforts underway to green Cleveland are benefiting from strong government and community support. Cleveland is known for sustainability efforts directed at community gardens and urban farms — there are already twenty-five for-profit farms within the city limits — and it is also working to develop the nation's first utility-scale offshore, freshwater wind farm. City leaders appear to possess the political will to enact transformative changes, and Mayor Frank Jackson is convinced that charting a more sustainable path is Cleveland's best hope for an economic resurgence (Watterson 2010).

Sustainability Plans. Cleveland has adopted the statewide goal of obtaining 25 percent of its energy from “advanced” sources by 2025, but unlike the state does not count clean coal or nuclear as advanced energy sources. Although it was not yet available at the time of this publication, city officials should make public a strategic plan for sustainable growth sometime this August. The plan has emerged from a unique community dialogue that has been ongoing over the last year. In August 2009, about 700 people gathered at a downtown convention center for the Sustainable Cleveland 2019 summit. Everyone from corporate bosses to local high school students was included in the conversation. Participants split into twenty working groups and together produced a list of twenty-eight sustainability initiatives they would like to see the city pursue in the coming decade. Projects proposed included a “solarail” transit line, the establishment of an alternative energy business incubator called the Laboratories for Advanced Energy Commercialization, a \$100 million Regional Sustainability Fund, and a handful of local foods initiatives. Following that meeting, Mayor Frank Jackson appointed Andrew Watterson to head the city's Office of Sustainability, established in 2005, and he formed the Sustainable Cleveland Council to work the twenty-eight summit recommendations into a strategic vision for the city (City of Cleveland 2010). “It's truly an economic development plan that integrates sustainability,” Watterson said of the forthcoming plan (Watterson 2010).

Working groups formed at the 2009 summit continue to meet and advance various sustainability initiatives. According to Watterson, projects related to local foods and energy efficiency have been moving forward rapidly (Watterson 2010). A follow-up summit is scheduled for September.

Cleveland's Office of Sustainability has become an active unit of city government, and is currently involved in dozens of initiatives, though many of those remain in exploratory phases. The city is investigating the feasibility of offshore wind and combined heat and power. Plans for a \$160 million waste-to-energy facility have moved into the design phase, and will include a new single-stream recycling and sorting center. The sorting process will remove hazardous waste, identify recyclable materials for resale, and create pellets of solid fuel for burning. Since Cleveland currently conducts its own recycling, water treatment and electricity production, city officials expect a strong return on investment through savings on landfill tipping fees, decreased costs for the public utility, and the sale of materials and fuels (Watterson 2010).

Some tangible strides have been taken to reduce energy consumption and waste. In 2007, the city nearly doubled its recycling rate, saving \$1 million. Traffic lights and crosswalk signals are being replaced with energy-saving LEDs. The long-term goal is to eventually transition all city lighting to LED. Officials are working to consolidate all of their lighting contracts to a single supplier, with the stipulation that that supplier locate in Cleveland. A number of companies have expressed interest in the proposal, and the city plans to initiate a competitive bidding process (Watterson 2010). City government is putting increased emphasis on local purchasing across the board. Earlier this year, the city council passed an ordinance giving an up to four percent preference to sustainable local businesses in competitive bids.

All improvement projects funded by the city are being required to divert half of the construction waste they produce from landfills. Pilot projects to install solar hot water heaters in government buildings and convert the city fleet to 20 percent biodiesel are underway. Sustainability goals have also been built into the Connecting Cleveland 2020 Citywide Plan, which proposes a wide range of "green" policies such as the creation of mixed-use districts, the rehabilitation of brownfields, the amendment of zoning codes to promote green building, and the development of pedestrian- and bike-friendly trails and roads. In 2008, Mayor Jackson required that all municipal buildings reduce their energy consumption by 10 percent within three years. The city is also using \$550,000 in federal grants to enhance its credit in order to attract a pool of investors for a revolving loan fund that would help local residents and property owners invest in renewable energy and efficiency retrofits.

Until recently, Cleveland Public Power lagged behind other publicly-owned utilities in terms of investments in efficiency and alternative energy sources. The utility is now making up for lost time, either leading or partnering in the proposed offshore wind, waste-to-energy and LED lighting projects. It has also invested in a 50-megawatt hydroelectric plant on the Ohio River (Watterson 2010).

Like the rest of the state, underinvestment in public transportation remains a struggle for Cleveland. Even as bus ridership has increased in the wake of the recession, funding has been slashed and services were reduced. As a major highway hub with little traffic congestion and cheap, readily available parking downtown, there are few incentives for the city to invest heavily in a public transit system. Cleveland has a small but growing bicycle movement, which the city is supporting through initiatives such as installing bike racks and increasing the number of bike lanes. A planned downtown bike station will provide showers and lockers for commuters. A \$450 million project to replace the Inner Belt Bridge spanning the Cuyahoga River was supposed

to include bike lanes and pedestrian walkways, but those plans will likely be scrapped after the Ohio Department of Transportation concluded they were not feasible. Under an alternative proposal, bike and pedestrian lanes will be added to adjacent bridges instead.

Green-Building Initiatives. Although a green building amendment to Cleveland's residential building code was considered in 2002, the proposal was not adopted. However, a number of significant green building projects have moved forward (LaRue 2008); for example, a \$10 million recreation center under construction will be built to LEED Gold standards. By law, the city cannot enforce any building codes more stringent than those specified by the state, but officials are using tax incentives to encourage green building. Starting in 2010, all new developments that hope to qualify for a tax-abatement have to meet either Energy Star, LEED, or Enterprise Green Community standards. Mayor Jackson has also made it his unofficial policy that all new city facilities must qualify for LEED certification, and any design team hired by the city is required to include LEED-accredited personnel (Watterson 2010). Municipal government is also trying to green city infrastructure and improve stormwater management. A large permeable concrete parking lot was recently completed at a city park.

For the moment, green building is less of an issue in Cleveland than sustainable demolition. There has been little investment capital available for large building projects, but the city has been tearing down about 2,000 abandoned structures each year. Demolition and construction waste are now the leading contributors to city landfills. In an effort to reduce waste from such activities, Cleveland launched its Deconstruction Initiative in 2007. The initiative aims to encourage the reuse of building materials from sites slated for demolition. In 2008, the U.S. Environmental Protection Agency funded a study of deconstruction practices in Cleveland as one of sixteen Brownfields Sustainability Pilots. The study identified five categories of lessons learned from previous deconstruction practices and recommended numerous strategies for improving future deconstruction projects and fostering the use of deconstruction methods on a broader scale.

Deconstruction remains fraught with challenges — it is far cheaper to knock a building down and cart the waste to a landfill than it is to take it apart by hand and salvage the materials. The labor costs and time required for sustainable deconstruction practices remain obstacles to widespread adoption. But several small companies in Cleveland have ventured into the business and are having some success. Started in January 2008, A Piece of Cleveland has made a name for itself building high-end furniture from salvaged wood. Each piece they sell comes with a “rebirth certificate” describing the history of the materials. The company has been hired to decorate offices and restaurants around Cleveland, and it has spun off a second enterprise — Urban Lumberjacks of Cleveland — to procure the materials for their designs from demolition sites.

Green Jobs Training. The Pathways out of Poverty through Green, Sustainable Jobs program started in 2009 at Cuyahoga Community College provides training to individuals with significant barriers to employment, especially ex-offenders, though so far the program has only met with limited success. Almost thirty people had completed the training by August 2009, but only a little more than a third of them had been placed in green energy jobs (Van Lier et al.

2010). The community college has also begun offering Alternative Energy and Wind Turbine Technician certificate programs.

Green Business Initiatives. Cleveland provides a good example of second-generation sustainability initiatives that are very much focused on green job creation. Major investments in business development have come from northeastern Ohio's Fund for Our Economic Future, an organization of numerous philanthropies that has awarded more than \$40 million in grants since it was founded in 2004. Most of that money has gone to fund business accelerators like NorTech Energy Enterprise, which is working to promote the region's advanced energy cluster.

Recently, Nortech has placed a strong emphasis on the wind industry, and it is backing one of the most exciting projects under development in Cleveland — offshore wind. Community leaders have long discussed the possibility of placing wind turbines in the shallow Lake Erie, which has an average depth of only sixty feet. Those dreams are fast becoming a reality. In late May, the nonprofit Lake Erie Energy Development Corporation (LEEDco) announced a partnership with General Electric to build the nation's first freshwater wind farm off the shores of Lake Erie near Cleveland. GE has pledged to provide the turbines for the initial phase of the project. Although a specific site has yet to be announced, the turbines will likely be constructed about five miles offshore, and work should begin by the end of 2011. Lawyers are in the process of filing the necessary permits, and public hearings will probably be held later this year. So far, there has been little organized public opposition to the project. A 20-megawatt farm is scheduled for completion by 2012, and it may be expanded to as much as 1,000 megawatts by 2020 (Greene 2010).

An initiative now underway to build a network of cooperatives in impoverished Central Cleveland neighborhoods is garnering national attention. What numerous media and civil society organizations are referring to as the "Cleveland model" is in fact patterned after the famous worker-owned cooperatives of the Mondragon Corporation in Spain. The project, dubbed the Evergreen Cooperative Initiative and funded largely by the Cleveland Foundation, looks to provide good green jobs to residents of the slums surrounding the city's University Circle district, home to hospitals, museums and Case Western Reserve University. Employees of the cooperatives are also partial owners who build equity in the business over time. Initially, ten for-profit cooperatives were planned that would employ about fifty people each, and the project's leaders clearly envision a flowering of the model on a much larger scale over time. As of summer 2010, two cooperatives are in operation and a third is in development. The first to launch, Evergreen Cooperative Laundry, takes advantage of energy-efficient technologies to provide commercial laundering services in a LEED-certified facility. At present, the laundry's primary clients are local hospitals (The Economist 2010). Ohio Cooperative Solar provides weatherization services and solar panel installation. The company will soon be installing a 100-kilowatt photovoltaic system on the roof of the Cleveland Clinic (Schwartz 2009). A third cooperative, Green City Growers, is expected to open later this year in a building the size of a big-box store, to be constructed on fourteen acres of abandoned land. The business will grow hydroponic lettuce and herbs. Ten percent of the profits from the cooperative will go to a common fund that will provide the financing for additional cooperatives.

Cleveland start-up Tremont Electric has garnered significant interest in its first product offering, the \$150 nPower PEG. The baton-shaped device, meant to be placed in a backpack or purse, converts kinetic energy to electricity while the wearer walks. While the power output from the first-generation PEG is meager (ten minutes of walking will only store enough electricity to charge-up an iPhone for one minute of talk time), the patented technology is scalable, and the company is currently working with Ohio State University and Akron University on a large buoy that will harness wave power from Lake Erie. Tremont Electric founder Aaron LeMieux hopes to create 250 jobs in Cleveland within five years.

Other Cities

Aside from California, Ohio is perhaps the only state able to boast that it is home to several major cities engaged in broad and aggressive efforts to green their local economies and become more sustainable. Columbus Mayor Michael Coleman started the Get Green Columbus initiative in 2005, and created a city Office of the Environmental Steward. Since then the city has notched significant gains in sustainability. In 2007, Mayor Coleman and twelve other elected officials from around the region signed the Central Ohio Green Pact, committing their municipalities to a wide range of goals, including greening city infrastructure, growing the regional green economy, and educating their communities about sustainability. Columbus increased its recycling rate 69 percent from 2000 to 2009, decreased its total fuel use 4.5 percent in 2009, and secured \$30 million in Clean Ohio funds for brownfield redevelopments. The city has also committed to reducing its carbon emissions 40 percent below 2005 levels by 2030, at a rate of 2 percent each year. Columbus' GreenSpot recognizes environmentally-friendly businesses, and green building is widespread throughout the city. Notable projects include the installation of a 5,000 square foot green roof on a municipal recreation center (City of Columbus 2009). The city's new biking initiative will install 1,000 bike racks and create 500 miles of bike paths and trails by 2028 (Sustain Lane 2008).

Cincinnati is also beginning to take sustainability seriously, following Columbus' lead in adopting the goal of reducing carbon emissions 40 percent by 2028 and a whopping 84 percent by 2050. That target is just one of 80 recommendations included in the Green Cincinnati Plan, approved by the city council in 2008 (City of Cincinnati 2008). The city's Office of Environmental Quality recently hired a sustainability coordinator to help implement those recommendations. The Office of Environmental Quality has also started a \$5 million fund to provide loans for the installation of green roofs on residential and commercial buildings. A pilot project launched in 2009 offers free parking for electric vehicles at three city garages. Cincinnati was also awarded \$3.5 million in federal energy-efficiency block grants in March of that year. Those funds were distributed to a variety of projects, including recycling programs, community sustainability initiatives and improvements at city facilities. The city has entered into contracts for a total of \$5.6 million in efficiency upgrades. Late in 2009, the city council passed the nation's first environmental justice ordinance, requiring new industrial facilities to show that their operations will not negatively impact the health of nearby communities. The Green Partnership for Greater Cincinnati allies the city, the county, the public school system, the local utility and the University of Cincinnati to work on a range of projects including mass transit, green building and green purchasing.

Civil Society Organizations and Policy

A large number of Ohio citizen's groups are active in promoting green jobs as a pathway to revitalizing the economy of a state that historically depended on heavy manufacturing. Organizations with active statewide include Ohio chapters of Repower America, the BlueGreen Alliance and the Apollo Alliance. The latter group is convened by Policy Matters Ohio, a nonpartisan think tank dedicated to economic development. The institute publishes regular reports on energy policy and has consistently promoted green energy initiatives. One recent report from Policy Matters Ohio proposes increasing energy efficiency by capturing heat lost during electricity generation (Woodrum 2009). Clean Fuels Ohio, Ohio Advanced Energy, and the Ohio Business Council for a Clean Economy, among others, lobby for policies that create a favorable climate for the development of green technologies and jobs within the state. Greater Ohio is an advocate of smart growth, and lobbies for causes such as the revitalization of urban centers and the development of alternative forms of transportation.

In Cleveland, grassroots groups and local nonprofits, working both independently and as partners with city government, have been major players in the push to put Cleveland on a more sustainable track. The GreenCityBlueLake Institute, now an arm of the Cleveland Museum of Natural History, has long history of driving green initiatives in northeastern Ohio. Its accomplishments include launching the Cleveland EcoVillage, a neighborhood redevelopment project on the city's west side, and successfully lobbying for bike lanes along local bus routes. GreenCityBlueLake was also instrumental in the formation of city's Office of Sustainability. The Cleveland Foundation has been one of the primary sources of funding for redevelopment in the city. Among its many projects, the foundation administers the Cleveland Carbon Fund, which claims on its web site to be "the first community-based, open-access carbon reduction fund in the United States." Individuals who want to ease their consciences by selling off a portion of their carbon footprints can donate to the fund, which was launched in 2009. The money raised is then distributed to groups in the Cleveland area for sustainability projects. The first project being undertaken with proceeds from the fund is the installation of 10,000 compact fluorescent light bulbs in two city neighborhoods.

For Additional Information

Green Energy Ohio provides helpful resources for state residents considering a personal investment in renewable or efficient energy technologies, and for those seeking jobs in green industries (www.greenenergyohio.org). The Ohio Department of Development's Energy Resources Division maintains a comprehensive list of clean-energy incentives available to businesses and state residents (www.development.ohio.gov/Energy). Policy Matters Ohio has archived a virtual library of studies on their web site, many pertaining directly to green jobs and technologies (www.policymattersohio.org). GreenCityBlueLake stays on top of green energy initiatives in the greater Cleveland area (www.gcbl.org). The Green Strategies Group runs an active blog, called *Ohio Green Strategies*, cataloging developments around the state (www.ohiogreenstrategies.com).

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Wisconsin

Summary and Analysis

Wisconsin has no coal, oil, or natural gas, making it dependent on the importation of fossil fuels. The state generates 69 percent of its electricity from coal-fired generators. Although energy independence may seem idealistic, Wisconsin has started off strong with high renewable portfolio standards and other legislation that generates significant demand for renewable energy and energy efficiency. On the supply side of renewable energy, Wisconsin has carefully diversified its clean-tech sector and has begun to tap into its regional advantages. The state government has used trade organizations, economic development groups, and the university research structure to help coordinate different clean-tech industries.

- As the state with the most residents employed in the manufacturing sector per capita, Wisconsin has wisely focused on retooling that sector both in terms of assisting manufacturers in becoming more energy efficient and in helping manufacturers tap into new clean-tech supply chains.
- Wisconsin has used the federal ARRA funding wisely, instituting a centralized revolving loan fund, the Wisconsin Green to Gold Fund, to help small- to mid-size manufacturers transition to the green economy.
- Expansive public-private partnerships around the University of Wisconsin system and some of the state's larger companies such as Johnson Controls, Inc., have helped to develop clean-tech industry clusters in wind, biofuels, energy storage, and solar hot water.
- Wisconsin has created a sound organizational infrastructure that attracts federal dollars and also enables the state to get in on the ground floor of new federal programs such as the Department of Energy's state energy code compliance pilot program.

General Background Policy

Energy Goals. Wisconsin joined the Midwestern Greenhouse Gas Reduction Accord in 2007, therefore agreeing to a goal of 10 percent renewable-energy production by 2015. The 2006 Energy Efficiency and Renewables Act (SB 459) also established a 25 percent goal by 2025 and an increase in the state government's purchases of renewable energy to 20 percent by 2015. The state government also has a goal of 20 percent renewable energy by 2012 (EPA 2008). In April of 2010, legislation based on the recommendations of the Governor's Task Force on Global Warming was defeated, failing to get out of committee. The legislation, referred to as the

Clean Energy Jobs Act, would have created an energy-efficiency standard of 2 percent per year for electricity and 1 percent per year for natural gas. According to one study, the act would have saved consumers \$1 billion dollars and created 16,000 jobs by 2025 (Center for Climate Strategies 2010). In our discussions with advocates in Wisconsin, the failure of the Clean Energy Jobs Act was attributed to three things: the lame duck status of the governor, the failure of those who wrote the legislation to reach across the aisle, and the belief that the bill was “too much, too soon.” With the gubernatorial election slated for November of 2010, clean-energy policy appears to be at a standstill.

Public Benefits Fund. Wisconsin’s public benefits programs are administered by the Focus on Energy program, which has a budget of about \$94 million per year. Because of the problem of transfer of funds from the program to other parts of the state government, in 2006 the program was restructured to be administered directly by the utilities and organizations with which they contract. The programs support energy efficiency, renewable energy, and energy research (DSIRE 2010). Focus on Energy has programs geared toward large farms, businesses, and proprietors of commercial buildings providing cash-back rewards, generally 25 percent of project costs, for energy-efficient project and renewable energy system implementation (State of Wisconsin 2008a).

Green Building Policy. The Energy Efficiency and Renewables Act of 2006 (SB 459) requires state government buildings to maximize energy-efficiency standards and to exceed federal and other standards. An executive order issued in 2006 (145) called on the state government to reduce energy consumption by 20 percent by 2010 (DSIRE 2010) and ensure that new state facilities are 30 percent more energy efficient than commercial code (Center on Wisconsin Strategy 2007). In 2010, the state of Wisconsin was selected to participate in the Department of Energy’s state energy code compliance pilot program, which aims to help states measure and report compliance with building energy codes outlined by the Department’s Building Energy Codes Program (Midwest Energy Efficiency Alliance 2010).

Green Jobs Training. The Wisconsin Department of Workforce Development received \$6 million in ARRA funding for green jobs training in 2010. The most notable recipient of funding is the Wisconsin Regional Training Partnership/Building Industry Group Skilled Trades Employment Program (WRTP/BIG STEP), a leader in green-collar jobs training, particularly in weatherization, residential construction, lead abatement/hazardous materials removal, and manufacturing. Founded in the 1990s, WRTP was created to answer the skills shortage experienced by Wisconsin’s manufacturing sector and to meet the pre-employment skills training needs of the Milwaukee-area’s low-income population and the growing number of people no longer eligible to receive welfare benefits following Governor Tommy Thompson’s welfare reform program, Wisconsin Works (W-2) (Wisconsin Regional Training Partnership n.d.). WRTP works with member businesses and labor unions in order to identify industry needs, and it coordinates with training providers to develop a proper curriculum for workers. By working with businesses, WRTP ensures a demand for workers (Maguire et al. 2009). WRTP/BIG STEP’s Center of Excellence offers workers “academic assessments and individualized tutoring for apprenticeship exams; pre-employment skills training and certification; and connections to community organizations that can assist with daycare, transportation, GED preparation, job readiness and other services” (Center on Wisconsin Strategy 2010a). However, programs such

as WRTP/BIG STEP are facing significant challenges getting newly trained workers into the pipeline while there is a considerable number of skilled workers, laid off during the recent economic downturn, waiting in the wings.

Clean-Energy Industries

General Background. Wisconsin has more residents employed in the manufacturing sector per capita than any other state in the nation. In order to retain and create new manufacturing jobs, the state has created the Wisconsin Energy Independence Fund to award about \$150 million over ten years in grants and loans to businesses that are developing new clean-energy products (State of Wisconsin 2008b, 2010). The state also used ARRA funds to establish the Wisconsin Green to Gold Fund, a \$100 million revolving loan fund. The fund provides low- and no-interest loans to small- and mid-sized manufacturers to help make their operations more energy efficient, transition their facilities to manufacture green products, or to support clean-energy companies. The Green to Gold Fund will use funding from the State Energy Program, the Wisconsin Energy Independence Fund, and any future federal funding, creating a “one-stop shop” for manufacturers looking for funds to make their business more green. The organization of the fund positions Wisconsin to be a recipient of future federal funding sources such as Senator Sherrod Brown’s (D-OH) proposed Investment for Manufacturing Progress and Clean Technology (IMPACT) Act (Buffa 2010; Wispolitics.com 2010).

In 2005, the Wisconsin Angel Network (WAN) was formed as part of Governor Doyle’s Grow Wisconsin plan. Funded through the Department of Commerce and managed by the Wisconsin Technology Council, WAN seeks to build early-stage capital capacity throughout the state and to help high-technology start-ups. Currently, there are twenty-two angel investor groups under the WAN umbrella, three of which are actively funding clean technology and another six that are seriously considering focusing on clean-technology start-ups (Eggert 2010). In 2008 angel investors put \$99 million into state companies and in 2009 they invested \$73.2 million (Gallagher 2010). In order to stimulate early investment in the high-tech sector in Wisconsin, the state provides a tax credit of up to 25 percent of investments for angel investors (Act 255) (Wisconsin Department of Commerce 2010a). Interest in funding clean tech entrepreneurs in Wisconsin has been propelled by the Clean Tech Thought Leader Community Forum sponsored by the Business, Environment, and Social Responsibility Program at the Wisconsin School of Business. The series, which began in 2007, seeks to educate business students, investors, and the general public about investment opportunities by giving Wisconsin-based clean-tech entrepreneurs a forum to present their ideas.

In May of 2010, Governor Doyle announced the formation of the Clean Energy Generation, Transmission, and Storage Systems (CEGTS) consortium, creating a singular statewide energy research organization. The CEGTS is a public-private partnership connecting universities and industry along the Madison-Milwaukee corridor. Anchoring this venture is the Center for Renewable Energy Systems at the University of Wisconsin-Madison and the Southeastern Wisconsin Energy Technology Research initiative in Milwaukee. The consortium has a broad charge to take a systems approach to developing clean technologies including energy

efficiency, wind, solar, smart grid, biofuels, fuel cells, and energy storage. Moreover, the consortium will train workers in new technologies as they come on line. The University of Wisconsin-Madison, University of Wisconsin-Milwaukee, Milwaukee School of Engineering, and Marquette University will all host consortium activities. The hub of the consortium will be the Center for Renewable Energy Systems, which will relocate to the new \$50 million Wisconsin Energy Institute, alongside the Great Lakes Bioenergy Research Center. The Wisconsin Office of Energy Independence will provide \$300,000 in seed capital, while \$37 million over a ten-year period is expected from a combination of public and private sources (Content 2010a; U.S. Department of Energy 2010; Wisconsin Department of Commerce 2010b).

Biofuels. Executive Order 141, issued in 2006, established state vehicle fleet goals that would reduce gasoline consumption by 50 percent by 2015 and diesel by 25 percent by the same date (EPA 2008). The state government has a broad strategy of supporting the “bioproducts” industry, which includes electricity from biomass, bioplastics, and biofuels. As of 2010 the state was the ninth largest producer of ethanol in the country, and it had a half dozen large (over 2 million gallons per year) biodiesel refineries (State of Wisconsin 2009a). Although Forward Wisconsin, a public-private partnership that engages in industry recruiting, did not list biofuels among the state’s leading industrial clusters, the state has invested strongly in the industry (Forward Wisconsin 2009). For example, the government developed incentives for new biodiesel and ethanol pumps, provided a production tax credit for large biodiesel producers, and allocated \$4 million in grants for a soybean crushing facility (State of Wisconsin 2008b).

In 2007 the Wisconsin Bioenergy Initiative at University of Wisconsin-Madison College of Agriculture and Life Sciences received a \$125 million grant from the Department of Energy for the Great Lakes Bioenergy Research Center (GLBRC). The bioenergy research cluster includes over 250 affiliated researchers and staff charged with breaking the “cellulosic bottleneck” and developing second- and third-generation biofuels. The GLBRC collaborates closely with other DOE funded Bioenergy Research Centers and Oak Ridge and Lawrence Berkeley National Laboratories.

The Wisconsin Bioenergy Initiative has also identified biogas as an untapped “opportunity fuel” for the state. With nearly 13,000 licensed dairy herds, there is significant room for growth for anaerobic digesters, which convert the methane from manure and waste water to energy and convert the manure to saleable products such as fertilizer. As of 2009, there were thirty-one operating anaerobic digester systems on twenty-two farms in the state. In comparison, Germany currently has over 4,000 anaerobic digesters in operation. Some barriers to the adoption of anaerobic digesters by Wisconsin dairy farmers include the cost of the equipment, the scale of the dairy operation and the speed of the digestion process, and the low electricity buy-back rate offered by utilities (Wisconsin Bioenergy Initiative 2010).

Solar. Despite the popularity of distributed solar power in Wisconsin, as evidenced by the 70-80 percent growth per year since 2002 (Content 2009a), solar power does not play a significant role in the state’s future energy plans. According to Governor Jim Doyle’s Plan for Energy Independence, solar power currently accounts for about 5 percent of the state’s renewable-energy production and in 2025 when 25 percent of the state’s energy use is expected to come from renewable sources there is not an increase in the projected percentage of power

from solar (State of Wisconsin 2008b). Currently, the state offers no significant tax credits for developers of large-scale solar power projects; instead, the state government opts to subsidize smaller projects (less than 20 kilowatts capacity) by individual businesses and municipalities through the Focus on Energy program.

Without much support from the state, construction of the largest solar project in Wisconsin began in May of 2010 on a remediated landfill in urban Milwaukee at a cost of \$6.9 million. The Photovoltaic Educational Farm will employ 150 people and provide 510 kilowatt-hours of electricity per year to power the television transmitter for Milwaukee Public Television (Milwaukee Area Technical College 2010). Moreover, the farm will be a leading training center for students at Milwaukee Area Technical College, Milwaukee School of Engineering, Marquette University, and the University of Wisconsin—Milwaukee (Content 2010b).

Transportation and Energy Storage. Wisconsin has a budding rail industry thanks to \$823 million dollars in ARRA funding allocated to improve rail service in the state. About \$810 million is dedicated to the initial construction costs of a high-speed rail line between Madison and Milwaukee, and about \$12 million of that will be used to improve the existing rail infrastructure connecting Milwaukee and Chicago. The remaining \$1 million will be used to study the extension of the line from Madison to Minnesota's twin cities. In March of 2010, the Spanish manufacturer of high-speed trains, Talgo, agreed to establish its North American assembly plant in Milwaukee. The plant is expected to generate about 125 jobs. Additionally, the seven-county Milwaukee-area regional economic development group, Milwaukee 7 (M-7), has worked to put together financing packages with local, state, and federal tax credits and other incentives to support a burgeoning energy storage industry cluster developing rechargeable energy storage systems for wind and grid technologies as well as vehicles (Content 2009b).

Wind. Legislation approved in 2009 (SB 185) facilitates wind siting by developing uniform standards. In June of 2010, the Public Service Commission held public hearings in hopes of resolving issues such as minimum set-backs and maximum noise standards. There is a manufacturing cluster in the northeastern section of the state, and the eighteen counties in the region have grouped together to promote the industry under the banner of the "New North." In 2010, the regional economic development organization New North, Inc., transitioned its Wisconsin Wind Works Supply Chain Directory and its members into a formal trade organization. Tower Tech Systems Inc. of Manitowoc, a member of the New North, has recently been awarded significant contracts with Denmark-based Vestas and the Spanish firm Gamesa to supply the tall towers for wind farms operated by Wisconsin-based utility We Energies (Content 2010c). The state claims that over seventy-five companies work in the wind supply chain, and wind energy is identified as one of the state's leading industrial clusters (Forward Wisconsin 2009). Additionally, there is a wind energy technician training program at Lakeshore Technical College, and the Energy Institute at the University of Wisconsin-Madison, which was founded in 2000 and includes over fifty researchers in 2010, supports wind energy researchers throughout the state. In 2009 Vestas, the largest wind turbine manufacturer in the world, also announced a partnership with the College of Engineering (Mattmiller 2009). The college hosts an industry consortium, the Wisconsin Electric Machines and Power Electronics Consortium, and wind energy curriculum.

Milwaukee

Milwaukee regularly wins high acclaim on urban sustainability rankings, and it has won special acclaim for storm-water management, energy-efficiency improvements in city buildings, alternative fuels in city vehicles, and city planning. Since 2007, Milwaukee has hosted the Green Energy Summit, put on by Milwaukee Area Technical College, connecting Wisconsin businesses, government agencies, academic researchers, and civil society organizations through panels, presentations, workshops, and exhibits. The city also hosts Wisconsin's Solar Decade Conference.

Sustainability Plans. In 2004, Mayor Tom Barrett convened the Milwaukee Green Team to develop a sustainability plan for the city. In 2005, Barrett established the Office of Environmental Sustainability to direct efforts to improve Milwaukee's water quality, increase energy efficiency, and stimulate the economy by fostering green industries. These initiatives were outlined in the Milwaukee Green Team's Report to Mayor Barrett (City of Milwaukee 2005).

Green-Building Initiatives. Since 2005, Milwaukee has had a green building goal of reducing energy consumption for city buildings by 15 percent by 2012. The city has added green rooftops to its buildings both for energy-efficiency purposes and for stormwater run-off control. The city also developed sustainable design guidelines for the Menomonee River Valley redevelopment effort.

In April of 2010, the cities of Milwaukee, Madison, and Racine were jointly awarded \$20 million in federal funding for the Wisconsin Energy Efficiency (We2) program through the Department of Energy's "Retrofit Ramp-up" program. Milwaukee's portion of the money was allocated to the launch of the Milwaukee Energy Efficiency (Me2) Program, which was developed by the city and the Center on Wisconsin Strategy. The Me2 Program supports building efficiency improvements paid for through PACE financing (Center on Wisconsin Strategy 2010b). The city government plans to implement a Community Workforce Agreement (see the discussion for Portland, Oregon) and to partner with the Wisconsin Regional Training Partnership to ensure that city residents benefit from the new jobs (City of Milwaukee 2010a). Racine's program, which focuses on commercial properties, is already running and was the first operational PACE program in the Midwest. Prior to the federal delay on PACE financing, Madison's share of the grant was planned to be used to implement a PACE program that covers both commercial and residential retrofits. In June of 2010, the state's Office of Energy Independence submitted a grant application for the Whole Wisconsin Energy Efficiency (WWe2) program, based on We2, which intends to cover the rest of the state. An additional aspect to WWe2 includes plans to help hospitals increase energy efficiency.

Green Jobs Training. In 2009, the Milwaukee Area Workforce Investment Board was awarded a \$1 million grant for green jobs training to expand Milwaukee Builds, a program to

train low-income people to work in solar and weatherization fields (Barrett 2010; Content 2009b). Milwaukee was also awarded \$1,075,000 for green jobs training through the Department of Labor's Pathways Out of Poverty program, which targets high poverty areas (Content 2010c). A joint effort between Milwaukee Area Technical College and the University of Wisconsin—Milwaukee received \$330,184 in May of 2009 to develop the Wind Energy Education Collaborative to train students for the wind industry (Content 2009c). And in 2010 Milwaukee began the construction of the Photovoltaic Educational Farm training center, a partnership mentioned above.

Green Business Initiatives. Milwaukee is also known for its redevelopment of old industrial brownfields. The Menomonee Valley redevelopment project was developed with sustainable design guidelines, and the “30th Street Industrial Corridor” program uses tax increment financing to attract new businesses, retain old ones, and recruit new “green” businesses (City of Milwaukee 2007). In February of 2010, Spanish renewable energy firm Ingeteam agreed to locate its first U.S. manufacturing plant in Milwaukee's Menomonee Valley, basing its decision on a combination of tax credits and the skilled workforce (Sandler 2010). Ingeteam will be building wind turbine generators and power converter and control systems for the wind and solar supply chains. In July of 2010, Helios USA, a start-up photovoltaic module manufacturer, became the most recent company to sign a lease within the Canal Street Commerce Center in Milwaukee's Menomonee Valley. Helios USA anticipated providing over 100 jobs by 2015. The agreement with Helios USA ensures that 96 percent of the Canal Street Commerce Center's 146,000 square feet are occupied (Weiland 2010).

In March, 2008, Milwaukee was designated as a “Solar America City” by the U.S. Department of Energy. In October of 2009, the “Milwaukee Shines” initiative was awarded \$660,000 to make solar mainstream in the city through education, outreach, training and the installation of over 100 solar-electric and fifty solar-thermal systems, resulting in 1 megawatt of energy production by 2012 (State of Wisconsin 2009b). In March of 2010, the Milwaukee Shines Solar PACE loan program was signed into law, creating a revolving fund allowing homeowners to attach solar installation expenses to their property tax bill (City of Milwaukee 2010b). The program contracted with the Midwest Renewable Energy Association to provide solar electric and solar hot water installation training workshops in Milwaukee. That same month, the Solar Hot Water Business Council developed as an offshoot of Milwaukee Shines. The Solar Hot Water Business Council seeks to create a manufacturing cluster for solar hot water components many of which are already being produced in the area or require only minor retooling by existing manufacturers. Part of the Council's plan is to tap into the cluster of businesses in freshwater technologies that has been fostered by the Milwaukee 7 regional economic development alliance and supported with research at the University of Wisconsin-Milwaukee School of Freshwater Science (Luecke 2010). To date, it is the only solar hot-water initiative in the nation (Content 2010e).

City Society Organizations and Policy

Wisconsin and Milwaukee have benefited greatly from the work of the Center on Wisconsin Strategy (COWS). While their scope is not limited to the state, COWS partners with many municipalities and Wisconsin-based organizations to develop multi-sector approaches to healthy economic development. Additionally, COWS is the Wisconsin convener of the Apollo Alliance, a coalition of labor, business, environmental, and community groups seeking to advance the clean-energy industry and the creation of high-quality, green-collar jobs.

The Wisconsin Bioenergy Initiative is convened by the University of Wisconsin but includes stakeholders from industry, governments, and civil society. The initiative plays a significant role within state, Midwest, and federal policy circles with regard to biomass and biogas. Current foci include looking to improve upon the federal Biomass Crop Assistance Program through the regional Biomass Working Group and creating Advanced Renewable Tariffs in Wisconsin that are beneficial to all stakeholders.

Other important organizations with respect to clean-energy policy include RENEW Wisconsin and the Midwest Renewable Energy Association. RENEW Wisconsin is a network of clean-energy businesses, educators, farmers, builders, environmental advocates, and citizens who seek to identify and overcome barriers to renewable energy development. Currently, the organization's focus is on fighting for Advanced Renewable Tariffs that support smaller-scale renewable-energy projects and helping to standardize the state's wind energy permitting process. The Midwest Renewable Energy Association (MREA) hosts the nation's premier energy education event, the annual Energy Fair located in Custer, Wisconsin. Additionally, MREA is a national leader in developing training and certification for renewable energy site assessment and installation.

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Other Midwestern States

Most of the Midwestern states have a biofuels industry, and many have substantial wind-energy production. However, in most of the other Midwestern states, we did not find groups of manufacturers with connections to research facilities in the universities and national laboratories.

Indiana

Indiana does not have a renewable electricity standard and public benefits fund, and the state's dependence on coal for electricity (95 percent) is among the highest in the country. As a result, the state has not moved as rapidly toward clean-energy generation and industrial development as some of the other Midwestern states. Governor Mitch Davis has supported clean technologies in general, but in more targeted ways than some other governors. Some of the attention in energy development has gone toward clean coal, including the production of synthetic natural gas. The state has a large wind farm in Benton County and some wind manufacturing, and it has over twenty biofuels refineries. A report by the Natural Resources Defense Council suggested that the state could take advantage of its proximity to transmission lines to eastern cities to produce much more wind, and it could also convert coal-burning plants to biomass by taking advantage of agricultural waste (Cohen 2010).

Of particular note for Indiana is the Energy Systems Network, a partnership of businesses with government agencies. The network has helped the state to capitalize on the greening of the automotive industry by developing three programs. The Hoosier Heavy Hybrid Partnership is oriented toward hybrid-engines for trucks; Project Plug-In is developing an infrastructure for plug-in electric vehicles and received \$416 million of a \$2.4 billion ARRA allotment; and the MicroGreen Project is testing a smart microgrid system with distributed energy for commercial and military markets. Indiana has several businesses in the electric vehicle and battery industries, including Ener1 (a manufacturer of lithium-ion batteries), a partnership with the Chinese firm Wanxiang, and the Norwegian electric vehicle manufacturer ThinkGlobal.

Missouri

Missouri has some of the standard demand policies in place, including a renewable electricity standard (15 percent by 2020) with a solar set-aside. There are also some standards for state government buildings, but not at the level of LEED silver. The state is distinguished by some excellent research resources in biofuels, such as the Donald Danforth Plant Sciences Center and the Enterprise Rent-a-Car Institute for Renewable Fuels at Washington University. However, the research strengths have not yet translated into a cluster of biofuels technology companies, and the state government programs that would support the formation of new businesses are not as strong as in some of the other Midwestern states.

The Green Impact Zone in Kansas City has received national attention. The city is not otherwise known for leadership on environmental issues, although it received some recognition

for water control initiatives and the use of carbon dioxide that a local distillery uses in its water treatment facilities. However, the Green Impact Zone represents an important and relatively unusual model of combined economic and community development initiatives. In 2009, U.S. Representative and former Kansas City mayor Emmanuel Cleaver II proposed a comprehensive development strategy for the 150-block area of the city that is the home of the city's low-income, ethnic minority neighborhoods and has an unemployment rate of up to 50 percent. The proposal called for spending of up to \$200 million by combining local resources, ARRA funds, and other federal government funds. The city council quickly backed the proposal and awarded \$1.5 million in start-up funds to the Mid-American Regional Council, a nonprofit planning organization that connects local governments in the region, to supervise the initiative. In addition to funds from the ARRA for programs such as weatherization, the Green Impact Zone sought federal funds from the Environmental Protection Agency for brownfields restoration, the Department of Justice for community policing, the Department of Housing and Urban Development for rehabilitation of abandoned and foreclosed homes, and the Department of Labor for green jobs training. Local partner organizations included neighborhood councils and the Metropolitan Energy Center, an organization dedicated toward green energy issues that will train residents to become certified energy auditors. The city government also planned to invest \$27 million in a bus rapid transit system with green bus shelters (Grady 2009).

Although by mid-2009 there was some criticism about the slow pace of progress, a visit from Obama administration officials in September, 2009, suggested that the Green Impact Zone could become a showcase project, and in November 2009 some ARRA funds were awarded through the Department of Energy. Although far short of the original goal of \$200 million, the federal government provided \$24 million, which was matched by \$24 million by Kansas City Power and Light, to develop smart-grid improvements in the zone and surrounding area (Horsley and Everly 2009). It is possible that the full range of programs that would combine community and economic development may not materialize, but the initiative represents an innovative model that connects community development with building improvements and other sustainability initiatives.

South Dakota

South Dakota has a modest voluntary renewable electricity standard of 10 percent by 2015 and a goal of LEED-silver certification in its state government buildings. The state is home to a strong biofuels refining industry, there is some research at the Center for Bioenergy at the South Dakota School of Mines and Technology, and *Biofuels Digest* listed the biofuels firm KL Energy was listed among the 50 "hottest" bioenergy firms. The state is also home to one of the largest wind farms in the country. Due to the relatively small size of the state's population and research universities, it is likely to remain a production center for biofuels and wind energy rather than become a manufacturing and innovation center.

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The Northeast

Most states in the Northeast have strong demand-side policies, and most also benefit from substantial public benefits funds based on ratepayer charges and revenue from the Regional Greenhouse Gas Initiative. Because the states are generally importers of coal and oil, there is little industrial mobilization against green-energy initiatives. As a result, the states tend to have some of the leading policies in the country. Furthermore, the strong university base and state government investment have resulted in a region that has developed some of the country's leading innovation clusters in green-energy industries.



Massachusetts

Massachusetts is a national leader in high-technology innovation, and it has extended that leadership into high-technology, clean-energy businesses. The commonwealth has strong demand-side policies that have been connected at the urban level with green-collar jobs. Although the commonwealth has had some successes in clean-energy start-up companies, especially in the biofuels, fuel-cell, and solar industries, refining and manufacturing tend to be located elsewhere due to high overhead costs in the commonwealth.

Among the innovative programs are the following:

- The Massachusetts Clean Energy Center brings together the commonwealth's efforts to support clean-energy business development, clean-energy generation, and green jobs training under one roof.
- The Massachusetts Clean Energy Center has several programs that directly support clean-energy businesses, including venture capital for start-up companies.
- Through the Massachusetts Clean Energy Center, the commonwealth cosponsors the Ignite Clean Energy Competition, a business plan competition hosted by the MIT Enterprise Forum.
- In Boston, there is a clean-energy district and one-stop shopping for business assistance for clean-energy companies.

General Background Policy

Energy Goals. Massachusetts has a renewable-energy portfolio standard of 15 percent by 2020, with an ongoing increase of 1 percent per year. The Department of Energy Resources began issuing annual compliance reports in 2003 and maintains an active classification and qualification system for all power generating facilities. Governor Deval Patrick's 2007 Executive Order 484 mandated that 15 percent of electricity for state buildings come from renewable energy sources by 2012 and 30 percent by 2020. Every effort will be made by the commonwealth to power state facilities with renewable energy resources that are eligible through the renewable portfolio standard. The overall reduction of energy consumption by state-owned buildings is ordered to be reduced 20 percent by 2012 and 35 percent by 2020.

In 2008 the state legislature passed three laws that affect renewable energy and energy efficiency demand. The Global Warming Solutions Act mandates a reduction in carbon emissions to 10 to 25 percent below 1990 levels by 2020 and 80 percent below 1990 levels by 2050; the Green Communities Act, which supports energy efficiency, wind farm sitings, and net metering; and the Oceans Act allows wind, tidal, and wave power in the state's waters.

The Green Communities Act requires utilities to acquire all cost-effective energy-efficiency and reduction measures. The implementation of energy-efficiency measures in the commonwealth is attractive due to a combination of factors, including northern climate, the potential to avoid high energy prices, and numerous aging buildings (Clean Edge 2010). The Massachusetts Energy Efficiency Advisory Council formed out of the Green Communities Act legislation provides policy guidance. Current policies in place have the state on track toward 18 percent reductions by 2020. Public hearings were held throughout the state in June 2010 to provide an overview of the draft climate implementation plan and to summarize the technical assessment of greenhouse gas reduction to 2020 (Southeastern Regional Planning 2010).

Massachusetts has also been a party to the Regional Greenhouse Gas Initiative. The auction of allowances to offset emissions since the first quarterly trade on September 25, 2008, has generated a total of \$662.8 million dollars for the region. In 2009 Massachusetts received a share of \$50 million in RGGI auction proceeds, and through the first half of 2010 the commonwealth had received another \$25 million (RGGI 2010a, 2010b).

Public Benefits Funds. Massachusetts has two public benefits funds: the Energy Efficiency Fund and the Renewable Energy Trust Fund. The Energy Efficiency Fund is expected to mobilize about \$1.6 billion in expenditures between 2010 and 2012 for energy-efficiency and low-income weatherization programs (DSIRE 2010). The three-year energy-efficiency plan for 2010 through 2012 was approved on January 28, 2010, and it is aligned with the directive set forth within the Green Communities Act. In addition to the traditional revenue source of ratepayer surcharges, about 80 percent of the RGGI funds go toward energy efficiency. The Renewable Energy Trust Fund is administered by the Massachusetts Clean Energy Center and has a budget of about \$23 million per year. The fund is supported by a ratepayer charge and amounts to about \$23 million per year that can be spent on support for renewable energy development and on clean-energy companies. Altogether a total of \$6 billion in energy and gas savings to Massachusetts customers is planned to occur as a result of reduced energy bills. This is enough to power 350,000 households. The Commissioner of the Massachusetts Department of Energy Resources Phil Giudice stated recently, “Expanded efficiency programs, funded in part by RGGI, will generate roughly \$6 billion in consumer energy savings in Massachusetts over the next three years...the same programs are also expected to create or maintain nearly 4,000 jobs for contractors, HVAC technicians, architects and other specialists, also over three years” (RGGI 2010c).

Green Building Policy. Governor Deval Patrick’s 2007 Executive Order 484 required state buildings to reduce energy consumption by 20 percent in 2012 and 35 percent in 2020 over a 2004 baseline. It also established LEED “plus” as a goal for all major building construction and renovations. Additional legislation passed in 2008 (SB 2768) enabled state agencies to contract for energy conservation and solar photovoltaic projects. Under Executive Order 484, state buildings to the “greatest extent feasible” must meet the following goals by 2012.

- 25 percent greenhouse gas emission reductions from 2002 levels
- 20% energy reduction per square foot from 2004 levels
- 15% of energy consumption procured from renewable energy sources (either through purchase of renewable energy or through installation of on-site resources)

- 10% reduction in water use from 2006 levels

Green Jobs Training. The Executive Office of Labor and Workforce Development received \$6 million in ARRA funding in 2010 for green jobs training. The state government has also moved to support its green industries with green jobs training programs by bringing green jobs training under the umbrella of the Massachusetts Clean Energy Center, which had several green jobs training programs. The Springfield Technical Community College was awarded \$1.87 million through the Massachusetts Clean Energy Center for the development of a statewide energy-efficiency and building science skills initiative, now known as MassGREEN. The funds came in part from carbon allowance permit revenues under the Regional Greenhouse Gas Initiative. The funding will go towards training in the commonwealth's community colleges, as well as programs for the training of weatherization specialists and weatherization business development.

Clean-Energy Industries

General Background. Massachusetts has some of the world's finest universities, pre-existing high-tech clusters in computing and biotechnology, and a state government that has firmly supported clean-energy industrial development. Since 1982 the commonwealth has supported its high-tech industry via an organization that is currently known as the Massachusetts Technology Collaborative (2010). The organization first supported the state's economic development efforts for the semiconductor industry, but when that industry changed, the agency's mission shifted to an economic development strategy of identifying barriers and leveraging partnerships for high-tech industrial development. The agency also supported the growth of industrial clusters, including the state's clean-tech cluster.

In 2000 the agency began to administer the commonwealth's public benefits fund, the Renewable Energy Trust, which in 2009 transferred to the Massachusetts Clean Energy Center, which had been created by legislation passed in 2008. The Renewable Energy Trust had various programs to support clean-tech businesses. The Clean Energy Center subsequently launched a new suite of investment programs to support the state's clean-energy sector. Investments are tiered, with small amounts such as \$40,000 available for new inventions, \$500,000 for technology improvement, and more available for more mature technology. The funding structure helps some companies get through the difficult early stages of development (Padaria 2010, Roush 2009).

In addition to investments from the commonwealth, there is a strong venture capital industry that has invested in clean-tech businesses. The commonwealth's private-sector venture capital for clean-tech businesses, at \$1.1 billion between 2007 and 2009, is second in the country, ahead of New York and only behind California (Clean Edge 2010). The Massachusetts Clean Energy Center also became a sponsor of the Ignite Clean Energy Competition, a business plan competition hosted by the MIT Enterprise Forum (Commonwealth of Massachusetts 2008b).

Massachusetts is also home to the New England Clean Energy Council, which links the major stakeholders in the industry: businesses, investors, consumers, government representatives, universities, labor unions, utilities, and industrial associations. It has programs in five areas: innovation, growth, education, adoption, and policy. With an active membership of over 150 organizations, the council includes sixty clean-energy CEO's. In 2009 the council led the Governor's Clean Energy Challenge in Massachusetts, signing on 110 businesses with facilities totaling twenty-two million square feet to reduce their energy footprint. The council has also worked with partners to identify a workforce needs assessment focused on the clean-energy and energy-efficiency sectors. Council members were involved with initiating and fostering a public-private partnership to allocate \$50 million per year in each region into early stage ventures and university research projects (New England Clean Energy Council 2010a).

Biofuels. The state does not have the huge number of refineries typical of the Midwestern states, but it has nevertheless entered into the industry. In 2008 Governor Deval Patrick signed into law the Clean Energy Biofuels Act, which was intended to spur the industry. The law exempted ethanol derived from cellulosic fuels from the gasoline excise tax, requires all diesel and heating oil in the state to have a biofuel component, and establishes a framework for a low carbon fuel standard. Although the state's industry is small, it is home to some of the leading technology firms, such as Agrivida, Ameresco, BerkShire Biodiesel, BioEnergy International, Mascoma, Qteros, and Verenium (Commonwealth of Massachusetts 2008a).

A Massachusetts Sustainable Forest Bioenergy Initiative has identified 10.56 million green tons of biomass in and nearby the state capable of generating 795 megawatts (DOER 2008). The Commonwealth of Massachusetts contains over four-million tons of woody biomass available for electricity production totaling 150 megawatts of capacity. A Sustainable Forest Bioenergy Initiative within the state highlights the development of research, forest management, and market needs towards providing the structure for developing the biomass supply market within Massachusetts. This initiative was funded by grants totaling \$495,000 from the U.S. Department of Energy and \$245,000 from the Renewable Energy Trust (Massachusetts Energy and Environmental Affairs 2010).

Smart-Grid and Building Technologies. Massachusetts has some industry presence in this field, notably EnerNOC, but the commonwealth has not yet developed a full cluster of research and companies. In April of 2009 National Grid launched a \$57 million smart-grid pilot project in Worcester (Smart Grid News 2009). Over 15,000 New England customers benefit from smart meters, programmable thermostats, and e-billing. There are also plans for integrating distributed generation systems. Despite the accomplishments, Massachusetts does not have a smart-grid industry equivalent to that of California or Washington. It is likely to use smart-grid technologies rather than manufacture them.

Solar. Massachusetts has a solar energy set-aside in its renewable portfolio standard, and in 2010 the commonwealth was setting up a solar renewable energy credit market similar to that of New Jersey (Kahn 2010). Governor Patrick has the goal of 250 megawatts of installed solar capacity by 2015, a goal that could put the commonwealth at a rank of number two in installed capacity, after California and above New Jersey. The goal is supported by the Commonwealth Solar programs, which provide incentives for solar installations. Although the developments will

spur the solar installation industry, there are also elements in place for a solar manufacturing industry. Among the solar manufacturing companies are Evergreen Solar, Konarka, Solectria, 1366 Technologies, Spire Solar, and Wakonda Technologies. The commonwealth has invested in some of the solar manufacturing companies, such as Evergreen, which received tens of millions of dollars in state assistance. However, in 2009 the company announced that it would move some of its manufacturing to China due to price competition. In response to criticisms that the commonwealth had lost its investment in the company, State Energy Secretary Ian Bowles noted that the company had exceeded its promise of creating 350 jobs by creating 700 permanent jobs and 225 temporary jobs; hence, its decision to move some of its manufacturing to China would not affect its overall promise to create 350 green jobs in the commonwealth. He also noted that Konarka had decided to locate manufacturing within the commonwealth (Roush 2009). In support of the industry are a strong entrepreneurial tradition and research strengths at MIT and the University of Massachusetts at Amherst. Together those universities received nearly \$60 million from the U.S. Department of Energy (2009) for Energy Frontier Research Centers for solar-energy-related research.

Transportation and Energy Storage. Massachusetts has an established fuel-cell industry, with about sixty companies engaged in hydrogen- and fuel-cell-related research, and the companies are networked by the Massachusetts Hydrogen Coalition, which was founded in 2004. Fuel-cell companies include Ballard Material Products, Nuvera, and Protonex Technology. The commonwealth also has some leading companies in energy storage, including A123 Systems (batteries, but with much of its manufacturing in Michigan), Beacon Power (flywheels), General Compression (large-scale energy storage), Boston Power (rechargeable lithium ion batteries), Evercel (Nickel Zinc Battery Chargers), and Premium Power (grid scalable zinc flow advanced energy storage). The University of Massachusetts at Lowell is the home of the Massachusetts Hydrogen and Fuel Cell Institute. Although there are strengths in both energy storage and fuel cells, the commonwealth does not have the state-government programs designed to build and develop the industry similar to those of Connecticut, Michigan, New York, and Ohio. The Massachusetts Hydrogen Coalition administered through the New England Clean Energy Council has a mission to expand hydrogen, fuel-cell, and related industries in Massachusetts (New England Clean Energy Council 2010b).

Wind. The commonwealth has some wind manufacturers, such as Second Wind, but the total number of operations and the growth in wind manufacturing is lower than in California and other states described in our report (American Wind Energy Association 2009, Sterzinger 2009). However, the Clean Energy Center manages a federally funded wind turbine testing center in Charleston. Another, separately managed wind-energy facility is the Marine Renewable Energy Center of the University of Massachusetts Dartmouth, which could become a center for off-shore wind and tidal research. The University of Massachusetts at Amherst is home to the University of Massachusetts Wind Energy Center, which has been in operation since 1972 and claims to be only American university program that offers graduate training that specializes in wind energy.

In May of 2010, the nation's first large scale wind farm entered into a renewable-energy purchasing agreement with National Grid (Cape Cod Today 2010). Local and State permitting for Cape Wind was completed in 2009 and federal permitting issued in April 2010. Once underway, the construction will take two years. This development is planned to create 130 off-

shore wind turbines capable of generating a total of 468 megawatts at maximum capacity and 170 megawatts at average capacity. The assembly and construction of Cape Wind is expected to create 600 – 1,000 temporary jobs while adding 150 permanent jobs. Economic output to the region will also be increased between \$44 to \$71 million dollars (Cape Wind 2010). The Alliance to Protect Nantucket Sound (2010) represents the main opposition group. It is composed of a diversity of stakeholders including elected officials, tribal nations, tourism and business operations, commercial fishing, environmental organizations, towns and counties along with boating and air safety navigation authorities. Visual impact issues and negative long term impacts on the region's economy are some of the issues concerning this group. The Alliance intends to seek an injunction from the court to prevent construction until the case is finalized (Daley 2010).

Boston

Sustainability Plans. On April 22, 2010, Boston's Climate Action Leadership Committee unveiled a goal of reducing the city's greenhouse gas emissions 25 percent by 2020. The plan calls for advancing the city's green jobs and economy through public and private leadership. A variety of climate mitigation goals, including energy efficiency and behavior change, are designed to save over \$2 billion dollars by 2020. Mayor Thomas M. Menino presented a wind turbine proposal at Moon Island in Boston Harbor, allocating \$2.8 million.

Green-Building Initiatives. In January 2007 Boston became the first city in the U.S. to enact a green building ordinance that requires all new and rehabilitation construction in excess of 50,000 square feet to earn LEED certification. Furthermore, all new affordable housing must meet the LEED silver standard. Boston's Climate Action Plan includes a section devoted to buildings, and the city has undertaken various initiatives to support retrofitting and weatherization. For example, the Boston Energy Alliance was announced in 2009 as a revolving loan fund that would mobilize up to \$500 million to support retrofitting of buildings (City of Boston 2009a). Mayor Menino's "Food and Fuel Campaign" offered summits that provided access to information and financial assistance for food and energy in partnership with nonprofit organizations (City of Boston 2009b). The city's Renew Boston program, announced in 2009, provides support for weatherization and energy-efficiency improvements, with \$6.5 million from the Energy Efficiency Block Grant program (City of Boston 2009c). Of that funding \$1.8 million went toward energy-efficiency retrofits of 3,100 Boston homes (City of Boston 2010a, 2010b). Additional support for weatherization and green building work came in 2005 from a coalition of community development corporations and financial institutions, which launched the Green Building Production Network to support affordable housing, and the coalition has received various grants in the \$2 to \$7 million range to pursue the projects (Boston Community Capital 2009). The Solar Boston Program encourages rooftop solar.

Green Jobs Training. Boston does not have a longstanding green corps, but in 2009 Mayor Menino announced a \$300,000 Empowerment Zone grant that enabled the creation of the Green Youth Corps and other green jobs training programs. In 2009 the city also received \$18 million in funding from the American Recovery and Reinvestment Act for green building improvements in public housing, and it applied for a \$4 million grant from the ARRA to fund a

green pathways out of poverty program. Another \$6 million in stimulus funding supports the Renew Boston Initiative, which supports energy-efficiency improvement (American Institute of Architects 2009, City of Boston 2009a, 2009b). In 2009 Boston Mayor Menino announced green jobs training programs based on a grant to Boston's Empowerment Zone from the U.S. Department of Housing and Development that enabled green jobs training. The youth training programs, also called the Green Youth Corps, took place in partnership with various community organizations, including Bikes Not Bombs and Alternatives for Community Environment. Mayor Menino's Greening the Empowerment Zone Initiative also made funds available for adult training in brownfields remediation and green facilities maintenance, as well as job creation in residential weatherization. He also made \$250,000 in city funds available for jobs training in green facilities maintenance from the Neighborhood Jobs Trust, which administers job training programs for low-income residents (Boston Redevelopment Authority 2008).

Green Business Initiatives. In 2008 the Boston Redevelopment Authority developed the "Green Tech Initiative," which is aimed at bringing new clean-tech businesses to the city and greening existing businesses. The program provides "one-stop shopping" to assist green businesses that may want to relocate to Boston. Services include site selection, financing assistance, workforce training, and assistance with contacts in the city government. The city has also established an "industrial green corridor" in the Newmarket Business District (Boston Redevelopment Authority 2009).

Civil Society Organizations and Policy

The initiatives led by Mayor Menino and the city government have taken place alongside a variety of initiatives in support of green job development from civil society organizations. The Sustainable Business Network of Greater Boston, which supports small and independent businesses in the region, began a partnership with the Boston Redevelopment Authority in 2006 to support the greening of small- and medium-sized businesses. From the bimonthly meetings for local businesses the two organizations launched the Sustainable Business Leader Program (2009), which provides assistance to the businesses that want to undergo further green. Another network has emerged from regional labor, community, and environmental organizations as the Green Justice Coalition, has pushed for weatherization and building efficiency legislation at state and city government levels as a strategy for green job creation (Green Justice Coalition 2008). In 2005 a coalition of community development corporations and financial institutions launched the Green Building Production Network to support affordable housing, and the coalition has received various grants in the \$2 to \$7 million range to pursue the projects (Boston Community Capital 2009).

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New Jersey

Summary and Analysis

New Jersey is the most densely populated state in the country, an essential transportation hub for the northeast corridor; it is strong in manufacturing, fuel refining, and agricultural industries. The state is known for its leadership in environmental policies to address the pollution from the compounding factors of the aforementioned characteristics of the state. However, New Jersey is also a leader in the country in a number of best practices supporting green job creation in the clean-energy sector:

- New Jersey has the largest solar set-aside-driven photovoltaic (PV) market in the U.S. since 2000 and has transitioned away from a rebate-based solar market toward a market primarily supported by solar renewable energy credits (RECs). To provide some encouragement for longer-term REC contracting, New Jersey established, in advance, an eight-year schedule for solar alternative compliance payment (ACP) levels, thereby removing at least some market uncertainty.
- New Jersey's net metering (required for all Class I renewables) and interconnection standards are among the best in the country with no limits to generation capacity, and, unlike other states, there is no requirement for renewable energy generators to purchase additional liability insurance.
- All major new construction of state government buildings in New Jersey are required to be at LEED silver level. Executive order (#04) in 2002 required new school designs to incorporate LEED Version 2.0 guidelines.
- Green jobs training programs in weatherization funded through The New Jersey Department of Labor and Workforce Development (LWD), Renewable Energy Incentive Program, New Jersey Board of Public Utilities, New Jersey Building Laborers Training & Apprenticeship Fund (NJBLTAF) and include the Green Job Training Partnership Program (GJTP), NJ Center for Energy and Environmental Training (CEET) and the Weatherization Training Program.

Newark, at the heart of New Jersey's industrial centers, still has functional industrial land as well as ability to redevelop its brownfields for industrial uses as well as clean energy technology production and generation. It is at a major distribution nexus of international sea and air ports and the northeast corridor by interstate highway and rail. Newark's green economic development strategy has been tied to the needs of its low-income neighborhoods. Among the programs in Newark that are focused on building green jobs in the clean energy sector are:

- A vigorous group of partnerships that engage in green jobs training for persons with employment barriers.
- The Green Economic Development task force of the Newark's Green Future Summit, which has been developing plans to use the port zone's industrial infrastructure and provide green jobs in growing sectors such as clean energy production.

General Background Policy

Energy Goals. The state's Renewable Portfolio Standard (RPS) increases the monetary value of renewable power. Under regulations already in place, the RPS requires that renewable energy sources generate 22.5 percent of the State's electricity consumption by 2020. New Jersey has continually attempted to improve on goals established in the standard.

In February, 2007, Governor Jon Corzine signed Executive Order (EO) 54, which established lofty goals for reduction in greenhouse gas emissions to return to 1990 levels by 2020 and an 80 percent reduction in 2006 levels by 2050. The executive order was enacted as law on July 2007 as the Global Warming Response Act (GWRA). The law required the state's Energy Master Plan (EMP), then under development, to determine what actions needed to be implemented to achieve the 2020 target (L. Miller 2010). The EMP (released in October, 2008) included a "business as usual" scenario that assumed no major changes in state policies and actions and an "alternative" scenario reflecting changes required by the plan to achieve the greenhouse gas reductions needed for 2020 and to put the state on a path to meet the 2050 target. The modeling conducted for the plan outlined how each scenario could affect energy use, economic growth, air quality, and greenhouse gas emissions. The Board of Public Utilities (BPU) worked with the Rutgers University Center for Energy, Economic, and Environmental Policy, and the Bloustein School's Economic Advisory Service of the Center for Urban Policy Research modeled what energy circumstances would look like in 2020 for the state (State of New Jersey 2008).

New Jersey's EMP included five goals each with specific action items to meet those goals:

1. Maximize the state's energy conservation and energy efficiency to achieve reductions in energy consumption of at least 20 percent by 2020 resulting in a reduction in current (2008) energy consumption;
2. Reduce peak demand for electricity by 5,700 megawatts by 2020;
3. Stimulate growth in renewable and alternative energy technologies by pursuing action items that may result in New Jersey producing 30 percent of its energy supply from renewable energy sources by 2020;
4. Develop a twenty-first century energy infrastructure that is responsive to the goals and action items in the plan, ensuring the reliability of the system, and making available additional tools to consumers to manage their energy consumption; and
5. Invest in innovative clean-energy technologies, businesses and workforce to stimulate the growth in the clean-energy industry in New Jersey" (State of New Jersey 2008).

As can be deduced, a number of the goals of the Energy Master Plan will directly stimulate green job creation in the clean-energy sector of New Jersey. The Center for Energy, Environmental, and Economic Policy at Rutgers University estimates that the state's Energy Master Plan has the potential to generate over 20,000 jobs by 2015 (John J. Heldrich Center 2009). Action items under the first goal are to "maximize" energy efficiency as well as reduce the state's energy consumption and work with the state legislature to authorize the development of statewide building codes to result in new construction being at least 30 percent more energy efficient than current state code by July 2009. The goal also includes developing a strategy to

achieve net zero carbon emitting buildings as well as increasing education of energy efficiency in the public and private sectors. The focus on energy efficiency, energy conservation, and weatherization of buildings will require experts in the green buildings sectors (contractors, installers, and manufacturers). The second goal of the EMP is to reduce peak demand for electricity by 5,700 megawatts by 2020 and includes action items to continue to develop incentives that achieve significant peak demand saving, most likely dependent on a smart-grid and feedback to energy consumers and on providing incentives for the development of combined heat and power.

The fourth goal of the EMP is to invest in updating the state's energy infrastructure. The State has been working with the electric and gas utilities to develop individual utility territory master plans through 2020 that reflect the goals of the EMP. This goal is being addressed through utility master plans, energy-efficiency projects, investment in renewable energy, and smart-grid technologies for better information to customers. However, the recommendation has been put on hold by the new 2010 administration and through action by the BPU. As a result, its status is indeterminate (L. Miller 2010).

Very significant to the creation of clean-energy industries in New Jersey are action items within the third and fifth goals of the EMP: the requirements for 30 percent renewable energy electricity generation by 2020 and the investment in clean-energy technologies, respectively. The third goal of 30 percent from renewables is broken down into the component energy technologies: 2,210 gigawatts from solar, 3,000 megawatts from offshore wind and 200 megawatts from onshore wind, 900 megawatts from biofuels and biomass and 50 megawatts from other sources such as low head hydro or tidal by 2020 for a total of 22,000 gigawatts from renewable energy. There will also be an increase in the RPS again for the period of 2021 to 2025. (The existing RPS is 22.5 percent by 2021.) The plan calls for incentives and subsidies, which include a federal tax credit (to expire in 2016) and state certificates as well as solar loans and financing that provide a set price for Solar Renewable Energy Certificates (SRECs) for ten to fifteen years. The purpose of these mechanisms is to drive down the price of renewable energy by building more capacity. The plan recognizes that through revisions to the renewable portfolio standard, new and emerging renewable energy technologies will generate up to 50 megawatts a year through 2020, and this will provide an incentive for the development of next generation renewable technologies as well as the opportunity for green job creation in these industries.

The fifth goal of the EMP is directly related to purpose of this report: to invest in clean energy to stimulate industry growth in New Jersey. The goal expands on existing efforts that encourage the development of clean-energy technologies by extending the Edison Innovation Fund, giving \$75 million to invest in innovative clean-energy technologies. The fund will also provide support to business incubators for clean-energy business development through the Energy Institute of New Jersey (at Rutgers University) and support basic and applied renewable energy research efforts at other state colleges and universities. (See more in the Clean Energy Industries section below.) An action item under this EMP goal is to develop timely and industry recognized job training programs to ensure that sufficient numbers of New Jersey workers have the skills demanded by industry to fill the jobs that are created from the goals of the EMP (see more in the Green Jobs Training section below).

Under state regulation (N.J.A.C. 14:8, Renewable Energy and Energy Efficiency) there are mandates for a minimum percentage of renewable energy required from each energy supplier in the state. Each supplier/provider that sells electricity to retail customers in New Jersey must ensure that the electricity it sells includes at least the minimum percentage of qualified renewable energy (New Jersey Board of Public Utilities 2010).

In 2009 another law (A3218) created a new, temporary eleven-member public body, the Solar and Wind Energy Commission, “to conduct a thorough and comprehensive study to examine State-owned property and determine where solar and wind energy installations would be feasible.” The commission’s report was required to include a discussion of the financial implications and projected energy and financial savings of the potential use of net metering for such installations. The Commission was to submit to the governor (Jon Corzine at the time) and the legislature, and also make available to the public, a report containing its findings, conclusions, and recommendations within one year after its organization. The report (limited to state property) included findings of the financial implications of installing and maintaining renewable-energy projects on state land or buildings as well as the projected cost savings. It also examined the impact of solar and wind on property values, land use, planning and development, and environmental factors (Energy Boom. 2010).

Public Benefits Fund. New Jersey’s 1999 electric utility restructuring legislation, the Electric Discount and Energy Competition Act, authorized the Board of Public Utilities to permit utilities to continue collecting funds for energy-efficiency and renewable-energy programs in a restructured utility market through a “societal benefits charge.” In 2003, the New Jersey Board of Public Utilities established the Office of Clean Energy to administer New Jersey’s Clean Energy Program. From 2001 through 2008, \$1.227 billion was collected to support the New Jersey Clean Energy Program, and an additional \$1.213 billion will be collected from 2009-2012, or about \$300 million per year. In 2008, 56 percent of the societal benefit funds collected were allocated to electric and natural gas efficiency programs, and the remaining 44 percent of funds were allocated to renewable energy initiatives (Hoffman et al 2004).

Three notable programs within the Clean Energy Program are Direct Install, New Jersey SmartStart Buildings, and Local Government Energy Audit (New Jersey’s Clean Energy Program 2010b). Of the initial amount given to Clean Energy Program, 80 percent was initially slated for energy-efficiency projects, but that amount was cut to 60 percent as of June, 2010, and 20 percent is available for renewable-energy projects (DSIRE 2010; New Jersey Clean Energy Program 2010b). The funds transferred out of the energy-efficiency program (as of June 21, 2010) were approved by the Board of Public Utilities with a number of changes and budgetary cuts to the Direct Install program. The Renewable Energy Incentive Program provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. (See more details in the relative sections of Clean Energy Industries below.)

The New Jersey Clean Energy Program’s SmartStart Buildings Program provides incentives for new energy-efficiency projects in areas designated for growth in the New Jersey State Development and Redevelopment Plan. Public school (K-12) new construction projects are eligible for the SmartStart incentives throughout the State. Financial and design incentives

include design support for larger projects (greater than 50,000 sq. ft) and no cost technical assistance for smaller projects (less than 50,000 sq. ft), technical assistance for custom energy-efficient measures, and financial incentives for qualifying energy-efficient equipment and projects (New Jersey Clean Energy Program 2010b).

Home Performance with Energy Star, also from the Clean Energy Program, provides incentives to residential owners for energy-efficiency upgrades. Certified contractors (accredited through the Building Performance Institute) do home assessments, and financial incentives are available to residents for energy-efficiency projects such as air sealing, or hot water, heating, ventilation and air conditioning upgrades. When the contractor determines that there will be an estimated energy savings of 5 percent to 25 percent, homeowners are eligible for a 10 percent cash rebate (up to \$1,300) *or* a 5.99 percent interest loan on the cost of the upgrades. If estimated energy savings will be 25 percent or greater, home owners are eligible for a 50 percent cash rebate (up to \$3,000) *and* a 0 percent interest loan (New Jersey Clean Energy Program 2010b).

Solar Renewable Energy Credits (SRECs) represent all the clean-energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners with a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kilowatt-hours of electricity, an SREC is earned and placed in the customer's account on the web-based SREC tracking system (New Jersey's Clean Energy Program. 2010b).

Green Building Policy. In 2002, Governor James McGreevey issued an executive order (#04) that required new school designs to incorporate LEED Version 2.0 guidelines. Additional Legislation passed in 2008 (SB 2146) requires that all major new construction of state government buildings be at LEED silver level (DSIRE 2010). The state also has programs for private-sector buildings. Pay for Performance is a program of the New Jersey Clean Energy Program directed at large existing facilities that directly links incentives to energy efficiency in a whole-building approach. Existing commercial, industrial and institutional buildings with a peak demand over 200 kilowatts are eligible, while hospitals, public colleges and universities, non-profits, affordable multifamily housing, and local governmental entities do not need to meet the 200-kilowatt requirement to qualify (New Jersey's Clean Energy Program 2010). The program relies on a network of "Program Partners," or registered professionals who provide technical services under direct contract to building owners. Participants select from a list of pre-qualified auditing firms who agree to follow the parameters set by the New Jersey Clean Energy Program. The Partners deliver an 'investment grade audit' which is 100 percent subsidized by the program (New Jersey's Clean Energy Program 2010). These Partners develop an Energy Reduction Plan as part of the audit that includes technical components typically found in a traditional energy audit, as well as a financial plan for funding the energy-efficient measures and a construction schedule for installation. Pay for Performance projects that incorporate combined heat and power are eligible for additional incentives. A Pay for Performance approach geared to new construction projects was launched in November 2009 as part of New Jersey SmartStart Buildings. The Local Government Energy Audit Program targets buildings owned by local governments, New Jersey State Colleges and Universities, and non-profit agencies. Energy-

efficiency measures are eligible for additional incentives available through the New Jersey SmartStart Buildings Program (New Jersey's Clean Energy Program 2010b).

Green Jobs Training. The Department of Labor and Workforce Development provides various green jobs training programs, and it has received \$6 million in ARRA funding in 2010 for green jobs training. One grant (\$300,000 from the Conserve to Preserve Foundation of the New Jersey Resources Corporation) to the department created the Green Job Training Partnership Program (GJTP), which provides a pipeline of entry-level workers for the new jobs that will be created as a result of the State's Energy Master Plan and the New Jersey Clean Energy Plan energy-efficiency projects. The program will provide clean-energy and energy-efficiency training to traditionally underserved urban men, women, and youth, as well as retraining for incumbent workers seeking to upgrade their skills in those green job sectors. The NJ Laborers' Training Center also received funding by the New Jersey Department of Labor to train 600 workers for the NJ Weatherization Assistance Program (WAP). The Weatherization Assistance Program is administered by the New Jersey Department of Community Affairs and provides income-qualified residents with energy-efficiency and conservation services. The program contracts with a network of community-based organizations (weatherization agencies) that deliver weatherization services throughout the state (New Jersey Department of Labor and Workforce Development 2010). New Jersey Building Laborers Training and Apprenticeship Fund has been awarded an eighteen-month grant to provide weatherization training for residents in distressed communities throughout New Jersey through the NJ Department of Labor. The Department of Community Affairs provided approximately \$4 million in Weatherization Assistance Program money to the New Jersey Department of Labor to assist them in training the 600 new weatherization workers. The comprehensive, ten-week training program consists of: basic skills remediation, employability skills, vocational weatherization training, intense case management, career exploration, job placement, and job retention services. The trainees must be residents of "a distressed neighborhood" (defined as an area with a rate of unemployment in excess of 150 percent of New Jersey's unemployment rate), and a maximum of 20 percent of participants can enroll without a diploma or GED, but must obtain a GED before the end of the training cycle. One-Stop Career Centers are also a mandatory partner in the training program and serve as a resource for referral of trainees. Training under the program requires a living wage plus benefits package (State of New Jersey 2010).

The Board of Public Utilities' Clean Energy Program has also supported some green jobs training (State of New Jersey 2010). The Renewable Energy Incentive Program (REIP) provides training for renewable energy installers, which was mandatory in 2010 (New Jersey's Clean Energy Program 2010). The Board of Public Utilities recently approved \$900,000 to provide three grants of \$300,000 each to enhance existing green jobs training programs current being funded by the Department of Labor and Workforce Development. The three recipients include the following non-profit organizations: the Hispanic Family Center in Camden, Isles in Trenton, and the Lincoln Park Coast Cultural District in Newark (see discussion below for Newark). Notable is Isles' new Center for Energy and Environmental Training, which brings together private industry, labor, state and local government agencies, higher education, and community-based organizations to train New Jerseyans for green jobs that improve the environment and stimulate the economy. Their green jobs training goals specific to the clean-energy sector include: energy auditing of buildings and for energy retrofits (both residential and commercial),

alternative energy design, installation and maintenance for solar, wind, and other renewable, distributive energy technologies, and green building operations and management training programs. They have developed curricula, which will lead to green jobs in energy-efficiency occupations such as assistant building analyst, assistant air sealer, and insulation installers. The program is expected to graduate over 300 qualified workers trained in green energy-related occupations over the next year. After their training, the participants will be placed in jobs with industry partners. To ensure the success of this initiative, the New Jersey Department of Labor and Workforce Development offers on-the-job training funds to reimburse employers for up to 50 percent of the minimum \$15 hourly wage paid during an initial three-to-six month internship (New Jersey Department of Labor and Workforce Development 2010, Isles 2010).

Innovation Partnership Institute (IPI) grants funded by the New Jersey Commission on Higher Education support the collaboration of New Jersey's educational institutions, employers, and other stakeholders to develop and distribute curricula to address skill gaps in key New Jersey industries. Currently, two such grants are addressing priority skill needs in the renewable energy and energy-efficiency industries, including one led by Essex County College that is focused on addressing gaps in the area of construction and facilities management and another at the New Jersey Institute of Technology focused on nuclear energy (John J. Heldrich Center for Workforce Development 2009). More specifically, Salem Community College has a new Associates degree program in Sustainable Energy Technology to prepare technicians in various energy fields, including wind. Essex County College launched an Energy Efficiency/Renewable Energy Technology certificate program in fall 2009. New Jersey also has a career guidance Internet portal for high school students, counselors, teachers, and parents. The site has a Green Jobs link with information on upcoming jobs in the sectors of weatherization contracting, auditing, renewable energy and energy efficient technologies installers and engineers and construction managers to plan large energy-saving or renewable energy projects.

Clean-Energy Industries

General Background. New Jersey's strong offshore winds and the abundance of flat roofs on the state's warehouses enable the implementation of large offshore wind farms and solar power generation (John J. Heldrich Center for Workforce Development 2009). It is estimated that 20,000 jobs will be created by the energy sector in New Jersey by 2020 (Apollo Alliance 2009). According to a PEW Charitable Trusts report, "New Jersey has a large piece of America's clean-energy economy. It ranks among the top ten states for jobs in the clean-energy economy, clean technology venture capital funding and clean technology patents" (Pew 2009a). In 2007, New Jersey had 25,397 clean-energy jobs (which include categories of conservation and pollution mitigation, clean energy, energy efficiency, training and support, and environmentally friendly products), yet the number is only 0.51 percent of total number of jobs in the state. According to a 2008 study by the Pew Charitable Trusts, there were 2,031 clean-energy businesses in New Jersey at the time of the study. Venture Capital Funds (2006-2008) totaled \$282,567,651, and there were 248 patents for clean-energy technologies in New Jersey from 1999-2008 (Pew 2009a). Most of the funds have been invested in clean-energy generation.

Of the companies in New Jersey that are either already performing green functions or may “turn green” (that is, through the installation and use of green technologies or through the manufacturing of clean technologies, or both), they employ almost 192,000 workers, which is 5 percent of New Jersey’s total employment. A significant proportion of the 3,900 manufacturing jobs in New Jersey is expected to become “green” in the near future (New Jersey Department of Labor and Workforce Development 2009). According to published information by the New Jersey Department of Labor and Workforce Development’s Division of Labor Market and Demographic Research, almost one-third of employment in New Jersey’s green industries is in renewable energy with over half of this (almost 34,000 industries) distributed among the biofuels, solar, and wind-related manufacturing industries. The state has Economic Enterprise Zones incentives administered through the New Jersey Economic Development Authority that can help support the growth of these clean energy industries in Urban Enterprise Zones.

The state’s Energy Master Plan includes a goal of starting an Energy Institute of New Jersey to support research, and the state has the research university strengths of New Jersey Institute of Technology, Princeton University, and Rutgers University. In 2009, Rutgers University opened a \$10-million, seven-acre solar energy research facility with support from the state’s Board of Public Utilities. The Rutgers Energy Institute has research in the areas of biofuels, solar energy, wind power, green buildings, and carbon capture and sequestration.

Additionally, to support the goals of the state’s Energy Master Plan strategy, the New Jersey Economic Development Authority has the Clean Energy Solutions Product Portfolio, which encompasses a comprehensive suite of financing programs, including interest-free loans and grants to ensure that commercial, industrial and institutional entities have the resources they need to grow and prosper. Among these programs are the Clean Energy Solutions Capital Investment, the Combined Heat and Power program, and the Clean Energy Manufacturing Fund. These three programs are designed to promote the purchase and installation of clean technologies that reduce energy consumption and/or generate energy through recycling production wastes (New Jersey Department of Labor and Workforce Development 2009).

The state also has the Edison Innovation Clean Energy Fund, which began administering awards in 2009 (State of New Jersey Commission on Science & Technology 2008). The fund is supported by the societal benefits charge and collaboration between the New Jersey Commission on Science and Technology and the New Jersey Board of Public Utilities. It provides funding to New Jersey renewable energy technology manufacturing companies for project assessment and the design of demonstration projects as well as construction and operation projects. The funding mechanisms support the developmental and ancillary activities necessary to commercialize identified renewable energy technologies and innovative renewable energy and energy-efficiency technologies. The maximum incentive is \$3.3 million with \$300,000 in grants and \$3 million in loans. Under the fund 50 percent of the cost is shared required, and loans can have zero-percent interest for up to ten years with three year deferral of principal repayment. In addition, the New Jersey Economic Development Authority offers additional grant monies (20 percent of the approved costs, not exceeding \$100,000) for non-research and development costs that are not covered by the Edison Clean Energy Fund grant (State of New Jersey Commission on Science & Technology. 2008.)

Some of the energy-related economic development policy has also been directed at the Garden State's still substantial agricultural industry. In 2009, two new laws allowed farm owners to install wind, biomass or solar energy systems on their farms. The power or heat generated by the systems has to be used to provide energy for the farm and ensure farm viability; however, up to 10 percent of the energy could be sold back to the power company through the net metering standards (to be discussed in the Smart Grid section). These renewable-energy systems can be up to two megawatts in size. The bill has an interesting provision that requires that biomass generation on preserved farmland must be done on-site. However, in addition to other state regulations regarding land and water use on farms, income generated from the sale of energy created from these systems cannot count toward income to qualify for farmland assessment. Any system larger than two megawatts would be licensed by the Board of Public Utilities as an energy provider and not covered or protected by the law (New Jersey Farm Bureau 2010).

The New Jersey Department of Environmental Protection's new office of Economic Growth and Green Energy, created in 2010, is tasked with working and coordinating with stakeholders from environmental groups, business and industry, local governments, and residents to explore and create opportunities for economic growth in the clean-energy sector. Included in the role of the new office is studying the economic growth aspects of the Offshore Wind Economic Development Act (discussed in the Wind section below).

Biofuels. New Jersey does not have a renewable portfolio standard for biofuels per se, but biofuels were included in the state's Energy Master Plan. The focus in the plan is on biomass and biodiesel in heating oil. As mentioned above, there are incentives for biomass generation on New Jersey farmlands; however, biomass generation on preserved farmland must be done on-site. The Renewable Energy Incentive Program provides up to \$4.00 per watt for biopower systems with a maximum incentive of 30 percent of eligible system costs (New Jersey Clean Energy Program 2010).

In terms of training in the biofuels industry, Sussex County Community College offers a three-hour course in biofuels as part of their clean-energy certificate program. Essex County College has a new certificate program in Energy Efficiency and Renewable Energy, which will include biofuels as one topic of study. For chemical manufacturing more broadly, County College of Morris has an associate's degree in Chemical Technology, which includes an environmental option (New Jersey Department of Labor and Workforce Development 2009).

Smart-Grid and Building Technologies. Smart grid with net metering in New Jersey allows producers (residential, commercial, or industrial) of renewable energy to get paid for excess (above consumption) generation of the energy they produce. As part of the Electric Discount and Energy Competition Act of 1999, net metering was required for photovoltaics and wind power, but much iteration of the policies have now required net metering for all class I renewables (includes solar, wind, fuel cells powered by renewable fuels, geothermal technologies, wave or tidal action, landfill gas, anaerobic digester gas, and sustainable biomass). Unlike most other states, there is no limit to system capacity in New Jersey's interconnection standards (DSIRE 2010b). According to the Network for Free Energy Choices, New Jersey's net metering and interconnection standards (adopted in 2004) are among the best in the country (Network for New Energy Choices 2009). Originally, to be eligible for net metering, the

generating capacity of a renewable energy system could not exceed two megawatts (which has been recently removed by legislation in January 2010, see below). Also, to be eligible for net metering, the system cannot exceed the customer's annual electric needs (New Jersey Clean Energy Program 2010b). Before receiving the benefits of net metering, the Board of Public Utilities requires that customer-generators have interconnection agreements (governing connection to the grid) in place with their investor-owned electric distribution companies. The interconnection agreement specifies the terms and conditions, technical requirements, and safety and testing requirements needed (New Jersey Clean Energy Program 2010b). Also unique to New Jersey is the fact that customers are not required to purchase additional liability insurance for most renewable energy systems.

In 2009, Jersey Central Power and Light (which serves one million customers in thirteen NJ counties) was part of a demonstration site by the Electric Power Research Institute (eight megawatts) which included technologies in smart grid such as peak load shifting, substation electricity storage, and monitoring and control (Jersey Central Power & Light 2009). The company, owned by FirstEnergy Corporation (Ohio), was also part of ARRA funding for smart-grid technology advancement and pilot projects in 2010 which expands on the smart-grid project in 2009. As a result, smart-grid technologies will be brought to over 20,000 customers in New Jersey with the potential to reduce peak load by twenty megawatts (FirstEnergy 2010).

Although New Jersey is a leader in grid interconnect policy and has moved forward with smart-grid installations, it does not yet have a related manufacturing and software industry. One notable energy-efficiency manufacturer in New Jersey is Honeywell International, the inventor of the iconic round thermostat found in homes around the world. Honeywell has an international company portfolio of \$38 billion, nearly half of which is embedded in their energy-efficiency products and services. Honeywell engineers also provide building energy audits for energy-efficiency improvements as well as oversee the retrofits. These projects create and sustain jobs for Honeywell engineers, local subcontractors and manufacturing workers in energy-efficiency supply companies (Pew 2009b).

Solar. Given the mandate of a specific level of solar electricity and the use of solar renewable energy credits (SRECs), the state has been very successful in developing solar installations. More than 6,000 solar arrays are already installed in New Jersey with an increase of solar energy installations ten-fold between 2006 and 2009. By 2009, the total was 100 megawatts of solar energy installed, enough to supply the electricity needs for more than 15,000 New Jersey homes and making New Jersey the state with the most solar installations in the country per square mile (Corrales 2009). New Jersey also boasts more solar panel production than any other state aside from California (Corrales 2009, Grotewold 2009). The "societal benefits charge" on utility bills has funded the Board of Public Utilities Clean Energy Program, which supports the solar installations as well as some green jobs training programs mentioned above (State of New Jersey 2010).

In 2010, the state passed three laws designed to advance the state's solar generation industries (Pruitt 2010). The "Solar Energy Advancement and Fair Competition Act" (A3520) required energy providers to purchase 300 gigawatt-hours of solar electricity in 2010-2011, with the amount increasing up to a level of 5500 gigawatt-hours in 2026. The law also removed the

two-megawatt cap on net metering for solar interconnection (New Jersey Clean Energy Program 2010b). Another law created the Solar and Wind Energy Commission to study solar and wind energy installations on state property. A third law provides incentives for renewable energy generation on the state's farmlands (M. Miller 2010).

In June, 2010, construction of a solar power plant was commenced on the Mennen Sports Arena in Morristown. SunDurance Energy, a New Jersey-based solar power installation contractor, began construction on the 1.57-megawatt system. The project is part of a larger project approved in January, 2010, that should ultimately see some 3.2 megawatts of capacity installed on nineteen public buildings in Morris County (Grotewold 2010). The project includes elevated solar-topped enclosures covering 500 parking spaces and panels on three separate ice rinks. Morris County's pilot will install 14,000 solar panels installed throughout the jurisdiction, and saving the county approximately \$3.8 million. It was financed through a structure being called "a landmark public-private solar development model" coined the "Morris model" by the investors. The Morris County Improvement Authority, a local development agency, received approval from the state to issue government bonds to help pay for the construction of the solar project. Tioga, a California-based solar power firm, will own and maintain the solar power-plant facilities, generating income by selling the electricity directly to the county while also receiving in federal tax credits. Tioga signed a fifteen-year power purchase agreement, agreeing to sell the electricity from the solar plant at 35 percent below what the existing utility currently charges for electricity (Grotewold 2010).

Although New Jersey is known for its strong demand policies for solar energy generation, as of 2010, the elements of a solar energy manufacturing and innovation cluster had not yet come together as they have in Ohio. Rather, the state's solar industry has remained largely installation. However, there are also some companies in the state that are engaged in solar manufacturing and other forms of solar energy development (e.g., EPV Solar, Petra Solar, and Princeton Power). For example, EPV Solar of Robbinsville, in operation since 1991, is a solar energy company that designs, manufactures and markets thin-film amorphous silicon photovoltaics and vertically integrated systems.

New Jersey's Renewable Energy Manufacturing Incentive program provides incentives to New Jersey residents, businesses, local governments, and non-profit organizations that purchase and install solar panels, inverters, and racking systems manufactured in New Jersey. Incentives for panels start at \$0.25 per watt, and rebates for racking systems and inverters start at \$0.15 per watt for Customers available for up to 500 kilowatts of a solar project. To be certified as a solar manufacturer in New Jersey, companies must supply products manufactured with at least 50 percent of the product cost from facilities located in New Jersey. Organizations awarded a grant under the New Jersey's Economic Development Authority's Clean Energy Manufacturing Fund are automatically certified as a New Jersey manufacturer.

In terms of training the next generation of solar technicians and experts, New Jersey's community colleges offer degrees, certificate programs, and courses focused on solar industry training. Various colleges and community colleges offer courses in solar-energy training. Jersey City University offers a Bachelors degree in solar/photovoltaic training, while Mercer County

Community College is introducing a 31-credit Solar/Energy Certificate program (New Jersey Department of Labor and Workforce Development 2009).

Transportation and Energy Storage. In January, 2004, New Jersey passed Zero Emission Vehicle (ZEV) Sales Tax Exemption legislation. In January 2006, the state adopted rules to implement the California Low Emission Vehicle (LEV) program beginning in 2009. These rules implement the Air Pollution Control Act provisions at N.J.S.A. 26:2C-8.15, which require rules to implement the California LEV program in New Jersey. The New Jersey program contains three components: vehicle emission standards, fleet wide emission requirements, and a Zero Emission Vehicle (ZEV) sales requirement. The rules will require automakers to reduce fleet-wide greenhouse gas emissions from the vehicles they sell in New Jersey 30 percent by 2016 (American Council for an Energy efficient Economy 2009). Every year, the New Jersey Department of Environmental Protection provides a yearly list of clean vehicles including fuel cell, electric, Advanced Technology Partial Zero Emission Vehicles (AT PZEVs), and all hybrid-electric vehicles (NJDEP 2010b). Although the state has impressive demand policies, there is little evidence that it has developed equivalent policies to support manufacturing for electric transportation, batteries, and energy storage. However, as noted below, there are signs of electric vehicle manufacturing in Newark, and the Fisker plant in Delaware could create supply-chain jobs in Trenton.

Wind. The state is also positioned to develop an offshore wind industry through the planning process for offshore wind production growth, and it is already a national leader in an effort to develop off-shore wind-to-energy power (NJDEP 2010a). The Energy Master Plan has the goal of producing 30 percent of the state's electricity from renewable energy by 2020. Together with other planned wind energy sources, an estimated 13 percent of the state's electricity would come from wind energy (State of New Jersey 2008). The state has engaged in a planning process for offshore wind production growth, and it is likely that the high targets will lead to the growth of the state's wind manufacturing industry.

Solar and wind energy generation has been promoted on state properties and encouraged on state landfills by the new administration. The Solar and Wind Energy Commission created in 2009 investigated and reported on the effects of the production of solar and wind energy on state property. State law limits the ability of local governments from unreasonably limiting small wind energy installation, and there are rebates of up to \$3.20 per kilowatt-hour on small wind through the Renewable Energy Incentive Program (New Jersey Clean Energy Program 2010b).

In June 2010, a two-year, \$7-million, seventy-five-square-mile-area, ecological baseline study of offshore wind impacts off the coast of New Jersey was completed. The study concluded that there would be minimal environmental impact from offshore wind development. The research was designed by scientists from the Department of Environmental Protection, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration and the U.S. Minerals Management Service, to help identify optimum sites off the Jersey coast for wind energy projects that would have the least impact on the environment. According to NJDEP Commissioner Bob Martin, New Jersey now has "the science and data needed to take the first steps towards making wind energy projects a reality for New Jersey. It puts us in the forefront environmentally, while also providing New Jersey with a great economic boost from jobs that will be created by this

new green industry” (NJDEP Press Release June 18, 2010) According to Dr. Gary Buchanan, Manager of the New Jersey Department of Environmental Protections’ Office of Science, “New Jersey is the first state to take such a detailed scientific look at its offshore ecological resources in the context of wind energy” (NJDEP 2010a).

There is a pilot project for three-to-five turbines proposed by Fisherman’s Energy (Cape May, NJ) that would be located some three miles off the coast of Atlantic City (M. Miller 2010). Four federal leases were granted to New Jersey offshore wind projects in 2009 partially in order to meet the Energy Master Plan’s goals. Fisherman’s Energy, Garden State Offshore Wind (GSOE), OffshoreMW, and Bluewater Wind, LLC have announced plans to build ocean large wind (300+) facilities over ten miles from shore between Brigantine and Avalon, New Jersey (L. Miller 2010, M. Miller 2010). The projects would include a 348-megawatt farm consisting of 116 turbines over a 40-square mile area (Heininger 2008). GSOE is a joint venture between the utility PSEG Renewable Energy, a subsidiary of PSEG of Newark, and Deepwater Wind of Hoboken.

Concurrently, in June 2010, the Offshore Wind Economic Development Act (S2036) passed both houses. If signed by the governor, the law would give wind energy a boost by providing the ability for offshore wind developers to obtain a fixed price for Offshore Wind Renewable Energy Certificates (ORECs) and requiring the state utilities to get at least 1,100 megawatts of energy from wind power: enough to power over 360,000 homes and businesses across New Jersey (L. Miller 2010). It is believed by most stakeholders that the bill would help make New Jersey a magnet for clean energy investment and green jobs. The bill would require utilities to purchase a portion of their energy from offshore wind farms. Companies that want to build windmills off the coast of New Jersey will have the ability to obtain a guaranteed price-for their ORECs energy which will reduce regulatory risk and greatly improve the ability to attract financing for these billion dollar plus projects. The bill essentially attempts to support “artificially” a market for 1,100 megawatts of offshore wind power (M. Miller 2010). A spokeswoman for Fishermen’s Energy, Rhonda Jackson, believes that the proposed bill will put “New Jersey in a very unique position to attract manufacturing and create a new industry with green jobs.” However, the New Jersey Business and Industry Association has outwardly opposed the measure, because it claims that renewable energy can add undue costs to business, especially during a recession (M. Miller 2010).

The New Jersey Wind Working Group is made up of the state government, municipalities, academia, businesses, and citizens interested in advancing small terrestrial wind applications throughout the state. It was initially funded by a grant provided by the U.S. Department of Energy’s Wind Powering America Program, with a goal to address barriers to the deployment of terrestrial-sited wind generation in New Jersey. The group also developed the Small Wind Model Ordinance, which addressed the development of a model ordinance addressing small wind energy systems for New Jersey municipalities. Furthermore, the New Jersey Office of Clean Energy has partnered with five colleges to implement the New Jersey Anemometer Loan Program, a tool used to assess the wind potential prior to installing small wind generating equipment.

Sussex County Community College offers a three-hour course in wind power as part of its clean energy certificate program. Brookdale and Cumberland County Community Colleges has proposed certificate programs for wind turbine technicians. In addition, Cumberland County Community College new associate's degree program in Renewable Energy Technology includes a concentration in wind (New Jersey Department of Labor and Workforce Development 2009).

Newark

Newark is one of the fastest growing urban centers in the Northeast and the largest city in New Jersey, yet problems of poverty and crime have hindered prosperous, sustainable development. In the early 1900s to the 1940s, Newark thrived as an industrial and transportation hub, attracting residents to the city for its well-paying jobs. The population peaked at 440,000, and approximately 160,000 residents left for the suburbs between 1950 and 1990, leaving behind abandoned buildings and contaminated lots. Currently, Newark, also known as the Brick City, has the existing infrastructure to infill from the explosive development of the 1940s; hence, it can support at least a 40 percent growth in business and industry development as well as housing for Newark residents. The city and community organizations have been working together to ensure that Newark grows in a sustainable manner while trying to meet economic development goals. Among the city's comparative advantages is its strategic port location and transportation infrastructure, proximity to the New York City metro region (which is third in the country in clean-technology job activity), its strong redevelopment focus, the commencement of the greening of municipal buildings, the influx of private and federal funding to metropolitan regions for municipal and household weatherization efforts, the extensive brownfield sites near its transit hubs, the unused industrial waste material at its port, and the numerous Newark-based universities, namely Seton Hall, Rutgers Newark, New Jersey Institute of Technology (NJIT), University of Medicine and Dentistry of New Jersey, and Essex County Community College.

In a year long process that culminated in 2008 with the Newark's Green Future Summit, over 300 stakeholders convened by the Apollo Alliance came together to articulate a vision and strategic recommendations around green building, green economic development and open space (Apollo Alliance 2009). The city's green economic development strategy has clearly been tied to the needs of its low-income neighborhoods, and as a result economic development and community development have been closely intertwined: "Green economic development must be grounded in equitable community development and public health. Strategies must support the greening of existing industries while engaging new sectors. In both cases, the creation and retention of well-paying, career-track jobs is the priority" (Apollo Alliance 2009). One can see in this statement a vision of green economic development that explicitly links it to good jobs and community development. However, for Mayor Cory Booker, the strategy of building green jobs and attracting new green firms is only one element of an overarching economic development strategy, which includes attracting a range of new employers to the city, reducing crime, and building the arts industry (Booker 2009).

Sustainability Plans. In 2006, the Regional Plan Association (of Connecticut, New Jersey, and New York) put together a vision plan for Newark that included discussion of sustainability and green buildings as well as transportation and incentives focusing on equitable,

accessible, green, and prosperous growth as well as local knowledge development through the numerous educational institutions in the city from secondary to higher education (Regional Plan Association 2006). A new draft is expected at the end of July 2010. In September, 2007, the city of Newark began a process to articulate Newark's green future. In August of the following year, Mayor Cory Booker leveraged philanthropic funding that enabled a local nonprofit organization to loan the city its first Sustainability Officer, Chelsea Albucher, who was housed in the Mayor's Office. Beginning in September 2007, the city began a year-long process of community meetings and planning sessions that culminated in a two-day Green Future Summit organized by Apollo Alliance in collaboration with government officials and community leaders. Then in February, 2009, Newark adopted a Master Plan Re-examination Report that focused on "healthy and safe neighborhoods and sustainability." Newark swore in its first-ever Environmental Commission in March 2009. The authorizing legislation is unique in that it specifically charges the commission with addressing sustainable development (Buendia et al 2010). The city has had a strong environmental justice movement for years.

The planning process for general greening and the creation of a green economy culminated with a summit in 2008 from which "Imagining Newark's Green Future: A Year Building the Green Economy" was published (Apollo Alliance 2009). The summit's strategy focused on three areas of improvement: green open spaces, green buildings, and green economic development. Among the open spaces strategies have been opening or rehabilitating ten parks since 2007, annual clean-up days, cleaning up abandoned properties, waterfront restoration, and tree planting in conjunction with corporate, philanthropic, local business, faith based organizations, and residents including youth.

In 2009, the Newark Sustainability Officer collaborated with Professor David Kinsey to develop a course at Princeton University's Woodrow Wilson School solely dedicated to developing a sustainability plan framework for the city of Newark. They produced the report "Sustainability Action Plan Framework: A Plan for Greening Newark, New Jersey," in which they discussed Newark's existing economic engines in the "emerging clean technology sectors," its comparative advantage in developing these sectors, and the crosscutting benefits of recommended actions within the goals they laid out. The goals includes sustainability capacity building and built partnerships; waste and water management; green buildings and neighborhoods (including urban farms); appropriate land use and revitalization (including brownfields; energy efficiency and conservation; and the greening of Newark businesses and its workforce, transportation, and public health (Buendia et al 2010). The report also discussed linkage to Newark's existing "Economic Engines" such as weatherization, the port's Clean Air Strategy and Greening Truck Industry programs, scrap metal companies at the Port, and the leveraging of local universities.

Notable green accomplishments in Newark include connecting over a thousand households to cost-saving weatherization programs; helping over fifty businesses reduce operating costs through energy-efficiency upgrades; bringing hundreds of units of new energy efficient affordable housing units on line; and supporting green career path job-training to put Newarkers to work. In addition, the city has leveraged millions of dollars to reclaim brownfields (a place suited for some renewable energy technologies) and has marked the largest

rehabilitation and renovation project of city parks in decades, opening the largest such municipally-owned facility, Nat Turner Park, in 2008 (Albucher 2010b).

Green-Building Initiatives. Newark's green buildings strategy has focused on building retrofits, both by the city government and, through incentive programs, for private buildings as well. There are many federal, state, and local programs available to Newark residents, as well as local programs for energy efficiency and weatherization. For example, the Local Government Energy Audit subsidizes 75-100 percent of the cost of a local energy audit up to \$300,000 (dependent on square footage). The program, offered through the New Jersey Clean Energy Program and the New Jersey Division of Local Government Services within the Department of Community Affairs, targets buildings owned by local governments, public colleges and universities, and 501(c)(3) nonprofit organizations. Energy-efficiency measures identified are also eligible for additional incentives through the Clean Energy Program's SmartStart Buildings program described above.

Energy efficiency holds enormous potential for urban economic development, from job creation to the generation of savings that can have a multiplier effect to support the local economy. However, for these programs to be effective, they must connect to residents and owners. By launching the Climate Prosperity Initiative, the city partnered with the BPU, the New Jersey Clean Energy Program, and community, faith-based, and business organizations to raise awareness of the availability of incentives and funding mechanisms. In some cases the programs themselves are not easily applied to yield maximum benefits; for instance, the state and utility's Whole House Residential program is for structures up to four units and is most easily applied to owner occupied buildings. In Newark, there is approximately a 23 percent rate of owner occupancy, and about 50 percent of residents live in structures greater than four units. Hence, the Whole House program is not a great fit for Newark's demographic and there market penetration has been challenging (Albucher 2010b). In addition, in New Jersey, there is still a lack of energy-efficiency programs widely applicable to multi-family residential buildings; there is assistance for a small subset of New Jersey Housing and Mortgage Financing Association (NJHMFA) financed buildings and for Housing Authorities, but these programs leave a wide swath of Newark's buildings unserved. The federal Weatherization Assistance Program (WAP) funding, distributed through the State for deployment through local nonprofits, serves low income households at up to \$6500 of upgrade per unit. Service is via application and is deployed across the providers service area, which means a scattered site (Albucher 2010b). Although the income eligibility of WAP is suited to most of Newark's residents, deployment on a per unit basis does not yield the same depth of savings that a whole building approach could offer. While it is possible for an owner to take a whole building approach through documentation that at least 50 percent of tenants are eligible, this is not widely done, and even with the increased WAP allocations, if applied on a whole-building basis, only a handful of buildings would be served. It has been recommended that Newark pursue funding (federal, philanthropic and project related investment financing) to deploy new strategies that can yield deeper savings; e.g. whole building, census tract, and whole-block approaches (Albucher 2010b).

Green Job Training. Manufacturing is still big business and a significant source of employment in Newark, yet the training programs seem to be focused on weatherization contracting and energy-efficiency and technology installation. In 1950, manufacturing

employment in Newark was approximately 10,000 employees and 8 percent of total jobs (the fourth largest sector in the “Brick City”; Ronderos 2010). Newark has been proactive in green jobs training with the establishment of a Green Jobs Network to provide residents with quality training for green career path jobs. There are training programs for youth, ex-offenders, career transition, and white-collar workers. Highlights include Local 55, which provides union jobs for weatherization workers; Clean & Green, which provides ex-offenders with immediate attachment to meaningful work reclaiming vacant lots; EPA- funded brownfields job training; green summer work in youth employment programs; green building workshops for contractors; and UEI’s solar job training graduates helped install solar on a city leased municipal garage (Albucher 2010b) The city also has NewarkWorks, a one stop online network for employment opportunities and career development.

A community development corporation in the city, the Lincoln Park Coast Cultural District (LPCCD; 2009), has diversified its mission from arts and cultural development to green building construction and green job development. The organization has two green-collar jobs programs: GreenCAP, which trains 100 at-risk youth, parolees, and veterans in the building and solar construction trades; and the Green Collar Job Training Program, which trains about sixty residents mostly for green construction jobs. More recently, LPCCD secured two rounds of state funding for weatherization worker training, and has seen a decent job placement rate.

The open spaces strategies discussed in the sustainability plans section include some forays into green job development. For example, through a coalition with the nonprofit organizations Project U.S.E. (Urban Suburban Environment) and Trust for Public Land, the city government developed a job training program for the city’s youth in the Mildred Helms Park. Through the City’s Re-Entry Initiative, a Clean & Green program has been launched with the Greater Newark Conservancy to train and provide short-term employment to former offenders. Clean & Green provides vacant lot maintenance and has helped to establish community gardens. A second phase of the program, a landscaping business and an Integrated Pest Management business, is being scoped. The city also partnered with the Urban Environmental Institute (sponsored by the Clean Water Fund of NJ) to develop a Solar Panel Savings and Training Project. The city’s building improvement projects have been linked to green job training programs.

As noted, the majority of green jobs training in Newark are in weatherization. A new model geared to unionize weatherization workers has emerged in Newark (Albucher 2010b). In 2009, the city government worked with the Laborers Union International of North America (LiUNA) Local 55 and the Garden State Alliance for a New Economy (GANE) to launch a green-collar job training program. The program provided general training with practical green job experience for twenty-five Newark residents in weatherization. Funding for the weatherization came from a grant of \$85,000 from the U.S. National Institute of Environmental Sciences and the U.S. Department of Health and Human Services’ National Institute of Environmental Health Sciences. Additionally, the Laborers Union Eastern Region Organizing Fund (LEROF) also donated funding to weatherize the initial thirty homes for free and to create job opportunities in green construction. The cost for weatherizing the thirty homes was approximately \$10,000, plus an in-kind donation of volunteers from the Laborers Union, who were also onsite working with the trainees. Local employment in weatherization jobs has been a

challenge, which may be partly due to the lack of BPI certified contractors in Newark, and because the construction slow-down has seen many folks with existing skills under-employed or unemployed. Many cities have expressed concern about the numbers of weatherization training programs emerging, and they question the ability of the market to absorb new workers (Albucher 2010b, City of Newark 2009).

Questions have emerged about the match between the weatherization training programs and demand: if there are contractors and professionals trained, can they get contracts to do the work? One suggested approach to addressing these problems includes outreach, especially engaging small contractors. Newark has conducted a training program to make contractors aware of state programs (Albucher 2010b)

Green Business Initiatives. Newark's economic development strategy includes a plan to green Newark's port, which is the third largest container port in the country and a source of air pollution and asthma, and to attract green businesses to the port and city. Through a bonding program for contractors and a small business, women, and minority fund, the city also supported business development loans (Apollo Alliance 2009, Booker 2009). The city is working on creating a nexus for electric bus manufacturing which would create 400 jobs per 100 buses built (Albucher 2010a). The city also partnered with various nonprofit and for-profit organizations to launch an urban farm on Weequahic Park.

Among some of the notable works of the city in greening of business include engaging Newark businesses in being more environmentally and socially responsible through energy conservation, hiring locally, and participating in good stewardship activities such as tree planting and neighborhood cleanups. The city also helps to connect businesses with cost-effective programs to reduce their electric bills. Over fifty businesses and non-profits are enrolled in PSE&G's Direct Install program (see more in the Public Benefits Section of New Jersey above), where 80 percent of energy efficient upgrades are paid for by PSE&G, and in a dozen filed solar projects. The city has also attracted new green business such as Innovation Fuels, a biodiesel producer, and two new solar companies. Newark also works to green capital construction and renovation projects and make municipal buildings more energy efficient to reduce their operating costs. The city has also installed solar on a municipal garage in the East Ward, it is greening its fleets with 100-percent electric cars and cleaner sanitation trucks (Albucher 2010b).

City Society Organizations and Policy

Environment New Jersey, a non-profit environmental group, has supported the goals of New Jersey's Energy Master Plan and has encouraged the recent administration in Trenton to enforce the goals, especially those of energy efficiency, offshore wind production, net metering, community solar incentives, 30 by 20, and updating the building codes for energy-efficiency goals (Madsen et al 2010). Additionally, in another report published in 2009, Environment New Jersey endorsed zero-energy buildings (carbon neutral) for all new construction by 2030 and 30 percent less energy use for all new and renovated buildings by 2012 (Jameson and Sargent 2009).

The New Jersey Work Environment Council (WEC) is the nation's oldest state-based labor-environmental coalition (formed in 1986), linking workers, communities and environmentalists throughout the state of New Jersey. The coalition has recently joined with the Blue-Green Alliance as their New Jersey Affiliate. With the United Steelworker's Center for Health, Safety, and Environmental Education and the Labor Institute, WEC piloted the nation's first training program for chemical workers to debate the challenges and opportunities for sustainable jobs in the green chemical industry. With the Blue Green Alliance, Sierra Club, Environment NJ, Green for All, Working America, and other partners in the Green Jobs for America Campaign, WEC released a report showing how a "green recovery program" could create more than 57,000 jobs in New Jersey (New Jersey Work Environment Council 2010).

The Renewable Energy Policy Project (REPP) worked with the United Steelworkers and the Sierra Club to document the state's potential of green jobs on the clean-energy sector if a national renewable portfolio was created. The document "New Jersey's Road to Energy Independence: Building on Job Growth in Renewable Energy Component Manufacturing" reported on the job implications of a national policy for renewable energy for New Jersey's clean-energy manufacturing sector, assuming a renewable portfolio standard 18,500 megawatts from renewables every year for ten years (a figure based on stabilizing U.S. emissions of carbon dioxide). The Report looked at the total demand generated and analyzed the existing renewable energy industries in New Jersey capable of manufacturing components. REPP projects that there would be a total of 1,351 clean-energy manufacturing industries grown from the 457 currently active in New Jersey. The resulting growth would be capable of providing a total of 17,698 green jobs: 7,870 jobs in wind, 6,741 in solar, 1,620 in geothermal, and 1,467 in biomass (Blue Green Alliance 2010).

The Mid-Atlantic Solar Energy Industries Association (MSEIA) is a solar energy non-profit advocacy trade association created in 1997 representing New Jersey, Pennsylvania, and Delaware to advocate for solar energy incentives, create permanent solar energy jobs, a renewable energy infrastructure, and promote solar energy as a viable and important electric and hot water source. MSEIA promotes local solar research and development as well as solar manufacturing in the New Jersey region as well as works with local governments to promote the local adoption of solar energy (Mid-Atlantic Solar Energy Industries Association 2010).

With respect to Newark, the Newark Alliance is a non-profit organization comprised of key leaders from some of New Jersey's major corporations, Newark's higher education community, and civic and non-profit organizations. The Newark Alliance works in partnership with government, civic organizations, labor, the non-profit sector and the community to improve Newark's economy and public educational system. The Urban Environmental Institute is a project of Clean Water Fund and New Jersey Environmental Federation in collaboration with the Ironbound Community Corporation focus on environmental justice issues. The Greater Newark Conservancy has a Community Greening Program that focuses on preserving and rebuilding Newark's open spaces by enhancing existing community parks, creating new 'pocket' parks, establishing greenways, and improving neighborhoods with street trees, street-side planted flower barrels and community gardens.

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New York

Summary and Analysis

As a populous state with significant industry and university resources, New York is in a good position to become a leader in green-job creation and clean-tech industrial innovation. The state has relatively large revenue pools from the Regional Greenhouse Gas Initiative and its system benefits charge, and it has fundamental demand-side legislation with clean-energy and green-building goals. The state's research and economic development agency (NYSTAR) has historically focused on other high-tech industries, but it has increasingly shifted toward clean-tech development, often in partnership with NYSERDA. The state has continued to face the challenge of connecting entrepreneurial start-ups and innovation clusters with the state's substantial investments in high-technology research in the high-quality and extensive university system. Among the most innovative aspects of New York State clean-energy industrial development policy are the following:

- The establishment of 501(c)(6) industry organizations, with support from the state government, to bring together research, development, and manufacturing in specific industries (energy-storage and smart-grid technologies).
- A long-term planning process under the 80 percent by 2050 plan.
- A pension-fund set-aside for clean-energy investments.
- Cooperation between the state's energy research and development agency (NYSERDA) and its economic development functions.
- Development of a 2050 climate action plan to establish a framework for long-term transition planning.
- In New York City, easy-to-access information on green jobs training programs and green manufacturers in the city.

Background Policy

Energy Goals. New York has a state energy plan first developed in 2002 and then revised in 2009. The plan develops goals and implementation mechanisms for a ten-year period, and it is supported by the New York Energy Policy Institute, which provides a research resource for energy policy. The state has many initiatives related to energy efficiency and renewable energy that make the state a leader in demand policies. In 2004 the state's Public Service Commission established a renewable portfolio standard of 25 percent of retail electricity consumption by 2013, measured against the baseline of 19.3 percent in 2004 (NYSERDA 2010c). Although the baseline is high due to the hydropower resources in the state, the goal required about 4500 megawatts of new renewable energy capacity. In 2009 the New York State Public Service Commission increased the renewable portfolio standard to 30 percent by 2015. In the same year Governor Patterson developed a new goal of 45 percent of the state's energy from renewable energy and energy efficiency by 2015. He also issued an executive order (No. 24) to reduce

greenhouse gas emissions by 80 percent below 1990 levels by 2050 and required the state to draft a climate action plan. The result has been a long-term planning process with multiple stakeholders and public commentary. The process was not yet complete in 2010, but it promised to become a model for other states.

The state's energy-efficiency goal for electricity is 15 percent reduction with respect to project use by 2015, and the energy-efficiency standard gradually expands to 2 percent per year by of electricity sales by 2015.

Public Benefits Fund and Emissions Credits. New York's system benefits charge provides about half of the funding for the New York State Energy and Development Authority (NYSERDA), with another quarter of the funding coming from the sale of emissions allowances from the Regional Greenhouse Gas Initiative and the Clean Air Interstate Rule. The total revenues for 2009 were \$494 million (NYSERDA 2009d). The organization supports energy efficiency and renewable-energy projects, research and development, education, and low-income energy assistance. The revenue basis for NYSEDA has enabled it to play a significant role in the growth of clean-energy and increasingly in clean-energy business development. The organization also has about \$600 million in net assets.

In 2009 the State of New York passed the "Green Jobs/Green New York" legislation, which earmarked \$112 million in revenue from carbon credits sold via the Regional Greenhouse Gas Initiative and authorized NYSEDA to spend the funds. NYSEDA was charged with establishing a revolving fund of credit to support home energy audits and support energy-efficiency building retrofits of \$13,000 for homes (\$26,000 for businesses). The loan payment in turn is deducted from the energy bill, which is lower than would have been paid due to the retrofit improvements. The program is estimated to fund about 14,000 new jobs in the building retrofit and related industries (New York State Senate 2009).

Green-Buildings Policy. Since 2000 the state has offered a green building tax credit for energy efficiency and other building improvements. In 2001 Governor George Pataki signed Executive Order No. 111, also known as the "'Green and Clean' State Buildings and Vehicles" order (NYSERDA 2004). The guidelines set goals for 2010 as follows: a 35 percent reduction in energy consumption from 1990 in state government buildings; 20 percent renewable energy for electricity consumption for state buildings; and procurement of energy-efficient products. The executive order also encouraged buildings to obtain LEED certification but did not require it.

In 2007 the state government's building authority, the Dormitory Authority, began to require that all new construction and major renovations be registered with LEED with a goal of LEED silver certification. In 2008 new legislation (A10684) authorized NYSEDA to provide grants for green building construction and renovation for residential buildings, and in the same year the State Green Building Construction Act (amended in 2009) required all new state government building construction and major renovations to meet green building standards (US Green Building Council 2010). Additional proposals under consideration in 2010 would close loopholes in the energy building code, such a restriction on the current code that limits its applicability to building improvements on 50 percent or more of the property.

In addition to the large energy-efficiency program for homes and businesses developed under the Green Jobs Green New York legislation, the state government has also authorized Property Assessed Clean Energy (PACE) bonds. Whereas the Green Jobs Green New York program uses RGGI funds for a revolving loan for on-bill payment, PACE programs (currently stalled at the federal level) use municipal bonds to finance payment via property taxes. Both forms of payment stay with the building when it is sold. The PACE program enabled the state of New York to receive the largest allocation of ARRA funding (\$40 million out of \$252 million) for such programs.

The state has other significant demand-side legislation and administrative reforms, such as recent improvements in net metering rules, appliance standards, and facilitated permitting for energy-storage facilities.

Green Jobs Training. New York has a grant from the U.S. Department of Labor to study and estimate the number of green jobs in the state (Empire State News 2010). That grant will help the state to undergo planning for green jobs training. The state also supports a green jobs information web site (greencareersny.com).

There is a wide range of green jobs training programs. Beginning in 2004 NYSERDA supported training of photovoltaic installers under its Clean Energy Program, which was budgeted at \$1 million per year. The program worked through community colleges and the International Brotherhood of Electrical Workers. In 2009 the programs in clean-tech training were expanded to \$4 million, which was allocated to a network of training centers located in community colleges, four-year colleges, BOCES, and building trades organizations. The scope was also expanded to include training for solar water heating, wind, geothermal, and fuel cells (NYSERDA 2009). Furthermore, NYSERDA will use some of the revenue from carbon trading to provide green jobs training programs for the new jobs described above under the Green Jobs Green New York legislation (New York State Senate 2009). In 2009 Governor Paterson of New York also announced a program for a Green Jobs Corps. Financed by \$5 million from Temporary Assistance for Needy Families and \$2 million from state funds, the program provides competitive grants to local governments for training in green jobs and subsidized employment for “workfare” recipients (New York State Office of Temporary and Disability Assistance 2009). This program is oriented toward low-income individuals who either receive public assistance or have incomes below 200 percent of the poverty line, but the state has also inaugurated green jobs programs that are oriented toward general job training.

New York’s Workforce Development Institute has a staff of thirty people in offices across the state that provide jobs training and gap funding for training programs. The organization receives funding primarily from the state and federal governments, and it partners with organized labor to provide high-quality jobs training programs. Several of the programs and initiatives include green-jobs training. For example, the Green and Sustainability Program works with employees on the ground level to ensure LEED compliance and to train the trainers. The organization is also developing regional Green Learning Centers, in partnership with the plumbers’ and electricians’ unions, to educate people about green jobs, display innovative green products, and provide training.

Clean-Energy Industries

General Background. New York's efforts to develop clean-energy industries come through several of the state government organizations: Empire State Development, which links various economic development organizations; the New York State Foundation for Science, Technology, and Innovation (NYSTAR), supports high-technology economic development in the state through research efforts and its ten regional development centers; and the New York State Energy and Research Development Authority (NYSERDA), which focuses on energy-related issues. Empire State Development has played a central role in the recruitment of some clean-energy companies, such as the recruitment of the silicon producer Global Specialty Metals, which in turn was used to recruit the solar manufacturer SpectraWatt (Paterson 2009). In 2010 Empire State Development also launched the Exelsior Jobs Program, which incentivizes companies to locate in New York and includes clean-energy companies among its targeted industries (Mullin 2010).

With respect to NYSTAR, in 2007-2008 (the last year for which data were publicly available) the foundation invested \$53 million in partnerships between academic research and the private sector (NYSTAR 2008). Among other programs NYSTAR funds fifteen centers for advanced technology that specialize in university-industry collaboration and technology transfer. Some of the centers focus on research directly relevant to clean-energy technology. For example, the Center for Future Energy Systems received \$20 million initially from the state government, and the Syracuse Center of Excellence in Environmental and Quality Systems (2009) has received over \$44 million from the state government since 1998. The organization conducts and coordinates state-level research in several clean-energy areas, including indoor environmental quality, water resources, and renewable energy. NYSTAR also supports five other major research centers in energy and environmental research (New York State Foundation for Science, Technology, and Innovation 2009).

In 2009, one of the NYSTAR centers, the Center for Economic Growth, entered into partnership with NYSERDA and the University at Albany to fund clean energy and environmental technology companies (Graven 2009). NYSERDA also spent about \$14 million per year on the Saratoga Technology + Energy Park, which is located next to a technology campus that houses a new chip manufacturing plant and can house three additional plants (NYSERDA 2009a). The state energy agency also supports both intramural and extramural research, and it has plans to support several Clean Energy Advanced Research Centers and Clean Energy Business Incubators (NYSERDA 2009a). NYSERDA has also supported the Clean Energy Center, which provides assistance to start-up companies in partnership with the Syracuse Technology Garden. In 2009 and 2010, NYSERDA also had a \$6.4 million program to support "Clean Energy Business Growth and Development." The Energize New York initiative, approved in 2010, provides low electricity rates, including for manufacturers, to make the state more attractive to business.

Other sources of financing for clean-energy companies include the state's pension fund and economic development authority. The New York State Common Retirement Fund has invested about \$500 million of the \$155 billion fund in green technology, and a smaller amount (\$40 million) has gone into in clean-tech private equity (DiNapoli 2009).

Despite the many efforts and substantial infrastructure for clean energy in the state, the development of the state's clean-energy industries is uneven. It is strongest in energy storage and buildings technologies, but it is not a national leader in biotechnology associated with biofuels and wind manufacturing, and its solar manufacturing industry is small. The state's rail industry is quite strong in manufacturing, but there is the corresponding research and development side is less well developed than its battery, nanotechnology, and energy storage research.

Biofuels. Governor Pataki's 2001 Executive Order 111 required that the state have a goal of 100 percent alternative-fuel vehicles for the state's light-duty fleet by 2010. The state's biomass and biofuels industry exists but is not well developed in comparison with the industrial clusters in the Midwest and West Coast. The New Hampshire-based company Mascoma has a demonstration plant for cellulosic ethanol that is operated in partnership with three universities, and Genencor is headquartered in Rochester. NYSERDA (2010b) funded a biofuels roadmap that may help the state to catch up with efforts in other states, and NYSERDA also funded the development of E85 ethanol stations. Because there is little evidence for biotechnology-based start-up firms similar to the ones emerging in California, Colorado, and Massachusetts, it is possible that the biofuels industry in New York will remain a production industry. There is considerable potential for a broader biomass industry due to the state's large resource base in the Adirondack Park and broader north country (Washburn 2010).

Smart-Grid and Building Technologies. In 2009 the New York State Smart Grid Consortium was founded to bring together state agencies, utilities, universities, and companies that produce smart-grid technologies. Although the consortium will focus on deployment of smart-grid technologies, its strategic plan also includes a role for supporting the state's technology companies that have entered the smart-grid market (NYS SmartGrid Consortium 2009). IBM, which is headquartered in New York, has entered the smart-grid industry and also forged partnerships with smart-grid start-up companies (Ritch 2009). General Electric's Global Research and Development Center, located near Schenectady, has also conducted research on smart-grid technologies. In 2009 NYSERDA and public and private electricity providers in the state also received \$88 million in funding for smart-grid development (Hull 2008, NYSERDA 2009c).

Although New York has the elements in place to become a significant player in the smart-grid industry, to date the main companies in the field are concentrated in the states of California and Washington. New York's large corporations that have an interest in the industry tend to locate manufacturing globally, and some of the partnerships developed so far, such as those between IBM and smart-grid companies, have been with California-based companies (e.g., Silver Spring, SynapSense, and Trilliant). It is likely that New York will not specialize in meters and software, where the West Coast firms have a lead, and instead will focus on distributed energy storage, where the state has significant advantages, and in the related lighting and building controls industries (Cooke 2009). The state has substantial research strengths in lighting via the research center at Rensselaer Polytechnic Institute as well strong research clusters in materials and engineering in the state's universities. Brookhaven National Laboratory also conducts energy-efficiency research, and several large companies (Philips, Carrier, Lockheed Martin, Pall, Siemens, and GE) have strengths in lighting, building control systems, and heating, ventilating, and air conditioning. Companies include E2TAC, Pall, Cemtrex, and Evident.

The Syracuse Center of Excellence in Environmental and Quality Systems mentioned above also conducts and coordinates research on indoor environmental air quality, and the heating and air conditioning company Carrier is headquartered in the city. Although the central New York region has lost manufacturing jobs in the building controls industry, it has also been the site of new start-up companies in the green-building manufacturing industries (Fitzgerald 2010). The Syracuse Technology Garden, which incubates technology companies, and the state's Clean Energy Center, which supports clean-energy companies, are located in the city.

Solar. New York has strong demand policies, but the manufacturing side of the state's solar industry is not as well developed as in some other states. In 2007 the state and its industry partners produced a solar roadmap, and the system benefit charge has enabled NYSERDA to develop over 800 installations (New Energy New York 2007). The public power agencies, Long Island Power Authority and New York Power Authority, have large solar installation projects underway. In January 2010 Governor David Patterson announced the plan to install 100 megawatts of solar energy in the state (a 500 percent increase) as part of a plan to produce forty-five percent of the state's energy through renewable sources by 2015 (UPI 2010). The proposed New York Solar Jobs and Development Act would charge an average of about 39 cents per month on ratepayer bills to finance solar-energy installations, and it is estimated to produce about 22,000 direct and indirect jobs. The New York Solar Thermal Consortium (n.d.) has also produced a solar thermal roadmap that calls on the state to promote both installation and manufacturing in that industry.

As of 2010, the state had three photovoltaic manufacturing plants and some research in its universities, including the Center for Autonomous Solar Power at Binghamton University and the Center for Advanced Materials Processing at Clarkson University. In addition, the state has a strong nanotechnology research base, and it is possible that advances in the field will make the state a center for the next generation of nanosolar applications. However, the state did not have an innovation cluster in solar energy similar to the one in northwestern Ohio, and it is possible that its solar industry will be mostly in installation and maintenance.

Transportation and Energy Storage. The clean-energy industry where New York has achieved national leadership is fuel cells and energy storage. The state's Public Service Commission granted \$21 million for fuel-cell installations, and NYSERDA has supported growth of the battery and electricity storage cluster by providing research seed funding for the New York Battery and Energy Storage Consortium, a nonprofit organization that began in 2009 (Curtin et al. 2010, New York Battery and Energy Storage Consortium, 2010, NYSERDA 2009a). The primary research and manufacturing cluster for fuel cells is in the Rochester area. Both General Motors and Delphi have fuel-cell divisions in the area, and Congresswoman Slaughter helped to obtain \$10 million in federal funding for research at the two companies and at the Rochester universities (Dube 2009). In addition, Eastman Kodak and Harris RF Communications are working on fuel-cell applications, and both the University of Rochester and Rochester Institute of Technology have significant fuel-cell research strengths. Elsewhere in the state other companies that are involved in products that tie in with fuel cells include Ener-G-Rotors, ENrg, and Raymond. MTI Micro Fuel Cells and Plug Power are located in the Albany area, and the two companies received over \$8 million in ARRA funds (Curtin et al. 2010).

The state also has strengths in the broader industry of energy storage. Although battery manufacturing is not as extensive as in Michigan and the national center is located in Kentucky (enabling an arc through Indiana and Ohio), there were strengths in some areas. The state includes established energy storage companies (such as Ultralife and BAE Systems), start-ups (such as the Paper Battery Company), and testing facilities in the universities and in private-sector companies. In 2010 General Electric announced plans to invest \$100 million in GE Energy Storage Technologies at the GE Energy headquarters in Schenectady for a manufacturing plant that will produce sodium batteries for the companies hybrid-electric locomotives (Allen 2010). New York has the bulk of the rail manufacturing in the U.S., due largely to the infrastructure needs of the rail system that centers on New York City. The companies (Alstom, Kawasaki, and Bombardier) all have foreign headquarters, and it is likely that design is done in France and Japan. However, the General Electric battery-manufacturing facility may become connected with the state's rail industry and spur connections between the battery and energy storage cluster. The state's capital district is also home to a \$69-million flywheel energy storage facility built by the Massachusetts-based company Beacon Power.

New York has extensive research facilities related to fuel cells and energy storage. In addition to research and testing capabilities at Brookhaven National Laboratory, General Electric's Global Research Center is located outside Schenectady, where there are 1800 researchers. Many of the new projects entail clean-energy research, and between 2005 and 2006 the company invested \$150 million in the "green battery" market. Likewise, General Motors has the Electrochemical Energy research Laboratory (300 employees) outside Rochester, where research on fuel cells and batteries is conducted. The Cornell Fuel Cell Institute (2009) is funded primarily by the Department of Energy, but it also has state government support via NYSTAR that enabled a partnership with the state's other fuel-cell research center, the Center for Advanced Technology for Future Energy Systems at Rensselaer Polytechnic Institute. The College of Nanoscale Science and Engineering at the University of Albany has also entered into clean-energy applications, with fuel-cell research in its Energy and Environmental Technology Applications Center. The state also has five energy research frontier centers, of which three do research related to energy storage, and there are research and testing clusters at various universities.

Given the demand of New York City for urban transportation technology, the state has also been able to nurture bus and train manufacturers. For example, NYSERDA worked with two companies in the state, BAE Systems Controls and Orion Bus Industries, to develop hybrid-electric drive trains for buses (NYSERDA 2009a). The state is also home to several major manufacturers of rail transportation (including Alstom, Bombardier, and Kawasaki), and a report by the Apollo Alliance indicated that the state had the highest number of rail manufacturing companies in the country (Lowe et al. 2010). As a result, New York State is well-positioned to take advantage of high-speed rail initiatives. However, it should be noted that most major rail manufacturers are foreign companies that have manufacturing operations in the U.S., but the higher-end innovation and research functions tend to be located abroad. As a result, the potential for rail manufacturing to become a global export industry may be limited.

Wind. New York also has a geographical advantage with access to both saltwater wind near Long Island and freshwater wind in Lake Ontario, and requests for proposals were

underway for installations in both areas. Although the state has terrestrial wind farms and is pursuing off-shore wind, the state does not have a major initiative to develop wind-turbine manufacturing. There is some research in wind energy at the state's universities, and General Electric has a wind-turbine manufacturing center in Schenectady as well as research at its Global Research and Development facility in nearby Niskayuna. As a result, there is potential in the state for a wind-manufacturing effort that might also be connected with the state's supply-chain manufacturers for the rail and automotive industries.

New York City

Sustainability Plans. New York City's initiatives to create green jobs are part of the broader "PlaNYC" framework, a plan that Mayor Michael Bloomberg launched on Earth Day in 2007. The broad sustainability plan includes goals for housing, open spaces, brownfields, water, air, transportation, and energy. A unique and impressive aspect of the plan is that the city reports annually on progress toward its goals, with a description of actions taken and the status of the progress as complete, redirected, or delayed. People who want to know about the progress on various goals can go to the web site and find updates.

PlaNYC committed the city government to reducing its carbon footprint by 30 percent below 2005 levels by 2030. Although urban sustainability plans often flounder on implementation, the city has made significant progress since the plan was launched, and a progress in report in 2009 indicated that 85 milestones were completed or on time, whereas 42 were delayed or redirected. By 2010 there were some setbacks, and only 51 of 127 milestone had been completed (Einhorn 2010). The plan also suffered some major setbacks, such as a decision in Albany not to allow congestion pricing for entrance into New York City. The plan would have used the funds to support greater public transportation. Instead, the city had not been able to move forward on crucial public transportation goals (Paul 2010). Furthermore, there were some criticisms about the lack of inclusion of grassroots perspectives (Angotti 2010).

In 2009 Mayor Bloomberg announced a development of the PlaNYC that included thirty new initiatives that could create as many as 13,000 new jobs for the city by 2018, many in the sectors of green buildings, distributed renewable energy, and carbon trading (City of New York 2009b). The city's green plan does not emphasize the low-income weatherization jobs to the same degree that is found in other city plans, but the city received \$50 million in ARRA funds for weatherization.

Green-Building Initiatives. New York has had green-building initiatives in place since 1999, when the city's Department of Design and Construction launched its high-performance guidelines (City of New York 2010). A significant reform for the city was Local Law 86, which was passed in 2005 and implemented in 2007. The law requires any buildings constructed by the city or with the use of city funds above a threshold to be certified as green buildings according to LEED standards. As a result, about half of the buildings covered by the law have achieved a 20 percent savings on energy and water as well as LEED silver certification. In addition, the 2007 Executive Order 109 required city agencies to develop and implement energy conservation plans. Those and other reforms were intended to drive a transition to produce green jobs in the

construction sector. In 2009 New York Mayor Bloomberg announced that existing buildings of 50,000 square feet or more would be required to undergo an energy audit and then to pay for many of the designated changes. However, when faced with vehement opposition from building owners, the mayor backed off the plan and said he would only seek mandatory energy audits. The resulting Greener, Greater Buildings Plan, approved in late 2009, requires all commercial buildings over 50,000 square feet to report on energy and water use. Furthermore, the city will reduce carbon dioxide emissions in its buildings by 30 percent by 2017, and by 2009 the city was investing about \$80 million per year into retrofits (City of New York 2009b). The city also launched a public awareness campaign, a solar installation tax abatement program, and solar zones (areas with an accelerated permitting process).

Another innovative program in New York is the “1 Year: 1,000 Green Superintendents” initiative, which was launched by the Service Employees International Union Local 32BJ. It trains superintendents and building managers in a forty-hour course based on standards set by the Building Performance Institute and the Urban Green Council for energy-efficient multifamily building operators.

Green Jobs Training. The city maintains a list of green jobs training programs and opportunities (New York City 2010). The web site enables people to download a list of training programs that provides a description and contact information. It also directly sponsors two green job training programs in addition to the many programs available through local training institutes and higher-education institutions. The Million Trees NYC Training Program offers seven months of training in horticulture, tree pruning, and ecological restoration for young people who are out of school or out of work; the Partnership of Brownfields Practitioners also has a job training program (City of New York 2009). There are also two green-job training programs offered by nonprofit organizations. Sustainable South Bronx was founded by Majora Carter in 2001 to advocate for various brownfields restoration projects in the tradition of urban environmental justice organizations. Subsequently, the organization pioneered one of the country’s first urban green jobs training programs and became involved in a number of local policy issues that include green business development and remediation of environmental damage and exposure. Omar Freilla, who served as the Program Director for Sustainable South Bronx, subsequently founded Green Workers Cooperatives in 2003 to provide an incubator for worker-owned, green businesses in the Bronx such as ReBuilders Source, a reuse store. Another nonprofit organization that provides green jobs training in New York is Solar One (2009), which has focused on programs in high schools and has partnered with various community organizations. In 2009 the organization was planning to offer a full set of five tracks: building performance; photovoltaic installation and advocacy; deconstruction and materials recycling; green entrepreneurship; and horticulture, landscaping, and park maintenance. A perhaps uniquely New York green job training initiative is a program for junior and mid-level employees for work in carbon trading. The city intends to become the world capital of this industry.

Green Business Initiatives. The city’s Green Manufacturing Initiative has supported the development of the industry in the city. Studies published by the Industrial and Technology Assistance Corporation and the New York Industrial Retention Network (2005, 2006) identified over 1,700 manufacturing companies in the city in a building-related industry, but only about 53 returned survey information. The Made in NYC web site (www.madeinnyc.org), which followed

from the Green Manufacturing Initiative, later identified thirty-seven companies that specifically were in the green products sector for construction and furnishings. Sustainable Hudson Valley has also worked with firms north of the city to develop green products for the city's green buildings initiatives.

Civil Society Organizations and Policy

The New York State Apollo Alliance has a ten-point plan for the state and has convened various meetings to support the ongoing development of the state's environmental and economic development policies. For example, in January, 2009, the Apollo Alliance convened a statewide conference with forty representatives from environmental, labor, educational, and religious organizations. Policy goals for the New York State Apollo Alliance include a feed-in tariff, on-bill financing, smart-growth infrastructure, 5000 megawatts of solar energy by 2025, expanded net metering, and brownfield revitalization.

In New York City, the organization Urban Agenda has convened the Apollo Alliance. In 2009 Urban Agenda and the Center for American Progress produced a green jobs roadmap for the city (Cha and Defoe 2009). Among the many recommendations were the following: amend the city's procurement process to allow local sourcing, reduce zoning restrictions and provide tax incentives for green manufacturing, develop large-scale building retrofits and renewable-energy projects, and incorporate jobs standards, local procurement, and local sourcing in PlaNYC.

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Pennsylvania

Summary and Analysis

According to the PEW Center study (2009), Pennsylvania ranked third in the country in clean-energy jobs, after the more populous states of California and Texas. Governor Rendell and the legislature have mobilized a significant amount of state and federal funding to support green economy development on the supply side, and they have also established strong demand-side policies. Every clean energy sector examined by this study showed some activity, and most had large grant and loan support from the commonwealth. Any glowing assessment of Pennsylvania's aggressive promotion of its green goals must be tempered, however, by two significant obstacles particular to this case. The coal industry still holds significant political influence in the commonwealth and has used this to maneuver several rather un-clean generation options onto the portfolio standard, most notably waste coal combustion. While this compromise may have been necessary to institute any kind of renewable portfolio standard, some have criticized it as too steep a cost for the benefit. Pennsylvania also has a complicated landscape of regional and departmental divides and overlaps that makes standardized practice, evaluation, and statewide coordination difficult. Despite these areas of concern, we have found the following policies to be of exemplary impact:

- Pennsylvania's Alternative Energy Investment Fund, supplied by a statewide rate charge on electricity, has spent \$650 million in virtually every area of alternative energy production and research, and it has attracted billions in federal funds and private investment.
- The industry partnerships for job training, including green jobs training, provide a model for collaboration among training organizations, industry, and government.
- The Green Building Alliance provides a model for initiating a building materials manufacturing cluster.
- Philadelphia's award-winning Greenworks plan is currently being revised to use new green jobs data to improve its goals and strategies.
- Philadelphia also provides manuals to support building owners who are greening their buildings.
- Philadelphia has an active sustainable business association that has led green jobs efforts and also served as a founding network of the national association, the Business Alliance for Local Living Economies.

General Background Policy

Energy Goals. Pennsylvania established a two-tiered Alternative Energy Portfolio Standard in 2004 (SB 1030), which was amended and expanded in 2007 (HB 1203). The first tier includes solar thermal and photovoltaic energy, wind energy, “low-impact” hydroelectric, geothermal energy, biomass, biologically-derived and mine-captured methane, non-combusted solid waste energy, and fuel cells powered by these sources, and the second is composed of waste coal energy, fuel cells charged from any source, and emission offset credits from waste heat capture, efficiency improvements, and carbon sequestration. By 2021, 8 percent of in-state production would have to come from the first tier (with an additional requirement of 0.5 percent solar generation) and 10 percent from the second tier. A 2008 estimate from PennFuture claims that by 2013 the first tier requirement will be approximately 2,441 megawatts of electricity and jump to 4,134 megawatts by 2018, with 70 percent of this projected to be met with wind generation (PennFuture 2010b).

This legislation was originally opposed by ActionPA, Citizen Power, the Pennsylvania Environmental Network, the Sierra Club’s Pennsylvania Chapter, and many other organizations for several reasons, including its weak enforcement language, its inclusion of relatively non-clean-energy sources in the first tier, and the inclusion of waste coal, among other controversial energy sources, into the second tier. Waste coal, mineral refuse from coal mining that contains roughly 60 percent of the thermal energy value and over three times the mass of mercury, chromium, and lead than bituminous coal, is abundant in Pennsylvania, which also operates the most waste coal power plants of any state by far. Its inclusion in the AEPS is evidence of the political influence of the coal industry in Pennsylvania. Governor Rendell and PennFuture, one of the state’s largest environmental advocacy groups, have been criticized for supporting such a capitulation, even if it allowed the passage of beneficial parts of this legislation. Proposed legislation (HB 2405) would not affect the inclusion of these controversial components of the AEPS, but would raise the solar requirement to 3 percent and the overall first tier requirement to 15 percent (ActionPA 2005).

In 2008 Act 129 set a goal of reducing Pennsylvania’s total electricity consumption to 3 percent below 2009 levels by 2013 and cutting 4.5 percent from peak demand consumption within the same time parameters (Commonwealth of Pennsylvania 2010b, 2010h). The state government itself accounted for 30 percent of its electric load with renewable sources in 2008, and is aiming to reach 50 percent by mid-2010. (Commonwealth of Pennsylvania 2008a).

Public Benefits Fund. In 2008 the Alternative Energy Investment Act led to the establishment of the \$650 million Alternative Energy Investment Fund, supported by a \$0.0005 per kilowatt-hour rate charge on electricity statewide. This fund targeted over \$180 million for solar energy (\$100 million for the Sunshine Solar Program and \$80 million to be distributed by the Commonwealth Financing Authority), \$190 million for non-solar alternative energy projects (\$25 million for wind and geothermal projects and \$165 million for loans and grants to small businesses and local governments), \$100 million for energy conservation for building owners, and \$50 million in tax credits to recruit investors in alternative energy projects (Commonwealth of Pennsylvania 2009a, 2010b, 2010h). The programs are jointly administered by the Department of Community and Economic Development, the Department of Environmental Protection, and

the Commonwealth Financing Authority, and many of them have grant and loan amount criteria that are based in part on job creation estimates (DSIRE 2010).

Total investment for renewable energy and energy efficiency from Alternative Energy Investment Fund and ARRA funds for 2010, 2011, and 2012 was estimated to be \$1.6 billion. However, when one includes policy-driven private sector investment and other investments in environmentally-related areas, the figure was estimated to be \$10.1 billion (Commonwealth of Pennsylvania 2010h). This figure, from the Pennsylvania Department of Labor and Industry's 2010 *Green Jobs Report*, includes funding across a variety of different green economy sectors: renewable energy, energy-efficiency, pollution prevention and cleanup, clean transportation, and resource conservation and agriculture. They find further that approximately \$4 billion of this money will be spent to meet the demands of the Alternative Energy Portfolio Standard, and a further \$2 billion to comply with Act 129's energy-efficiency requirements. This level of spending is projected to create 115,000 new green jobs in those sectors, a nearly 33 percent increase over the baseline figure of 350,000 in 2008, with roughly 48,000 of the new jobs falling into the category of energy efficiency (Commonwealth of Pennsylvania 2010h).

Following the beginning of the deregulation of electric generation in Pennsylvania in 1999, four regional sustainable energy funds were created to correspond with the service areas of PECO, PP&L, WPP, and the combined area of Penelec and Met-Ed. A subsequent arrangement created a special fund administered by the Pennsylvania Energy Development Authority to cover Duquesne Light's service area. These funds provide loans to energy efficiency and renewable-energy projects, but each of them has independent criteria for selecting projects and setting loan parameters (PennFuture 2010c).

Green-Buildings Policy. In Executive Order 2004-12, Governor Ed Rendell established the goal of reducing energy consumption in state buildings by 10 percent by 2006. In 2008 an additional order (720.25) increased the reduction by an additional 10 percent (DSIRE 2010). In 2005, an amendment to HB 628 provided incentives to school districts for LEED silver certification for their buildings. In addition to funding available from the Alternative Energy Investment Fund, the commonwealth received ARRA funds of \$253 million for weatherization and \$100 million in Energy Efficiency and Conservation Block Grants for local governments. The ARRA funds will weatherize an estimated 29,700 housing units statewide by 2012, generating an estimated 940 jobs (Commonwealth of Pennsylvania 2009c, 2010h). The Keystone HELP program offers a variety of loans and rebates directly to low- and moderate-income homeowners for weatherization, targeting specific appliances or for whole-house improvements (AFC First 2009). A sum of approximately \$1.5 billion is also being used to improve water and sewer infrastructure, drawing from ARRA funds, the H2O PA program, and the Pennsylvania Infrastructure Investment Authority (Commonwealth of Pennsylvania 2010h).

Green Jobs Training. The commonwealth of Pennsylvania has developed "industry partnerships" programs that have included some green jobs training. Begun in 2005, the commonwealth funded about seventy industry partnerships at a rate of about \$21 million per year. By 2010 there were programs in the energy (five), building (ten), and manufacturing (some green) in operation. The programs bring together local government workforce agencies with businesses in a leading industry in a specified region of the commonwealth. After meeting and

deliberating, plans are established for job training needs based on future trends. In 2010 the budget was cut to about \$8 million, but the programs were well-enough established that local businesses were contributing more than the state government (Herzenberg 2010). It is hard to say how effective the partnerships have been overall, because each region is independently managed. There is probably a range of success and failure, because participants have given a mix of positive and negative reviews, some praising the effectiveness and relevance of the training while others criticizing aspects of the management (Keystone Research Center and Pennsylvania Economy League State Office 2009).

The Department of Labor and Industry received \$6 million in ARRA funding in 2010 for green jobs training, and it used the award to create the Pennsylvania Center for Green Careers. This center had a goal of using this funding to issue over 1000 certifications in eighty-one target occupations, and over 300 additional workers trained in basic support skills for green enterprises. This project is also divided regionally, with six teams responsible for their own training strategies (Commonwealth of Pennsylvania 2010e, 2010h).

Clean-Energy Industries

General Background. A 2004 study by Black & Veatch pointed out that the Union of Concerned Scientists had issued a grade of D to Pennsylvania in the category of support for renewable energy, prior to the institution of the renewable portfolio standards. That same year Governor Rendell formed the Economic Development Committee to explore green job growth, and a year later the committee announced the Keystone Principles, which guided the commonwealth's agencies toward more sustainable economic development. The treasurer's office then announced the Keystone Green Investment Strategy, which included the Keystone Green Fund. Beginning in 2006, the Fund invested approximately \$40 million in clean tech industries, including \$15 million in Pennsylvania-based companies, using the money to leverage private sector investment (Commonwealth of Pennsylvania 2006, Young 2009).

In 2004 Governor Rendell issued an executive order (2004-5) to revitalize the Pennsylvania Energy Development Authority (2010), which had been dormant since 1995. The authority funded "clean, advanced energy" projects and helped to bring clean-energy companies to the state. Between 2005 and 2009 the authority funded about \$68 million with about \$1 billion in matching funds, financing 143 projects. The funding level in 2009 was about \$10 million, with an additional \$10 million from the ARRA and matches that put the total to over \$140 million. This was claimed to result in the creation of 430 permanent green jobs. There is \$16 million available for PEDA in 2010, and the authority is aiming to fund thirty projects, five more than the previous round (Commonwealth of Pennsylvania 2009b, 2010f). It should be noted that PEDA's selection criteria also includes projects that are aimed at developing waste coal, coal mine methane, and landfill gas power generation, in correspondence with the alternative portfolio standard requirements (DSIRE 2010).

The 2008 Alternative Energy Investment Act also included \$40 million (over several years) for Ben Franklin Technology Partners to administer the Alternative Energy Development Program to fund clean-energy start-up companies. Ben Franklin Technology Partners is the

commonwealth's program for investment in high-technology business development. The program is based on four, independent, regional nonprofit organizations across the commonwealth that provide start-up funds, capital development assistance, and technology transfer assistance for universities.

The commonwealth also supported a small-grant program for Keystone Innovation Zones (KIZs), which facilitate technology transfer and local relationships among universities, businesses, government agencies, and entrepreneurial support services, as well as having priority for all Department of Community and Economic Development grant applications. Some of the innovation zones have attracted clean-energy developers, such as Acutec Wind and Ernst Biomass at the Northwest PA KIZ, Aset Solar and Biomass Fuel Stocks at the Greater Susquehanna KIZ, and Gamesa Wind at the Greater Johnstown KIZ (Allegheny College 2010, Greater Johnstown KIZ 2010, Greater Susquehanna KIZ 2010). The zones were established with the intent of being independent of state funding after three years; since 2007 was the last year applications were accepted, these clusters will be on their own after 2010 (Commonwealth of Pennsylvania 2010c).

The Department of Community and Economic Development was also furnished with \$100 million in tobacco settlement money to establish the Life Sciences Greenhouse Initiative, founding regional biotechnology research clusters in western, central, and eastern Pennsylvania. The greenhouses have the capacity to support bioenergy research, but as of now they are focused almost entirely on genomics and pharmaceuticals (Commonwealth of Pennsylvania 2010d).

The past two years have seen significant funding cutbacks for the Department of Community and Economic Development, and according to one source the combined budget for the Ben Franklin centers, Keystone Innovation Zones, and Life Sciences Greenhouses dropped from a previous level of roughly \$89 million per year to only \$15 million in 2010. Part of the cut in the budget can be accounted for by the scheduled phase-out of the Keystone Innovation program, but given that its award cap was set at \$250,000 per year and only twenty-nine zones were established in the history of the program, its budget represents a relatively minor component of the total spending and its contraction. There are significant concerns over a lack of state-level coordination for all of these programs, and even as they are rolled back, no strategy is in place to succeed their function in economic development or institute a comprehensive program targeted specifically at cultivating green innovation zones.

Biofuels. In 2008 the commonwealth approved the Biofuel Development and In-State Production Act (HB 1202), which set a renewable fuel standard for the state and established incentives for biofuel production. A subsidy of 75¢ per gallon is provided for biofuel producers with a cap of \$1.9 million per year, amounting to a rough payout of \$4.7 million per year (Commonwealth of Pennsylvania 2010a, 2010b). The same legislation set biofuel blending requirements for transportation gasoline and diesel produced in-state: diesel must be blended at B2 (2 percent) when 40 million gallons are produced in-state, B5 at the 100 million gallon mark, B10 at the 200 million gallon mark, and B20 at the 400 million gallon mark. Likewise, gasoline must also be blended at cellulosic E10 at the 350 million gallon mark.

Pennsylvania has also worked with neighboring states to develop a next generation strategy and roadmap for cellulosic ethanol (Chesapeake Bay Commission 2008), and in 2008 the commonwealth attracted the company Coskata, which opened a demonstration plant for cellulosic ethanol. Hero BX operates a \$54 million biodiesel plant in Erie that is capable of producing 45 million gallons of biodiesel per year (Hero BX 2009). As of 2010 the commonwealth was investing about \$8-13 million per year through the Alternative Fuels Investment Grant Program, Pennsylvania Energy Harvest, and other programs, although Energy Harvest grants are now handled as a sub-program of the Pennsylvania Energy Development Authority (Commonwealth of Pennsylvania 2008b, 2010h).

Although the commonwealth has both supply- and demand-side support in its policies, it lacks any more focused efforts to cultivate biofuel research or production. There is considerable potential with the Life Sciences Greenhouses and existing biotechnology industry to develop next-generation biofuels companies. However, the commonwealth does not have the focused research component at public and private universities that is found for biofuels research in California, Iowa, Minnesota, and Wisconsin.

Smart-Grid and Building Technologies. Pennsylvania has made some recent strides toward implementation of smart-grid technology, but the culmination of these moves is not expected anytime soon. Act 129 mandates that electricity distributors in Pennsylvania supply all new construction projects with smart meters immediately and provide them to all of their customers by 2023. In 2009 PECO received \$200 million from the Department of Energy toward its \$650 million plan to complete full smart-meter provision for its entire service area within ten years. This covers approximately 1.6 million customers and is estimated to “bring the equivalent of about 4,300 jobs” to southeast Pennsylvania (Commonwealth of Pennsylvania 2010b, PECO 2009a, 2009b).

As of 2010, Pennsylvania had 187 LEED-certified buildings, good enough to rank fifth in the country. As with other program areas, supporting organizations for the green building industry are divided regionally between western, central, and southeastern Pennsylvania. The Pennsylvania Green Growth Partnership, supported in part by the Ben Franklin Technology Partners, links the Green Building Alliance of Western Pennsylvania with the Engineering and Design Institute of Philadelphia University. The Engineering and Design Institute offers a post-professional Master’s Degree in Sustainable Design and provides training and product design consulting to private firms (Philadelphia University 2010). The Green Building Alliance of Western Pennsylvania has offered grants to green-building manufacturers, maintains a database for analyzing sustainable and high performance buildings (DASH), and organizes professional education and networking efforts. It has also launched the Green Building Products Initiative, which has networked green building materials manufacturers in the state, assisted in certifying new products as green, and produced several reports on the industry (Green Building Alliance 2008, Fitzgerald 2010, Flora 2006). The Green Building Association of Central Pennsylvania and the Delaware Valley Green Building Council provide similar networking and educational services in their regions (Delaware Valley Green Building Council 2009, Green Building Association of Central Pennsylvania 2007).

The Green Building Alliance provides a model of what can be done to strengthen manufacturing in this industry. Few other states or cities have selected the green-building manufacturing industry for further development, with the exception of Oregon and to some degree Minnesota, as well as a program in New York City. As a result, the Green Building Alliance warrants attention. It also warrants comparison with Oregon's efforts in this area, which have linked the industry to university-based research.

Solar. Solar power is the only electric generation method with its own specific requirement (0.5 percent by 2021) in the Alternative Energy Portfolio Standard. The Department of Community and Economic Development accepts grant applications for solar projects with over 200 kilowatts of generation capacity, while the Commonwealth Financing Authority has an \$80 million fund tagged for solar projects. Of that figure, \$45 million has already been distributed to thirty-three projects with a total generation capacity of 29.7 megawatts. The Department of Environmental Protection received separate U.S. Department of Energy funding for its Green Energy Works! program, \$7 million of which is set aside for solar projects that have a capacity of over 500-kilowatt generation. Small-scale generation on residential or commercial property is supported by the Department of Environmental Protection's Sunshine Solar Rebate program. Out of a \$100 million fund, 1000 rebates have been given, supporting 10 megawatts of generation capacity (Commonwealth of Pennsylvania 2010g, DSIRE 2010, Philadelphia Solar Energy Association 2010).

Pennsylvania has a chapter in the Mid-Atlantic Solar Energy Industries Association, and the commonwealth has attracted major manufacturing facilities from AE Polysilicon and Heliosphera. There has been no effort, however, to organize a solar innovation cluster of any sort. The commonwealth remains an attractive potential home for either solar power manufacturing or generation, but any growth in this sector appears piecemeal and reliant primarily on demand-side policies. Again, the crucial piece that connects university-based research to technology transfer, innovation, and entrepreneurship is missing.

Transportation and Energy Storage. Pennsylvania has only minimal involvement in fuel-cell development and no programs supporting clean transportation. Pennsylvania State University's H2E Center claims to have over 100 researchers working on all aspects of hydrogen production and incorporation into fuel cells, and the University of Pittsburgh's Center for Energy has its own hydrogen focus. The U.S. Department of Defense operates its Fuel Cell Test and Evaluation Center in Johnstown, and fuel cell development and/or manufacture is being conducted in-state by Franklin Advanced Materials, PPL, ZeTek, and Siemens. These instances demonstrate potential, but they remain isolated. There is no active public or private organization trying to advance these sectors of the green economy in Pennsylvania.

Wind. The commonwealth has recruited the wind manufacturers Gamesa, GE Wind, Omniwind, and Iberdrola, and in 2008 it developed the Wind Energy Supply Chain Initiative to identify potential suppliers in the commonwealth and supply chain needs for the large manufacturers. Pennsylvania also offers a full property tax rebate for wind power systems, but the lack of a state-level guideline for assessing their value has proven problematic especially for residential-scale distributed generation (DSIRE 2010). The Regional Economic Development District Initiative in south-central Pennsylvania has also focused on wind energy and

manufacturing (Sterzinger and Svrcek 2004). Pennsylvania State University claims to have relevant expertise for wind power research and development, citing its strong program in meteorology and the ability to convert the expertise in naval technology of its Applied Research Laboratory to use in turbine design. The university was also selected to participate in the Department of Energy's Wind for Schools education outreach program (Pennsylvania State University 2010). However, these developments remain incipient, and the commonwealth has not developed an innovation cluster that connects the research capacity of the universities with the industry. Ultimately, Pennsylvania is ranked among states as fifteenth in existing wind power capacity with a maximum output of 748 megawatts, and twenty-second in potential capacity with no wind power installations currently under construction (American Wind Energy Association 2010).

Philadelphia

Sustainability Plans. Philadelphia is the country's fifth largest city, but its former industrial strengths have been lost, and its principal employers are in the "eds and meds" industries of the life sciences, health care, and education. In 2009 Philadelphia Mayor Michael Nutter announced Greenworks Philadelphia, his plan to make Philadelphia the "number one green city" in the country (City of Philadelphia 2009c). The plan has 169 initiatives grouped under five goals: energy, environment, equity, economy and engagement. Some of the goals are ambitious: insulating 15 percent of the homes in the city and generating 20 percent of electricity in the city from solar, biogas, and other "alternative energy sources." Although there are many other contenders for the crown of "number one green city," the energy-efficiency measures were likely to generate jobs, at least enough for the hundreds of graduates planned for the green jobs programs. The plan shows much more attention to green jobs development, weatherization, and building efficiency programs than some of the first-generation climate action plans. The plan follows that of New York by having a goal of reducing the city government's energy consumption 30 percent by 2015, and it also has goals of reducing citywide building energy consumption by 10 percent. The Greenworks plan won the 2010 Siemens Sustainable Community Award in the large community category (Mastrull 2010).

The Greenworks plan explicitly draws its definition of a green job from the Apollo Alliance: "a well-paid, career-track opportunity that contributes directly to preserving or enhancing the environment." There were approximately 14,000 of these jobs in Philadelphia in 2006 according to the United States Conference of Mayors, and they projected that this number would swell to 114,000 by 2038. The immediate goal of the initial plan was doubling the 2006 number, and the plan specifically mentioned the need to introduce both high- and low-skill green jobs. An early 2010 progress report claimed several successes, particularly in the area of green job training, and shortly thereafter the Mayor's Office of Sustainability began working on a revision of the plan. The Philadelphia Workforce Investment Board has observed that projections about the job creation rate relative to dollars invested have often been over-optimistic, and it is currently collecting new data on green jobs using new definitions to replace the proprietary, pre-recession figures taken from the Conference of Mayors. There is also concern over the number and type of training programs and what proportion of their students are city residents, as there is currently no comprehensive data available to reference. The results of the Workforce Investment

Board's research should allow the new Greenworks goals to be developed some time in late 2010 (Hoffman 2010, Houston 2010).

Green-Building Initiatives. The city's plan has a goal of retrofitting 100,000 low-income homes by 2015 (City of Philadelphia 2009a). The city has a guidebook for renovation of existing city buildings (City of Philadelphia 2004) as well as a weatherization manual for residents (Philadelphia Housing Development Corporation 2006). The Greenworks plan includes tax abatement policy, revolving loan funds, low-interest loans through the Redevelopment Authority, an expansion of the weatherization program, and participation from the city-owned gas utility. In 2009 the city's Weatherization Assistance Program received \$30 million in ARRA funding, \$16 million of which was routed to the Philadelphia Housing Development Corporation, with the remainder going to the Philadelphia Energy Coordinating Agency. In 2008 the WAP was able to weatherize 2000 homes, but with the ARRA funding the number of homes was projected to rise to 4000 in 2009. The spending cap per home was raised from \$2500 to \$6500, and eligibility by household income increased from 150 percent of the federal poverty line to 200 percent (Philadelphia Housing Development Corporation 2009). The Department of Energy's EECBG Retrofit Ramp-up program added an additional \$25 million in 2010 for residential and small business energy efficiency through a five-county region including Philadelphia and its suburbs (City of Philadelphia 2010a). The Greenworks Philadelphia plan also will build on the city's "Solar America City" status by attempting to streamline solar energy installations and establishing more solar energy on city rooftops. The Solar City Partnership, which includes several universities, industry associations, and solar energy companies, plans on achieving 2.3 megawatts of solar generation capacity in the city by 2011 and reaching 57.8 megawatts a decade after that (City of Philadelphia 2010b).

Green Jobs Initiatives. In 2008 the Philadelphia the city council began the process of developing green jobs training programs, and in 2009 the John S. and James L. Knight Foundation gave \$1.1 million to the Energy Coordinating Agency of Philadelphia, which administers federally funded weatherization programs, to train lower-skilled workers for green-collar jobs. In April 2009 Mayor Nutter and the Energy Coordinating Agency welcomed the first class of twenty students to the four-week weatherization training program (City of Philadelphia 2009b). A year later the program opened its new Knight Green Jobs Training Center in an 18,000 square foot warehouse that was renovated to meet LEED Gold standards (Energy Coordinating Agency 2010). The U.S. Department of Labor's Pathways Out of Poverty program has given grants totaling over \$5.28 million to the Community College of Philadelphia, the Metropolitan Career Center, and the Green Jobs Readiness Partnership to set up additional training programs for disadvantaged and low-income workers (City of Philadelphia 2010a). The Knight Foundation also gave the Sustainable Business Network of Greater Philadelphia a \$125,000 planning grant to develop a green corps program, which is still under development (Knight Foundation 2009).

Green Business Initiatives. The city has an incubator for green-tech businesses run by the Philadelphia Industrial Development Corporation in the Philadelphia Navy Yard. The nascent center includes a Keystone Innovation Zone, is the development site of the Center for Distributed Power, and has attracted Greek photovoltaic company Heliosphera to construct a photovoltaic manufacturing plant on the premises. The Heliosphera plant, when complete, will be able to manufacture 160 megawatts of solar panels per year, and it is projected to create 400 jobs in the

area (Richard 2009). The Center for Distributed Power is backed by the Ben Franklin Technology Partners of Southeastern Pennsylvania and Pennsylvania State University. Penn State is also using \$5.5 million in U.S. Department of Energy funding to establish the Mid-Atlantic Clean Energy Applications Center and the Mid-Atlantic Solar Resource and Training Center (Key 2010). The Navy Yard also requires all new buildings to be LEED registered, is home to the first LEED Platinum certified building in the category of multi-tenant office space, and is currently installing its own 1.5 megawatt solar array (Philadelphia Navy Yard 2009).

Civil Society Organizations and Policy

PennFuture is one of the leading environmental advocacy organizations in the commonwealth. In addition to information dissemination and lobbying activities, the organization claims to offer \$2 million per year in free legal services for environmental causes, and their own facilities operate at carbon neutral status (PennFuture 2010a). Citizen Power, based in Pittsburgh, does similar work with a focus on energy issues (Citizen Power 2001).

The Sustainable Business Network of Greater Philadelphia is the city's chief civil society organization focused on developing the green economy. It was established in 2001 and was a founding network of the Business Alliance for Local Living Economies (BALLE). An off-shoot of the Social Venture Network, BALLE supports the independent, small business sector with the goal of building a more just and sustainable local and global economy. With respect to green jobs, the BALLE perspective shifts the economic development priorities away from recruitment and high-tech start-ups to the small business sector, including retail, services, community finance, and food and agriculture. The Sustainable Business Network of Greater Philadelphia (2009) has been very involved in the city's efforts to develop green jobs by hosting various efforts, writing reports, and meeting with city leaders. It is the original sponsor and convener of the city's Green Economy Task Force, a network of businesses and civil society organizations that works to coordinate green job development efforts and circulate information among green collar employers, employees, and program sponsors. The recent surge in public and private funding for green jobs programs in the city and resulting complexity of the situation was the chief impetus for the organization of this task force, and it has answered the call by engaging a diverse ensemble of partners and making stakeholder access a priority.

Philadelphia is home to many other standout or developing organizations that cater to the needs of industries and communities with green interests. The Delaware Valley Green Building Council is an industry partnership that provides networking, LEED training, and other educational services to professionals in and around Philadelphia, as well as collaborating with the Sustainable Business Network and the Pennsylvania Green Growth Partnership (Delaware Valley Green Building Council 2009). Grid Magazine, founded in 2009, is a free monthly publication focused on community sustainability within the city and its suburbs (Grid Magazine 2010). PlanPhilly is another journalistic enterprise operated by the University of Pennsylvania School of Design, engaged in publicizing design-related issues in Philadelphia neighborhoods, including a focus on sustainable development (PlanPhilly 2010).

Further Reading

Pennsylvania's Department of Community and Economic Development maintains a searchable online database of community initiatives, economic incentives, and grant and loan programs, including those for green businesses (www.newpa.com). PennFuture's website offers tracking of green legislation and court cases as well as policy analysis and advocacy (www.pennfuture.org). The Green Building Alliance uses its website to catalogue green building projects in western Pennsylvania, lists connections to information about project funding and certification, publicizes training programs, and links to the gateways of its own Green Building Products Initiative and its directory of participating businesses (gbapgh.org). Philadelphia's Green Economy Task Force connects its stakeholders and disseminates a large amount of green job-related information online as well (greeneconomytaskforce.com).

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Other Northeastern States

Other states in the region generally have strong demand-side policies and some green jobs programs, but they do not have the same level of active state government intervention that supports research programs in universities, start-up companies in the clean-energy sector, and manufacturing initiatives for clean technology. Although the political climate is often favorable, the other states generally have smaller state government budgets, smaller and fewer research universities, and/or a more agrarian and tourist-based economy. Several of the states are participants in the Regional Greenhouse Gas Initiative and have a renewable portfolio standard, system benefits charges, and green-building and energy-efficiency standards. Connecticut, Delaware, and Maryland are the three states in the New England and the Mid-Atlantic region that have some supply-side policies and related industries.

Connecticut

Connecticut had a strong renewable portfolio standard of 23 percent by 2020 with an additional 4 percent from combined heat and power. However, in 2010 the state legislature considered a roll-back on the renewable portfolio standard because of problems in achieving financing. The money that utilities would have spent on achieving the standard was planned to be shifted to no-interest loans for consumers for energy-efficiency and renewable-energy projects (Spiegel 2010). In May, 2010, Governor Jodi Rell vetoed the Act Reducing Electricity Costs and Promoting Renewable Energy (SB 493), whose supporters claimed would reduce energy costs by shifting to more long-term contracts. The governor supported aspects of the bill but rejected the high investment associated with it. As a result, the policy signals at the state-government level have been generally supportive but somewhat mixed.

The state has supported its clean-energy businesses through two public benefits funds. The Connecticut Clean Energy Fund has a budget of about \$20 million per year, and it is authorized not only to provide grants and support but also to invest in companies. The fund has various programs, including support for solar energy and the state's fuel-cell industry. The Connecticut Energy Efficiency Fund has a budget of about \$60-70 million per year plus \$6 million from the Regional Greenhouse Gas Initiative. The fund supports energy-efficiency projects, education, research, and development. In some years the state's General Assembly has transferred \$1 million per month from the fund to the general fund (DSIRE 2010). In 2008 the state launched the \$9 million Clean Tech Fund. By March 2010 it had only invested \$2 million, but additional investments were available from the state's Eli Whitney Fund for technology businesses (Cohen 2010).

There is also a biotechnology cluster around Yale University that could develop into a biofuels innovation cluster, but so far the industry has remained focused on medical applications. So far the state's fuel-cell industry is the leading clean-energy manufacturing industry. Largely due to support from the state government, Connecticut has two large companies in the stationary fuel-cell market (FuelCell Energy and UTC Power) and some smaller companies and hydrogen companies. The industry is small (estimated at about 1,000 direct jobs), but the state's roadmap

for fuel cells estimates that the industry could grow to 30,000 jobs statewide by 2020. The state government has consistently supported the industry through various mechanisms. The state's Clean Energy Fund has supported fuel-cell installations, and fuel cells are included in the state's renewable portfolio standard. The Connecticut Center for Advanced Technology (2009) administers the Connecticut Hydrogen Fuel Cell Coalition, which links industry, government, and research. The state has also used the funds described above to support fuel-cell research and development, and with support from the state government, the Connecticut Global Fuel Cell Center was established in 2001 at the University of Connecticut. As the center grew to include over forty researchers, its clean-tech research interests diversified, and the center was subsequently renamed the Center for Clean Energy Engineering. In 2008 the state produced a hydrogen fuel-cell roadmap. The state's roadmap explored competition with other states and concluded that Connecticut was first among states in fuel-cell patent activity. In 2009 the government dedicated \$8 million of federal ARRA funds to the industry.

Delaware

Delaware has a renewable electricity standard of 20 percent by 2019 with a 2 percent photovoltaic set aside. The state's Sustainable Energy Utility provides support for energy-efficiency and renewable-energy projects (Sustainable Energy Utility Task Force 2009). It is funded partly by a public benefits charge and partly by other sources, including a share of renewable energy credits and savings from clients. The state of Delaware also has a LEED silver standard for new construction and major renovations of public buildings. To complement the demand policies, there are some efforts oriented toward economic development for the clean-energy industries, but clean-energy was not listed as a separate industrial cluster on the state's Economic Development Office web site. The office does offer a Clean Energy Center Partnership program, which provides matching grants for industry research at the University of Delaware or Delaware State University. The office also offers Clean Energy Performance Grants, which support manufacturing for photovoltaics, fuel cells, and wind energy in Delaware.

The state has some manufacturing. It has a power purchase agreement for off-shore wind and a 2 percent photovoltaic set-aside in the renewable electricity standard. There is some solar-energy research and development at DuPont, and manufacturing of photovoltaics takes place in Newark by the Taiwanese firm Motech Industries. The most advanced clean-energy manufacturing industry in the state is fuel cells. DuPont, W. L. Gore, and Ion Power are all major suppliers of fuel-cell components, and the University of Delaware hosts the Center for Fuel Cell Research. Although the industry is small in comparison with those of larger states, Delaware is centrally located along the main transportation corridor of the East Coast and able to integrate easily with the broader cluster of fuel-cell research and manufacturing in the Northeast. Delaware is also home to the electric vehicle manufacturer Fisker, and a supply-chain is emerging in the state and in southeastern Pennsylvania.

Maryland

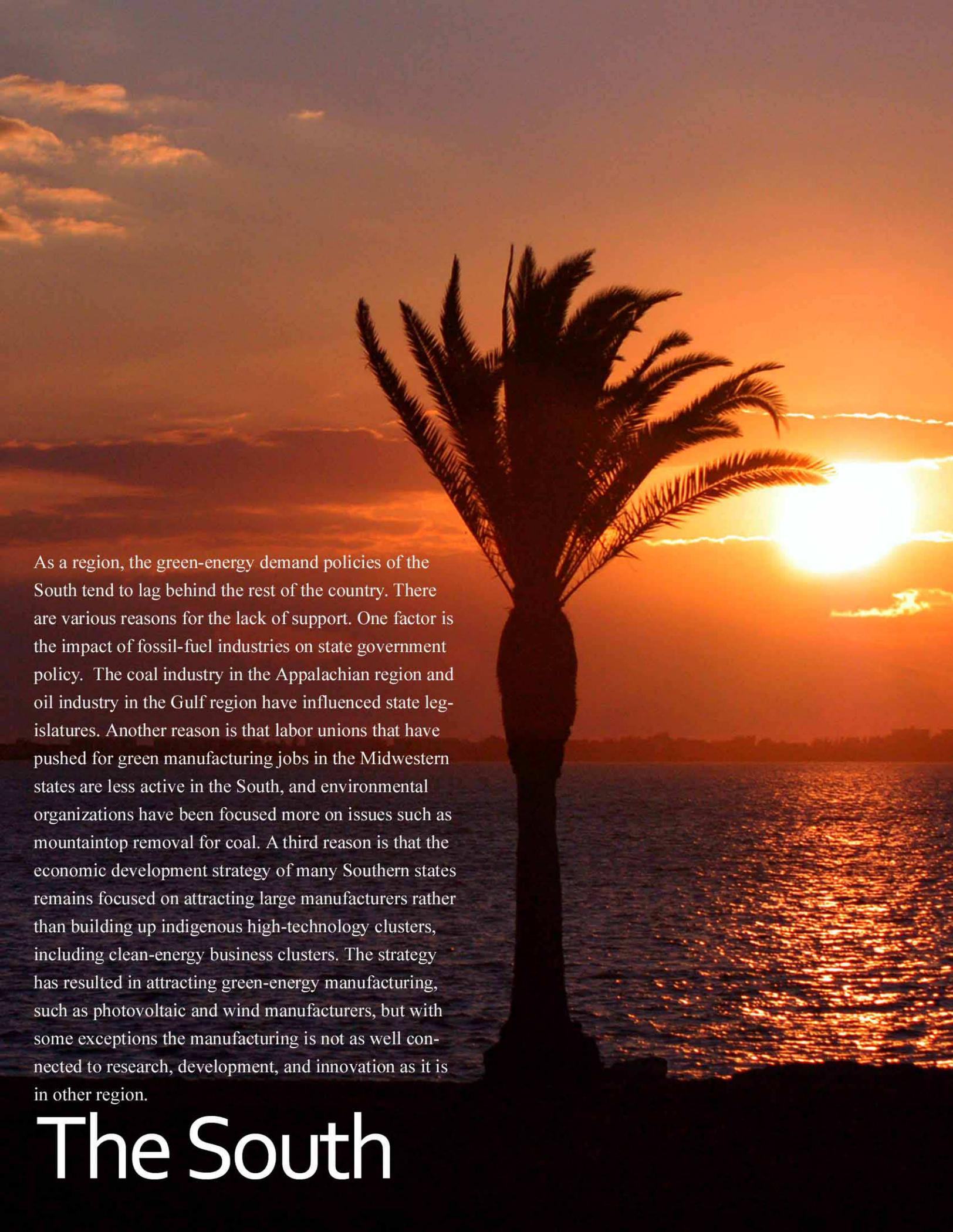
The state of Maryland has strong demand-side policies that make it a leader on many rankings of renewable energy and energy efficiency. However, the state does not have a strong suite of supply-side policies that would support green business development and job creation, and it has no cluster of manufacturing or biorefining firms that could be considered an industrial strength. On the demand side, in 2008 the legislature approved three laws that brought about the following changes in energy policies: a goal of a decrease in greenhouse gas emissions by 25 percent by 2020 in comparison with a 2006 baseline, an increase in the renewable portfolio standard to 20 percent by 2022 with a 2 percent set-aside for solar energy, and an energy-efficiency standard of a reduction in per capita electricity consumption of 15 percent by 2015 from a 2007 baseline. However, the state lacks a public benefits fund, which can be a valuable resource for helping local companies, providing jobs training, and supporting new business development.

The green jobs policy in the state has been largely oriented toward the installation, construction, and service jobs for green energy generation. For example, in 2009 the governor's Workforce Investment Board released a report on energy and green jobs that emphasized jobs in those industries, and in 2010 Governor Martin O'Malley released a clean-energy agenda that focused on demand-side policies such as solar energy generation, off-shore wind energy, and plug-in electric vehicles (State of Maryland 2009, O'Malley 2010). However, a report by the Maryland Energy Administration (2010) recognized the need and potential to diversify Maryland's green jobs efforts from weatherization, construction, and energy generation maintenance to a broader clean-energy economic development strategy. To support the diversification, the Clean Energy Economic Development Initiative allocated 15 percent of the state's energy program funds, or about \$7 million, to business development. In 2009 the state also launched the Maryland Clean Energy Center, which groups together business development efforts with green-energy installation projects. The center also provides an incubator for green-energy businesses and links to the state's research universities. Consequently, Maryland has many pieces in place to have a diversified green jobs strategy. It needs a public benefits fund and a good assessment of which areas of manufacturing or biorefining make sense given the state's other industrial strengths.

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As a region, the green-energy demand policies of the South tend to lag behind the rest of the country. There are various reasons for the lack of support. One factor is the impact of fossil-fuel industries on state government policy. The coal industry in the Appalachian region and oil industry in the Gulf region have influenced state legislatures. Another reason is that labor unions that have pushed for green manufacturing jobs in the Midwestern states are less active in the South, and environmental organizations have been focused more on issues such as mountaintop removal for coal. A third reason is that the economic development strategy of many Southern states remains focused on attracting large manufacturers rather than building up indigenous high-technology clusters, including clean-energy business clusters. The strategy has resulted in attracting green-energy manufacturing, such as photovoltaic and wind manufacturers, but with some exceptions the manufacturing is not as well connected to research, development, and innovation as it is in other region.

The South

Florida

Summary and Analysis

There is plenty of potential for Florida. A substantial portion of the state's income relies on well-kept beaches, wetlands, and other natural landscapes. With an abundance of sunshine and agricultural waste, the state is in a good position to take the lead in renewable energy. Florida's strengths lie in the innovative policies enacted by its local governments, the scientific advancements produced by its universities, and the groundbreaking work achieved by private industry. While Florida is further along than most of the South, the state government has yet to fully capitalize on its substantial opportunities. Good science has been produced and thorough policy work has been done, but many state-led initiatives have been left unfunded or face political opposition. Florida's reliance on property taxes (severely effected by the Great Recession) as a revenue source means that resources are scarce, thereby making substantial state-instigated industry changes difficult. While this may be the case now, state lawmakers in the wake of the Great Recession are beginning to realize that the state's economy must diversify. High-tech industries and the construction of solar energy may complement the tourism jobs that supported the state for seventy years. The following have been identified as break-away programs, policies, and organizations that make Florida a leader:

- Its research universities, the University of Central Florida in particular, are producers of cutting-edge technology in green industry and sustainable building practices such as cellulosic ethanol (biofuels), solar energy (both photovoltaic and thermal), and alternative building construction (such as green roofs and permeable concrete).
- Many New Urbanist planning firms are based in Florida and have done substantial work in many local governments, and the "Treasure Coast Regional Planning Council" provides a multi-country model of regional planning.
- The state's Farm to Fuel initiative provides both funding and networking for the biofuels industry, with innovative technologies using citrus peels and sugar-cane stalks.
- Florida has several new initiatives in high-speed and commuter rail.
- Gainesville has a city-level feed-in tariff, and Orlando is a national leader in alternative-energy transportation.

General Background Policy

Energy Goals. In 2008 the state legislature approved HB 7135, which included many significant changes: it authorized the state's Department of Environmental Protection to develop a cap-and-trade program, set out a plan to reduce greenhouse gas emissions in the electricity sector to 1990 levels by 2025, created provisions for net metering and a renewable standard portfolio plan, set building efficiency standards, and established a 10 percent renewable fuel standard for ethanol. The law catapulted Florida from the bottom half of solar deployment, to second only to California (Susac 2010). In 2009 the Florida Public Service Commission approved a 20 by 20 renewable portfolio standard (20 percent by 2020), but the proposal did not gain legislative approval. A bill introduced in the 2009 legislative session by State House Representative Keith Fitzgerald attempted to implement feed-in tariff regulations for the entire state but was also defeated (Fitzgerald 2010).

Public Benefits Fund. Like most southern states, Florida has no public benefits fund.

Green-Buildings Policy. Florida has long had a statute that mandates energy efficiency and cost-effective solar energy in building design (255.251). In 2007 Governor Charlie Christ signed Executive Order 07-126, which established greenhouse gas emissions reduction goals for all state buildings. The level of reduction will be increased gradually toward a goal of 40 percent below 2007 levels in 2025. Legislation passed in 2008 (HB 7135) requires that all new buildings financed by the state must meet LEED certification or equivalent standards for new construction (LEED-NC). Existing state-financed buildings be retrofitted to meet LEED existing building standards (LEED-EB) and have a life-cycle analysis (DSIRE 2010).

Florida has been an active participant in LEED standards testing. Not only are state buildings required to meet LEED standards, but state universities also administer LEED certification. In 2006 Florida was one of a few pilot regions that tested the LEED for Homes building standard. The Florida Solar Energy Center at the University of Central Florida administered the program and continues to certify LEED buildings (Florida Energy Center 2010).

Florida Statute 718.113(8) prohibits any deed restrictions or other binding agreements from disallowing the use of or installation of "energy devices based on renewable resources" which include everything from clotheslines to thermal solar hot water heaters (DSIRE 2010b). This is particularly noteworthy, considering Florida has one of the largest concentrations of gated communities in the nation (Blakely and Snyder 1997).

Green Jobs Training. In June of 2009, Workforce Florida, the state's workforce policy organization was asked to "design and implement strategies that help Floridians enter, remain in, and advance in the workplace" (Cornelius and McMullian, 2009). The report defined a green job as one that "increases the conservation and sustainability of natural resources for the benefit of Floridians. This includes jobs that reduce energy usage or lower carbon emissions, and protect Florida's natural resources. Green jobs should provide worker-friendly conditions, pay sustainable wages, and offer opportunities for continued skill training and career growth" (ibid.). The report concluded with an eight-point recommendation, which stated:

- 1) identify needed labor supplies within various “green industries;”
 - 2) conduct a “gap analysis” to identify needed training within the state;
 - 3) work with learning centers and related state departments as well as NGOs to establish needed training;
 - 4) create a communication action plan to distribute needed information to Floridians;
 - 5) monitor the training programs;
 - 6) identify relative advantages unique to the state when applying for ARRA funds;
 - 7) actively promote the green jobs definition within political entities; and
 - 8) tie green job initiatives closely to any kind of economic development issues (ibid.).
- To date however, no major programs have been undertaken.

Clean-Energy Industries

General Background. In 2006 the state government approved the Florida Renewable Energy Technologies and Energy Efficiency Act, which created incentive programs for renewable energy and energy-efficiency products. The act also authorized the Renewable Energy Technology Grants Program, which began providing matching grants in 2007 to research and development projects at a rate of about \$15 million per year. The state launched the Florida Institute for the Commercialization of Public Research, the \$30 million Florida Opportunity Fund, and a 1.5 percent (of \$130 billion) earmark from the state pension fund for high-technology companies. Those three developments apply to a wider range of industries, but they have benefited the clean-tech sector (Institute for Economic Competitiveness 2009).

In 2009 Florida Power and Light (FPL) formally changed its name to NextEra Energy in order to “better reflect the company’s clean-energy mission and market focus” (FPL 2009). NextEra, based in Juno Beach, Florida, owns and operates nearly 9,000 wind turbines, none of which are located in Florida (FPL 2010a). The company obtained recovery funding for smart-grid installation and is also constructing the Martin Next Generation Solar Energy Center (See *Solar* section).

Biofuels. In addition to the renewable fuel standard mentioned above, the state government in 2009 joined the Florida 25 x ’25 State Alliance. The alliance links businesses, government agencies, and university researchers in the fields of agriculture, forestry, and renewable energy to ensure that 25 percent of energy production comes from renewable resources by 2025 (FDACS 2009).

A large contributor to the 25 X ’25 Alliance is the state’s Department of Agriculture and Consumer Services’ “Farm to Fuel” initiative. The initiative was started in 2006 and includes an annual summit and \$25 million in grants to the bioenergy sector between 2006 and 2009. Among the more noteworthy projects funded are two facilities that convert citrus peels to ethanol and a \$7 million state government grant that attracted Verenium, a Massachusetts-based company that located its first commercial cellulosic ethanol plant in Florida (Bevill 2008, Lindenboom and Carmody 2009).

The “Farm to Fuel” summits include panel discussions and speakers within the biofuel industry as well as academia. By hosting these summits, Florida hopes to position itself at the center of a new biofuel economy. The Farm to Fuel website also provides an Alternative Fuel Map, which list the Florida gas stations that offer E85, B20, and B100 blends (FDACS 2010).

Henry Daniell at the University of Central Florida has pioneered a method of turning citrus waste (as well as switchgrass, straw, sugarcane, and possibly even tobacco) into cellulosic ethanol. Daniell’s process uses enzymes to break down the organic matter into sugar, which can then be fermented into ethanol (Kotala 2010). Unlike corn-derived biofuels, the method produces less greenhouse gas emissions than conventional gasoline (Kotala 2010).

The Farm to Fuel Initiative is backed by not only the citrus industry but also by Florida’s more powerful (but lesser known) sugar industry. Florida Crystals and the U.S. Sugar Corporation have large land holdings in rural areas of South Central Florida and are looking for a market for their spent sugar cane stalks (Fitzgerald 2010).

Florida is also working to use biofuels in one of its largest bus systems. The Central Florida Regional Transportation Authority (LYNX) operates bus lines in Orange, Osceola, and Seminole counties. It is the first transit company to own and operate its own biodiesel mixing station, which began construction on June 10, 2009, and was unveiled on May 21, 2010. The entire fleet will be converted to B20 biodiesel and is expected to reduce their carbon dioxide gas emissions by 16 percent. The University of West Virginia will monitor emissions throughout the fleet and make suggestions for further emissions reductions (City of Orlando 2010, GoLYNX 2010a, 2010b).

Green Buildings. Florida is home to two architecture and planning firms headed by the founders of New Urbanism. Duany Plater-Zyberk & Company, Inc., (DPZ) and Dover Kohl and Partners, Inc., have their main offices in Miami. Principal architect of DPZ Elizabeth Plater-Zyberk is also the Dean of The School of Architecture at the University of Miami. DPZ has produced downtown master plans and regional comprehensive plans that encourage transit-based building patterns for the cities of Dadeland, Doral, Fort Myers, Madeira Beach, Miami (Miami 21), Naples, Sarasota, Stuart, and West Palm Beach (DPZ- Projects 2010). Dover Kohl and Partners has done similar work in regional plans for Collier County and Southern Martin County, as well as the “Lake Okeechobee Regional Plan,” which reinforced sustainable ecotourism and low-impact development in five counties surrounding Florida’s largest lake (Dover Kohl & Partners, 2010). These firms also provide a sort of “export” by producing similar on-site work internationally (DPZ- Projects 2010; Dover Kohl and Partners 2010), and provide a welcoming work environment by providing support services for other large New Urbanist firms that have substantial projects in the state, including Moule and Polyzoides (2010) and Calthorpe and Associates (2010).

There is substantial smart-growth planning expertise in the public sector as well. The Treasure Coast Regional Planning Council was established in 1976 to help local municipal governments carry out various Florida’s various growth management mandates and requirements. It began as a simple shared resources agreement between four counties located on the Eastern coast of Florida (Indian River, St. Lucie, Martin, and Palm Beach). Today, the

TCRPC provides planning assistance and support for governments all over the state. Regions without the professional capabilities necessary to execute complex regional planning efforts and resources management turn to the TCRPC for expertise. The Council's mission statement describes itself as "Florida's only multipurpose regional entity in a position to plan and coordinate intergovernmental solutions to growth-related problems on greater-than-local issues, provide technical assistance to local governments, and meet other needs of its communities." It is a unique organization in that it is "by and for, local government" and has acted as a local government advocate in jurisdictional matters involving state and federal conflicts (TCRPC 2010).

Smart-Grid and Building Technologies. The Solar Energy Research Center at the University of Central Florida teamed with the Power Center for Utility Explorations at the University of South Florida and the state's Energy and Climate Commission to build a smart-grid network that integrates renewable energy in the St. Petersburg area. The "Energy Smart Miami" initiative involves a similar effort in that region of the state, and in 2009 Florida Power and Light received one of the larger (\$200 million) U.S. Department of Energy awards to build a smart-grid system in Miami-Dade and Broward Counties, with the intention of expanding to Palm Beach County as well (Genuardi 2010). FPL will outfit 750,000 homes in Broward and 980,000 in Miami-Dade, before moving on to commercial and industrial customers. FPL projects the total cost of residential smart-grid installation to be \$800 million and hopes that the information made available to homeowners will significantly reduce wasteful energy habits. Future upgrades to the system could even provide diagnostic reports to FPL, providing information on the reason for outages and actually prevent future blackouts (Genuardi 2010).

The smart-grid projects are likely to utilize technologies produced out-of-state, we did not find evidence that the state government was using the opportunity to create local manufacturing, software, and building technologies in the industry. The state may have more potential to build on existing research and demonstration projects for green-roof technologies. The University of Central Florida's Stormwater Management Academy has focused on training and demonstrating green-roof technologies and installed a demonstration project on the Student Union. The 1,600 square-foot planting was funded by a state Department of Environmental Protection grant, making it the first university in the state to install a green roof on its campus (Binette 2005).

Solar. Florida is more established in the solar industry than most other alternative energy industries. The Solar Energy Center at the University of Central Florida was originally founded by the state legislature to test and certify all solar photovoltaic systems in the state, but over time it moved into research on thin-film production, solar thermal, and grid integration for solar energy. The center also operates the U.S. Department of Energy's Southeast Regional Photovoltaic Experimentation Center. Also at the university are the Power Electronics Center and the NanoScience Technology Center, which have research projects on solar energy and other types of clean energy. Several solar energy installation and manufacturing companies are located in the region, notably PetraSolar. The company is headquartered in New Jersey but has located its global research and development facility in Orlando, where it partners with the university (Institute for Economic Competitiveness 2009). Solar energy research can be found at the Energy and Sustainability Center at Florida State University, the Florida Institute for Sustainable Energy

at the University of Florida, and the Clean Energy Research Center at the University of South Florida. The latter became part of a consortium of southern states that will provide training in solar energy installation (University of Central Florida 2009). There are also collaborations among the centers, although without the facilitation of the state government as found in Colorado and New York.

Miami-Dade County's Targeted Jobs Incentive Fund was set up in May of 2005 to bring certain industries to the metropolitan area, which include solar thermal as well as photovoltaics. Companies moving to the area or existing firms expanding into these green industries are given up to \$3,000 in tax refunds for each new job. There are also \$1,500 bonus incentives for operating out of a "green construction" building, hiring someone living in a Designated Priority Area, or if the company is located within a Designated Priority Area.

According to the Washington Economics Group, if all proposed solar legislation were enacted, it would generate \$8.1 billion in gross revenues from private and public firms, and create 40,045 jobs. The projects are also estimated to contribute \$200 million to state coffers (Villamil et.al. 2010).

One of the projects underway is the Martin Next Generation Solar Energy Center in Indiantown, Florida. Florida Power and Light began construction of the seventy-five megawatt plant on December 2, 2008, and is scheduled for completion at the end of this year (FPL 2010b). The plant will rank as the second-largest solar thermal power plant in the nation, behind California's Solar Energy Generating Systems facility (Spear 2010). Although the parabolic trough system is the same in both plants, the Martin facility is unique because it is connected to the turbines of existing oil and natural gas-fired plants. This not only saves on construction costs associated with building the facility, but also maintains steady energy production, preventing the peaks and lows associated with solar power.

The state's solar industry still has a lot of room to grow. Florida produces 25 percent of the world's phosphate (FDEDP 2010). One of the byproducts of phosphate mining is gypsum, a silicon-rich mineral. Manufacturing of solar panels would be very cheap, due to the plentiful, unused, silicon, but only recently has HB 7135 created a viable domestic market for solar panels (Fitzgerald 2010).

Transportation and Energy Storage. Having experienced most of its growth after World War II as part of the rapidly developing "sunbelt," much of Florida's built environment presupposes car-based transportation. With the price of gas increasing, alternatives to fossil-fuel-based automobile transportation are central to Florida's sustainability initiatives. To date however, there have been only a handful of major steps in this direction. Nissan announced that Orlando would be one of the few test markets for their new all-electric car, the Leaf (Nissan News 2010). The Florida Hydrogen Business Partnership, H2 Florida, was launched in 2003, and The Florida Hydrogen Initiative was set up in 2007 as a non-profit organization to aid and develop a robust hydrogen industry in the state (Levine, 2007). Since 2008, however, most hydrogen initiatives seem to have stalled.

Much of Florida's future sustainability may come from a reduction of automobile use, rather than a switch to renewable energy sources. While the hydrogen projects have faded away, high-speed rail and retrofitting car-based cities to a more transit-friendly built environment promises to not only reduce carbon emissions but also provide significant job creation. Thanks to a comprehensive multi-modal transit plan (which includes House Bill 1B as well as local transit initiatives), Florida received \$1.24 billion from the Federal Railway Administration to build a high-speed rail lines from Tampa to Orlando along the I-4 corridor (phase 1), and from Orlando to Miami along the I-95 and Florida turnpike corridors (phase 2). By providing the federal government with detailed plans to connect the high-speed rail with light rail, bus, and pedestrian-friendly neighborhoods, Florida was able to win the grant (Fitzgerald 2010).

Florida House Bill 1B establishes the bureaucratic infrastructure necessary to oversee the state-wide roll-out of passenger rail. The Florida Statewide Rail Commission will advise the legislature and Florida Department of Transportation on all train-related business. The Florida Rail Enterprise will oversee the operation of state-owned rail lines (SunRail 2009b). Currently, surveying teams and soil test crews are doing initial work on the project. Completion of the first phase is slated for late 2014 and the second phase by 2017 (Florida High Speed Rail 2010). According to a report paid for by Siemens (one of the companies bidding to build the railroad), 27,500 new jobs would be created in the central Florida region (Tracy, 2010).

Wind. The University of Central Florida also hosts the Center for Advanced Turbines and Energy Research, which has established a partnership with Siemens Power Generation, Inc., the Florida-based subsidiary of the international company. In 2008 FPL stated that they would construct six wind turbines off the coast of St. Lucie County on company-owned land. The company estimated that the \$45 million project would spur seventy-five construction jobs and \$4.6 million in economic activity, annually, in the county (FPL 2008).

Gainesville and Orlando

Gainesville and Orlando suffer from the problems of most Sunbelt cities: their post-World War II transportation infrastructure is automobile-centric and difficult to service by mass transit. But all of that is changing, as new federal grants and local movements are transforming these cities into more walkable neighborhoods. As more pedestrian-friendly communities are constructed, there has to be a larger plan to link them via multiple transportation options. The value of a transit plan has already been confirmed; the decision to award Florida \$1.25 billion to build its high speed rail corridor was predicated on a fully developed transportation network.

Both cities are home to large research universities that have produced substantial scientific breakthroughs in green technologies and have students who are proactive in establishing renewable energy initiatives that are intended to spread to the larger community. In many instances, the cities have excelled where the state as a whole, has lagged. For example, Gainesville instituted a feed-in tariff for solar energy, replacing its already successful rebate program. Orlando will be the first city to operate its own ethanol mixing station for its biofuel-powered tri-county bus system (see *Biofuels*). It will also begin operating the SunRail

Commuter Rail System, which is expected to create thousands of jobs and spur billions of dollars-worth of commercial sales over the long term.

Sustainability Plans. Florida's cities do not have comprehensive green jobs and green industry development initiatives, but there are some interesting developments. The city of Orlando's Green Works Program and the county's Orange to Green program have helped spur the green building and local solar industry. Green Works Orlando has goals for energy efficiency and green buildings, but as of 2010 the programs mainly took the form of building standards (City of Orlando 2009b). The city encourages businesses to undertake a green challenge, but there were no programs to finance retrofitting of buildings other than ARRA funding for weatherization of low-income homes. The GreenWorks Business initiative also offers workshops to help existing businesses to undergo greening (City of Orlando 2009a), and the city's green plan includes a provision to develop a green business park. Overall the program is comprehensive in scope, but is not aggressive in implementation.

Green-Building Initiatives. Gainesville has implemented several "environmental overlays" to their Comprehensive Plan, which implement special environmental impact restrictions and regulations for particularly environmentally sensitive areas. Buffers are required for any construction adjacent to natural lakes, creeks, and wetlands.

The Orlando metropolitan region has embraced commuter rail as a solution to highway congestion, carbon emissions, and economic development. On December 19, 2009, Governor Crist signed House Bill 1B, which provided state support for several commuter rail projects throughout the state. In addition to increasing funding to southeast Florida's Tri-Rail, it established a new commuter rail service called "SunRail" for the Orlando metropolitan area. Sixty-one miles of existing rail would receive needed upgrades to accommodate a passenger rail service. The rail line will stretch across Valusia, Seminole, Osceola, and Orange Counties, connect several major employment hubs and residential areas.

Initial economic studies indicate that the SunRail service, over thirty years, will create a net increase of \$981 million commercial business sales and create an additional 11,523 jobs within the four counties, and generate an additional \$188 million of business sales and 1,985 jobs in the rest of the state. Construction and continued operation is expected to generate \$1.2 billion-worth of sales over thirty years (SunRail 2009a).

Green Jobs Training. We did not find city government sponsorship of green jobs training programs in either city.

Green Business Initiatives. In 2009 the University of Central Florida published a study commissioned by Orlando County Mayor Richard Crotty that outlined the prospects for the clean-energy industry in the region and made policy recommendations (Institute for Economic Competitiveness 2009). As mentioned above, there are significant research strengths in the Orlando area for the solar industry, and the city, county, and Orlando Utilities Commission have worked together to support the industry.

On March 1, 2009, Gainesville, Florida passed Ordinance No. 080566; establishing itself as the first city in the U.S. to provide a feed-in tariff for solar-energy production. Gainesville Regional Utilities replaced their previous rebate program with a fixed rate of \$0.32 per kilowatt-hour for projects below twenty-five kilowatts. Projects larger than 25 kilowatts are rated at \$0.26 per kilowatt-hour. Installation of new solar generation projects has been capped at a maximum of 4 megawatts of capacity per year (Rolland 2009).

This method of financing has the benefit of establishing long-term predictable energy purchase rates while also spreading the cost of initial installation over the entire user base (Daily Climate 2010). This model, based on similar initiatives pioneered in Germany, is the only one to have been enacted at a regional level. Other state-based programs have been established but only Vermont's program was rated "passing" by the World Future Council (Renewable Energy World 2010). As of April 2009, the Gainesville Regional Utility claimed that they had received applications for forty megawatts of solar capacity and has scheduled project installations through 2012 (World Future Council Policy Action on Climate Toolkit 2010).

Civil Society and Policy

Florida lacks the labor-environmentalist coalitions that are prominent in the northern and western states and that provide a popular basis for green jobs policy reforms. As a result, advocacy from civil society has tended to fall on the shoulders of other organizations. Many of those organizations have been concerned primarily with design, sprawl, and land-use issues that plague a rapidly growing state. For example, the Florida Congress for the New Urbanism is the largest state chapter in the nation and hosts annual "congresses" in which interdisciplinary panels and speakers share expertise in areas of sustainability, planning, and resource management. These congresses are attended by elected officials and provide a good platform for networking and sharing of ideas. The last meeting held in January was titled "Great Expectations! (Even in tough times)" and focused on Florida's economic woes as an opportunity to reposition sustainable urbanism as an economic catalyst for the state (CNU 2010).

As noted above, Florida's biofuels industry has innovative technologies under development for the production of ethanol from citrus peels and sugar-cane stalks. Unfortunately, agriculture in this part of the state has a long history of human rights infractions recognized by state and federal agencies. Largely related to citrus and tomato harvesting, the Coalition of Immokalee Workers (2009) has worked since 1993 to draw attention to these abuses. If the biomass coming from these farms were to be used as fuel, it would run counter to the WorkForce Florida's definition of a green job unless human-rights abuses were addressed.

1000 Friends of Florida has been a proactive advocacy organization that has engaged in public awareness campaigns to fight sprawl and encourage support for planning efforts. The Florida 2060 Report, a joint effort between 1000 Friends and the University of Florida's GeoPlan Center, took current population projections and mapped them onto existing planning regulations. The results were startling, showing urban development would more than double from six million acres to thirteen million in fifty years. They identified the counties that would be most affected by unchecked sprawl and did a detailed analysis of the environmental and resource impacts

(1000 Friends of Florida 2006). The University of Central Florida's Metropolitan Center for Regional Studies, in partnership with the University of Pennsylvania's design studio, released a "2060 Alternative Scenario," which encouraged compact development and mixed transportation choices (University of Central Florida 2007a). In terms of job creation and industry, this report (like others from 1000 Friends) has received substantial attention in both government and private industry. In contrast to vague awareness campaigns, 1000 Friends chooses to engage actively the legislation process and provides research, professional expertise, and alternative policy recommendations for development and planning (Fitzgerald 2010).

The Southern Energy Network was formed in 2004 to promote youth-led action to promote renewable energy, and has chapters in twelve Southeastern states. Their efforts have established "green fees" on University of Florida (in Gainesville) and New College of Florida (in Sarasota). Chapters in five other public universities are in the late stages of approving the fee as well (Southern Energy Network 2010a). The money generated by these fees are controlled by student governments and earmarked to finance sustainability initiatives on campus. SEN is active on college campuses and seeks to, "Leverage campus victories to achieve greenhouse gas reduction plans and/or comprehensive clean-energy policies" (Southern Energy Network 2010b).

Further Reading

For reports completed by the 1000 Friends of Florida, visit <http://www.1000friendsofflorida.org/Publications/main.asp>. For a summary and photos of any of the New Urbanist projects by Florida's New Urbanist firms, go to <http://dpz.com/projects.aspx> (DPZ), or <http://www.doverkohl.com/portfolio.aspx> (Dover, Kohl, & Partners). For further reading on smart growth and regional planning, see the Treasure Coast Regional Planning Council's publications page: <http://www.tcrpc.org/publications.html>. Visit the Florida Solar Energy Center's website (<http://www.fsec.ucf.edu/en/research/index.htm>) for a review of major research projects underway at the University of Central Florida.

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Texas

Summary and Analysis

Texas has strengths in renewable-energy generation, especially wind, but it has done less than other states to build up its manufacturing sector. Overall, there is very little policy implemented to encourage clean energy or green jobs. However, the state has extensive wind and solar resources that have not been substantially exploited, perhaps because the primary energy focus of the state is on oil and natural gas. With respect to demand-side policies, the state pioneered the idea of an energy efficiency portfolio standard in 1999 and settled on the location of \$5 billion dollars in new transmission lines. Among innovations of policy and programs in Texas are the following:

- In West Texas, there is an emerging public-private partnership that will link wind-energy research with manufacturing.
- Austin Energy's Pecan Street Project will learn how to standardize, support, and manage the infrastructure of smart-grid technologies, in the process creating a new business model for utilities.
- Austin's Energy Conservation Audit and Disclosure Ordinance requires homeowners to complete an energy audit before the sale of a home, and commercial building owners must receive an energy rating. Austin Energy also supports building greening through a variety of programs.
- Austin also requires that all new single family homes be zero-energy (with on-site 100 percent renewable energy generation) by 2015.
- Austin successfully recruited the Clean Technology and Sustainable Industries Association to locate in the city.

General Background Policy

Energy Goals. Texas' heavy industry in combination with the cooling needs of residences and businesses means that the state both produces and consumes more electricity than any other (Combs 2008; U.S. Energy Information Administration 2010). According to data provided by the Energy Information Administration for 2007, in terms of total megawatt hours of non-hydroelectric renewable energy generated, Texas ranks second just behind California, primarily due to wind-energy generation (Doris, McLaren, Healey, and Hockett 2009). However, compared with other states in terms of megawatt-hours per capita, or, renewable energy as a percentage of total in-state generated energy, Texas' ranking is much lower. About 89 percent of the energy produced in the state is from natural gas (66 percent) and petroleum (23 percent); Texas provides approximately 30 percent of the natural gas produced in the U.S. (U.S. Energy Information Administration 2009; U.S. Energy Information Administration 2010). From 2003 to 2007 renewable-energy production (not including oil, natural gas, nuclear energy, coal, or biofuels) increased from 1.02 percent to 1.70 percent of the total energy produced within the state; however, during this time, biofuels were not being produced at all (U.S. Energy

Information Administration 2009). Most of the renewable energy (approximately 83 percent) came from wind (Combs 2008).

In 1999, Texas developed its first renewable-energy portfolio standard and the nation's first energy-efficiency portfolio standard (EEPS) (SB7). The program originally required utilities to use energy efficiency to off-set 10 percent of load growth, and in 2007 the goal was increased to 20 percent of load growth, with current discussions underway for an increase to 30 percent (American Council for an Energy Efficient Economy 2010). In 2005 the state expanded its renewable portfolio standard (SB20) to a goal of 5880 megawatts by 2015 (about 5 percent of the 2005 demand) and 10,000 megawatts by 2025 (Combs 2008). Two of the municipal public utilities (Austin and San Antonio) have their own standards. In March 2010, the Texas Public Utility Commission was considering a proposed Energy Efficiency Portfolio Standard increase that off-sets up to 30 percent of load growth by 2014.

The Public Utility Commission also had an open meeting in June, 2010, for considering a non-wind renewable portfolio standard. (In Senate Bill 20 there was a target for 500 megawatts of non-wind renewable energy that was interpreted as optional by the Public Utility Commission (Lewin 2010). The 2007 session of the legislature added language to the renewable portfolio standard to clarify that the target was mandatory, but one of the three commissioners still believed (as of July 2010) that the Public Utilities Commission does not have the authority to enforce the target as a mandate (Power 2010). Increasing the energy-efficiency portfolio standard or starting a non-wind renewable portfolio standard would be important for driving up demand and increasing jobs in the clean-energy sector. As Doug Lewin of the Good Company Associates stated, "We've got a significant number of green jobs in the state, particularly in West Texas for wind energy, but we need more policies to promote other forms of renewable energy and increase adoption of energy efficiency to create more clean energy jobs" (Lewin 2010). Also in Senate Bill 20, the Texas Public Utilities Commission was authorized to determine which places in Texas have both the capacity to generate renewable energy and the investors demonstrating a commitment to develop a renewable-energy project, and then designate the places as Competitive Renewable Energy Zones (CREZs) and authorize new transmission lines (Combs 2008; Doris, McLaren, Healey, and Hockett 2009). David Power from Public Citizen Texas (2010) pointed out that most "of the incentives on the books are for traditional energy sources." For example, the 45-cent-per-gallon ethanol subsidy will expire soon, and a recent Congressional report shows that BP, Exxon, and Valero have received the majority of these funds, which go to the blender of gasoline and ethanol instead of the original ethanol producer (Michaels 2010).

Texas has an advantage in the energy sector because it has its own electricity grid, which is managed by the Electric Reliability Council of Texas (ERCOT). Texas is also the country's largest wind-energy producer and has significant solar radiation. However, considering the state's large size, its current renewable-energy production per capita is miniscule in comparison to the energy that it consumes (Combs 2008; U.S. Energy Information Administration 2010). It is behind the rest of the country in some of the basic demand-side policies. In addition to policies already discussed, a law passed in 2007 (House Bill 3693) mandated net metering, but the state's public utility commission and ERCOT weakened the definition and implementation of it, and a 2009 report card on net metering gave Texas a grade of D (Network for New Energy Choices 2008). As of May 2009, Texas was one of only seven states without a net metering policy and

one of thirteen states without renewable energy access laws (Doris, McLaren, Healey, and Hockett 2009). David Power from Public Citizen Texas (2010) pointed out that most “of the incentives on the books are for traditional energy sources”, for example, the 45 cent per gallon ethanol subsidy will expire soon. A recent Congressional report shows that BP, Exxon, and Valero have received the majority of the funds, which go to the blender of gasoline and ethanol instead of the original ethanol producer (Michaels 2010).

Public Benefits Fund. Texas has a “system benefit fund; [however,] it is only partially distributed. Currently it is estimated to contain over \$500 million dollars that is held as part of the general revenue fund to help balance the state budget”(Power 2010).

Green-Buildings Policy. Texas does not have specific targets, such as LEED-silver certification or energy reduction goals, but since 1995 it has had a statutory requirement for new government buildings and major building renovations. Specifically, the state has adopted the IECC 2009 building code for 2011 for commercial buildings and the 2009 IRC for residential buildings in 2012. Also, the State Energy Conservation Office is recommending that the cities amend the IRC to address regional temperature zones (Power 2010). The agency or department must undertake an analysis of building design and energy consumption with conventional assumptions, then compare the cost-effectiveness of using alternative energy sources (biomass, geothermal, solar, and wind energy). If the alternatives are cost effective, they must be included (DSIRE 2010). Specific cities such as Austin, Dallas, Houston, and San Antonio, as well as the municipality of McAllen, have green building requirements (Power 2010).

Green Jobs Training. For a large state only limited funds have gone into workforce development for clean energy (Young 2009). In 2009 the state passed legislation that authorized a Green Jobs Skills and Training Program (Senate Bill 108), which would dedicate 20 percent of the funds to low-income and unemployed persons. The estimated appropriation for the program was \$5 million per year, in contrast with the \$75 million for green jobs training in California. As of July, no funds had been appropriated for green jobs skills and training (Wood 2010). The state does have a skills development fund operated by the Texas Workforce Commission and funded through the U.S. Department of Labor; however, there is no formal benchmark for creating or training green jobs. However, training for green jobs has been identified as a high-need area; training for energy conservation related jobs and training for wind energy jobs have been funded through \$5 million in ARRA funds (Wood 2010). The Texas Workforce Commission has also reviewed the *Texas Green Jobs Guidebook* that the Environmental Defense Fund put together for the state for distribution primarily to high school guidance counselors (Robertson and Smith 2010).

The Jobs and Education for Texans (JET) program, operated through the Texas Comptroller’s office, identifies high-demand jobs and facilitates the creation of training programs for those jobs (e.g., electricians trained to work in solar and, or, wind installation; Wood 2010). Texas Tech University and Texas State Technical College in collaboration with the American Wind Energy Association and other organizations together formed the Texas Wind Energy Institute. Together they have received \$1 million from the Texas Workforce Commission for the purpose of developing training programs to support the wind industry (Cranford 2008).

Good Company Associates is keeping track of the HomeStar Energy Retrofit Act of 2010, which has passed the U.S. House of Representatives (HR 5019) and is (as of July 2010) in the U.S. Senate (S 3434). The legislation would make the cost of a retrofit to one's home much more agreeable. Currently the lack of consistent sustained rebates and lack of financing options are barriers to the creation of jobs in solar energy and energy efficiency/retrofitting. Companies also complain of the lack of a correctly trained work force. To address the problem, Good Company Associates has a partnership with the Texas Foundation for Innovative Communities to create a Green Jobs Business Council and Green Jobs Initiative (Good Company Associates 2010). They are also involved in the Green Corridor Collaborative along Interstate-35, which includes seven community colleges, eight workforce boards, and forty companies (e.g. Siemens, Dell, Dow Chemical, renewable energy designers, solar installers, geothermal installers, etc.; Lewin 2010). The collaborative is currently developing twelve course modules to green the existing curriculum for skilled trades and to be offered as continuing education for both incumbent workers and job seekers.

Clean-Energy Industries

General Background. Texas has about 800 companies that are affiliated with clean and or renewable energy and some manufacturing, especially near Austin (Texas Clean Energy Park 2010). Although Texas has many advantages, the state government has not shown the same levels of commitment that has been seen in other states to developing the manufacturing and innovation side of clean-energy jobs, perhaps because Texas remains dominated by the oil and gas industries. An alternative explanation offered by the Local Government Assistance and Economic Development (LGAED) division of the Texas Comptroller's office is that Texas has not invested in renewable energy technologies (i.e., solar panels) at the same levels as other states because it is interested in investing taxpayer dollars in projects that are commercially viable (Wood 2010).

In 2003 the state legislature passed SB 275, which called for an economic development strategy based on industrial clusters, including "manufactured energy systems." The Texas Enterprise Fund, billed as the largest "deal-closing" fund in the country, is used to recruit new businesses to the state and had an initial funding level of \$295 million. In 2005 the state designated \$200 million for the Texas Emerging Technology Fund (TETF), where the non-specific category of "energy" is one of six targeted industrial clusters. The others include advanced technologies and manufacturing, aerospace and defense, biotechnology and life sciences, information and computer technology, and petroleum refining and chemical products (HB 1765; Office of the Governor 2004). Each cluster had a team assigned to evaluate it, and in August 2005 the Texas Energy Industry Cluster Team published an evaluation of energy in Texas that stated there needs to be an increased "use of state incentives for emerging sources in [renewable and sustainable energy sources], in addition to the current efforts in wind energy [to] ...provide matching funds for a demonstration and testing facility for offshore wind energy generation; host a conference on renewable and sustainable energy similar to the Western Governors' Association Energy Conference held in Albuquerque; [increase] funding for research, as well as for commercialization... and promote research consortia within this sector"

(Billingsley et al 2005). Of the twenty-nine organizations making up the Texas Energy Industry Cluster Team (including the fossil-fuel industry, public colleges, and other organizations) that sent representatives to help make the report, Cielo Wind Power and Public Citizen Texas stand out as organizations that advocate renewable energy.

The TETF monies appear to have been disbursed to many high-tech industries and have not achieved the same level of concentrated “clean tech” support seen in other large states (University of Central Florida 2009). For example, our review in July, 2010, of the TETF website’s case studies suggested the following: (1) many of the sixteen research superiority awards went to agriculture or medical biotechnology projects; (2) of the fifteen research matching awards, one went to the Texas A&M’s Texas Agricultural Experiment Station in Pecos for algae-based biofuels, a second went to Lynntech, Inc in College Station for fuel-cell research; (3) of the seventy-nine commercialization awards, \$1.5 million went to Solar Bridge in Austin for improved solar radiation harvesting technology in 2010, \$250,000 went to ActaCell in Austin for lithium-ion batteries in 2009, \$3.5 million went to 21st Century Silicon in Dallas for advanced solar panel manufacturing techniques in 2009, \$750,000 went to Stellarray for flat panel radiation source technology in 2008, \$250,000 went to Faradox Energy Storage in 2008, \$250,000 went to Sunrise Ridge Algae in 2008, an unknown amount went to EQMA for ethyl alcohol production from industrial wastes, an unknown amount went to TXL Group in El Paso for waste-to-heat conversion, \$250,000 went to Texas MicroPower (formerly called Texas Piezoelectric, Inc.) in Richardson for low energy harvesting, an unknown amount went to Xtreme Power in Kyle, Texas for advanced microgrid technology (Texas Emerging Technology Fund 2010). In summary, since 2005, our review of all of the awards listed on their website shows that the Texas Emerging Technology Fund has awarded at minimum a total of \$6 million to two clean-energy research projects out of fifteen research projects listed and ten clean-energy commercialization projects out of seventy-nine commercialization projects listed (Texas Emerging Technology Fund 2010). Unfortunately, due to accounting errors, the TETF had to stop accepting applications, despite the fact that only \$100 million has been disbursed by TETF out of the \$203 million that was allocated to it by the legislature for the 2009-2011 budget (Lubbock Avalanche-Journal 2010; Power 2010). Texas has also attracted at least \$716 million in private venture capital for clean tech from 2006 to 2008 (Lesser 2009). Some interesting start-up companies that have come out of University of Texas at Austin, including the fuel-cell research and development companies ActaCell and Graphene Energy, the biodiesel company Organic Fuels, and the solar company Inspired Solar (Lesser 2010).

Biofuels. Out of the many different types of biofuels, Texas may exhibit leadership in biodiesel. The state claims to be number one in biodiesel production with “22 plants capable of making 200 million gallons of the fuel each year” (Combs 2008) and “with [a total of] 30 production facilities, and 32 biodiesel distributors, from the Texas Panhandle to the Gulf Coast” (Biodiesel Coalition of Texas 2009). The biodiesel is primarily used by large city fleets in Dallas and Austin (Biodiesel Coalition of Texas 2009).

The large oil and natural gas cluster located in Texas is showing some signs of investment in biofuels. In addition to the investment of Exxon-Mobil in Synthetic Genomics in San Diego, the San Antonio-based Valero paid \$477 million for VeraSun Energy, a South Dakota-based company that owns ethanol refineries (Ritch 2009). Conoco-Phillips entered into a

strategic partnership with Tyson Foods to make biodiesel (Childs 2007a), and it has also entered into a partnership with Iowa State University. The California-based company Chevron also has a biodiesel plant in Galveston, and it has launched a partnership with Texas A&M along with other universities (Georgia Tech, U. C. Davis, and the Colorado Center for Biorefining and Biofuels). In addition, there are strengths on algal biofuels research at the University of Texas at Austin, which has a \$25 million grant to transform algal oil into jet fuel.

Although the considerable capital available from the oil industry could lead to a vibrant biofuels industry in Texas, to date the companies appear to be investing across the continent. In other words, Texas companies such as Exxon, Conoco-Phillips, and Valero have made major investments outside the state, and likewise companies with headquarters outside Texas such as Chevron have invested in the state. The potential to develop a concentrated biofuels industry in the state is therefore limited, and there is no proactive state government policy to encourage a cluster in this industry with investments in next-generation biofuels biotechnology. To the contrary, a decision in 2006 by the Texas Commission on Environmental Quality indicated that it would ban the 20 percent biodiesel blend because of its nitrous oxide emissions. Although a compromise was reached with the Biodiesel Coalition of Texas (2009), the decision put the industry on edge. Furthermore, Governor Rick Perry opposed the federal ethanol guidelines, because they resulted in an increase in corn prices that hurt the state's cattle ranchers (Wall Street Journal 2008). The Biodiesel Coalition of Texas emphasizes the use of soybean oil when describing biodiesel production (2009).

Geothermal. As of July 2010, “[t]here are already 20,000 megawatts [worth] of existing wells drilled which are suitable for geopressure facilities,” and “this high-pressure hot water is the ‘bane’ of the oil industry” (Power 2010). Instead of the tapped water shooting a geyser 100 feet in the air, its heat is removed and the brackish, nonpotable water is replaced back into the disposal well with two fortunate results: (1) the same skill set for oil exploration is used for geothermal, with the implication that less re-training is required than other renewable energy sources; and (2) the recovered energy generation process gives a constant base load, with the implication that it can mitigate some of the unreliability of other renewable energy sources in a diverse portfolio (ibid.). Public Citizen Texas reports that a state auction leased 60,000 acres for geothermal production to Nevada-based Ormat Technologies and a Texas company called Geopower Texas (which specializes in geopressure and geothermal), which is raising funds (ibid. 2010).

Smart-Grid and Building Technologies. There is considerable potential for leadership in smart-grid technologies, and Austin Energy has been a pioneer in this area (see “City of Austin” below). The U.S. Department of Energy allocated \$620 million dollars of ARRA funding to award thirty-two smart-grid demonstration projects nationally out of 135 applications (Kin 2009). “U.S. Energy Secretary Steven Chu [...] said the projects chosen — which include large-scale energy storage, smart meters, transmission system monitoring devices and a range of other smart technologies — will serve as models for the deployment of smart-grid systems on a broader scale” (Hawkins 2009). The state of Texas has received three awards out of those thirty-two awarded, including \$10.4 million (out of a total project cost of \$24.7 million) to Austin Energy’s Pecan Street Project (described further below), \$3.5 million (out of a total project cost of \$7.3 million) to Dallas-based Oncor’s transmission line testing, and \$13.5 million (out of a

total project cost of \$27.4 million) to the Center for the Commercialization of Electric Technologies (a public-private association of twenty-one companies and five universities that includes Austin Energy and is based in Austin) to figure out how to regulate fluctuations in power caused by the addition of wind power within an electric energy transmission grid based in Houston (Mottola 2006 ; Hawkins 2009; King 2009; Leffingwell 2010).

Legislation in 2005 (HB 2129) established the basis for the deployment of smart meters. By 2012 there will be five million smart meters installed in the state, a number that is second only to the estimate for California (Finney 2010). However, opportunities to develop manufacturing and research strengths for smart grid in the state have not been fully pursued. For example, when CenterPoint Energy of Houston announced a \$613-639 million smart-meter project (with \$200 million in funding coming from an award by the Department of Energy's \$3.4 billion SmartGrid Investment Grant program), it contracted with eMeter of Silicon Valley, Itron of Seattle, and IBM of New York (Ritch 2009). Without a concentrated state-government program dedicated to developing an in-state smart-grid industry, green jobs in this field will likely be in the installation and maintenance side of the industry rather than in manufacturing, software, and technology development. Although the state government has not provided the leadership, Austin Energy's leadership and connections with the state's information technology industry may create opportunities for a Texas-based manufacturing and software industry in smart-grid technologies.

Texas has a natural advantage for leadership in smart-grid technologies because the state has its own grid. The Electric Reliability Council of Texas (ERCOT) manages the Texan Interconnection, which is not well connected to the Eastern Interconnection or the Western Interconnection of the U.S. (hence New Mexico's aspirations to connect the three). However, the state government has focused more on internal transmission issues than its potential as an engine of innovation for smart-grid technologies. Within the current Texan Interconnection, the isolated areas of the panhandle and the southwest (which are known for their high wind speeds and intense solar radiation) are not well connected to the urban centers of the state. This is changing with the creation of the Competitive Renewable Energy Zones (CREZs), which are primarily focused on analyzing and approving wind power projects and transmission lines in central Texas (Combs 2008). The state has already identified \$5 billion dollars in new transmission lines, in a commitment to bring power to the market (Wood 2010). The creation of CREZs is a long-term process; this first stage took over two years (Taylor 2010). The transmission lines will serve wind farms already in the western part of Texas and possibly solar farms (Wood 2010). With the multiplier effect, it is possible that "an economic benefit of \$30.6 billion will be created, along with an additional 41,000 jobs for the State" (Sharp 2010).

Solar. Texas has the one of the highest levels of solar energy radiation in the U.S. (ranked with the top seven, including Arizona, New Mexico, Utah, Nevada, Colorado and California). At the local level there is considerable support for distributed solar energy. For example, both Austin and San Antonio have public electricity utilities and were named Solar America cities by the U.S. Department of Energy. However, Texas lacks a developed solar industry cluster of manufacturing, state government initiatives, and large, university-based research centers. In 2009 the state legislature missed an opportunity to jump-start the solar

industry when it defeated a bill that would have allowed \$500 million in solar energy rebates (Gold 2009). The rebates are necessary because “the cost of solar amortizes the entire cost of fuel that a regular plant would bill” in comparison to building a traditional fossil fuel plant where the fuels are not taxed, just the installation (Power 2010).

By combining solar energy with other forms of renewable energy, it is possible to overcome some of the intermittency problems. The peak load tends to lag the solar peak by a couple of hours; solar peak dies at 4pm. However, because the sun sets later in west Texas than the eastern portion of the state, placing concentrating solar wind farms in west Texas will help cover the load peak in east Texas (Power 2010). With wind farms in the west being most active at night, solar active in the morning, and coastal wind farms late in the day, then having diversity in renewable resources helps with load coverage. Public Citizen Texas has been suggesting this type of strategy for years (Power 2010).

Although there are some manufacturing companies (including HelioVolt in Austin), much of the Texas solar industry involves installation. The University of Texas did receive two of the large Energy Frontier Research Center grants from the U.S. Department of Energy (2009) and another award for photovoltaic research. The company Inspired Solar, a spin-off from the University of Texas, is developing solar tracking systems.

Transportation and Energy Storage. In Texas there are some beginnings of a fuel-cell industry. While Texas is the second highest producer of hydrogen in the U.S. and has significant hydrogen transportation infrastructure, it lags behind California, New York, and other states in terms of investments for research and development (Combs 2008). Texas’ biggest claim is that “the inventor of the lithium-ion battery, John Goodenough, is a professor of mechanical engineering at UT” (Lesser 2010). There are two interesting spin-offs from the University of Texas. ActaCell is developing the “next generation high-power lithium ion batteries for motive applications,” and Graphene Energy produces “nanotechnology based Ultracapacitors for energy storage” (Actacell, Inc 2009, Graphene Energy Inc 2009). There is other initial stage research going on at Texas A&M University and Rice University on ionic fluids and graphene, and there is limited research on energy storage. More research in this area is necessary because storage helps counter industry bias against unreliability of renewable energy generation (Power 2010; Public Citizen Texas 2010).

Wind. As of May 21, 2010, approximately 10,000 jobs in the state are related to wind energy (Sharp 2010). As of 2007, Texas: (1) produces the most wind power of any state in the U.S., even though it is ranked second behind North Dakota in terms of potential wind capacity (Combs 2008; U.S. Energy Information Administration 2010); (2) has the distinction of being the first state to install one gigawatt of wind in a year; and (3) has the largest wind power installation in the world, the Horse Hollow Wind Energy Center’s 736-megawatt facility (U.S. Energy Information Administration 2010). In March 2008, the nonprofit Coastal Habitat Alliance attempted to block the construction of the 202-megawatt off-shore wind farm Peñascal Wind Power project, which successfully started operating in May 2009 (Combs 2008; Goldenberg 2009). In September 2009, Iberdrola received a \$114 million stimulus grant to expand this coastal wind project (Power 2010; Michaels 2009). Within Texas the growth of electricity produced by wind has surpassed that of the growth of electricity produced by other

renewable energy and fossil fuels (Combs 2008). This has been driven in part by deliberate minimal state oversight; wind installations must follow federal and local regulations, but there are few state regulations (Combs 2008). Furthermore tax incentives such as school property-tax breaks “have been widely credited by the wind folks as a catalyst for wind development” (Wood 2010). In west Texas there is a low population density and hence a low tax base; students previously often had at least a two-hour bus ride to school. Now the average tax is \$4000 per year per turbine, and “apparently the cows don’t mind wind turbines at all,” so while wind turbines do get a tax break, they generally still pay a substantial school tax (Power 2010).

As of May, 2009, Texas, Colorado, and Arizona were the only states that have a line extension analysis policy, where new rural locations requiring connection to the electric grid are analyzed to determine if an on-site renewable energy generation system will be cheaper than extending a transmission line (Doris, McLaren, Healey, and Hockett 2009). A proposed \$10 billion wind farm that would have been rated at 4000 megawatts (almost doubling Texas’ 2007 wind production capacity) has been delayed and cites the lack of transmission lines to western Texas (Pilkington 2008; Souder 2009).

There is some wind manufacturing in the state, such as Trinity Industries, Wind Clean, and TECO-Westinghouse (Combs 2008). There are wind-energy research groups at the University of Texas, Texas Tech University, and West Texas A&M University, so some of the crucial elements of a successful regional innovation system are in place. However, it appears that the state government has invested minimally in wind energy research and development, instead relying on a deregulated investment environment, tax breaks for installers and consumers of renewable energy, and, the federal production tax credit to drive the industry growth (Combs 2008; State Energy Conservation Office n.d). That may be changing; in 2010 Texas Tech University announced a new public-private research consortium that will focus on wind energy, the National Institute for Renewable Energy (NIRE) (Cranford 2010). Because “the National Renewable Energy Laboratory estimates that six to ten permanent operations and maintenance jobs are created for every 100 megawatts of installed wind capacity” (Combs 2008), it may be that continued growth in this method of electricity production will produce a new energy industry for Texas, as it appears to have done in the town of Sweetwater (Pilkington 2008). An alternative explanation for Sweetwater’s success is less a fascination with wind, and more a commonsensical attitude to diversify businesses in the small town economy and therefore increase their ability to weather economic recessions and the typical ups and downs of a fossil fuel economy. This may be why former trucking and rail companies convert some or all of their business to wind power (Taylor 2010). For example, the town of Brownwood had a machine shop that became involved with the wind industry and has grown, possibly indicating that a skilled workforce is more necessary than an incentive package for clean-energy companies to relocate to Texas towns (Wood 2010).

Austin

Sustainability Plans. The capital of Texas and home of the University of Texas has developed a reputation for its software and semiconductor industry, but it also has ambitions to become a clean-tech center. The community in Austin is considered to be environmentally

conscious, and those values are reflected in the city's public utility, Austin Energy (Beceiro 2010). The public power organization has a national reputation as a leader in green electricity. Its innovative Green Choice program resells wind power directly to the customer through a long-term fixed-price contract. The standard rate is 3.5 cents per kilowatt-hour to 4cents per kilowatt-hour, which is locked in for ten to fifteen years (Beceiro 2010).

The dividends from the utility are about \$100 million each year and are paid into the city's general fund (Leffingwell 2010); it is the largest contributor to the city budget. Austin Energy has exhibited leadership in programs that facilitated energy-efficiency improvements, solar panels, and smart grid.

In 2007 the city launched its Climate Protection Plan to reduce greenhouse gas emissions. It has five sub plans: a municipal plan, utility plan, homes and buildings plan, community plan, and "going neutral" plan. The municipal plan involves both making the facilities use renewable energy and making the city vehicle fleet carbon neutral by 2012. The utility plan governs Austin Energy's renewable-energy portfolio. The city's public utility has had a renewable-energy portfolio standard since 1999, and in 2010 the city increased its renewable-energy portfolio requirements to 30 percent by 2020 with 100 megawatts of solar and 700 megawatts conserved through energy efficiency (Austin Smart Energy 2010, Beceiro 2010). In 2010 the renewable portfolio standard was increased to 35 percent by 2020, and the energy-efficiency portfolio standard to 15 percent by 2020 with a set-aside of 200 megawatts for solar. In order to fulfill its renewable-energy portfolio goals, in 2008 Austin Energy was interested in building both 100 megawatts of solar capacity via a solar farm on land that the city owns as well as within parking lots, and also in creating a biomass plant in East Texas and a 600-megawatt wind farm (Mottola 2008). As part of the "going neutral" plan, Austin Energy offers a carbon calculator tool and carbon return on investment matrix for residential and commercial users to take advantage of (Duncan 2007). Austin Energy will reduce its carbon dioxide output by purchasing carbon offsets. The utility is also currently debating the Generation Plan, which lays out a plan for "reducing Austin Energy's carbon emissions by 20 percent, from 2005 levels, by 2020" (Leffingwell 2010). The Austin City Council also wants to create a plan to reduce carbon dioxide emissions, generate energy in a way that is carbon neutral, and to save 700 megawatts through energy efficiency and load-shifting (Austin Smart Energy 2010).

In 2010 Mayor Lee Leffingwell pointed in out in his state of the city address that Austin is one of the most congested large cities in the U.S., especially Interstate 35. He called for a November transportation bond election, which would potentially include new and repaired roads, sidewalks, bike lanes, and urban rail and could potentially add to (or at least maintain) the economic strength of Austin's downtown (Leffingwell 2010). The newly created transportation department has just issued a list of 3000 mobility projects and is continuing to develop the Strategic Mobility Plan, with sustainability as one component (City of Austin - Austin Strategic Mobility Plan 2010). The 200 participants gave pretty consistent positive feedback in regards to social justice, multi-modal and environmental goals of the comprehensive development plan (Austin City Connection 2010).

Green-Building and Smart-Grid Initiatives. The city has had a green building program since the 1980s. It began using green technologies in its municipal buildings in 1993 and

mandated that all municipal buildings be LEED Silver certified in 2000 (Austin Energy 2010a). A best practices development in Austin is the city's Energy Conservation Audit and Disclosure Ordinance, which requires homeowners to have an energy audit completed before the sale of a home. Likewise, owners of a commercial building that receives energy from Austin Energy must receive an energy rating. Under Austin's Climate Protection Plan, the city's buildings will all be powered by renewable energy by 2020 (City of Austin 2007). Furthermore, new single-family homes after 2015 will be "zero-energy," that is they will be required to produce as much energy as they consume and use on-site renewable energy generation by (Leffingwell 2010). All other new buildings will need to be 75 percent more efficient by 2015. Austin Energy offers a wide variety of energy-efficiency and weatherization programs, including rebates for solar energy and energy-efficiency improvements and free home energy improvements for low- and moderate-income customers (Austin Energy 2010b). Austin Energy, unlike the state of Texas, has a feed-in tariff program, where the utility pays for energy generated by the customer. These policies have spurred the growth of renewable energy industry in Austin (Beceiro 2010). Austin Energy also spent \$3.3 million out of \$4.5 million for the 2010 fiscal year before informing solar installers that they were out of money; it then restructured the program to stretch the remaining million (Ankrum 2009).

In 2008 Austin Energy has also joined the city government, the University of Texas, Austin Technology Incubator, Greater Austin Chamber of Commerce, Environmental Defense, and nearly a dozen companies (including Dell, IBM, Oracle, Cisco, Applied Materials, GE, Intel and Microsoft) to form the Pecan Street Project. The Pecan Street Project is a nonprofit corporation dedicated to enhancing the city's position as a leader in the smart-grid industry by allowing startup companies to test their smart-grid technologies 'live' while Austin Energy figures out the smart-grid business model (Gregor 2008).

The Pecan Street summary depicts a fictional resident [...] monitoring her electricity and water usage from her mobile phone, while her rooftop solar panels feed juice to the 'Energy Internet' and her 'home energy gateway system' adjusts appliances, monitors and adjusts sprinkler performance, and even shuts off a leaking toilet. The DOE grant will help buy a 'demonstration project' to 'create, operate, and evaluate' an Internet-style smart grid, according to the summary, that will involve 200 in-home smart-grid water systems, 200 smart sprinkler systems, and 1,000 residential and 75 commercial meters, distributed to neighborhood volunteers (King 2009).

Whereas other smart-grid projects are using U.S. Department of Energy grants to make improvements to infrastructure (i.e. smart meter installation), Austin Energy was already ahead of most utilities when stimulus funding became available (Rowan 2010). For example, by 2009 Austin Energy had already paid for and installed smart-grid meters in most of the city's buildings. As a result, the Pecan Street Project is not simply a technology deployment project; instead it is the next level, or, "Smart Grid 2.0" (Rowan 2010). The Pecan Street Project is a unique type of smart-grid project because of the Texas Interconnection, which allows the testing of innovative technologies with great speed and flexibility; the collaborative nature of the project, which is comprehensive and community-driven, including a publically owned utility, government agencies, and civil society organizations as well as businesses; its emphasis on integration, which must include, for example, water infrastructure (as the water utility is the

largest user of municipal energy for treating and moving water) as well as the efficiency of irrigation systems; and the fact that the project results will be “open-source from the get-go,” published and available for anyone to learn from including other private or public utilities and environmental conservation organizations (Rowan 2010). The Pecan Street Project shares an interest in the behavior of energy consumers with other smart-grid projects (i.e. Xcel Energy’s smart grid city Boulder, Colorado) and advocates that a Center of Excellence for Energy Use Behavior is necessary (Rowan 2010).

Changing people’s behavior is difficult; it is especially hard to change private industry such as an investor-owned utility, which is likely to be protective of its business model because it provides reliable revenue and keeps their stock price up. In contrast, a publicly owned utility can conduct itself in a way that is consistent with the population it serves (Rowan 2010). In Austin, there is pressure on the utility to “do the right thing.” Colin Rowan of the Pecan Street Project stated, “What we’re trying to figure out is how do we reinvent the business model of the utility so that utilities and city councils and state governments can get on the same side of the incentives equation in figuring out how we can build a more robust energy system that is just as reliable, cleaner, affordable, but that uses less energy from fossil fuel sources, and makes us less dependent on burning stuff” (2010). To that effect they published a report in March, 2009, that “has thirty-seven recommendations for the region to lead in this area; five or six are being addressed at this time via the demonstration project at Mueller”(Rowan 2010). Rowan does not think it is necessary to leverage the financial resources of oil and gas companies who work on a traditional business model. Instead, he points out that the energy industry is actually two industries: electricity and transportation. With the move away from fossil fuels toward renewable energy, there is a concomitant move away from the traditional energy business model to the telecommunications-based business model. Rowan believes that “[i]n the same way that the telecom industry spends on front-end capital (one time) and it depreciates, the smart grid...is going to rely less on fuel and more on technology deployment. With Austin a hotbed of the semiconductor industry, AT&T headquartered in Dallas, Dell in Austin, Compaq in Houston, and a telecom corridor from Dallas through Austin down to San Antonio and into Houston...Austin is well positioned to play a prominent role. It’s been doing it with internet companies for fifteen years and with mainframes and semiconductors before that” (2010). The city also has a good testing facility, Drumond Laboratories, that is involved in the Pacific Northwest smart-grid project.

Green Jobs Training. Although the city government does not directly manage green job training programs, it has partnered with a prominent nonprofit organization that does. American Youth Works was founded in 1976 to help youth and adults who had dropped out of high school to get job training. In partnership with the City of Austin and the federal government, the organization has run two green jobs programs since the mid-1990s: Casa Verde Builders, a green building training program, and Environmental Corps, a parks and public lands preservation program that was founded. In 2009 the organization won a \$750,000 grant from the U.S. Department of Commerce to launch a Green Jobs Training Center. Austin Community College also received grants to start up weatherization and solar energy training programs. In 2009 the Chamber of Commerce launched the Green Job Task Force to coordinate job training (Austin Chamber of Commerce 2009). See also the discussion above at the state level.

Green Business Initiatives. In 2007 the city's Chamber of Commerce announced a five-year economic development plan that included clean energy as a crucial cluster. In February of 2010, Mayor Leffingwell stated, "Renewable energy, creative media, and medical technology—[t]hese industries are the future of Austin's economy"(Leffingwell 2010). There are over thirty-five independent solar installers in Austin (Beceiro 2010). The clean technology incubator is part of the Austin Technology Incubator at the University of Texas at Austin. It assists start up companies focused on clean energy, with resources from angel networks, venture capital firms, and practical skills such as how to put together and execute business plans. It also has a partnership with Austin Energy to beta test technology; Austin Energy provides grants to incubator businesses.

In 2009 the Chamber of Commerce's Clean Energy Council announced that the leading industry association, the Clean Technology and Sustainable Industries Association, would move its global headquarters from Massachusetts to Austin. The University of Texas, which is located in the city, also has a Center for the Commercialization of Clean Technologies. The Texas Workforce Commission, Austin Energy, and University of Texas also supported the creation of the Texas Clean Energy Park, which attracted the solar manufacturer HelioVolt (Fitzgerald 2009). HelioVolt will manufacture solar panels and create 150 jobs (Austin Chamber of Commerce 2008).

Unfortunately, Austin is not seeing the hoped for development of a large-scale solar-energy industry. To date, HelioVolt is the only company in the Austin area producing solar panels (Beceiro 2010). Most of the solar-energy employment growth has been in system design and installation. This is not trivial but only provides a couple of thousand jobs (Fitzgerald 2009). Joan Fitzgerald, who studies green economic development policies, adds that one company explained that New Mexico and New York were offering "more attractive financial packages" and that the city has lost some companies due to interstate competition (Fitzgerald 2010: 54).

Any development plan must keep in mind the specific makeup of this large city where "90 percent of companies in Austin have fewer than ten employees, and about 75 percent of all Austin jobs are with companies that employ fewer than 100 people," indicating the importance of small businesses to the economy of the city (Leffingwell 2010). Austin Energy is well aware of this, with three newsletters that target: (1) residents, (2) environmentalists and (3) small businesses.

City Society Organizations and Policy

The Center for the Commercialization of Electric Technology in Austin has been criticized by the Texas Ratepayers' Organization to Save Energy as being industry-oriented and not particularly concerned with energy efficiency (despite its interest in smart meters/grids as more efficient; Mottola 2006). In particular, the Texas Ratepayers' Organization to Save Energy, which represents low-income consumers, is not a fan of smart-metering which has the potential to increase the price of electricity during periods of high demand, regardless of a person's ability to pay. The executive director, Carol Biedrzycki, is more interested in building

weatherization, energy-efficient appliances, and stricter building codes as methods of managing demand on the electric grid (Mottola 2006).

The Clean AIR Force of Central Texas is a nonprofit organization founded in 1993 that in the past has been involved in clean air research, creating and distributing educational materials about air quality and reducing ozone in Austin and other areas of central Texas (Clean AIR Force of Central Texas 2010).

Public Citizen was started by Ralph Nader in the 1970s and has an office in Washington, D.C., and Texas. In the Austin office, Public Citizen Texas works on policy, spending a lot of time meeting with legislators on changes to bills, tweaking bills and encouraging legislators to file them earlier. On average it takes three sessions to get a bill passed, the first to get everyone familiar with the bill's content, the second to determine who is for and who is in opposition to it and work out compromises and the third session to get the bill actually passed (Power 2010). There are exceptions of course, for example, "we actually found sponsors for our Green Fees bill (HB 3353 & SB 2182), which allows students of any university that votes for it to impose a fee at their campuses to green the campus. Much to our surprise this sailed right through; it was approved at five universities, and each campus has its own fund and has a group of students that evaluate projects and choose what will happen on their campus" (Power 2010). Public Citizen Texas finds that in general, "the perception is still perpetuated that renewables are too expensive; that is something that we have to overcome" (Power 2010). Public Citizen Texas was involved in the two-year process with Austin Energy that created the Generation Plan (Power 2010). They work on supporting PACE legislation, tracking the stimulus dollars as well as other funds the federal government has for renewables, promoting energy storage for wind power, and educating utilities and public cooperatives about clean energy (Power 2010; Public Citizen 2010). They find that they are fighting a three-pronged opposition: (1) traditional energy companies have figured out that renewable energy helps moderate the cost of electricity; (2) large commercial customers do not want to see additions to their utility bills (even though state ordinances exempt them); and (3) some customers do not like the bill impacts (the incentives do not pay for themselves; Power 2010).

Additional References

For some of the best references, please peruse the state of Texas energy report produced under Susan Combs, the state comptroller, in 2008 for a very thorough breakdown of energy production and consumption by energy type (<http://www.window.state.tx.us/specialrpt/energy/>). The City of Austin (<http://www.ci.austin.tx.us>) and the Austin Chamber of Commerce's (<http://www.austin-chamber.org>) websites were useful in providing information about the city's current clean-energy plans and industry. The U.S. Department of Energy website provided useful statistics (<http://www.eia.doe.gov/>).

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Other Southern States

Some of the other southern states have made initiatives toward the development of clean-energy industries, but the initiatives tend to be on the demand side. For example, the Commonwealth of Virginia has established an Off-Shore Wind Development Authority, and there is a large smart-grid installation project in the state, but neither is connected with a plan to develop manufacturing or software companies. Among the southern states that show some signs of developing clean-energy industries are Georgia, Kentucky, North Carolina, South Carolina, and Tennessee. With the exception of North Carolina, the five states lack renewable portfolio standards, and none of the states has a public benefits fund. In most cases they also lack specific investment funds designated for the clean-energy industries. The states have energy-efficiency goals for state buildings, but with the exception of South Carolina the goals are not at the level of LEED-silver designation. Although the states did receive ARRA funding for green jobs training, they do not have extensive training programs and state-government coordination. An exception is North Carolina, which has also emphasized sustainability in its community-college initiative, which is framed around three major educational goals: creativity, entrepreneurialism, and sustainability. Nevertheless, the five states are showing signs of emergent clean-energy industrial clusters.

Georgia

Georgia supports high-tech innovation through its Centers of Innovation program and a statewide conference of venture capitalists, but there is no dedicated green business fund. The state has focused its clean-energy development resources on bioenergy. In 2008, the state government launched the Center for Innovation of Bioenergy to provide support for the biofuels industry, and it has helped to attract manufacturers from other states and countries. The University of Georgia and Georgia Tech were named collaborators in the large cellulosic biofuels research center at Oak Ridge National Laboratory in nearby Tennessee. Georgia Tech's Advanced Technology Development Center has also helped new companies in the biofuels industry to get started, including Aska Energy, C2 Biofuels, EnerTech Environmental, and Green Cusp. Colorado-based Range Fuels also selected Georgia as the site for its commercial-scale cellulosic ethanol plant due to the state's forestry and wood waste resources. The state government also contributed a grant of \$6 million in addition to private capital funding and a \$76 million federal government grant (Sims 2008).

Georgia Tech's University Center of Excellence for Photovoltaics Research and Education is one of two such centers sponsored nationally by the U.S. Department of Education, and Suniva and LumoFlex are two examples of spin-off solar energy companies from the university. However, as of 2009 the solar industry in Georgia remains largely installation and services, and Suniva has located manufacturing outside the state.

Kentucky

Under Governor Steve Beshear, the state of Kentucky developed an energy independence plan that includes higher levels of renewable energy for electricity, biofuels development, and “clean” coal technologies (coal to liquids, coal to gas, and carbon sequestration). Kentucky has received national attention because it will host the national Battery Manufacturing Research and Development Center in Lexington. The center will involve collaboration with the Argonne National Laboratory, the University of Louisville, and the University of Kentucky. Two manufacturing plants are planned with a goal of creating 2000 new jobs. The national center will likely integrate regional businesses, including Ohio’s Proctor and Gamble (HQ in Cincinnati) and Johnson Controls in Wisconsin. The relationship with Michigan’s battery manufacturers was not yet clear in the original statements (State of Kentucky 2009).

North Carolina

North Carolina has a combined renewable energy and energy-efficiency portfolio standard of 12.5 percent by 2020 for investor-owned utilities, with a small solar set-aside. Legislation that was pending in 2010 would create a 25 percent tax credit for the construction of facilities that generate renewable energy. North Carolina also has a goal of reducing the energy consumption of government buildings by 30 percent by 2015. Legislation passed in 2007 (SB 668) and 2008 (SB 1948) added to the goal by requiring that all new state government buildings, including those of the public higher-education system, must exceed by 20 percent a state-government energy-efficiency code. Major renovations must exceed the code by 30 percent. Other directives include water conservation.

In the high-technology sector, North Carolina is known for the Research Triangle area near Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill. The successful example of high-tech development was pioneered during the 1950s with strong support from the state government. However, due to the failure of the state government to attract some prominent manufacturers, which went to other southern states, the state shifted its economic development strategy back toward a more traditional recruitment approach. Still, the innovation culture developed in the Research Triangle area has been able to sustain the transition to lower levels of state-government funding, and there are some signs that the successes in the biotechnology and information-technology fields were translating into clean-technology business development as well.

To support green business development, the state launched the Green Business Fund in 2007, but the initial grants were small in comparison with investments found in other states (\$1 million per round). In 2009 the newly elected Governor Purdie announced a plan to use ARRA funds to expand the pool to \$10 million (Pearson 2009). The most likely industrial foci are biofuels and solar. In 2007 North Carolina established a strategic plan for its biofuels industry and began its implementation with the establishment of the Biofuels Center of North Carolina (State of North Carolina 2007). In 2008 the state’s biodiesel companies formed a trade association to promote the industry. The Biofuels Center lists about twenty biofuels companies across the state, with strengths in biodiesel, and it awards grants to the industry to support

research and education projects. However, only one of the companies was listed as among the 50 “hottest” bioenergy companies in *Biofuels Digest*. The total value of the grants awarded during the first years of operation was relatively modest (less than \$5 million per year) in comparison with some of the biofuels investments occurring elsewhere. One of the goals of the center is to have ten percent of the state’s liquid fuels grown within the state by 2017.

Since 1988 the state government has supported the North Carolina Solar Center at North Carolina State University. Over the years it has become a general information center for support of renewable energy industries and building efficiency. The university also is home to several research centers related to solar energy, including the Silicon Solar Consortium, an Industry/University Cooperative Research Center that is sponsored by the National Science Foundation. The University of North Carolina at Chapel Hill also hosts the Solar Energy Research Center, which has received support from the U.S. Department of Energy as an energy frontier research center. The state is home to several solar companies, including Enertia Building Systems, K-Flex, SBM Solar, Solargenix, SunQuest, and Surry Solar Services.

The FREEDM (Future Renewable Electric Energy Delivery and Management) Systems Center at North Carolina State University is an engineering research center sponsored by the National Science Foundation that links research at several universities across the country for work on green energy and smart-grid technologies. The program also offers graduate training in smart-grid technologies and renewable energy systems, and it has over 65 industrial partners (DeGraff 2008).

South Carolina

In the clean-energy field, South Carolina is best known for its efforts to develop a fuel-cell industry. In 2007 the state passed the Hydrogen Infrastructure Development Act, which allocated \$15 million over three years toward hydrogen infrastructure development. Interstate 20 between Aiken and Columbia became a “hydrogen highway” with fueling stations. The Savannah River National Laboratory (2009) claims to have the largest concentration of hydrogen experts in the country. Although known for weapons research (as in hydrogen bombs), the laboratory also conducts research on hydrogen storage and metal hydrides. Much of the research is classified, but the laboratory engages in partnerships with automobile manufacturers and local universities. In 2006 Aiken County launched Center for Hydrogen Research (subsequently the Center for Applied Research: Hydrogen) adjacent to the national laboratory to catalyze research and industry partnerships. The other pillar of hydrogen research in the state is the University of South Carolina (2009), which has conducted fuel-cell and hydrogen research since the 1980s. By 2010 the university had four research centers related to fuel-cell and hydrogen research. It received recognition as one of the 31 “energy frontier research centers” sponsored by the U.S. Department of Energy and was designated by the National Science Foundation as the Industry/University Cooperative Center for Fuel Cells. Transportation and materials science research at Clemson University and South Carolina State University also includes fuel-cell specialties, and BMW, which has a factory in South Carolina, has piloted fuel-cell vehicles. The cluster of companies in the state that are engaged in work related to the hydrogen and fuel-cell industry includes Collexis Holdings, Dantherm, Küsters Zima, Logan Energy, Midlands Tech,

and Trulite. There are more energy- and fuel-cell-related companies in the technology incubator at the University of South Carolina, which has worked in collaboration with the city of Columbia and local firms to develop the industry in the region.

South Carolina is a regional center for wind manufacturing due to General Electric's large wind turbine design and manufacturing center in Greenville and several bearing manufacturers in the state. As in the case of the Midwestern automotive industry, there is some potential for the automotive supply chain in South Carolina other neighboring states to contribute to the wind industry. In 2009 the Clemson University Restoration Institute received \$45 million from the U.S. Department of Energy, with \$53 million in matching funds, to establish a drive-train testing facility for wind turbines. There is some hope that the off-shore wind resources could enable the state to establish a wind industry cluster, but the demand side of the industrial cluster will require a commitment from the state government to develop offshore wind. Meanwhile, the testing facility has begun to attract companies, such as the German wind turbine manufacturer IMO Group.

Tennessee

Tennessee Governor Phil Bredesen has been a supporter of green jobs and clean-energy companies, and the state has made some progress in the biofuels, solar, and electric vehicle industries.

With respect to biofuels, in 2006 Governor Bredesen established the Alternative Fuels Working Group for the state, and in the following year the state's legislature allocated \$72 million to develop biofuels. In 2008 the state announced a partnership with DuPont Danisco Cellulosic Ethanol and the University of Tennessee that included a \$40 million investment from the state to develop a pilot plant for cellulosic ethanol and a research and development facility. In 2007 Oak Ridge National Laboratory was also designated as one of three national centers to receive a total of \$375 million for cellulosic ethanol research, with the University of Tennessee named as one of the collaborators (Childs 2007). Although Oak Ridge works with companies and universities as far away as Hanover, New Hampshire, its location in the state provides an important resource.

The Oak Ridge National Laboratory also has solar-energy research in its Solar Technologies Laboratory, Center for Advanced Thin-Film Solar Cells, and other research centers and facilities. To develop the state's solar industry, in 2002 the state government launched the Tennessee Million Solar Roofs program, which was funded by the U.S. Department of Energy to bring together stakeholders to reduce barriers to solar energy use. The next year the Tennessee Valley Authority launched the Green Power Switch Generation Partners program, which provided incentives and support for renewable energy installation. In 2006 the state Department of Economic and Community Development offered the Tennessee Clean Energy Technology grant program to support renewable energy installation, and the next year Knoxville was named a Solar America City. The state government also recruited solar manufacturers to locate in the state, and its economic development efforts have led to new factories owned by Sharp, Hemlock Semiconductors, Wachter Chemie AG, and other companies. In 2009 the Volunteer State Solar

Initiative was launched, which will include a solar farm and a Solar Institute sponsored by the University of Tennessee. The solar farm will include an educational facility, and the Solar Institute will provide technical assistance and installation grants. Although Tennessee has made great headway in developing a solar installation and manufacturing industry in the state, crucial elements are lacking. A representative from the Southern Alliance for Clean Energy has noted that the TVA remains focused on coal and nuclear energy, and its efforts to promote solar energy have been limited (Gomberg 2009). The capacity to move upstream from installation and manufacturing to innovation and new technology development remains unproven.

Tennessee has an advantage with its location as the site of the North American headquarters of Nissan and home to a large manufacturing facility for the company. When Nissan moved into electric vehicle production, the state seized on some opportunities in this industry. In 2008 the state government, Tennessee Valley Authority, and Nissan announced a plan to promote electric vehicles by introducing charging stations in the state. With \$5 million in matching funds from the state government, the U.S. Department of Energy selected Tennessee in 2009 as one of five states (along with Arizona, California, Oregon, and Washington) to test a release of electric vehicles (State of Tennessee 2009).

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The West is a mixed region. California is the national center of clean-energy innovation and policy, and other states in the region benefit from spill-over effects from California. The states of Colorado, Hawaii, New Mexico, Oregon, and Washington have strong demand policies, and the governors in some of the states have made green jobs central to their administrations. The Pacific Northwest has a strong environmental ethic, emergent industrial clusters, and grassroots support from major cities. However, interest in green jobs is highly variable in the region, and in some states coal mining companies have played a role in dampening interest in clean-energy development.

The West



California

Analysis and Summary

California has the scale of many national governments. Commonly cited statistics mention that if it were an independent country, its economy would be roughly the sixth, seventh, or tenth largest in the world, depending on the year and metrics that are used. It also has a strong innovation culture and broad public support for environmental policies. As a result, it has innovated in many areas of general environmental policy. The state does not have the strong and concentrated economic development policies found in Ohio and Michigan, nor does it have the concentrated clean-energy innovation apparatus as in Massachusetts. Nevertheless, California has many noteworthy innovations for state-government green jobs and green business policies, among which are the following:

- Strong public benefits funds with over \$60 million per year for research and development.
- Goals for in-state production of biofuels.
- Plans for building codes that target net zero emissions for new buildings.
- Leadership in models for community choice, clean-energy revenue bonds, PACE bonds, and feed-in tariffs.
- Strong state-government support for green-jobs training programs, with programs available for persons with employment barriers.
- State government support for research and development in the public university system, including dedicated clean-energy research institutes, and among firms.
- Industrial clusters in all of the industries covered in this report.

At the city level, California cities have often broken new ground in urban policies. In some cases, the green-transition policies appear to be driven more by business elites and city-government leaders, but in other cases there is substantial involvement from grassroots groups. We identified the following urban-level policies with respect to green jobs and green business development as especially noteworthy.

- In cities such as Sacramento, San Diego, San José, concentrated efforts by city governments to support and develop clean-tech industries through the development of new funding mechanisms, business associations, incubators, and training programs.
- An experimental “clean tech corridor” in Los Angeles, which may help foster cluster development through proximity, and a clean-up of the city’s port.
- In San Diego, a local purchasing policy to assist green businesses.
- In cities such as Oakland and Los Angeles, close partnerships with neighborhood, advocacy, and other civil society organizations to connect green jobs creation with broader community development goals.

General Background Policy

The state has a history of air quality and water management issues that have led to bipartisan support for green policy initiatives. Because it was the only state to have an air quality regulatory agency before the federal law was established, it was permitted to keep the agency, whereas other states were required to follow either California or federal law. Through the California Air Resources Board (CARB), the state has established some emissions and air quality standards that are higher than those of the federal government, thereby encouraging innovation.

Energy Goals. In 2002 the state set a goal of 20 percent electricity from renewable energy by 2017, and in 2010 it accelerated the goal to 20 percent by 2010 (SB 107). The renewable portfolio standard builds on previous initiatives dating back to the 1980s. A subsequent executive order in 2008 (S-14-08) increased the renewable electricity standard to 33 percent of the load for retail sellers by 2020.

Under the 2006 Global Warming Solutions Act (AB 32), the state government established a timetable for bringing greenhouse gas emissions to 1990 levels and charged the CARB with preparing plans for its implementation. In 2010 an opposition ballot measure was floated that would required the suspension of AB 32 until the unemployment rate is below 5.5 percent for one year. It was called the “California Jobs Initiative,” but even though an official report by CARB indicated that AB 32 would create jobs. Governor Schwarzenegger blasted the ballot initiative as the work of “greedy” Texas oil companies (Carey 2010).

California is also a participant in the Western Climate Initiative. It will join with other Western states and some Canadian provinces to implement a cap-and-trade system for greenhouse gas emissions that is scheduled to begin in 2012. The initiative will aim for a 15 percent reduction in greenhouse gas emissions levels from 2005 by 2020.

The state’s energy-efficiency goals have resulted in 4 percent electricity reduction for the state’s three largest investor-owned utilities (American Council for an Energy Efficient Economy 2010).

Other Energy Policies of Note. The State of California has broken policy ground in a number of areas, among which the most notable are electricity decoupling, community choice, and feed-in tariffs. In 1982 California became the first state to introduce electricity decoupling, a policy that maintains the revenues of a utility at a steady rate by adjusting prices up or down. The policy is intended to overcome a hurdle to energy conservation measures, and although it passes on increases in rate increases to customers, the customers also save by having greater support for energy conservation. Some groups believe that a better approach is to have an energy-efficiency utility or other public entity that encourages conservation measures. California’s decoupling policy contributed to the state’s relatively flat per capita electricity consumption, whereas other states have seen increases.

In 2002 California became one of the few states to approve community choice legislation. The legislation allows cities or other local government districts to aggregate electricity customers, with an opt-out provision, then bargain with electricity service providers over rates

and energy mix. In San Francisco, community-choice legislation went to the next level, when it was combined with a revenue bond to enable the construction of 350 megawatts of renewable electricity generation, distributed energy, and energy conservation projects. Other cities are pursuing the combination of community choice with revenue bonds. About forty cities in the state have pursued community choice aggregation, some with a renewable electricity standard of 51 percent by 2017. In 2010 Pacific Gas and Electric floated a ballot proposition against community choice called the “Taxpayers Right to Vote Act.” The proposition would have required local governments to obtain a two-thirds vote before using taxpayer funds to start a public power agency or expand to new customers. Although the utility spend tens of millions of dollars on the ballot proposition, voters defeated it in June 2010 (Hansen 2010).

A third innovative energy policy is the state’s feed-in tariff. Although the policy instrument has been used with success in Germany, Spain, and other countries to support the solar industry, it has been infrequently used in North America. Feed-in tariffs guarantee access to the grid for renewable energy generators such as residences and businesses, and they pay a long-term rate based on the cost of generation. California has used a “standard offer contract” since the 1980s at a price that supported wind energy but not the more expensive solar photovoltaic electricity. In 2008 the state directed the investor-owned utilities to offer a feed-in tariff, but again the price was not high enough to attract rooftop solar energy. In 2009 new legislation required utilities to pay customers for excess solar energy fed back into the grid (AB 920) and to establish a feed-in tariff (SB 32). The Renewable Energy and Economic Stimulus Act may solve some of the problems of the previous generations of feed-in tariffs (Wei and Kammen 2010).

Public Benefits Funds. California’s public benefits funds support the California Energy Commission at a rate of about \$65.5 million per year for renewable energy and \$62.5 million per year for research under the Public Interest Energy Research Program of the Research and Development Division of the California Energy Commission. In addition, there is \$228 million per year for energy efficiency that is administered by the utilities and supervised by the California Public Utilities Commission (California Energy Commission 2009, DSIRE 2010).

Green-Buildings Policy. An executive order by Governor Schwarzenegger of California in 2004 (S-20-04) required that all new and renovated state government buildings with state-government funding meet the silver certification level of the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) rating system. In the same year the state legislature approved the Governor’s Million Solar Roofs Initiative (SB 1). The legislation built on a much longer history of initiatives in support of solar-energy production in the state. Implemented by the California Public Utilities Commission as under California Solar Initiative, in cooperation with the California Energy Commission, the initiative had a budget of \$2.167 billion from 2007 to 2016 (Go Solar California 2010).

In 2009 the California Public Utilities Commission approved a \$3 billion plan for 2010-2012 for the state’s regulated utilities to support energy-efficiency improvements in the state’s residential and commercial buildings. The plan was the largest ever by a state for energy efficiency, and the commission claimed that it would 15,000 to 18,000 skilled jobs. The implementation included a target of 120,000 homes for retrofit as well as grants to local

governments for retrofits of public buildings. The plan also includes a goal of net zero energy for new residential homes by 2020 and for commercial buildings by 2030 (California Public Utilities Commission 2008, 2009).

In 2008 the state government approved AB 811, which allowed cities to fund solar rooftop that is paid for by a line on the property owner's tax bill. Originally developed in Berkeley, PACE became available statewide with the passage of the legislation. In 2010 the state approved the Property Assessed Clean Energy (PACE) Bond Reserve Fund (SB 77), which assists local governments in efforts to develop the financing for PACE programs.

Green Jobs Training. California has also shown leadership in legislation and programs that support green jobs training. The Green Collar Jobs Act of 2008 authorized a Green Jobs Council to assess training and resource needs for the state, develop public-private partnerships, and establish guidelines for green jobs training programs. In 2009 California announced two green jobs programs. The California Green Corps, funded with \$10 million federal stimulus money and matching funds from public-private partnerships, offered 20-month training sessions for green-collar jobs for 1,500 at-risk youth and was administered via ten regional green corps centers operated by colleges, local governments, and workforce training centers (State of California 2009a, 2009b). Later that year the state announced a second, much larger program: the \$75 million California Clean Energy Workforce Training Program, which was planned to train 20,000 people for green jobs (Willon 2009). A report by the California Community Colleges projected that the most jobs will be in service industries such as solar installation technicians, wind turbine technicians, and in the green building occupations, rather than in manufacturing (Centers of Excellence 2008). In addition to the state programs, many California cities have an independent, local "conservation corps" that provides education, community services, and conservation work opportunities for at-risk youth. Increasingly, those organizations have developed more specific green jobs training programs. In addition to the state-sponsored green jobs corps and the local conservation corps, there are several unique city green jobs programs that will be described below. The Employment Development Department received \$6 million in ARRA funding in 2010 for green jobs training.

Clean-Energy Industry Development

General Background. Because of the size of its economy and high concern with environmental issues, California leads the nation in clean-tech businesses (10,209 in 2007) and was far ahead of second-place Texas (4,802) and third-place Florida (3,831; Pew Charitable Trusts 2009). The state's position in clean energy also derives from the spill-over effects of the entrepreneurialism of Silicon Valley and the southern California cities. California leads the country in number of leading venture capitalists, level of investments, and patents (Burtis et al. 2004, Pew Charitable Trusts 2009). The trend was also upward for California, which received 34% of venture capital investment in 2005, 56% of in 2008, and 60% in 2009 (Cleantech Group and E2 2009; Cleantech Group 2009b).

California has a strong venture capital industry that has invested in biofuels, solar energy, smart-grid technologies, and other clean-energy technologies. As a result, the need for state-government support of early-stage companies is lower than in other states. Nevertheless, the state

has supported early-stage companies in the green-tech industries through a few programs. Under the Green Wave Initiative of the California state treasurer in partnership with CalPERS and Cal STRS in 2004, the public pension funds pledged to invest \$450 million in private equity and venture capital for clean-tech companies (State of California 2005). The California Clean Energy Fund (2009) launched in 2004 as a nonprofit corporation with \$30 million in settlements from the PG&E bankruptcy, also supported new companies in partnership with three venture capital funds: Nth Power, Element Partners, and VantagePoint Venture Partners. Until 2010, the California Resources Board had a small program (about \$1 million per year) that awarded funds for demonstration projects through the California Innovative Clean Air Technologies (ICAT) program.

California does not have a concentrated clean-tech business development program such as Massachusetts, but the state government has various programs that provide support for clean-energy businesses. One major source is the California Energy Commission's annual research budget, a portion of which goes to businesses for new technology development. In 2010 the California Energy Commission announced the merger of two programs under the Clean Energy Manufacturing Program. The Clean Energy Business Financing Program uses ARRA funds to support a \$30.6 million revolving loan program for clean-energy businesses that improve manufacturing facilities located in the state. The second program, Alternative and Renewable Fuel and Vehicle Technology Program provides support for companies in the biofuels (\$40.5 million) and vehicle and component manufacturing (\$19 million) industries. The intention of both programs is to rebuild in-state manufacturing and refining jobs (Sustainable Business 2010). In 2010 state legislation (SB 71) added to the efforts by providing a sales tax exemption for purchases of green manufacturing equipment. Another significant source of funds is through the California Industrial Development Financing Advisory Commission, which offered \$100 million per year of industrial bonds to businesses in 2007 and 2008 before declining in 2009. The program also supported businesses that engaged in clean manufacturing that created jobs.

The state government has contributed significantly to the clean-energy research infrastructure, at least up until the budget crises of 2008 and after. The Energy Institute of the University of California links together energy-related research of the system's campuses, and it also connects research with government and industry. In 2000 the state provided \$100 million to start the California Institutes of Science and Innovation, which are located on various campuses of the state university system. Although those institutes were not specifically focused on green technology, there were spill-over effects. Furthermore, in 2006 the state provided \$30 million to support the Helios Laboratory at the Lawrence Berkeley National Laboratory, a research center that studies energy-storage technologies associated with solar energy (State of California 2006).

There are also considerable resources in the private universities. For example, in 2002 Stanford University launched the Global Climate and Energy Project (2009) with pledges from ExxonMobil, General Electric, Schlumberger, and Toyota for up to \$225 million over a decade. The project links researchers at Stanford and across the world who are engaging in research on solar, biomass, hydrogen, carbon sequestration, and other topics. In 2006 Stanford launched the Precourt Energy Efficiency Center, which will explore buildings, vehicles, electricity storage, and smart-grid technologies. The TomKat Center for Sustainable Energy will focus on materials and energy conversion problems such as photovoltaics, fuel cells, batteries, and grid conversion.

the Precourt Institute for Energy at Stanford was launched with initial pledges of \$100 million. The institute will include three centers, two of which are pre-existing.

Biofuels. California has the highest number of headquarters of leading biofuels firms, with over 30 percent of fifty of the world's "hottest" bioenergy firms in *Biofuels Digest* for 2009-2010. The strength in the area is due to spill-over from Silicon Valley entrepreneurialism and the San Diego biotechnology cluster, but the state government has also supported the industry. For example, in 2006 Governor Schwarzenegger announced a target of producing 40 percent of the state's biofuels within the state and 20 percent of the state's renewable electricity from biomass produced within the state, both with a 2020 target date (California Energy Commission 2006). In 2007 he announced an executive order (S-01-07) for the country's first low-carbon fuel standard, which sets a goal of a 10 percent reduction in carbon emissions from passenger fuel vehicles by 2020. At UC Davis there is a center for biofuels research supported by a \$25 million grant from Chevron. The state also promised \$40 million in matching funds for the Energy Biosciences Institute, which was supported with \$500 million from British Petroleum, in partnership with the Lawrence Berkeley National Laboratory and the University of Illinois at Urbana-Champaign (Sanders 2007). Lawrence Livermore Laboratories, in collaboration with the University of California at Berkeley, University of California at Davis, and Stanford University, also was designated one of the three centers to receive a portion of the \$375 million allotted by the U.S. Department of Energy for cellulosic ethanol research (Childs 2007). In San Diego there is a cluster of academic researchers and firms specialized in algae-based biofuels who have formed the San Diego Center for Algae-Based biofuels, which links five local research institutes: Scripps Research Institute, UC San Diego, Scripps Institution of Oceanography, the Salk Institute and San Diego State University. In 2009 ExxonMobil announced a \$600 million partnership with Synthetic Genomics, a biotechnology company founded by Craig Ventner and located in La Jolla (Bigelow 2009, Filkes 2009).

Smart-Grid and Building Technologies. California also has leadership in the smart-grid and buildings systems industry, and it also received over \$400 million in awards from the U.S. Department of Energy in 2009 for smart-grid development (Chong 2009). The state is distinguished from other states because it also has become the country's center of smart-grid companies. Both Cisco and Google have entered the smart meter market in addition to smaller companies such as Silver Spring Networks and SynapSense, and the company eMeter has received some prominent contracts (see Ritch 2009). For regional projects, see the discussion in the cities section below.

Solar. California has the country's highest number of headquarters of solar-energy manufacturing firms. The industry is located throughout the state, but there is a concentration of manufacturing firms in the San Francisco Bay area. In 2009 the University of California system funded the California Advanced Solar Technologies Institute at three of the state universities, and in the same year the California Energy Commission helped to form the California Solar Energy Collaborative to identify roadmaps for solar energy research and policy. California has also done well at capturing the large grants (generally at \$15-\$20 million over five years) from the U.S. Department of Energy (2009) for the Energy Frontier Research Centers. Grants for solar energy-related research went to Cal Tech, Stanford, UC Santa Barbara, UCLA, and the University of Southern California.

Transportation and Energy Storage. The state government has consistently created a regulatory climate that favored the use of the state for technological innovation. In the late 1990s the state established a zero-emission vehicle mandate, which led to the production of electric vehicles. The automotive industry fought the mandate and eventually brought about a reversal of the mandate from the CARB. However, interest in electric vehicles continued in the state, and it is currently home to several electric vehicle manufacturers, including Tesla. There are institutes for transportation studies at U.C. Berkeley and U.C. Davis, as well as the Plug-In Hybrid Electric Vehicle Center at U.C. Davis, which provide the institutional home for a wide range of research projects from engineering to policy.

With respect to fuel cells, in 2004 Governor Schwarzenegger announced the “hydrogen highway” for California (S-07-04). The hydrogen highway did not appear as completely as anticipated, with only thirty-one stations completed out of a target of 100 by 2010 (King 2010). In retrospect the support at the federal government level for hydrogen vehicles was linked to automotive industry’s concern with the growing popularity of electric vehicles. When the Obama administration came into power, federal government support shifted to back electric and hybrid-electric vehicles with biofuels. Although hydrogen-fueled vehicles have turned out to be expensive and only feasible in the long term, the fuel-cell industry, which is based on a wider array of technologies than hydrogen, has achieved more traction. In 1998, U.C. Irvine launched the National Fuel Cell Research Center, which was funded by the Department of Energy and California Energy Commission. The organization researches fuel cells for vehicles as well as residential uses. In 2001 the state founded the California Stationary Fuel Cell Collaborative, which has led to installations across the state. The California Fuel Cell Partnership was formed in 2009 as a partnership between government agencies and industry to support the continued growth of hydrogen fuel-cell vehicles. However, fuel-cell vehicles have increasingly lost ground to electric and plug-in electric vehicles, and while California remains a center for the testing of fuel-cell vehicles, the potential for commercialization in the short term may be limited. The state is home to some fuel-cell manufacturers, including Bloom Energy, ClearEdge Power, Jadoo Power, Oorja Protonics, Polyfuel, and UltraCell Corporation.

Wind. California also has a wind industry that dates back to the early twentieth century, when wind mills were used to power wells on the state’s farms. Given the state’s demand-side policies and large population, it is not surprising that it has one of the highest levels of installed wind generation in the country. The state also includes some prominent wind manufacturing companies, including the General Electric facility in Tehachapi, Clipper, Continental Wind, Mitsubishi Power Systems, and a variety of suppliers (Sterzinger and Svrcsek 2004). However, other states have aggressively recruited wind manufacturers, and they also have major research and testing facilities.

California Cities

We focused on four cities in the state (Los Angeles, Oakland, San Francisco, and San Diego), for which Gresh conducted interviews and site visits. We also include brief discussions of Sacramento and San José based on publicly available sources.

Los Angeles

As the fourteenth largest economy in the world, Los Angeles has the potential to make a significant impact by developing in a sustainable way. In comparison with other California cities, Los Angeles has an inclusive model of growth that incorporates low-income, disadvantaged residents within regulatory structures like the Green Building Retrofit Ordinance and future renewable energy plans. The city has strong sustainability leadership through Mayor Antonio Villaraigosa and the Mayor's Office, as demonstrated by Green LA plan. The Green LA plan establishes carbon emissions targets at 35 percent below 1990 levels (a goal that exceeds the Kyoto Protocol agreement). The publicly owned utilities and assets (such as the Los Angeles Department of Water and Power (LADWP), Los Angeles World Airports (LAWA), and the Port of Los Angeles) have given the city government more control over some of its greening initiatives than in cities that lack such large, publicly controlled institutions.

Sustainability Plans. With 2004 carbon dioxide emissions produced at the level of Sweden, and forming part of the fourteenth largest economy in the world with over four million residents spanning 469 square miles, Mayor Antonio Villaraigosa has sought to transform LA as a major contributor of global climate change to a model of urban sustainability. The goal is to make LA the “cleanest and greenest big city in America” (City of Los Angeles 2007: 2). As part of the growing awareness of the negative environmental impacts of global climate change on the city and its residents, the city produced a climate action plan in May of 2007 called “Green LA: An Action Plan to Lead the Nation in Fighting Global Warming.” The document goes beyond existing city conservation strategies by setting a goal to reduce carbon dioxide emissions to 35 percent below 1990 levels by the year 2030. The vision in the Green LA plan is to meet the reduction goal by elaborating on the city's direct role, capacities, and community influence to grow a green economy as well as to produce a greener and cleaner city. It focuses on transforming city operations and employee practices, greening city buildings, and promoting sustainable practices for residents and businesses. The plan makes use of LA's direct influence over its publicly owned assets—Los Angeles Department of Water and Power (LADWP), Los Angeles World Airports (LAWA), and the Port of Los Angeles—to lower greenhouse gas emissions and stimulate market demand for green technologies, products, and services. Additionally, it calls for leveraging city resources to promote private investment as well as green business clusters and for the participation of disadvantaged communities through green workforce development. The Green LA plan creates 50 action items with a focus in the following areas: energy, water, transportation, land use, waste, port, airport, green spaces, and green economy (City of Los Angeles 2007).

A year later in 2008 the city adopted the implementation program for Green LA called “Climate LA: Municipal Program Implementing the GreenLA Climate Action Plan.” The implementation program provides more detail and context to each action item by identifying the leading actors, providing calculations of impacts where possible, as well as developing a timeline for each item identified in the Green LA plan. The plan targets energy through greening LADWP, greening private and public buildings, and helping residents conserve energy. Other initiatives such as greening the city vehicle fleet, reducing water consumption, and offering rebates for energy-efficient appliances were included (City of Los Angeles 2008a). To promote sustainable practices within city operations, in July of 2007 the mayor issued Executive Directive 10, which establishes departmental sustainability plans as well as mandating green building practices.

Following its sustainability plans, the City of Los Angeles has also pursued plans to invest in renewable-energy pathways such as geothermal, biomass, wind power, and especially solar. In November of 2008, Mayor Villaraigosa announced Solar LA, a plan designed to leverage LADWP in the development of 1.3 gigawatts of solar energy by 2020 via rooftop solar, local projects owned by the department, and large-scale projects outside the city. According to the document, between 200 and 400 new jobs are potentially created with every 10 megawatts of solar energy in the areas of research and development, manufacturing, installation, maintenance and repair (City of Los Angeles 2008b). However, in 2009 the voters defeated Measure B, the ballot initiative that would have implemented a component of the plan by installing 400 megawatts of solar panels throughout the city. According to the document, between 200 and 400 new jobs are potentially created with every ten megawatts of solar energy in the areas of research and development, manufacturing, installation, maintenance, and repair (City of Los Angeles 2008b). A setback in the solar plan occurred with the 2009 voter defeat of Measure B, known as the Los Angeles Green Energy and Good Jobs for Los Angeles Initiative. This measure would have implemented a component of the larger plan to install 400 megawatts of solar panels on LA city buildings. However, opponents charged that rates would rise and without the public’s knowledge would put the city council in the driver’s seat (LA Times Editorial Board 2009). Currently, the city is engaged in alternative ways to go forward with the 400 megawatts installation.

Despite the defeat of Measure B, there is still interest within the city to harness the potential of solar energy. In March, 2010, the mayor proposed a carbon reduction surcharge that raises average monthly utility rates by less than \$2.50 per month, creates a solar feed-in tariff, and includes a Renewable Energy and Efficiency Trust Fund for investment in energy efficiency. The energy-efficiency component creates partnerships with the Los Angeles Community College District, Community Development Department, and the Joint Training Institute for entry-level workforce training in energy audits and retrofits. The establishment of a solar feed-in tariff makes it possible for in-basin solar facilities to sell back electricity to the grid through a twenty-year purchase-power agreement. The intent is to promote energy efficiency while creating jobs within this solar industry as well as grid administration and upgrades. With regard to wind power, Los Angeles has also completed the first municipally owned 8,000 acre wind farm, “Pine Tree,” which produces enough wind power for 56,000 homes (City of Los Angeles 2010a; City of Los Angeles 2010b).

Los Angeles is not unlike other cities in our report that have had to reorganize city budgets in the face of the economic crisis while still providing necessary services and functions. Effective in June 2010, the city eliminated the Environmental Affairs Department (EAD) and shifted key functions and staff to the Bureau of Sanitation, Department of Transportation, and Department of Building and Safety. Dispersing staff throughout these departments is also part of a larger intention to distribute environmentalism while preserving core programs. As a result, the mayor expanded his Energy and Environment Office to include sustainability. Now called the Office of Energy, Environment, and Sustainability, this reorganization “reflects the necessary interrelationship of energy, environmental and sustainability policy,” while also coordinating and overseeing these efforts (Mayor’s Office 2010a). This restructuring also replaced the Environmental Affairs Commission with the Environmental Advisory Council, which includes a cross-section of the city’s central environmental, academic, labor, community, environmental justice, and business leaders. Currently, the sustainability program is creating a framework for a communitywide sustainability plan for 4.4 million LA residents. Working with the public, UCLA, and U.C. Irvine, the plan’s completion is expected by the end of 2011 (Mayor’s Office 2010a).

Efforts to create regional climate action and adaptation plans are also underway through a collaboration created with seed funding provided by the organization NextTen (Mayor’s Office 2010a). The collaboration is composed of members from the city and county governments including the Metropolitan Transit Agency, local Councils of Government, watershed management groups, environmental organizations, and others. Created with the understanding that the region’s eighty-eight cities, the county, and the city all share the same watershed and airshed, one of the objectives for this collaboration is to put climate action and sustainability on a unidirectional pathway through shared goals. Such a plan would reduce federal and state costs while at the same time provide regional autonomy with regard to project management and grant distribution.

In a recent request on Capitol Hill in May, Mayor Villaraigosa asked the federal government to partner with the City to help raise funds for local sustainable transit projects. While the government has already pledged funding for twelve major projects over the course of thirty years, Villaraigosa is asking for financing to help the city complete projects in ten years. Calling for the government to create a national bank or I-Fund for development projects, he cited the recent half-cent transportation tax (Measure R) that was approved by Los Angeles citizens in November of 2008 that created a revenue stream for the improvement of the police force as well as the expansion and improvement of transportation systems such as high-speed rail. Villaraigosa has argued that this local-federal partnership, or 30/10 Transit Initiative, helps create “green jobs, reduces dependence on foreign oil, and cleans our air.” According to the 2010-2011 budget summary, the initiative is projected to create approximately 170,000 construction jobs over the next ten years (City of Los Angeles 2010c; City of Los Angeles 2010d).

Green-Building Initiatives. Working within the Green LA framework, one of the ways in which the city has stimulated the local green economy and an inclusive model of sustainable development is through its support and collaboration with the city’s Apollo Alliance. Driven by local labor, environment, and community-based organizations, the Apollo Alliance introduced and helped the city to draft the Green Building Retrofits Ordinance, which was passed in April,

2009. The ordinance mandates a rating of LEED silver or higher for existing city buildings over 7500 square feet or buildings constructed prior to 1978. Significantly, the ordinance connects green-building retrofits to local poverty alleviation by requiring the city to hire local residents for the retrofit of its 1,000 municipal buildings. The ordinance also supports the development of workforce training programs that are currently underway. Formalizing the commitment to invest in the physical landscape of communities hit hard by the Great Recession and the longer-term economic distress of deindustrialization, the ordinance also establishes a program goal to retrofit at least 50 percent of city buildings that are located in areas with high levels of poverty and unemployment.

To oversee these goals and create shared governance between the city and civil society groups, the ordinance established an advisory council, composed of representatives from environmental, labor, and community organizations, among others. The council makes recommendations to the Green Retrofit Development Interdepartmental Task Force and its Program Director, who is part of the Mayor's Office of Energy, Environment, and Sustainability. Of the city's \$37 million received in Energy Efficiency Block Grants, the city allocated \$16 million to the Green Retrofit and Workforce Program, the largest sum awarded out of a dozen city projects. (The city received \$37 million in EEBG funds and divided it up according to twelve or thirteen areas of focus. This program—retrofitting existing buildings—received the most of the dozen program areas.) Currently, the program is working on pilot projects that experiment with green-building practices and come online in September, 2010. As a model for green sustainable development nationwide, what began as a community-driven effort has become institutionalized as part of the city's framework for poverty alleviation that simultaneously addresses the environmental crisis by greening existing city buildings (City of Los Angeles 2009a; Delp, Stewart, and Applebaum 2009; Mayor's Office 2010a, 2010b).

The city also approved a green building ordinance for the private sector in April of 2008. The ordinance mandated LEED certification for all new private-sector projects at or greater than 50,000 square feet or 50 units. As an incentive, for those projects going beyond the general LEED certification, applications will be expedited through the Planning and Public Works Departments (City of Los Angeles 2008c; Environment News Service 2008). To encourage greening of private-sector buildings, the city also has a Green Business Certification Program that certifies businesses in compliance with program standards for resource conservation, pollution prevention, and minimizing waste. The green hotels component is the first area of focus for the city, and the city recently oversaw the certification for LA's largest hotel, the Westin's Bonaventure Hotel & Suites. The Green Hotels program works with the non-profit organization Green Seal to complete certification. A local community college is the contractor for the city, which provides training for business audits and expertise for the certification process. With the \$20,000 in upfront investment, the hotel is said to have saved about \$225,000 per year. According to the mayor's office, this program has been successful and currently has applications in process (City of Los Angeles 2009b; Mayor's Office 2010a).

For the private sector (both residential and commercial users), the LADWP also offers several options to power their homes or businesses with solar energy. Under the SB1 California Solar Initiative signed into law in 2006, the LADWP offers the Residential Solar Power Incentive, which provides a financial incentive for those who pay for and install their own solar

power systems. The city also has AB 8-11, the local implementation of the PACE program, that will focus on financing energy retrofits for homeowners. As part of AB 8-11, the program will also ensure adequate sizing of solar systems so consumers do not overpay for their systems, and UCLA is currently working on adaptation modeling that looks at in-basin energy generation potential (Mayor's Office 2010a). The PACE program is currently on-hold pending a lawsuit in California and federal policy negotiations.

For those without the ability to install private systems, customers may invest in solar energy through the Green Power Program by paying an extra 3 cents per kilowatt-hour for renewable energy sources (City of Los Angeles 2008b). Also in the pipeline is the SunShares program, which allows customers to purchase a share of the LADWP solar power plant in exchange for monthly dividends that act as credits to their power bill (City of Los Angeles 2008b; LADWP 2007). Although the focus of AB 8-11 is homeowners, the city is also collaborating with the Clinton Climate Initiative to create a commercial financing program for energy retrofits. The hope is to implement a model that is financed through the commercial market, rather than selling bonds (Mayor's Office 2010a).

Green Jobs Training. Los Angeles has been a leader in green job development since 1986, when the Los Angeles Conservation Corps was founded. Billed as the nation's largest program of its kind, the organization provides job training for at-risk youth who work on environmental and service projects. Community colleges, such as Long Beach City College and Los Angeles Community College District, were also recipients of one of the state's eleven grants for its California Green Jobs Corps training programs for at-risk youth (State of California 2009a). In the last six months, further federal and state funding has gone to workforce training, targeting low-income, unemployed, and under-skilled people for green jobs. In January of 2010, the Los Angeles Community College District was awarded funds from the ARRA block grant under the Pathways out of Poverty initiative, which supports green jobs initiatives, many of which work in areas with poverty rates at 15 percent. They were given \$4 million for communities such as Watts and Willowbrook for workforce training, including services such as recruitment and referrals, occupational skills, and other resources (Hsu 2010). Veterans are also targeted recipients of recent employment grants through the State's Workforce Investment Act (WIA), which prepares veterans for high-wage clean-energy employment and other industries. \$12.7 million was distributed to organizations such as Community Career Development and Managed Care Solutions, Inc. among others, and is projected to help 2,200 veterans (California Employment Development Department 2010). Private-public partnerships such as the \$1 million green jobs initiative between Southern California Edison and California Community Colleges have helped to fund the Los Angeles Southwest College's new associate degree program in environmental science and technology (Rivera 2010).

Green Business Initiatives. Although the Green LA Action Plan did not directly address green jobs, Mayor Villaraigosa vigorously supported clean-tech industrial development in the city. In 2009 he announced the Clean Tech Los Angeles initiative, which involved a partnership among the city, the LADWP, the major universities, and the business community. According to sources from the Mayor's Office (2010a, 2010c), the idea is to create a model of sustainable development by transforming LA's historic industrial land in downtown area into a green business cluster called the Clean Tech Corridor. The mayor's plan includes a twenty-acre Clean

Tech Manufacturing Center, which houses clean-tech companies and manufacturers that adhere to mandated wage and living-wage requirements, as well as a Clean Innovations Research Center, which contains both a clean technology business incubator and clean technology research center. The goal of the business incubator is to foster the development of clean-tech startup companies by providing mentorship opportunities such as city-partnered demonstration projects that are linked up with interested investors, as well as provide clean tech resources through the research center. The research center will bring experts from the University of Southern California, UCLA, CalTech, and the LADWP together to work on energy and climate-change projects. In this way, the initiative will encourage and support the formation of clean-tech start-up companies, but it will also assist in recruiting new companies to the area in addition to working on climate change and energy problems (City of Los Angeles 2009c; Los Angeles Community Redevelopment Agency; Mayor's Office 2010a, 2010c). The incubator associated with CalTech, called "Entretec," has already produced and supported many companies in the clean-energy sector.

With regard to the creation of manufacturing jobs, the city is currently looking for a tenant at the manufacturing site after which a deal with the Italian manufacturing company AnsaldoBreda fell through in 2009. The company planned a factory that would build rail cars for the city's light-rail system and move its corporate headquarters to the city. Together the factory and headquarters were planned to create 661 direct jobs and generate over 2000 jobs through indirect and induced effects (Freeman, Cooper, and Poghosyan 2009). However, the Los Angeles County Metropolitan Transit Authority (MTA) refused to sign the deal. The company was alleged to have failed to meet quality standards on its previous contract (Los Angeles Times 2009). Since then the city has also considered a few solar companies; however, producers were not willing to share the risk with the city. Instead, they expected the city to purchase all output within a five-to-ten year time frame (Mayor's Office 2010c).

In April 2010, Mayor Villaraigosa enlisted the help of the Urban Land Institute (ULI) for expert advice on how to develop the clean-tech corridor into "the global capital of clean technology...that will create good-paying green jobs" (City of Los Angeles 2010e). This came after the Chinese hybrid-electric vehicle producer, BYD Co. (Build Your Dreams), announced plans to locate its headquarters in downtown LA near the Staples Center (Lopez 2010). The decision by the Chinese company to locate downtown coincides with the expansion of the State Enterprise Zone approved in May 2010. First Deputy Mayor Austin Beutner states that "the LAX approval, combined with BYD's arrival and the Valley area expansion, sets the stage to potentially create more than 25,000 jobs in Los Angeles in the near future" (City of Los Angeles 2010f).

In December 2009 Mayor Villagairosa announced another major new initiative: the Southern California Regional Plug-In Electric Vehicle Plan. He promised that the collaboration among cities in the Los Angeles area with utilities and automakers would make the area the nation's electric vehicle capital. Cities pledged to develop infrastructure, alter zoning codes where necessary, change fleet purchasing priorities, and educate consumers about electric vehicles. The plan also included incentives for early adopters, off-peak hour charging rates, and high-occupancy vehicle lanes for users of plug-in electric vehicles (City of Los Angeles 2009d). The hydrogen community is also working with the city as regional collaborator for the hydrogen

fuel-cell working group. Mercedes-Benz is coming out with a car in October 2010 and will be investing in hydrogen infrastructure in LA. This pilot program also has the potential to create green jobs and make LA a training hub for the development and maintenance of these vehicles.

In an effort to reduce emissions at the Port of Long Beach and Los Angeles, the city created the Technology Advancement Program (TAP) to support innovative green businesses by acting as an investor. Through the program, the city provided funding for entrepreneur Balwinder Samra, the owner of Balqon Corporation, to develop a heavy-duty port drayage vehicle. Due to Port's support, Balqon has located manufacturing there, and the Port currently receives \$1,000 for each vehicle Balqon sells or leases (City of Los Angeles 2010g). In addition to electric drayage vehicles, the Clean Trucks Program implemented as part of the Port's Clean Air Action Program has also generated over \$600 million in private investment for the purchase and leasing of low-emission trucks, of which 600 are natural gas vehicles. Since the 2008 ban on approximately 10,000 heavier polluting trucks at the ports, the rate of emissions declined 70 percent compared to the average emissions in 2007 (Port of Los Angeles). The city has also recently applied for a state grant to train mechanics at the port for maintaining alternative fuel vehicles (Port of Los Angeles 2010).

Civil Society Organizations and Policy. In 2006, a unique group of twenty-four labor, environmental, and community organizations formed the Apollo Alliance. The alliance is convened by SCOPE, a community-based organization in South Los Angeles. Creating a green jobs campaign, the LA Apollo Alliance focuses on the creation of green pathways out of poverty for low-income, disadvantaged populations through localized job creation. The organization also actively engages in an inclusive model of sustainable economic development for all people at all levels on the skill ladder. The LA Apollo Alliance pushes for green jobs that have benefits and worker protections, are safe, and provide pathways into career advancement.

After thorough research and planning, in 2006 the LA Apollo Alliance proposed their draft Green Building Plan to the city, which later became the Green Building Retrofit Ordinance adopted in 2009. Through this Ordinance, the Apollo Alliance linked a workforce strategy and inner city development with the city's need to reduce climate change and stimulate businesses and good jobs. Currently, experts and members of civil society organizations active in the effort serve on the Advisory Council to the Director of Green Retrofit and Workforce Programs and are engaging with the city in pilot projects for greening the inner city as well as citywide buildings (LA Apollo Alliance 2009; Lee 2010). The work of the LA Apollo Alliance serves as a national model for community engagement and democratic participation in the making of a new green economy.

Oakland and the East Bay

The East Bay (including Oakland, Berkeley, Richmond, and other cities) has been an incubator for innovative solutions such as PACE, direct install, and retrocommissioning. Oakland has a strong sustainability program, and the city collaborates with civil society organizations such as the Ella Baker Center and the Apollo Alliance to create a more inclusive and sustainable path to

development. Oakland also received five out of the twelve awarded California State Energy Program grants on account of its collaborations organizations throughout the region.

Sustainability Plans. Oakland was ranked within the top ten U.S. green cities eight times in four years preceding 2010 (City of Oakland 2009a, 2009b). What is now the Sustainable Oakland Program first started in 1997 with the Sustainable Community Development Initiative (SDCI), which began in the planning department but whose framework has increasingly informed everyday thinking within city departments (Fitzgerald 2010; Lautze 2010; Wentworth 2010). Sustainable Oakland unites “economic prosperity, social equity, and environmental quality” (the “Three E’s”) into an overall development framework that forges new relationships among the city, businesses, and civil society groups. This larger umbrella that guides the city’s activities is positioned as a corrective to serious challenges such as high poverty and crime rates (City of Oakland 1998).

The city of Oakland launched the SDCI, shortly before Mayor Jerry Brown took office. During his term the city supported various greening initiatives, including a civic green building ordinance and guidelines, transit-oriented development, and solar rooftop construction. However, according to Van Jones (2006), Brown failed to deliver fully on his campaign promises to green the city. Furthermore, Brown’s urban redevelopment plans drew criticism for encouraging gentrification rather than addressing urban poverty and housing needs. Nevertheless, Oakland has consistently received recognition on various sustainable city rankings. Under the leadership of Mayor Ron Dellums, who succeeded Brown as mayor in 2007, green economic development in Oakland has been more formally linked with green job creation. The report of the Task Force on Economic Development included suggestions for the creation of a green jobs corps and plans to green the Oakland army base and port (City of Oakland 2007).

In 2005 under the leadership of Mayor Jerry Brown, the city of Oakland signed the UN Urban Environmental Accords on United Nations World Environment Day, which committed the city to take twenty-one action steps in seven main areas: “energy, waste, urban design, transportation, environmental health, and water” (City of Oakland 2006a). Since 2009 the city has been developing an Energy and Climate Action Plan (ECAP), which incorporates a sustainable development strategy to reduce both energy consumption and greenhouse gas emissions by 36 percent as well as create green jobs. The draft ECAP is a ten-year plan that includes over 150 actions that reduces Oakland’s greenhouse gases by focusing on three major sources: transportation and land use, building energy use, and material consumption and waste. Two additional target areas—community engagement, and climate adaptation and increasing resilience—are also central areas identified in the initial Three Year Priority Implementation Plan. The ECAP anticipates that the overall plan will create demand for a green workforce in the areas of building construction and retrofits, solar installation, the creation of bikeways, and growing local food (City of Oakland 2010b).

Although the topic of waste is not directly a clean-energy issue, it is significant to note that the ECAP also incorporated its 2006 policy on zero waste, which calls for reducing the amount of waste that is sent to the landfill by 90 percent. Already an important hub for recycling industries, the zero waste plan improves existing efforts by restructuring the city’s solid waste management system to recycle more and reduce waste, capture and expand more materials for

reuse, recycling, and composting during the construction and demolition process, encourage waste reduction practices at community events by lending collection containers for recycling, and create new requirements for recycling (City of Oakland 2010b). Such policies are also projected to simulate the creation of local green-collar living wage jobs (Dowdakin 2010).

According to the Sustainability Coordinator Garrett Fitzgerald, the sustainable development strategy uses policy to create demand for green services that drive green business growth and the need for a green workforce. Part of the puzzle is financing, and the recent stimulus money from the State Energy Program awarded to Oakland and its regional partners will help to bring these proposed plans into reality. Totalling more than \$40 million, five stimulus grants were awarded that included PACE and energy retrofit programs for residential, commercial, municipal, and affordable housing projects (Fitzgerald 2010).

Green-Buildings Initiatives. Oakland was recently ranked second only to San Francisco as a top market for green building possibilities, a key area of opportunity for green job creation (Cushman and Wakefield 2010). Since the late 1980s, the city has prioritized and begun the process of performing energy-efficiency upgrades on its largest 140 buildings, of which 120 have been completed. Interestingly, services that are now part of Pacific Gas and Electric's core energy-efficiency programs—direct install (free energy audits with some free follow-up installations) and retrocommissioning (for public and private buildings)—were pioneered by teams like the Oakland Energy Partnership that emerged out of the California energy crisis in the early part of the decade. This partnership was funded by the California Public Utilities Commission (CPUC) and combined efforts from the Mayor's office, city energy staff, and researchers from Lawrence Berkeley National Lab and Quantum Consulting (Lawrence Berkeley National Laboratory 2003; Wentworth 2010).

In addition, in 2005 Oakland developed the Civic Green Building Ordinance that requires LEED silver for new civic buildings and major retrofits after 2005. This ordinance further promotes green-building techniques such as the use of sustainable wood products; reduction, reuse, and recycling of waste that is generated during demolition and construction; and the modification of heating, ventilation, and air-conditioning systems to provide energy efficiency and improved indoor air (City of Oakland 2005). The city is also in the process of developing a Green Building Ordinance for private development. If adopted, the ordinance will require all commercial and residential buildings and retrofits to meet green performance criteria as well (Fitzgerald 2010).

Because energy retrofits and solar installation are costly improvements and require upfront capital for investment, the financing of green-building initiatives is also focus for policymakers. Bordering Oakland in the East Bay, the city of Berkeley pioneered a unique program called BerkeleyFIRST for financing rooftop solar systems, which created the concept of property assessed clean-energy (PACE) financing. As originally conceived in Berkeley, a "Sustainable Energy Financing District" sells bonds through a financing company to socially responsible investors, then loans the money out to homeowners who install solar panels. With utility rebates and rebates from the state and federal governments, homeowners end up paying the district a price that approximates the cost of buying electricity from the grid. Furthermore, if the owners need to sell the house, the bill stays with the house as part of the property tax. Two

obstacles to investments in rooftop solar—the high cost of borrowing and the liquidity risk of not recouping the long-term investment if the owner moves—are surmounted. The original Berkeley model was implemented in a pilot program of thirty-eight homeowners (City of Berkeley 2009; Jenkins 2009).

Inspired by BerkeleyFirst, the statewide program CaliforniaFirst is being developed. The statewide program is expected to expand property-based financing to include energy retrofits and solar, and to expand eligible property owners to include homes and businesses. The programs are made possible by Assembly Bill 811, adopted in November of 2008, which allowed local government to adopt PACE programs (StopWaste.Org). As of July 2010, the programs were on hold pending federal policy decisions and, in California, state-level litigation.

The City of Oakland, in partnership with Quantum Energy Services and Technologies and the Community Energy Services Corporation, is also using \$4.8 million recently awarded by the State Energy Program to offer new support and incentives for commercial businesses to perform energy retrofits of existing buildings (emphasizing older buildings) and locate to downtown Oakland. This program will cover approximately 120 blocks of the downtown area and seek to reduce energy consumption and costs, create jobs, foster demand for green technologies, and further enhance Oakland's "Smart Growth" downtown (Lautze 2009). Another hidden incentive is Oakland's existing recycling market. That Oakland already has approximately thirty-five recycling and reuse companies in the area makes it easier for the adoption of green building practices, especially with regard to demolition and debris (Lautze 2010). Local businesses can also take advantage of energy efficiency through the East Bay Energy Watch, which offers services such as lighting upgrades and evaluations of building energy systems as a subcontractor to Pacific Gas and Electric (Fitzgerald 2009b; Wentworth 2010).

For low and moderate-income homeowners, the city of Oakland has also used \$2 million in Community Development Block Grant (CDBG) funds to create the Weatherization and Energy Retrofit Loan Program (WERLP) that rolled out in January of 2010. In this program homeowners can borrow up to \$30,000 for energy retrofitting (not including solar) and home rehabilitation. These loans have no interest, no periodic payments, and are paid back when the property is sold. This program also provides incentives for contractors to seek local employment and connects contractors with the Oakland Green Jobs Corps. Through this program, 108 jobs are anticipated (Green For All 2010).

The city has also received awards for its high number of installed solar-energy installations, including on city buildings, the Municipal Service Center, the downtown ice rink, the port, and on the rooftops of large businesses (City of Oakland 2009a).

Green Jobs Training. Oakland and its partners throughout the broader East Bay region have pioneered green workforce training programs that serve as inclusive models to sustainable development by creating pathways out of poverty that target low-income and disadvantaged communities. One such model is the Oakland Green Jobs Corps (OGJC), originally conceived by the Ella Baker Center (a local nonprofit organization co-founded by Van Jones that served as the incubator for Green For All) and the Apollo Alliance. In 2008 the Ella Baker Center partnered

with the Mayor's Office to secure \$250,000 in seed funding for the project, which has since received over \$600,000 in additional support from the State of California and the Yahoo Foundation (Ella Baker Center 2010a; Fitzgerald 2009a, 2010). This workforce development model is informed by professor Raquel Pinderhughes' work, which helped to identify and define green collar jobs as an effective strategy in serving communities with barriers to employment (2007).

Administered by the Peralta Community College District, the OGJC is led by three partners, each of which plays a role in workforce training and ongoing social support services: Laney Community College, the Cypress Mandela Training Center, and Growth Sector (Ella Baker Center 2010a). The program is uniquely designed to meet the specific needs of local employers and consists of three phases. In the first phase, students gain training in pre-apprenticeship construction and trade skills through a hands-on approach. The next phase follows with academic training on eco-literacy, solar installation, and energy efficiency, among other topics. In the last phase students are provided with paid on the job internships, which provide green-collar career paths (Fitzgerald 2009a). In June 2009, the Oakland Green Jobs Corps graduated its first class of forty students, who received jobs in solar and construction companies (Bender 2009).

The broader East Bay region features additional green jobs training programs that have gained broad attention. In Richmond, a city known for its poverty and environmental justice concerns associated with the refinery of the oil company Chevron, the city has also achieved strong leadership on green issues under Mayor Gayle McLaughlin. In 2007 the Richmond BUILD program was launched to provide employment opportunities for residents and reduce the area's violence. The program has been granted several awards, including the Conservation Champion Award given by Senator Barbara Boxer, and has also received national recognition (City of Richmond 2010a). The program offers a ten-week training curriculum that develops skills for pre-apprentice construction and solar installation. Students also have several days of on-the-job training by completing a live solar installation. The program operates with support from the city in partnership with nonprofit organizations, local unions, and local colleges such as Contra Costa College. Funding has also come from the federal government as well as corporate sponsors such as Chevron, Mechanics Bank, Home Depot, and others. In terms of placement rates and wages for their eleven graduates, thus far the program has been successful. According to Richmond BUILD, the program has achieved a 91 percent placement rate at an average wage of \$18.33 per hour. Part of the course is led by the nonprofit organization Solar Richmond, which trains students in solar energy installation (City of Richmond 2010b; Solar Richmond 2010). Their future work is focused on expanding the length of the solar program and solar certifications, as well incorporating youth into a Career Ladder for Energy Efficiency training (City of Richmond 2010b).

The Rising Sun Energy Center also offers green workforce training to adults and youth, but it is perhaps better known for its California Youth Energy Services Program (CYES). Initially started in 2000 through a residential energy workshop at Berkeley High School, the summer program now operates in ten cities in the Bay Area and includes youth ranging from ages fifteen to twenty-two. The program lasts seven weeks and trains youth as Energy Specialists to perform green house calls. These green house calls identify simple energy

inefficiencies in the home such as lighting and plumbing, provide free solutions such as the installation of lighting and clotheslines, and offer further energy-efficiency measures. The program targets renters, non-English speakers, and moderate-income households. According to the CYES, they have trained more than 550 youth and adults and provided services to more than 12,000 homes (Rising Sun Energy Center 2010).

Green Business Initiatives. Since 2007, Oakland has been working on two major initiatives to enroll and retain green businesses in Oakland: the Oakland Partnership Green Tech Cluster and the East Bay Green Corridor Partnership. Both of the initiatives generate partnerships between the public and private sectors that target green technology as a key growth industry sector in both Oakland and regionally. The cluster is composed of government, business, education, labor, and community organizations. It is currently working on several initiatives such as the Green Jobs Corps and the Green Workforce Academy. Other supporting policies include access to capital through the Oakland Business Development Corporation's Bay Area Green Business Loan Fund, as well as green certification for small businesses called the Bay Area Green Business Program (2010), which is coordinated through the Association of Bay Area Governments (Fitzgerald 2009b; Lautze 2009). In the last three years the city has chronicled and promoted the development of green businesses in Oakland by publishing a special insert in the *San Francisco Business Times* called "Oakland: Building Greening Business." The publication increases awareness of Oakland's green economy and opportunities for development (Fitzgerald 2010). In addition to attracting new businesses, Oakland promotes existing green businesses through the "Oakland Green Map." Brought online in March 2010, the map identifies green buildings and businesses as well as resources like recycling centers and community gardens (City of Oakland 2010b). In April, 2010, the city also hosted the Oakland Earth Expo, which brought together local green businesses, community and activist organizations, artists, and governmental agencies (City of Oakland 2010c).

The city is also part of the East Bay Green Corridor Partnership, which is a regional collaboration working to create a green economy by making use of academic clusters, government resources, and targeting green business development in the East Bay. Oakland has already been identified as a target for green development, and the city is currently home to 150 companies that have an inherently green product or service. The partnership has grown to encompass eight cities in the region and a total of thirteen partners, and it has recently brought on a staff person to lead the project. Part of the strategy is to nurture businesses "cradle to scale," which means to attract venture capital, accommodate and keep startups, foster the growth of existing green businesses, and work on expanding green supply chains (Lautze 2010). According to Fitzgerald (2009b) the partnership's second year will focus on collaboration with the private sector such as venture capitalists, brokers, and developers, as well as green entrepreneurs. In 2009 the group released a report that summarized focus group meetings with five green sectors (solar/alternative energy, green building, environmental consulting, recycling, and HVAC/home performance), and established goals for clean-tech business development in the region (Redman 2009). In addition, the partnership has also created the Green Academy Workforce Initiative to build a broad green labor market that provides green pathways for both entry-level positions as well as advanced level careers in both the private and public sectors. It also seeks to deepen green education by beginning curriculum in grades K-12 (Oakland Partnership 2007).

AC Transit, the public transit agency that serves Oakland and the East Bay, has also fostered private partnerships with Van Hool, UTC Power, and ISE Corporation to develop fuel-cell technology for the region (AC Transit 2010). In 2005 Oakland had three hydrogen buses—the most of any city in the nation at the time—that have become part of Oakland’s city bus fleet. A flagship project in its infancy, as of 2008 it was projected to grow to nine buses in 2009 (Murdoch 2008). The City of Oakland has also partnered with AC Transit to develop hydrogen energy fueling stations and has worked with U.C. Berkeley, Humboldt State University, and Chabot Space and Science Center in Oakland to develop a public education center called the HyRoad Learning Center (City of Oakland 2006c).

Oakland is also home to Sirona Fuels, a biodiesel manufacturer that uses waste oil and grease from restaurants and other sources to make diesel fuel for local trucks, boats, and buses that emits much lower levels of particulates, sulfur dioxide, and greenhouse gases than conventional fuel. In addition to Sirona, the East Bay Municipal Utility District (the regional water and wastewater utility) is developing another biodiesel production facility, based on its interest in using the plentiful glycerine byproduct of that process which EBMUD will feed into its surplus industrial scale methane digester capacity to produce electricity, which will be supplied to the local grid (Lautze 2010).

Many green jobs can also be found in Oakland’s approximately thirty-five recycling based businesses, which collectively employ approximately 1,000 people. The city has placed a priority on recycling-related green economic development through the creation of its Recycling Market Development Zone and Zero Waste Strategic Plan (Fitzgerald 2010).

Civil Society and Policy. Civil society groups have played a significant role in Oakland’s policy landscape since the election of Mayor Ronald Dellums, infusing green politics with a redistributive framework. Both the Ella Baker Center and the Apollo Alliance have worked with the city and Oakland residents to foster a green collar jobs campaign in an effort to make sustainable development inclusive and democratic. Recent efforts to influence the policy process have converged over the development of Oakland’s ECAP. The Oakland Climate Action Coalition was forged at the Ella Baker Center and hosts a coalition of community-based organizations, environmental experts and advocates, labor unions, and green businesses (Ella Baker Center 2010b, 2010c). The coalition rallied on March 30th at Oakland City Hall, and various city council members spoke. For example, council members Nancy Nadel and Rebecca Kaplan spoke about the importance of ongoing civil support to drive the shift from “killing guns” to “caulking guns” (ECAP Rally 2010a, 2010b).

Many of the coalition’s policy recommendations were included in the draft ECAP. The coalition has also taken a stance on recent energy policy, calling for Oakland to exercise authority granted under California’s Community Choice Aggregation law to form a Joint Powers Authority (JPA) to maximize the use of clean renewable energy delivered to Oakland residents and businesses via the grid and meet local energy needs. They argue the change will increase local hiring, create compliance with prevailing wage and project labor agreements for large-scale contracts, hire minority owned and union contractors, and create local manufacturing, monitoring, and reporting to the city and the public (Ella Baker Center 2010c).

Sacramento

Sustainability Plans. In 2007 the city developed the Sustainability Master Plan, which included goals for energy, air, urban design, nutrition and health, water, and open spaces (City of Sacramento 2007). It set a goal for 2030 of having city government electricity and vehicles “fossil free” and of reducing overall per capita energy consumption by 25 percent. It also set a target of adding 25,000 new jobs to the “renewable/clean-energy sector” by 2015. Although the goals are lofty, the city has the advantage of having a publicly controlled electricity utility (SMUD, or the Sacramento Area Municipal District), which is one of the greenest public power agencies in the country. In 2009 the city developed a 2030 General Plan, and in 2010 the city followed with the implementation plan of its Sustainability Master Plan, which documented achievements in 2009 and set goals for the next years. Sacramento County (2009) has developed a climate action plan, and the city is in the process of developing one as well (City of Sacramento 2010a). All of the plans focus on demand-side environmental issues such as programs to reduce greenhouse-gas emissions, but they do not explore the supply-side problems of developing a green business sector and green jobs. Even the economic development portion of the 2030 General Plan is not attuned to the issues. However, the focus shifted in 2010 under the green business initiatives of Mayor Kevin Johnson.

Green-Building Initiatives. The 2007 master plan set a target of LEED silver for all new city government buildings. It also set goals of having LEED-type ratings for all new and retrofit buildings, including commercial and residential, and of having 80 percent of all new construction be LEED certified (City of Sacramento 2007). The city also participates in a regional consortium, the Sacramento Regional Energy Alliance, that works on energy efficiency and retrofitting of the area’s buildings. The Business Environmental Resource Center (2010) also provides assistance to area businesses for greening of their operations and environmental compliance, and it also offers certification through the Sustainable Business Program.

Green Jobs Training. The Sacramento Area Employment Agency administers one of the California Green Jobs Corps programs (State of California 2009). California State University at Sacramento received a \$1 million grant for smart-grid job training, and the university has other programs oriented toward green-job training (Sacramento State University 2010). Likewise, the community colleges in the area have put together a strong suite of green jobs educational programs (Los Rios Community Colleges 2010).

Green Business Initiatives. In the state of the city address in 2010, Mayor Kevin Johnson announced his goal of making Sacramento a national hub for green businesses. In May, he launched his green initiative plans to transform the region into “Emerald Valley,” or a green version of Silicon Valley. The initiative will move forward based on monthly meetings of policy groups that are open to public participation (Hannon 2010). In concert with the initiative, U.S. Congresswoman Doris Matsui hosted a clean-tech forum at Sacramento State University in June (Lee 2010). The region has research facilities at U.C. Davis and Sacramento State University, the very environmentally oriented public power agency SMUD, and the state government. As a result, there are already many clean-energy businesses in the general region near Sacramento, and the city has held a leadership position within the state in green-job growth.

To support clean-energy businesses, the Sacramento Area Trade and Commerce Organization (2010) has partnered with the McClelland Technology Incubator to help clean-tech entrepreneurs. By 2010 the organization had assisted twenty-five companies and created 1,000 clean-tech jobs.

Although the state of California is strong in all of the green industries tracked in this study, the industry that the Sacramento region is poised to achieve a strong presence in is smart-grid technology manufacturing and production. The smart-grid company SynapSense is located in nearby Folsom, and in 2009 a group of Sacramento organizations (SMUD, Sacramento State University, Los Rios Community Colleges, and the state government's Department of General Services) received \$127 million in ARRA funding for a smart-grid project. Sacramento State also hosts the California Smart Grid Center, which develops curriculum and studies technology integration.

In summary, unlike some other cities across the country, Sacramento has substantial potential to develop its green businesses and create green jobs. The proximity to the Bay Area and state government, combined with lower real estate prices, make the region an especially strong candidate. The initiatives in green jobs are coming mostly from the business community, educational institutions, and city government, rather than grassroots and labor organizations. As a result, in contrast with Los Angeles and Oakland, the focus of green jobs is less on weatherization and installation and more on clean-tech. However, Mayor Johnson's planning process under the green initiative is open to all and was only getting started in mid 2010.

San Diego

Sustainability Plans. In 2007, San Diego was rated as the second largest city in California, with a population 1.7 million people and an area of 342 square miles (City of San Diego 2008a). In early 2002, the city council began the process of addressing climate change in their planning by adopting the San Diego Sustainable Community Program. This program approves San Diego's participation in the Cities for Climate Protection Campaign, which is administered through the International Council for Local Environmental Initiatives (ICLEI). The ICLEI requires participating cities to identify and inventory greenhouse gas emissions within their locality in the areas of energy use, transportation, and waste management, as well as create an action plan. Like many cities in California, the program also included the benchmark of a 15 percent reduction in greenhouse gases based on 1990 levels by 2010. In 2005, following suggestions of an *Ad Hoc* Advisory Committee, the City established their Climate Protection Action Plan, comparing sustainability across the three broad categories of transportation, energy, and waste. Interestingly, based on 1990 emissions levels, the report found that city operations contributed only 0.2 million tons of emissions out of the 15.5 million tons generated each year. Thus, the major sectors contributing to greenhouse gas production are communitywide – both the business community and residents. The climate plan also identified the transportation sector (followed by energy and waste) as a key agent in the production of greenhouse gases. The plan targets the following areas: transportation, energy, waste, ozone production, and environmentally preferable purchasing (City of San Diego 2005).

Although the city expressed that it can do more on its own part, the plan called on the larger community to aid in the reduction of carbon emissions: “If the largest one-hundred companies in San Diego put forward the same level of commitment, actively working to reduce the greenhouse gas emissions associated with their energy, water, and transportation operations, we would be much closer to reaching the 2010 target for the community” (2005: 10). The focus on the private sector creates challenges for the City of San Diego. Unlike cities like Los Angeles that own large facilities like the ports, airport, and utilities and thus have direct regulatory power to influence greenhouse gas reductions, the City of San Diego does not have similar publicly controlled institutions and thus relies upon communitywide participation to achieve its goals.

In March of 2008 the city adopted its General Plan but also included the local greenhouse gas emissions strategies in the general document. In this way the General Plan is consistent with Climate Protection Action Plan goals. First, the “Conservation Element” of the plan addresses sustainable development by focusing on the way growth happens. Part of this strategy is to redesign development for mobility on foot, bicycle, and transit by creating denser, mixed-use spaces connected to the transit system. Second, because buildings are also major contributors to greenhouse gases from design to use, buildings are targets for improvement through resource conservation, sustainable building practices, energy efficiency, and the use of clean technologies. Although the General Plan does not include language on green jobs, clean technology as a mechanism for achieving a new industry for businesses, employment, and technological innovation is recognized (City of San Diego 2008a, 2008b). The city adopted its Action Plan in 2009 for the General Plan and has since received \$250,000 for an updated Climate Action Plan, which is currently in process (City of San Diego 2009a, EHC 2010).

Green-Buildings Initiatives. The General Plan emphasizes the role of redesigning buildings for greenhouse gas reductions, but voluntary legislation for LEED began in 2002 (Jackson 2002). In 2002 the city encouraged the use of LEED silver for new city buildings, and the standard became mandatory under the 2008 Green Building Policy. According to this policy, all new City projects and major renovations over 5,000 square feet must be to LEED silver standards. Some notable city projects have been completed to LEED silver standards such as Fire Station 47 and Nobel Athletic Park and Recreation Center, as well as LEED gold such as George L. Stevens Senior Center, and Fire Station 29 (City of San Diego 2010a).

Although the measures pave the way for new City buildings and large renovations, there are some limitations. For instance, much of new development has significantly slowed down due to the Great Recession. Therefore, new green building regulations might not impact greenhouse gas reductions for years to come. Instead, retrofitting existing buildings will have a greater impact in the short-term.

For the private sector, the 2008 Ordinance is voluntary and offers as an incentive a program to expedite permitting. In addition, the Centre City Development Corporation has been working on a plan for private development in the downtown that widens the range of incentives and is building a framework that ideally is transferable to the region. Called the Centre City Green, the plan is a voluntary program that makes use of two incentive mechanisms for encouraging sustainable building practices. The first path a business can take is called the

performance path, which incentivizes standards that go above and beyond existing State regulations, such as Cal Green Tiers 1 and 2 as well as LEED silver or gold. A second option is the prescriptive path that prescribes high-energy yield green building measures such as high efficiency plumbing fixtures and on-site photovoltaics that the business owner can then choose according to the logic of their project. According to Sachin Kalbag (2010), the Senior Urban Planner/Urban Designer at the Centre City Development Corporation, working with the private sector is central to sustainable growth, especially in a climate where local governments have to cut back on resources. The logic is that with an already stringent California Green Building Code coming out in January 2011, an incentive-based approach that builds upon the code will create an even playing field for bringing more sustainable development into the city. It can also provide a framework for the region that supports measures like AB 32 and AB 375, which target suburbanization.

San Diego has also been pushing the terrain for rooftop solar. San Diego established a goal of fifty megawatts of solar energy production within the city's limits by 2013, and as a result of its incentive programs it became the leading city in California for solar energy installations (City of San Diego 2009b). In 2009, San Diego had more rooftop solar than any other California cities, with an installation level of 2,300 solar roofs that produce enough energy for 12,000 homes (Cavanaugh and Crook 2009). However, a single focus on solar would be misunderstanding the capacity to reduce greenhouse gas emissions. Retrofitting all existing buildings (including homes) has the ability to generate more reductions in greenhouse gases in comparison with solar photovoltaics or new construction. In addition, retrofits and solar installations are not mutually exclusive but go hand in hand (Energy Policy Initiatives Center 2010).

The city has also sought to encourage energy efficiency by making it more affordable for businesses and homeowners. In 2008, Mayor Sanders announced the Clean Generation Program that will be administered by the California Center for Sustainable Energy and uses PACE bonds (currently stalled at the state and federal level) to provide affordable financing to property owners for energy retrofits and renewable energy installations. While the city does not refer to this initiative as creating "green" jobs, Mayor Sanders states that it will boost the clean-energy technology sector in San Diego, as well as creation of jobs in product development, sales, and installation (City of San Diego 2008c). For small businesses, the city also partnered with San Diego Gas & Electric as well as CleanTECH San Diego for a mechanism called on-bill financing, which offers no-interest energy-efficiency upgrades that is repaid through a customer's energy bill (City of San Diego 2010c).

Green Jobs Training. Like many cities in California, San Diego is also invested in training the workforce in preparation for demand-side policies that make residential energy-efficiency improvements affordable. This affordability is intended to create the demand necessary to bring a new green industry into being. However, because it is a burgeoning field, much work needs to be done in the way of training, from home energy audits to jobs that involve communicating rebates and incentives to homeowners, to construction, coursework, and on-the-job training and internships. According to the San Diego-based California Center for Sustainable Energy, two gap areas they encounter for employment that are also consistent with the Centers of Excellence green industry findings are as follows: those with sales backgrounds that can explain

to customers how solar systems work, and home performance contracting that includes those with a systems approach to residential energy efficiency (Watkins 2010).

Currently, there are grants for the formation and support of programs coming down the pipeline for green jobs training. For instance, in 2010 the Grossmont-Cuyamaca Community College District in partnership with the San Diego Green Building Training Collaborative was awarded a \$1 million dollar grant from the Employment Development Department, California Clean Energy Commission, and the California Workforce Board targeting those with previous construction experience. Called the Clean Energy Workforce Training Program, the District will develop six green training programs in the green construction industry such as the certified green building professional, home energy rater, solar photovoltaic installer and solar thermal installer, water auditor, and building analyst professional. San Diego County is also creating the Residential Retrofit Program, which will provide training for the Building Performance Institute's Building Analyst as well as on-the-job training and internships for those enrolled. Among many employment opportunities, these programs will help to fill in gaps for Building Performance Institute's certified professionals needed for San Diego Gas and Electric's Whole House Program and the proposed HOME STAR program, two key industry drivers identified by the California Center for Sustainable Energy (California Energy Commission 2009; Watkins 2010). For those without previous construction experience, and also specifically for veterans, out-of-school youth, and un- and under-employed adults, the San Diego Workforce Partnership with the San Diego and Imperial Counties Regional Community College Consortium received \$700,000 for workforce training for five occupations in high demand: HVAC mechanics, technicians, or installers; building performance or retrofitting specialists; building controls systems technicians; energy auditors or home energy raters; and solar photovoltaic installers. The training program provides classes and hands-on experience as well as employee soft skills (California Energy Commission 2009).

The creation of curriculum for training programs is also in the works. For instance, the Department of Energy indicated a gap between the number of quality instructors for solar classes and the numbers of students desiring them. The California Center for Sustainable Energy, California Community Colleges, and Labor Management Cooperation Committee partnered together for the Solar Market Transformation Grant funded by the U.S. Department of Energy to create the availability and quality of instruction, which will increase the number of trained community college instructors for photovoltaic and solar heating and cooling systems. The program will also develop a standard solar curriculum to be used statewide (Watkins 2010).

At the same time, while much training has necessarily gone to workforce development and continues to do so, more jobs are needed. As Watkins from the California Center for Sustainable Energy has indicated, the demand for green jobs is overwhelming and has shaped their creation of the Green Career Network, a website that brings together green job seekers and employers (greencareernetwork.org). As the Manager of Education and Training programs, in her experience these job-seekers "are perfect employees because they are willing to go out and get educated and trained on their own time and commit to this" (Watkins 2010). However, the "buzz" around green jobs overstates their supply, which places ever more pressure on policymakers to ensure the creation of demand, especially financing mechanisms like PACE, and their translation into actual jobs.

Green Business Initiatives. In August of 2008, Mayor Jerry Sanders announced San Diego's enrollment in the Solar America Cities Program, which granted San Diego \$200,000 to integrate solar power into city infrastructure, planning, and zoning (City of San Diego 2008d). Mayor Jerry Sanders has also furthered solar development through public-private partnerships. As part his stated goal of generating five megawatts of solar power on city buildings by 2013 to offset energy demand from the utility grid, the city has thus far entered into two agreements with SunEdison, North America's largest solar energy provider. In 2007, a 1.1 megawatt solar capacity installation went online at the Alvarado water treatment plant in San Diego. More recently in April of 2010, a second installation was located at the Otay Mesa water facility plant, providing 945 kilowatts of solar energy. For the Otay Mesa plant, no upfront costs were necessary, and the city agreed to purchase solar power for the next twenty years from SunEdison and their solar infrastructure. This capacity is said to power 2,600 average U.S. homes for about a year and over a twenty-year period is equivalent to taking 2,800 cars off the road (City of San Diego 2010d). With regard to city benefits, SunEdison states that providing solar power provides "no upfront costs, create[s] green jobs, and stimulate[s] local economies" (SunEdison 2010). The next solar power project will take place at the Miramar water treatment plant as well as other planned facilities.

With strong demand policies in place, the city has a growing solar installation industry, but it is not clear whether jobs created are linked to local photovoltaic manufacturing. One positive sign with respect to green manufacturing jobs is the decision in 2010 by Kyocera to open a solar manufacturing plant in San Diego. The creation of the plant is to serve the rising demand for clean technologies, and has a current global production capacity of one gigawatt per year. Its initial production target for its first year in San Diego is thirty megawatts (Kyocera 2010).

Although the business development programs for clean-energy companies in San Diego are not as extensive as those of Los Angeles, in 2007 the city launched the San Diego Cleantech Initiative and issued a report of the potential for the industry in the region (GlobalConnect 2007). This initiative is a strategy to promote economic growth in the region as well as to advance the cause of environmental sustainability through the creation of a clean-technology cluster that puts San Diego on the map as a center for clean-tech research and development. Comprised of entrepreneurs, educators, researchers, environmentalists, investors, and others, the goal of the initiative is to create businesses that focus on clean energy, transportation, and managing water. To help spark this transition, San Diego has proposed a clean-energy incentives fund and has partnered with green industry leaders globally through the Cleantech Venture Network (City of San Diego 2010b, 2010c).

In addition, the San Diego Clean Tech Alliance was formed in 2007 to promote the industrial sector. The city has supported the clean-tech industry with its Environmentally Preferable Purchasing Program, \$150 million in federal clean-energy bonds (to fund solar energy), and a clean technology program manager. In addition to the solar installation industry, the city has become home to biofuels research and development as the city's biotechnology cluster has slowly diversified. In San Diego there is a cluster of academic researchers and firms specialized in algae-based biofuels who have formed the San Diego Center for Algae-Based biofuels, which links to five local research institutes: Scripps Research Institute, UC San Diego,

Scripps Institution of Oceanography, the Salk Institute and San Diego State University. Synthetic Genomics, a biotechnology company founded by Craig Ventner and located in La Jolla, received \$600 million from Exxon-Mobil (Bigelow 2009, Filkes 2009).

In 2008 the Biofuels Initiative was formed to bring together an array of public and private institutions to promote the development of an alternative fuel industry: CleanTECH San Diego, the BIOCOM Institute, the San Diego Regional EDC, San Diego Center for Algae Biotechnology, San Diego Workforce Partnership, and MiraCosta Community College. Recently in 2010 this partnership was just awarded \$4 million in grant money from the California Department of Labor for workforce training and job placement. Targeting unemployed and dislocated workers from San Diego and the Imperial Valley, the goal is to provide necessary knowledge and skills for career pathways in the growing biofuels industry (Forbes 2010).

Civil Society and Policy. Some critics charge that inequality still shapes the green economy that is emerging, and they push for a more democratic and inclusive vision of green jobs. A focus on clean-technology, while necessary for a sustainable world, can take access to resources like education and income for granted. The Environmental Health Coalition (EHC) is one of the groups in San Diego committed to an inclusive vision of the green economy by advocating jobs for everyone, regardless of skill, as well as jobs that are local and lift people out of poverty. In the context of the green economy, their goal is to expand the city's green jobs focus to include the less glamorous home retrofits, and to provide job training for those already disadvantaged by the gray economy, that is, people in poor neighborhoods and with low incomes.

The recent Energy Efficiency and Conservation Block Grant (EECBG) funds that cities receive is an opportunity for groups to intervene at the city level and push for inclusive green policies. For instance, spearheaded by the Environmental Health Coalition, a coalition of community, environmental, and labor organizations called the Green Energy and Good Jobs Alliance pushed the City of San Diego to create a public committee (EECBG Committee) to determine the best use of the twelve million EECBG dollars. In addition to the city's initial plan of retrofitting Balboa Park, the city also adopted the Committee's suggestions to jumpstart a green industry that includes low-income residents. San Diego City Council adopted the following from the Committee: \$250,000 for an updated Climate Action Plan, \$3 million for a low-income home retrofit program with required audits, education, and upgrades, \$1.5 million for a home retrofit program with no income requirements, \$2.5 million for a revolving loan fund for energy projects, \$2 million to retrofit City street lights, and \$2 million for energy-efficiency upgrades to Balboa Park buildings (EHC 2010: 6).

From the viewpoint of the Environmental Health Coalition, providing energy efficiency for low-income residents also gets into more complex issue of making energy efficiency (not just solar) available to renters as well. Because many low-income people do not own their own homes, the EHC is using knowledge from their existing work to make homes lead-free in order to draw landlords into retrofitting their apartments. This will not only increase the value of the property for landlords but will also translate into energy savings for low-income people who already spend a greater portion of their income on utilities. As the Environmental Health

Coalition's Nicole Capretz (2010) has also discussed, the retrofits will also render buildings more healthy and safe by creating better indoor air quality—a concern for those living in disadvantaged communities that suffer more health risks as a result of living next to freeways, the port, and industry. In another way, retrofitting apartments in low-income communities also invests badly needed resources into neighborhoods.

In sum, a more inclusive vision of the green economy encompasses everyone: homeowners, low-income renters, and clean-technology and home retrofits. Such a view creates more participation from everyone in the efforts to create as well as benefit from a more sustainable society.

San Francisco

Sustainability Plans. In the last two decades San Francisco (SF) has created numerous initiatives and plans that address both environmental and social problems. In 1996, the Department of Environment (now known as SF Environment) was created along with the first sustainability plan. The sustainability plan is the outcome of a four-year long process that incorporates over four hundred people from environmental advocacy groups, city agencies, businesses, academia, and the public. It is a visionary document that includes over a dozen topics such as air, climate, energy, environmental justice, waste, water, and toxics. Notably, the report also includes social justice as a key component to sustainability. According to the report, a society best positioned to maintain balance with natural systems is one whose overall wealth is equitably distributed (SF Environment 2006a).

In 2002 the city began to focus on the issue of climate change. That year the city passed the Greenhouse Gas Emissions Reduction Resolution in solidarity with the Kyoto Protocol, pledging to reduce greenhouse gases to 20 percent below 1990 levels by 2012. In 2004 the city also joined the International Cities for Climate Protection (ICCP) campaign and followed with a Climate Action Plan (CAP) that targets emissions reductions in the following areas: transportation, buildings, power plants, waste production, and consumption. Among some of the measures proposed, the city identifies stricter green building standards for all buildings, waste recycling, renewable energy investments, the adoption of fuel-efficient vehicles, and alternative forms of transportation (SF Environment 2004). Notably, in 2005 San Francisco also hosted the United Nations World Environment Day, and participated in the formation of the Urban Environmental Accords, which addresses issues of sustainable development (SF Environment 2010a).

Building on these previous initiatives in 2008, Mayor Gavin Newsom released San Francisco's environmental plan, which is called SForward. SF Environment followed with a strategic plan in 2009, which is a three-year strategy for 2010-2012 whose basis is the environmental plan and covers the following areas: "climate action; energy; clean air transportation; green building; urban forest; zero waste; toxics reduction; environmental justice; environmental education; and public outreach" (SF Environment 2008a, 2009a). The 2008 document updates actions to reduce greenhouse gases to its 20 percent goal. Interestingly, from 2004-2008 only small reductions were made despite the \$32 million in energy-efficiency

program investments. Like many cities, vehicles remain the leading source of emissions. However, Mayor Newsom recently stated that San Francisco has achieved the target set by the Kyoto Protocol. While the overall goal of 20 percent in reductions is far off, based on data up through 2008 San Francisco is currently 7 percent below 1990 levels (Sherbert 2010a).

The city has also created innovative pathways in the area of alternative fuels and clean transportation. For instance, the city is working on its Alternative Fuel program, which crafts partnerships to create infrastructure to serve the plug-in hybrid car (SF Environment 2009a). It has also converted all of its 1500 city diesel vehicles to B20 biodiesel (a mixture of 20 percent soy-based biofuel and 80 percent petroleum-based fuel) through its SFGreasecycle program (SF Environment 2008a). Starting in 2007 and administered by the San Francisco Public Utilities Commission (SFPUC), the city collects fats, oils, and grease from restaurants and residents, which is then recycled into the B20 fuel for the city's fleet (2010a). It has also regulated the taxicab industry, and over half of the fleet is using hybrids or runs on compressed natural gas (SF Environment 2008a; Sherbert 2010a). Lastly, the city is also exploring its wind opportunities. In July of 2008, Mayor Newsom and former Supervisor Tom Ammiano enacted the Urban Wind Power Task Force to investigate small-scale wind power and recommendations for policy (SF Environment 2009b).

Other innovative goals in the plan address carbon production specifically. For instance, a component of the overall proposal is a "carbon neutrality" plan, which sets the city's net emissions product to zero percent. Techniques such as carbon sequestration and mechanisms such as purchasing credits are ways to achieve this goal. In addition, the plan calls for the consideration of a carbon tax that charges companies on the basis of their greenhouse gas emissions that could "serve as an alternative to San Francisco business payroll taxes." The plan also calls for a San Francisco Carbon Fund to finance local carbon offset projects (SF Environment 2008a).

Although all plans discussed above are interested in merging job creation with solutions to environmental problems, the latest environment and strategic plans specifically use the language of "green job" promotion and/or creation. The environment plan targets the fields of renewable energy, energy efficiency, and clean-technology development as mechanisms to create "green jobs." The strategic plan also includes education and outreach by supporting city and non-profit workforce development agencies as well as the SF Environment Now! jobs training program. Other areas of job creation are in the areas of municipal and commercial waste diversion, and in the city's southeastern communities (SF Environment 2008a, 2009a).

Green-Buildings Initiatives. San Francisco has developed a national reputation with regard to its green buildings initiatives. In 2008 Mayor Newsom spoke at the House Climate Change Committee, where he advocated mandating green building requirements for commercial businesses and argued that such regulations are welcome by the business community due to their cost savings (SF Environment 2008b). San Francisco's green building policies began with the 1999 Resource Efficient Building Ordinance, which created the Resource Efficient Building Task Force and required green building standards for new municipal construction. In 2004 the ordinance expanded to require all new municipal construction and major renovations over 5,000 square feet to be certified LEED silver. In 2008 the city included the residential and commercial

sector as well, requiring all new construction and certain large renovations to meet LEED, GreenPoint (certified by Build It Green), or equivalent standards. In the process, projects must also meet elevated requirements for energy and water efficiency, recycling, pollution control, and others (San Francisco Department of Building Inspection 2010a, 2010b; SF Environment 2009a). These standards will increase over the next five years, ultimately requiring projects applying for entitlement in 2012 to achieve LEED Gold (Hooper 2010).

The city also has incentives to encourage efficiencies above and beyond existing regulations. Those projects seeking LEED Gold certification can go through the city's expedited permit process, and small businesses can apply for fee reductions and earn development bonuses. At the House Committee meeting, Mayor Newsom said that such regulations have created new growth (SF Environment 2008b). In 2008, there were forty-three municipal projects seeking LEED certification. San Francisco's flagship project, the California Academy of Sciences (CAS) building was completed in 2008 and is the first municipal LEED platinum building in the U.S. Among many efficiency measures, it has a living roof, integrated pest management, and diversion of 90 percent of its building construction materials from the landfill (CAS 2010). Future legislation currently under consideration includes mandates for new San Francisco municipal buildings to LEED gold standards by 2012, as well as requiring commercial buildings to receive energy audits and publicly report an annual energy score, or benchmark (Hooper 2010; SF Environment 2009a).

Mayor Newsom has also promoted the use of solar in creating energy efficiency and renewable energy, and this year the city will be given awards by the Northern California Solar Energy Association. Among large cities in the Bay Area, San Francisco ranked first in 2009 for the total number of systems installed and first for its overall progress since 2007 (Northern California Energy Association 2010). In 2008 San Francisco also entered a partnership with Recurrent Energy to implement the Sunset Reservoir Solar Project. The project goal is to install 25,000 solar PV panels on the reservoir roof whose scope spans twelve football fields and has a five megawatt capacity. The energy will be supplied to the General Hospital, SFO Airport, and public infrastructure. According to Recurrent Energy, this project creates seventy-one green collar jobs (Recurrent Energy 2010).

As part of the larger project to create jobs and promote environmental sustainability, San Francisco created GoSolarSF. This program began in 2008 and provides financial incentives to encourage non-profits, businesses, and homeowners to install solar systems. Since 2008 the program has more than doubled the number of solar installations in the city, owing in large part to a sizeable \$6,000 incentive offered (City and County of San Francisco 2010a). However, the city found that participation rates for low-income residents were lower and has since restructured the incentive program for fiscal years 2010-2011. Offered through the San Francisco Public Utilities Commission (SFPUC), the incentive structure includes a base and supplemental incentive level. For instance, a low-income resident may qualify for a \$7,000 supplemental incentive that is in addition to a \$2,000-\$3,000 base incentive. In total, the program offers \$5 million for all residents including commercial, and \$2 million is a set-aside for low-income residents (SFPUC 2010). If PACE legislation at the federal level goes through, property owners can also qualify for financing through the GreenFinanceSF program. This program allows homeowners to receive upfront financing for efficiency upgrades and solar panels, which is then

paid off through property tax bills (Baker 2010). The overarching goal the GoSolarSF program is to create environmental sustainability by creating a local solar economy. The plan is part of the larger framework of job creation designed to stimulate demand in the green industry.

Green Jobs Training. In line with the city's environment plan, which encourages sustainable growth but also pushes green job creation, the city's workforce development department launched a green collar jobs training and placement program in 2010 called TrainGreenSF (previously called the Green Skills Academy). Funded in part by federal stimulus dollars, the program is operated by Goodwill Industries and also includes nonprofits and local community colleges such as SF Clean City Coalition, Global Exchange, and the City College of San Francisco. The TrainGreenSF provides vocational training for positions in energy efficiency and solar, recycling, transportation, and non-installation positions such as clerical and administrative employment in green-industry firms (San Francisco Office of Economic and Workforce Development 2010).

Importantly, while the GoSolarSF translates into demand and business creation, the TrainGreenSF program offers a workforce training model that translates into employment with family supporting wages. For instance, all contractors who wish to participate in the GoSolarSF incentives must also participate in TrainGreenSF. Because the workforce development program serves low-income and disadvantaged individuals, the underserved communities receive employment opportunities. Beginning August 31, 2010, the program also calls for the hiring of one solar installer and one non-solar installer as a base requirement for compliance. In addition these jobs must be at least \$15 per hour, workers have to be performing skilled work or engaged in on the job training, paid the same wages as those in the existing classification, and employed at least 80 percent of the time. In addition, the workforce development program offers an On-the-Job Training incentive for contractors. From July through December 2010, contractors can receive a \$3,000 wage subsidy that goes toward on-the-job training for both installation and non-installation positions. The goal is to encourage employers to hire and train workers from the TrainGreenSF academy. Thus far the program has created thirty jobs, and brought seventy-five jobs overall to the industry.

City College of San Francisco also administers one of the state's Green Jobs Corps programs. In 2009, the city also launched the Green Skills Academy in 2009 to provide training programs in green buildings, alternative fuel vehicles, environmental remediation, and renewable energy. The programs utilize stimulus funds and involve partnerships between the city's Office of Economic and Workforce Development and local colleges, labor unions, and nonprofit organizations (City of San Francisco 2009).

San Francisco also has other jobs initiatives. In February 2010, San Francisco received \$19 million to fund energy-efficiency projects. Of the \$19.2 million in funding, \$11.5 million is used to fund the Energy Watch program in collaboration with Pacific Gas and Electric, which creates green jobs by employing people to make free-onsite assessments of energy savings as well as weatherizing homes. According to this partnership, there are 175 jobs in the field. The funding package will also support the Davies Symphony Hall retrofit project, which provides jobs to twenty-two efficiency workers. Energy-efficiency projects will create local jobs by

employing people from the JobsNow program, which has helped more than 1700 workers, some of which are green jobs (City and County of San Francisco 2010b).

Green Business Initiatives. By invitation, San Francisco joined the World Expo in China from May 1 through October 30, 2010. It is the only city in the U.S. that is officially represented. Attesting to its long-term connections with Shanghai as well as its well-known progressive green politics, San Francisco green technology and sustainability companies will have the opportunity to showcase their products for the global market (Macheel 2010).

Building on previous initiatives to attract biotechnology firms (Pernick and Mokower 2005), in 2005 San Francisco announced its efforts to build a clean technology cluster. In 2005 Mayor Gavin Newsom established the Clean Technology Advisory Council (CTAC) to attract clean-technology industries. The goal of the cluster is to grow green industries, create highly skilled and well-paid jobs for San Francisco residents within these industries, and create independence from fossil fuels (City and Council of San Francisco 2005). San Francisco has deployed the strategy of education and outreach to incite innovation. For instance, in 2006 CTAC hosted and provided support for the California Clean Tech Open, which was a competition designed to bring together innovators in the clean technology sector (SF Environment 2006b). The city has also created relationships with banks and investors in San Francisco to finance green businesses and green building projects (City and Council of San Francisco 2006). The city hosts conferences in clean technology, such as the upcoming CleanTech Forum in March of 2011 (Cleantech Group LLC 2010).

The city also uses demand-side policies and incentives to spur market development. For instance, businesses that go above and beyond existing environmental criteria can earn certification through San Francisco Green Business Program (2010). Those certified can take advantage of payroll tax exclusions (SF Environment 2010b). Another example is the partnership among the San Francisco Public Utilities Commission, BlackGold Biofuels, and the URS Corporation to create biofuels collected through the city's SFGreasecycle program (SF Environment 2009c). Through the Biodiesel Task Force, the city is working to broaden the biofuels market by making them publicly available at city gas stations (SF Environment 2010c). Other areas that the city currently has market incentives for are solar power, tidal and wave power, and green buildings (SF Environment 2010d). Finally, the city is also working with the Energy Watch Program (a partnership with Pacific Gas and Electric) that provides energy-efficiency retrofits for the commercial and residential sectors, and the city has entered into the \$11.5 million second phase of the program (City and County of San Francisco 2010b).

San Francisco is also part of additional green business initiatives. The Business Council on Climate Change (BC3) formed in 2005 through a partnership between SF Environment, the Bay Area Council, and the UN Global Compact (SF Environment 2010e). The goal is to reduce greenhouse emissions in the commercial sector by providing the necessary tools and encouraging business leadership (Business Council on Climate Change 2010).

Civil Society Organizations and Policy. Civil society is actively part of shaping San Francisco's policies on sustainability. One notable area is the environmental justice movement. Not unlike the cities of Los Angeles, Oakland, and San Diego, San Francisco has environmental

problems created by reliance on fossil fuels at the ports, power plants, and sites like the shipyard. The community advocacy group Literacy for Environmental Justice (LEJ) is actively involved in these issues in San Francisco. As they argue, the health risks created by these toxic sites are disproportionately located in their community. For instance, Bayview Hunter's Point is a low-income ethnic and minority community that has over three hundred and twenty five toxic sites within six square miles. This community is also home to the Hunter's Point Naval Shipyard, which is a Federal superfund site that is located within three miles of schools and childcare facilities. LEJ helped close the Hunter's Point Power Plant in 2006 and spearhead the restoration of the area that is now called Heron's Head Park (Literacy for Environmental Justice 2010a)..

LEJ's goal is to provide community leadership in environmental justice by training youth from BVHP in "environmental health research, education, and advocacy, and environmental conservation, restoration, and horticulture" (Literacy for Environmental Justice 2010). One of their major projects has been the Heron's Head Project, a brownfield site formally known as Pier 98. The Heron's Head Project includes restoration of this area as well as the creation of an EcoCenter that is located near the former site of the Pacific Gas and Electric Hunter's Point Power Plant. After years of community advocacy, the power plant was eventually closed in 2006. The EcoCenter has generated city attention, including Mayor Gavin Newsom. This 1500-square foot building is the first building in the Southeastern area of San Francisco that is off the grid. Among some of the features of this building are solar panels and a wind turbine, as well as its own wastewater treatment system, and a green living roof. More than four hundred students participated in its design, which will serve as an educational facility that teaches the public about environmental justice (Literacy for Environmental Justice 2010b).

San José

Sustainability Plans. The nation's tenth largest city, the largest city in northern California, and the capital of Silicon Valley has increasingly become a center for clean-tech industry. Shortly after taking office in 2007, Mayor Chuck Reed announced the Green Vision Plan (Reed 2007). The plan is noteworthy as an example of a second-generation urban sustainability plan that incorporates green jobs and business development goals along with general urban design, environmental, and emissions and energy-efficiency goals. It is also noteworthy in its use of performance metrics and annual reports akin to those of New York City. Unlike some of the other California cities that we have opted to discuss in more detail, the greening of the city appears to be driven mostly by a partnership of the city government and business community. Participation from grassroots organizations is less visible than in Los Angeles, Oakland, and San Francisco.

Building on some of the achievements of the city during past administrations, the plan set ten ambitious new goals for the fifteen-year period beginning in 2007. The goals included the following: create 25,000 new jobs to make San José the world center of clean tech innovation, reduce per capita energy usage by 50 percent, source 100 percent of electricity from renewable energy, achieve zero waste for municipal solid waste, have a city fleet that is 100 percent run on alternative fuels, and build 100 miles of trails. The city claims to have the country's most

aggressive urban greenhouse gas emissions reduction targets, with a goal of 50 percent reduction by 2030 (City of San José 2010).

Green-Building Initiatives. San José's Green Vision Plan includes a goal to build or retrofit 50 million square feet of green buildings. Since 2007 city buildings over 10,000 square feet must be certified as LEED-silver buildings. In January 2009 the policy was extended to include commercial and residential buildings, with a sliding scale of certification depending on the size of the project. At the upper end, commercial buildings of over 25,000 square feet must be certified at the equivalent of LEED silver (City of San Jose 2009). The city does not have the transparency regulations for private-sector buildings found in some other cities, such as Austin, New York, and Seattle, but San José has pursued a green buildings strategy through incentives and federal funds. For example, the city received \$8.8 million in Energy Efficiency Block Grants to support the greening of buildings and other energy-efficiency and distributed renewable-energy measures. The city has a suite of energy-related programs for building efficiency, both for the government and for commercial and residential buildings. In 2010 the city also engaged in a stakeholder process to determine how to implement a policy for the greening of renovations and retrofits (City of San Jose 2010).

Green Jobs Training. The Workforce Institute of San José Evergreen Community College District administers various green jobs training programs, including one of the California Green Jobs Corps programs and a program for 500 unemployed workers funded by the California Economic Development Department (Gomez 2010). Within the city's Office of Economic Development, the Work2Future program connects job seekers and employers, and it provides links to training programs. The program includes training for unemployed youth in various green jobs categories, and it has used about \$13 million in ARRA funds (City of San Jose 2010). In addition, there are programs at area universities, including San Jose State University and Santa Clara University as well as nearby Stanford and the University of California at Santa Cruz.

Green Business Initiatives. At the heart of Silicon Valley, San José was rated by BusinessWeek as the leading place in the country to start a clean-tech business (Westervelt 2009). The city brought in the second Underwriters Laboratory in the country, and in 2007 it also launched a \$3 million venture fund, the Economic Development Catalyst fund, to invest in clean tech (Pacific Community Ventures 2007). The city is home to the Environmental Business Cluster, a clean-tech incubator, and the Clean Tech Open, the largest annual clean tech business competition in the country (which is run in partnership with a nonprofit organization located in nearby Palo Alto). The city also applied to the federal Economic Development Agency to have funds to set up a demonstration center for clean-tech businesses in the region, and it also has applied to the state government for designation as an Innovation Hub. San José also has an international strategy that assists businesses in marketing to Europe, and it attempts to attract direct investment from Europe (City of San José 2010).

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Colorado

Summary and Analysis

Colorado has built strong industries in solar installations and wind manufacturing, and it has also built research strengths based on the state's research universities and national research laboratories. Governor Ritter has been a strong advocate of the clean-energy economy, with over sixty legislative acts and other administrative initiatives since 2007. The strong demand-side policies are not always matched by supply-side policies that provide funding for clean-energy start-up companies. However, the state has many policy innovations of note including the following:

- The state has several strong initiatives to strengthen university-industry collaborations, as well as connections with federal-government research organizations.
- The state has LEED gold certification goals for government buildings.
- The state hosts a clean-tech incubator.

Within the cities Denver and Boulder the following policies are of note:

- Denver's Green Print program has been nationally recognized as a model for energy and resource conservation.
- Boulder has a carbon tax, which it uses to fund loans for weatherization, renewable energy installation, and energy efficient construction (including PACE bonds).
- Boulder has its own green construction guild and subscribes to the Green Points program developed in Oregon, which mandates energy conservation and efficiency improvements to renovated and new buildings.

General Background Policy

Energy Goals. Since 2004 Colorado has had a renewable portfolio standard of 10 percent renewable energy by 2015. The standard is the result of a referendum by people in the state called Amendment 37 (COEDIT 2009). In 2010 the state approved legislation (HB 1001) to increase the renewable portfolio standard from 20 percent (the year 2007 legislated standard) to 30 percent renewable energy by 2020 (Fender 2010). This means, however, that the set-asides for solar energy have been changed to set-asides for locally produced small-scale solar or wind energy (Johnson 2010).

The state's governor, Bill Ritter, Jr., was titled the "Greenest governor" by Greenopia in 2009, and under his leadership the state government has approved sixty bills related to energy and the environment (Castle and Dreyer 2010, Metro Denver Economic Development Corporation 2010). Among the many reforms, one of the most outstanding with respect to green

energy was the Climate Action Plan, which was launched in 2007 and had a target of reducing greenhouse gas emissions in 2020 to 20 percent below 2005 levels (Ritter 2007). The reductions apply across a variety of sectors, including the government and utility industry. Other bills provided mechanisms for implementing the carbon-reduction and renewable portfolio standards goals. For example, in 2008 energy improvement districts were formed (HB 1350), which allowed PACE legislation and other innovative policies for renewable energy to be implemented across Colorado (Aspen Community Office for Resource Efficiency 2010). In 2010 rules for a new energy improvement district (via HB 1328) provided a statewide framework for PACE bonds that allowed counties the option of initiating programs. The state also passed the Colorado Clean Air-Clean Jobs Act (HB 1365) with the goal of retiring or retrofitting 900 megawatts of coal-fired electricity generation by switching to natural gas or renewable energy sources, or by using energy-efficiency and conservation measures (Fender 2010). Some of the natural gas will be from sources produced in-state, thus creating more local jobs in addition to new jobs in the energy-efficiency and conservation industries (Sustainable Business News 2010).

Colorado has remained an observer in the Western Climate Initiative because it has sought instead to have a national carbon trading system, but the state government has been active in establishing an economic climate favorable to clean tech, especially renewable energy. The state's energy-efficiency standard is set at a level that gradually increases from 2009 to a goal of 11.5 percent of electricity sales reduced by 2020.

In the western part of the state, the City of Aspen and Pitkin County have been using the Renewable Energy Mitigation Program since 2000 to garner over \$6 million. Such mitigation programs tax homeowners who build homes larger than 5000 square feet and/or exceed the energy footprint mandated for their lot of land, and then use the money for local renewable energy and energy-efficiency projects (Matranga 2010; Clifford 2002). Also, many of the rural counties have Energy Smart Loans funded by the U.S. Department of Energy (Matranga 2010).

Public Benefits Fund. The state of Colorado does not have a public benefits fund for renewable energy or greenhouse gas reductions; however, it has a voluntary carbon offset fund (State of Colorado, Governor's Energy Office 2010). The state's Clean Energy Fund is supported by limited gaming monies paid to the state by casinos; the fund is used to finance programs out of the Governor's Energy Office (Fitz-Gerald and Buescher 2007).

Green-Buildings Policy. In 2004 Governor Bill Owens signed Executive Order D005-05 to require LEED-NC practices for all state buildings and to establish the Colorado Greening Government Coordinating Council to develop energy-efficiency policies. In 2007, legislation (SB 51) established green building guidelines for state buildings that led to a LEED Gold standard for new buildings and major renovations. Two executive orders issued that year also called for a 20 percent reduction of energy consumption in state buildings by 2012, based on a 2005-2006 baseline.

Green Jobs Training. Currently, the state is using the U.S. Bureau of Labor Statistics definition of green jobs that was offered for public comment in March 2010: "Broadly defined, green jobs are jobs involved in economic activities that help protect or restore the environment or conserve natural resources" (Hill 2010; Lesh 2010). The state does not have comprehensive

green jobs legislation similar to that of California; however, the House Bill 1333 offers grants (regulated through a Green Jobs Colorado Advisory Council) for any party (e.g. colleges, vocational schools) to develop green job training programs (Castles and Dreyer 2010). Colorado State University is developing the School of Global Environmental Sustainability, which will provide job training. In 2009 the state also launched a certificate program for green construction courses in community colleges. In partnership with the Environmental Defense Fund, the Governor's Energy Office also developed a green jobs guidebook which includes different high-tech jobs (e.g., engineers and electricians at salaries of approximately \$70,000 per year) and low-tech jobs (e.g., installers of insulation or solar power at salaries of approximately \$20,000 per year) among other jobs. The state is interested in bringing in more manufacturing companies (Lesh 2010).

The Department of Labor and Employment received \$6 million in ARRA funding in 2010 for green jobs training. The state has spent over \$18 million in training, with some of the money going to organizations such as Mi Casa in Denver, the Alliance for Sustainable Colorado, and the Sierra Club. Potential employers are worried that the skills that the workforce has might not meet their needs. The importance of general life skills to do weatherization, retrofits, and audits in people's homes has been increasingly emphasized by businesses (Lesh 2010).

Clean-Energy Industries

General Background. From 2004 to 2007 renewable-energy production (not including oil, natural gas, nuclear energy, coal, or biofuels) increased from 1.0 percent to 1.9 percent of the total energy produced within the state, while biofuel energy production increased from 0.1 percent to 0.5 percent (U.S. Energy Information Administration 2009). However, since the 1990s, Colorado has successfully produced large quantities of natural gas; the state sells three fifths of what it produces and contributes 6.5 percent of the U.S. natural gas market (U.S. Energy Information Administration 2009, 2010). In 2010, legislation was passed (HB 1365) that requires Xcel energy to retrofit three of its coal-burning plants for natural gas instead (Fender 2010). Colorado is not currently a highly ranked state in terms of renewable-energy production, but the Department of Energy believes that it has a lot of potential in hydroelectric and wind power (U.S. Energy Information Administration 2010). The National Renewable Energy Laboratory map called "Photovoltaic Solar Resource of the United States" also indicates that Colorado is well positioned for solar energy production (Meehan 2010). The state is a leader in renewable-energy potential, including solar and wind energy (COEDIT 2009).

Governor Ritter has been a strong supporter of clean tech, and there are numerous smaller programs that add up to an overall environment that is supportive of clean tech. For example, the state sponsors an annual "New Energy Conference," and both the state and Denver support the Rocky Mountain Clean Tech Open and the Clean Launch Technology Incubator. Development Research Partners has ranked Colorado as number seven for clean-tech employment (Metro Denver Economic Development Corporation 2010). There are approximately 1500 companies that employ about 16,000 people in the renewable energy sector, including about 2500 in the solar industry (Apollo Alliance n.d., COEDIT 2009). It is possible that the political timeline has been faster than reality and the state's ability to stimulate the market and create jobs (Lesh 2010; O'Rourke 2009; Porter 2010).

With respect to the research infrastructure, in 2004 the state government chartered the Colorado Energy Research Institute (2009), located at the Colorado School of Mines, and has provided about \$4 million in multiyear support. The state government has also supported the Colorado Fuel Cell Research Center, which is also associated with about twenty companies in the industry in the state (Colorado Fuel Cell Center 2009). The state also has a regional advantage due to the location of the National Renewable Energy Laboratory (NREL) in Golden, just a few minutes west of Denver. As of 2007, NREL employed “some 900 engineers and scientists in research and development on biomass, wind, solar, hydrogen and other alternative-energy technologies” (Haag 2007), and those numbers have since increased. The state also supports the Colorado Renewable Energy Collaboratory, which links research centers at the University of Colorado, Colorado State University, the Colorado School of Mines, and NREL. The collaboratory was founded in 2007 and is funded with \$2 million in matching funds from the state government (Renewable Energy Institute 2009). In 2008, two new collaborations, the Center for Revolutionary Photoconversion and Center for Research and Education in Wind, were added.

The state of Colorado does not have the comprehensive investment policies for clean-tech business development that are found in some other states, but it does have a general track record of innovation, private investment, and use of federal resources. Overall, the state has a high level of venture capital activity, and the city of Boulder was rated in 2010 as the top U.S. city for technology start-ups (Wadhwa 2010). The statewide Colorado Cleantech Industry Association started in 2008 and reports that the state has the third highest level of venture capital investment in clean tech in the nation (Colorado Cleantech Industry Association 2009). Conversely, researchers and clean tech entrepreneurs in Boulder indicate that most of their funding is federal and claim there is a lack of venture capital for the clean-tech industry, even though business advisors are plentiful (Wallace 2010). As of 2009, the industry association was soliciting proposals for creating a 2010 plan for the state’s clean technology industry (Colorado Cleantech Industry Association 2009)

Colorado has historically had strengths in agriculture and mining, and in the last several decades it has developed information technology industries and electronics manufacturing to the point where it is ranked as the state with the third highest concentration of high-tech workers. The state hopes to leverage its strengths in IT and electronics manufacturing for clean tech manufacturing (COEDIT 2009). It received a grant from the U.S. Department of Commerce in the amount of \$363,135 (over three years) in order to support “exports of clean and environment-related products and services to China and Mexico” (Cheroutes and Castle 2009).

Biofuels. The Colorado Center for Biofuels and Biorefining is supported by the Colorado Renewable Energy Collaboratory and is affiliated with about twenty companies. In 2008 the Pasadena-based biofuels firm Gevo, which was funded with \$40 million in venture capital, relocated to Englewood, a suburb of Denver, due in part to the business-friendly environment (Jaffe 2009). Range Fuels, Inc., is a Colorado-based cellulosic ethanol manufacturer that is piloting the country’s first commercial-scale cellulosic ethanol plant in Georgia. Solix Biofuels, the pet project of a Colorado State University professor, has partnered with the Southwestern Ute tribe and is growing algae oil for biodiesel at their Coyote Gulch demonstration facility in

Durango (in southwestern Colorado). Their technique is unique because it is less land intensive, and they are reaping a yield of 2000 gallons per acre per year. To be competitive with the cost of petroleum at \$75-100/barrel the biodiesel facility would require a yield of 5000-8000 gallons per acre per year (Haag 2007; Solix Biofuels 2009).

Colorado is also working with biomass from waste. The many thousands of trees that have perished under pine beetle bark boring are being considered as a ten-year energy source for a biomass plant in Vail. The use of the dead pine trees would reduce the potential of forest fires in the area, but their potential to reduce carbon emissions is being carefully evaluated (U.S. Energy Information Administration 2010).

Smart-Grid and Building Technologies. There is little evidence of strength in this industry, but the state is moving ahead with some innovative policies that involve transmission congestion. The Governor's Energy Office is interested in drafting legislation to strengthen Colorado's capability for electricity transmission including creating new transmission lines and reinforcing the present electric grid (State of Colorado, Governor's Energy Office 2010). Transmission lines are major capital expenditures; for example, the one for the San Luis valley may cost \$180 million dollars (Johnson 2010; Raabe 2010). Colorado is one of three states (including Texas and Arizona) that has a Line Extension Analysis policy (as of May 2009), where new rural locations requiring connection to the electric grid are analyzed to see whether an on-site renewable energy generation system will be cheaper than extending a transmission line (Doris et al. 2009).

Overall, in Colorado, a theme that keeps appearing is whether de-centralized distribution (small scale and locally produced) or centralized distribution will win out as the dominant model for providing energy. This will shape the technological systems which may be large (capital intensive, robust, and less flexible) versus small (community-owned and more flexible). The decisions will also shape the physical landscapes of the future, such as acres of large wind or solar farms (with miles of transmission lines and no sign of life during a power outage) versus occasional clusters of small wind or solar farms (with very few transmission lines and less chance of the entire countryside being in darkness because of one cascading power failure).

Solar. Popular wisdom is that Colorado is known for getting the most sunshine of any state except for Florida, and many chamber of commerce websites will list the famous "300 days of sunshine per year" tagline to entice visitors. This tagline is accurate but based on an old study where one hour or more of sunshine measured per day made the day count. The National Weather Service and the National Renewable Energy Laboratory suggest that Colorado, Utah, Nevada, California, New Mexico, Arizona, and Texas all have great capacities for solar energy production. Colorado is home to the American Solar Energy Association and some solar manufacturers, and on the research side the National Renewable Energy Laboratory conducts some solar energy research. Furthermore, the state is the location of the Solar Technology Acceleration Center, the largest solar energy test facility in the country.

The state government's Colorado Higher Education Competitive Research Authority also provided matching funds for two large centers. The Renewable Energy Materials Research Science and Engineering Center at the Colorado School of Mines, supported by \$9.3 million

from the National Science Foundation, conducts research on photovoltaics and advanced membranes. The Extreme Ultraviolet Science and Technology Engineering Research Center at the University of Colorado conducts research related to solar photovoltaics and is supported by an NSF grant of about \$4 million per year (Renewable and Sustainable Energy Institute 2009). A planned \$24 million joint research project across the three universities and NREL will explore photo-chemistry for solar energy (Colorado Research Institute 2009). In the northern part of the state, Abound Solar, Inc., (formerly known as AVA Solar, Inc.), a Colorado State University spin-off that is headquartered in the university's hometown of Ft. Collins, had plans in 2007 to manufacture thin film photovoltaic modules, in a facility that would employ 500 people (COEDIT 2009).

The San Luis Valley has also had several small-scale solar projects (for the high school, for irrigation systems, etc); it almost has enough aggregated solar power to be 100 percent solar during daylight operating hours. Like the state of Texas, it could potentially have an independent electricity grid, becoming the first micro grid in the U.S. (San Luis Valley Renewable Communities Alliance 2010).

All of these new and interesting small-scale solar projects are supported by state legislation (HB 1001; HB 1342) that provides rebates as an incentive for small communities to purchase solar panels in a community accessible location (Fender 2010). This legislation, in combination with the mandate that electric utilities have a 30 percent renewable-energy portfolio by 2020, means that there is a real push for both small-scale solar and small-scale wind farms to be created. Colorado State University at Ft. Collins is looking at putting in a ten-acre 3.3 megawatt farm by Christmas of 2010 that would be facilitated by Xcel Energy, this would be in addition to their current 2.0 megawatts solar farm created in 2008. A newer Colorado State University campus, Colorado State University at Pueblo, also has a 1.2 megawatts solar farm (Hughes 2010). On an even smaller, but just as local scale, the Clean Energy Collective (CEC) is working with Holy Cross Energy Cooperative in the western part of the state to put in several solar-energy farms that would produce energy for as few as sixteen homes to as many as 180 homes. CEC is taking advantage of the new legislation by getting individual investors to buy in – paying for the infrastructure collectively in addition to receiving a credit on their electric bill from Holy Cross. With potential rebates from the energy cooperative, the local government's sustainability office, and the Governor's Energy Office, an individual investor could buy into the collective for about \$12,500 instead of \$22,500 for a 5 kilowatt array of solar power (Condon 2010). Alternatively they can buy into any number of micro-solar, micro-hydro, micro-biomass, micro-wind, or geothermal collectives for a starting price of \$500 (Clean Energy Collective 2010). This is different than the model that Colorado State University and other larger installations typically used, where they partnered with a private investor and a utility company (Hughes 2010).

Transportation and Energy Storage. The National Renewable Energy Laboratory has a battery thermal and life test facility, and the state government has supported the Colorado Fuel Cell Research Center. The research centers are associated with about twenty companies in the industry in the state (Colorado Fuel Cell Center 2009).

In 2004, Coloradoans passed Referendum 4A authorizing a 0.4 percent sales tax bond as part of funding the FasTracks, which is also funded through public-private partnerships, federal grants, and local contributions (TheDenverChannel.com 2004; Johansen 2004). FasTracks will involve creating 122 miles of commuter and light rail, eighteen miles of bus rapid transit, more local buses, and perhaps some limited introduction of street cars to relieve congestion in the eighteen-county Regional Transportation District (FasTracks RTD 2010). Originally approved to cost \$4.9 billion by 2017, it is now estimated to cost \$6.9 billion for the same schedule (TheDenverChannel.com 2004; FasTracks RTD 2010). Various city mayors have met in a task force several times as part of this process (which has since involved several tax hikes; Leib 2009); they are motivated in part because this legislation affects business development and growth in the areas where there is a transit stop in addition to reducing congestion (Johansen 2004).

Wind. The state courted the Danish wind turbine manufacturer, Vestas, and convinced it to locate several manufacturing plants in the state. According to Governor Ritter, the proximity of the National Renewable Energy Laboratory and the state's research universities attracted the manufacturer (Kohler 2008). However, the 2500 promised jobs ended up being approximately 1000, and with the recession there was a manufacturing freeze that reduced that number to 500 people employed (Lesh 2010). Siemens is also building a wind turbine research and development center in Boulder (American Solar Energy Association and Management Information Services 2008). In 2009, REpower USA Corp., a subsidiary of a German wind turbine manufacturer, had plans to move its U.S. headquarters to Denver (COEDIT 2009).

There is also an increased investment in small scale-wind farms which is similar to the increased push for small-scale solar projects described above. This is being actively promoted by the Government Energy Office's Wind for Schools Program, which places 1.8 kilowatt wind turbines that can produce up to 300 kilowatt hours per month with schools that apply and is part of a U.S. Department of Energy program (Governor's Energy Office 2010).

In 2009 the state's Renewable Energy Collaboratory launched the Center for Research and Education in Wind, which will conduct research on turbine modeling, electrical systems, and controls. Testing is also available through the NREL's National Wind Technology Center. Other national centers (both located in Boulder) include the Earth System Research Center in Boulder, and the National Science Foundation's National Center for Atmospheric Research (NCAR), which has stepped up in order to provide better predictions for wind and solar energy production (UCAR 2010).

City and County of Denver

Sustainability Plans. Denver is ranked second after San Francisco as one of the most desirable places to live, according to a Pew Research Center poll in 2008. The city and Mayor John Hickenlooper are known in sustainability circles because of the GreenPrint Denver plan (Metro Denver Economic Development Corporation 2010). In 2006 Mayor Hickenlooper announced the GreenPrint Denver Action Agenda plan in his state of the city address. The plan included ambitious goals for 100 percent biodiesel use in the city's fleet, increasing LEED

certified new or renovated buildings by 10 percent, increasing recycling by 50 percent, increased parkland and planting of trees, greenhouse gas emissions reductions, water conservation, and increasing public employee use of public transportation. The 2006 Greenprint Denver Action Agenda shows what each department of the City and County of Denver has been doing towards goals of economic, social and environmental sustainability. It has a mix of community focused goals (where volunteers and, or, individuals seeking job training would be needed) with government mandates (for new building construction, parks management, water management, waste management, and transportation development and transportation-oriented new urban development, and Denver government fleet management). The 2007 progress report shows that many of the goals were met, including a 63 percent increase in recycling and planting of 50,000 trees, many new LEED certified buildings, and a 32 percent increase in rapid transit ValuPass ridership.

In 2007 the mayor followed up GreenPrint's Action Agenda with the city's Climate Action Plan, which pledged to reduce the city's per capita greenhouse gas emissions by 10 percent by 2012, although how this goal will be fulfilled is not clear. In 2009 the program received \$6 million from the Department of Energy to fund weatherization and energy-efficiency programs under GreenPrint Denver (City of Denver 2009a). The focus is on changing behavior patterns for consumption and production more than green jobs and business development.

Green-Building Initiatives. There have been no announced plans to make Denver a smart-grid city. However, the city has developed programs that create green jobs in the building efficiency industry. Both the Denver International Airport (City of Denver 2009d) and the Denver Zoo are certified ISO-14001 for their Environmental Managements systems (Pankratz 2009), and many other buildings that are LEED certified, planned LEED certified or planned ISO-140001 certified.

The Greenprint plan includes a section on buildings and a plan to partner with the Metro Denver Economic Development Corporation to increase the number of green buildings. In an initiative intended to develop the Greenprint goals, in 2009 Mayor Hickenlooper announced the Greener Denver program. Included are programs to help businesses with their greening efforts, promote and connect area green and clean tech businesses, and assist with workforce training and certification (City of Denver 2009b). The program will also provide information for businesses that may want to green their buildings, and it has also worked with other departments and agencies to provide some weatherization services in the low-income neighborhood of Sunnyside through the Low-Income Energy Assistance Program (LEAP). The newer transit-oriented development areas that are centered around commuter light rail, rapid bus, and regular bus transit centers in the Denver metro area will have mixed-used properties that are built to LEED standards; however, they will be unaffordable for low-income buyers. The city lacks the extensive weatherization programs and funding initiatives for building retrofits found in some of the other cities.

Green Jobs Training. The city has developed programs to support green job development. The Greener Denver initiative includes a "green talent" component that will involve green jobs training through partnerships with the Metro Denver Economic Development Corporation and the city's Office of Economic Development. This city office has also supported

the Mile High Youth Corps, a nonprofit organization that has trained at-risk youth since 1992, to provide a green job training program. In 2009 the nonprofit organization also received \$1 million in federal ARRA funding to expand its green jobs training operations and help similar programs throughout the state (Grady 2009). Mi Casa has also been involved in training programs in energy audits and home weatherization for low-income individuals. The state's Office of Economic Development and International trade reports that "ConocoPhillips will locate its sustainable corporate training center and global research facility for renewable and alternative energy in metro Denver" (COEDIT 2009).

Green Business Initiatives. The Metro Denver Economic Development Corporation states that "[s]everal new headquarters of operations in renewable energy, healthcare, and other sectors are an advantage for Metro Denver in the recovery. These businesses may not begin major construction projects or add large numbers of jobs until the national recovery is more certain, but they will still form a solid base for growth after 2010" (2010). Denver hosts the state's Clean Launch Technology Incubator and the monthly meetings of the Colorado Clean Tech Initiative, a consortium of research, government, and industry organizations. The Colorado CleanTech Initiative started in 2005 and consists of affiliated industries that are part of Connected Organizations for a Responsible Economy (CORE). The Green Opportunity Program assists in the development of clean tech businesses in the city (City of Denver 2009b).

City of Boulder

Sustainability Plans. A look at the Boulder Convention and Visitor's Bureau will provide a huge list of the awards that Boulder has received for everything from being the 2009 #1 Best City to Raise an Outdoor Kid to being one of the top Green Cities or one of the top cities for Cycling or Farmer's Markets (Boulder Convention & Visitors Bureau 2010). Historically, Boulder citizens have been very concerned with environmental issues, land preservation, and land use. In the 1950s, they started an action group called PLAN Boulder County where they campaigned for a 'blue line' (the maximum height to which city water would be piped) to slow the development of the foothills. In 1967, they successfully voted in a sales tax of 0.04 cents in order to purchase, manage, and maintain open space; Boulder was the first U.S. city to do so. They have passed other urban growth management strategies, including a building height restriction in 1972, a historic preservation code in 1974, and a residential growth management ordinance in 1977 that mandated in-fill (City of Boulder 2009c). Boulder considers itself a leader in small city sustainable living, with the above historic policies and others the city has adopted to facilitate multi-modal transportation (bike lanes on the roads, hiking/biking trails through the city, and a great bus system), recycle, minimize pollution, and build green, etc. Unfortunately Boulder still depends primarily on electricity from a local coal power plant, though individuals can purchase a percentage of their bill as wind power through Xcel (Lesnes 2008; Simon 2010).

In 2004, after discussions with stakeholders, the city had the desire to create a social sustainability plan to both complement the city plan and the Boulder Valley Comprehensive Plan (an initiative of Boulder County). It has the following mission: "to enhance community livability by providing outreach and developing policies that address the needs of the

community, including under-served, under-represented and under participating residents so all who live in Boulder can feel a part of, and thrive in, our community” (City of Boulder, City Council 2007). While many of its goals are not yet concretely formed, the effects of one of them (goal 5 action item 2) was seen immediately when the EcoPass for low-income children to ride the regional transit system for school and after school activities was subsidized by the city in the Transportation Master Plan (City of Boulder, City Council 2007).

In 2002 the city signed the Kyoto protocol with its Resolution 906, and it set a goal to reduce greenhouse gas emissions to 7 percent below 1990 levels by the year 2012 (City of Boulder 2009a). The city of Boulder does not have a public benefits fund to rely upon, so they implemented their own carbon tax program in 2006 (Brouillard and VanPelt 2007). Having determined that the majority of greenhouse gas emissions come from electricity consumption, electricity usage is taxed. “The CAP tax is projected to generate approximately \$1.6 million in 2010. CAP tax revenues are expected to decline over time, as residents and businesses reduce their energy use and switch to greater use of wind and solar energy. The CAP tax will expire on March 31, 2013” (City of Boulder 2009a). The funds are used specifically in public marketing campaigns for energy efficiency and also in the Two Techs and a Truck initiative where “Boulder plans to spend about \$1.5 million in city funds and \$370,000 in federal stimulus money to hire contractors to do basic upgrades for residents”; simple changes like fluorescent bulbs and weather-stripping are performed by one of fifteen city-sponsored teams in any home that allows it (Simon 2010).

Wall Street Journal writer Stephanie Simon captures the ambivalences that people feel about the Climate Smart program—where low-income residents welcome the weatherization programs such as Two Techs and a Truck, but a mayoral candidate who considers himself an environmentalist also refuses to close the doors to his art gallery because he likes the welcoming effect it has on potential customers, despite its lack of energy conservation (Simon 2010). Despite the program having to figure out how to change individual behaviors concerning energy conservation and efficiency, there have been some successes. Boulder County Commissioner, Will Toor says, “Since the program began in March 2009, the new Climate Smart Loan Program has lent nearly \$10 million in private bond sale investments to 612 homeowners to improve their homes’ energy efficiency and install solar systems. Approximately 1/3 of this went to solar energy, the other two thirds to energy-efficiency improvements. More than 280 local independent contractors have received work from this program, producing jobs and keeping many vendors in business” (Yulsman 2010). Boulder’s Climate Smart loans are modeled after the bond based Property Assessed Clean Energy program that was innovated in Berkeley, California, where the low fixed-interest loan (like the renewable energy installation, and, or, energy-efficiency improvement to the home) is attached to the property and is not subject to income tax. However, the Climate Smart loans in Boulder are based on funds from the city’s Carbon Tax and provide up to \$50,000 for homeowners and up to \$210,000 for commercial property owners who want to improve their property by installing solar panels, energy-efficient appliances, etc. (Boulder Chamber of Commerce 2010). This Climate Smart loans program for commercial and residential buildings should help to spur the clean tech installation industry in Boulder. The loans are one of many initiatives in the Climate Smart program, which also includes vehicle and fuel programs, support for alternative transportation, and renewable energy credits for wind and solar installations (City of Boulder 2010).

Smart-Grid and Green-Building Initiatives. The city has had green building legislation since the 1980s and has mandated a green code for residences since 1996. As of July 2010 they use the Green Points program originally developed in Oregon. In Boulder it is mandated that “all new residential construction, and additions and remodels larger than 500 square feet... require applicants earn ‘points’ by selecting green building measures in order to receive a building permit” (City of Boulder 2010b).

Boulder is also recognized as a leader within the U.S. (Urie 2010b) both because of its history of environmentalism, and also because it is currently host to the nation’s first city-wide smart grid. This “smart-grid city” is under close scrutiny as the technical, social, and environmental effects are sorted out in Xcel’s new business venture as well as the successes and failures of the Climate Smart Program (Simon 2009; Simon 2010; Yulsman 2010). Xcel energy has invested \$100 million dollars in making Boulder the first smart-grid city. This involved putting a smart meter in 10,000 homes that checks their electricity usage every fifteen minutes (Simon 2009). It also means that a few homes, like that of University of Colorado at Boulder Chancellor G.P. ‘Bud’ Peterson and his wife, are more completely converted into a testing site, with the addition of new appliances that can send information to the smart meter, as well as, plug in hybrid electric vehicles whose batteries can act as a temporary energy storage for the smart-grid and a \$4000 battery pack that stores forty hours worth of energy for their home from the solar panels on the roof (Simon 2009). The initial tests reveal some problems with consumer acceptance of the new technology. Customers are not necessarily excited by boring or unclear menu options for power management, or compromises over energy-hogging appliances (Simon 2009). Similar to those in Texas, consumer advocate groups in Colorado are worried that those without the time or knowledge to set up their power management accurately will unnecessarily bear the cost burden (Simon 2009). Customers definitely are not interested in ‘big brother’ mandating the types of appliances in their homes (Simon 2009; Simon 2010).

In particular, the cybersecurity of the extensive and detailed information provided by the smart grid is a cause of concern (Jaffe 2010a). The U.S. Department of Commerce’s National Institute of Standards and Technology (NIST) located in Boulder has been charged since 2007 with the responsibility of creating physical and software standards and protocols for managing this information and ensuring interoperability of the different parts of the grid (NIST 2010). In Boulder, the legalized medical marijuana may have to be grown using 100 percent renewable energy only (on top of the other high taxes and license fees required to grow and dispense it); it is possible to check for this using smart-grid meters to determine if high wattage lamps for indoor plant illumination are being used (Urie 2010a; Jaffe 2010).

Green Jobs Training. In May of 2009, the city of Boulder committed to an alliance with Boulder Valley School System, the University of Colorado at Boulder, and Boulder County to develop green jobs training (City of Boulder 2009b). To that effect, Boulder County has a website called green jobs pipeline (<http://www.greenjobspipeline.org/>) but as of June 2010 it was not yet operational with detailed information.

Green Business Initiatives. The industries that the city of Boulder is interested in developing include natural products, active living, clean technology, biotechnology, and digital

media (City of Boulder 2010a; Wallace 2010). The Boulder Chamber of Commerce has a Clean Tech Forum (Boulder Chamber of Commerce 2010). The city is redeveloping an area just east of downtown as the Transit Village Area, a transit-oriented development for the new rapid bus transit hub being assigned to Boulder by state legislation called FasTracks. In 2007, the city was entertaining the idea of creating a Green Technology Park within the area (City of Boulder, Joint City Council and Planning Board 2007; Merrigan 2007). This idea does not appear to have been acted upon, though the research center for Energy Center of the Rockies may still draw many clean-tech companies to the Transit Village Area.

From 2008-2010 federal money has supported research and development efforts for clean-tech companies in Boulder (Wallace 2010). Lesser points out that, unlike the dot-com industry, the clean-tech industry requires close collaboration between the university and industry in order to be successful (2010). Lesser is a venture capitalist who rates the University of Colorado at Boulder as sixth (three spots behind the University of Texas at Austin) because it has great research but poor ties between the university and clean industry (Lesser 2010). In an effort to strengthen those ties, the Renewable and Sustainable Energy Institute was created in 2009 as a joint institute of the University of Colorado at Boulder and the National Renewable Energy Laboratory with the express purpose of “advancing solutions aimed at producing energy economically from renewable sources, decreasing reliance on foreign oil, reducing greenhouse gas emissions, and using energy more efficiently”(University Relations 2009). The University also hopes that the institute will build and then leverage a relationship with Conoco Philips, which is constructing a research center in the nearby town of Louisville for use starting in 2012 (University Relations 2009).

Civil Society Organizations and Policy

The pressure to make policy changes have come from individual citizens (i.e. the 2004 statewide referendum for a renewable-energy portfolio), green (or clean-energy) businesses, and the Governor’s Energy Office. Citizen groups have been involved peripherally but have not been as central to green-energy politics in Colorado as in some other states. As an example, the Alliance for Sustainable Colorado (2010), is a non-profit organization that has renovated a building in downtown Denver to demonstrate various renewable-energy projects and green building design, as well as using (and leasing) office space. It is sponsored by businesses that are directly involved with the clean-energy industry such as Namaste Solar and Xcel Energy, as well as sustainable design friendly businesses such as Citron (workspaces) and Adolphson & Peterson (construction). The Alliance for Sustainable Colorado lists the many regionally based sustainability organizations throughout the state as well as individual businesses. The Alliance for Sustainable Colorado is also a member of the Colorado Renewable Energy Society, a nonprofit organization that has a varied membership including businesses such as Cool Energy, Inc, Kyocera Solar Inc, nonprofit organizations such as Alliance for Sustainable Colorado and government organizations such as the Denver Museum of Nature and Science and Red Rocks Community College, etc. The Colorado Renewable Energy Society helps keep its members aware of legislation that they should contact their state senators and representatives about. It also helps to sponsor some dockets (Larson 2010). Another business oriented nonprofit organization, the Colorado Cleantech Industry Association, was involved in providing testimony (written and,

or, verbal) for several state government bills (Colorado Cleantech Industry Association 2009). The environmental community (i.e. Environment Colorado) and the oil and gas industry (i.e. the Oil & Gas Association) as well as Democrats, Republicans, the Public Utilities Commission and Xcel Energy were involved in drafting the HB 1365 Clean Air, Clean Jobs Act (Bowe 2010). For the HB 1001 legislation which has a mandated ratio of workers required on a solar installation site who meet specific certification requirements, “The International Brotherhood of Electrical Workers (IBEW) Local 68 [...] worked closely with the Colorado Solar Energy Industry Association to arrive at policy that makes sense for the workforce, contractors and consumers”(Apollo Alliance n.d.)

Public-interest civil society organizations are more evident in the green politics at the urban level, especially in Boulder. The city has a legacy of active citizens, starting with the PLAN B group fighting for urban growth limits and open space in 1967. The Social Sustainability plan was created with the assistance of non profit organizations (e.g. Boulder Chamber of Commerce, YMCA) and neighborhood associations (e.g. Mapleton Hill and University Hill), as well as social justice groups such as El Centro Amistad and Intercambio de Comunidades (both Hispanic immigrant rights organizations, each established in 2001). The Boulder Renewable Energy and Energy Efficiency Workgroup (BREE) was initiated by the Boulder City Council after the 2002 Kyoto protocol resolution and was instrumental in working on the Boulder Carbon Tax legislation (Brouillard and VanPelt 2007).

For More Information

The state of Colorado Governor’s Energy Office has several model state initiatives (http://rechargecolorado.com/index.php/programs_overview/colorado_carbon_fund/). The City of Boulder (<http://www.bouldercolorado.gov>;<http://ci.boulder.co.us>) and the City and County of Denver (<http://www.denvergov.org>) websites were useful in providing information about their current clean-energy plans and industry. The U.S. Department of Energy website provided useful statistics (<http://www.eia.doe.gov/>).

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New Mexico

Summary and Analysis

New Mexico has several unique resources that position it for potential leadership in green jobs and green business development. The state has a geographical position at the intersection of the country's three grids that could position it as a leader in the development of smart-grid technologies. In addition, the state's abundant solar energy has helped it to develop that industry in the state. In addition, New Mexico has several policy innovations that are potential models for other states:

- The state's *Green Jobs Guidebook* provides a low-cost model of analysis that links potential job seekers with job and training opportunities.
- The governor has developed a green jobs cabinet and produced a roadmap for the state that analyzes special resources in the state for creating green jobs and new businesses.
- The Tres Amigas Superstation may provide general lessons to states that are attempting to figure out new ways of organizing load management in the smart grid.
- The state government has compensated for a relatively small base of research universities by drawing on the national laboratories, thereby providing a model of how to strengthen research in a state that has a relatively small population.
- The emerging frame of "return on investment" for energy efficiency and renewable-energy projects suggests a way to bridge partisan divisions in green jobs policy.

General Background Policy

Energy Goals. Since 2007 New Mexico has had a renewable portfolio standard of 20 percent by 2020 for investor-owned utilities and 10 percent for rural electric cooperatives. There are also set-asides for solar and wind energy, but there are "off-ramps" in the event that costs are excessive (DSIRE 2010). In January 2010 the New Energy Efficiency Strategy Report mandated a 20 percent reduction in per capita energy use by 2020. Continued expansion is projected to add 236,800 jobs in both renewable energy and energy efficiency by 2030.

A corporate based renewable-energy production tax credit supports wind, biomass, and solar generation of electricity (DSIRE 2010). Under Governor Bill Richardson, the State of New Mexico positioned itself as strongly supportive of green industry and green job development. Executive order 2004-19 declared New Mexico the "Clean Energy State." A series of executive orders were issued in subsequent years to create the administrative structure and capabilities for being successful in this regard. The goals included becoming a center of the North American solar industry and a leader in green-grid innovation (Office of the Governor 2010b).

Public Benefits Fund. The state does not have a public benefits fund, but under the Efficient Use of Energy Act of 2005 the state allows utilities to collect a surcharge to support

energy-efficiency and load-management programs (DSIRE 2010). The state also has PACE enabling legislation (Hughes 2010).

Green-Buildings Policy. In 2005 the state government approved the Energy Efficiency and Renewable Energy Bonding Act, which allowed the state to sell \$20 million in bonds. The bonds allowed energy efficiency and solar energy improvements on public buildings that could repay the costs with long-term savings. In the same year the state also passed the Renewable Energy Bond Act, which finances schools and universities that add renewable energy installations (Dierkers 2007). Efficiency and renewable gains have the capability of directly offsetting teacher furloughs and layoffs.

In 2006 New Mexico Governor Richardson issued an executive order (2006-001) that required all new construction for the state's executive branch buildings to meet LEED silver guidelines and other energy-efficiency goals. A subsequent executive order (2007-053) for executive branch agencies set a goal of 20 percent energy consumption reduction below 2005 levels by 2015. Legislation in 2010 (SB 200) expanded on the goals for a wider range of new state government buildings and renovations throughout the state (DSIRE 2010).

Green Jobs Training. In 2010, New Mexico also released its *Green Jobs Guidebook* (State of New Mexico 2010c), which covers both occupations and educational resources in the state. Green jobs grew 50 percent between 1998 and 2007. Jobs are growing quickly in both rural and urban areas. In the past ten years, the "clean-energy sector grew by 118 percent, energy efficiency by 184 percent, environmentally friendly production by 99 percent, conservation and pollution mitigation by 35 percent, and training and support decreased by 5 percent. Unemployment in New Mexico was at 6.5 percent compared with 9.4 percent nationally in July 2009" (ibid.). The state established training centers in solar and wind technologies at San Juan Community College and Mesalands Community College (Miller 2008). Three bills were introduced before the legislature in 2010 with the goal of strengthening the research and training infrastructure: the Green Jobs Bonding Act (HB622), which targets low-income candidates, tribal communities, and veterans for green job training; the Higher Education Alternative Energy Program Awards (SB 288), which supports research and education programs; and the Development Training Funds for Green Jobs bill (SB 318), which will transfer up to \$1 million per year from the state's Job Training Incentive Program to green jobs (Miller 2009). The Department of Workforce Development received \$6 million in ARRA funding in 2010 for green jobs training.

Clean-Energy Industries

General Background. In 2009, the governor established the Green Jobs Cabinet, which produced a roadmap for the state's green energy industries (State of New Mexico 2009) that became the basis for an executive order (2010-001) issued in January, 2010. Although the plan has ambitious goals, such as becoming a leader in the solar and smart-grid industries, the state lacks a clean-tech investment fund and other crucial elements that have emerged in other states. The state does offer support for businesses through tax credits and tax-free revenue bonds.

New Mexico is challenged by not being able to invest directly to recruit new business development into the state. Instead, support must flow through tax incentives or similar mechanisms. The barrier of high start-up costs is being carefully examined with the goal of providing businesses with creative incentives that actively attract new business. Being the fifth largest state by land mass, a statewide goal is to encourage rural economic development through new renewable installations and easy access to governmental officials towards stimulating vibrant business growth (Cottrell 2010).

Biofuels. The main areas for biofuel development in New Mexico include algal biofuels and non-food crops like camelina, castor, canola and the *Pongamia pinnata* tree. The algal biofuel production at Sapphire Energy in the Las Cruces area plans to be commercially producing 1 million gallons of fuel by 2011 through an investment of \$100 million in venture capital. Another 1 million gallons is expected by 2018. New Mexico currently has a small biodiesel industry, and the state government has supported its growth by passing legislation in 2007 (SB 489) that requires a 5 percent biodiesel blend by 2012. There exists a tax credit offsetting state corporate income tax liability on each gallon of diesel fuel blended with 2% of biodiesel (U.S. Department of Energy 2010). Abengoa Bioenergy USA owns and operates the Portales-based biofuels' facility with "the capacity to convert 11 million bushels of grain sorghum into 30 million gallons of ethanol and approximately 90,000 tons of distillers grains annually...Oil seed crops grown in New Mexico show that for every 1,200 acres cultivated, about 94,000 gallons a year of fuel and 40,000 tons of meal for feed will be produced with an estimated combined worth of \$1 million" (State of New Mexico 2010e).

Geothermal. The state offers numerous sources of geothermal potential and associated hot springs. Michael Albrecht, President of TBA Power, Inc., has proposed to integrate direct use applications (green houses, fish farms, spa and resorts, etc.) into geothermal power generation facilities that circulate some 10,000 gallons of hot brine per minute. For each facility the integration would have the potential to generate about 2,000 permanent jobs. Geothermal power generation facilities alone would generate only about five permanent jobs. Currently the Pueblo of Jemez and TBA Power (Pueblo's general contractor) have managed the largest geothermal exploration project in New Mexico for about twenty-five years. The final goal is geothermal power production with an integrated direct use component. Raser Technologies of Provo, Utah, has also recently begun a geothermal project in Lightning Rock, New Mexico. A conservative estimate of the geothermal potential throughout New Mexico based on USGS findings available for short term development with existing technology appears to be around 2,000 megawatts (Albrecht 2010, Raser Technologies 2010, TBA Power 2010).

Smart-Grid and Building Technologies. The New Mexico Renewable Energy Transmission Authority actively develops new transmission projects that promote renewable energy, and it is one of only eight energy transmission authorities in the entire country (Office of the Governor 2010a, RETA 2010). With a population of less than two million, it is critical that New Mexico plans an economically and technologically feasible approach to transmitting power well beyond state borders. Several major transmission lines are being planned within the state to move power to regional demand centers with expected completion dates scheduled for as early as 2014 (Miller 2010).

In 2008 New Mexico launched a “smart green grid” initiative, which involved collaboration among the state government, utilities, electricity cooperatives, and research centers at government laboratories and universities (Robinson-Avila 2009). The state has also partnered with Japan’s New Energy and Industrial Technology Development Organization, which will provide up to \$30 million in funding and cooperation with nineteen Japanese companies (State of New Mexico 2009). Using Internet-based technologies, the system will monitor energy use and remotely enable and disable energy sources for the grid, including distributed renewable energy sources. The system will be modeled on the state’s supercomputer and tested in “microgrids,” probably before 2014. When federal stimulus money became available in 2009, the state’s Computer Applications Center submitted a \$50 million proposal for smart-grid technology development (State of New Mexico 2009).

In October 2009 the state announced Tres Amigas Superstation, which would link the country’s three electricity grids—Eastern, Western, and Texas—near the city of Clovis, New Mexico. The planned superstation would occupy a twenty-two-square-mile private project on state trust land and would eventually have thirty gigawatts of transmission capacity, which would enable it to transmit renewable energy from the Southwest to the rest of the country (Associated Press 2009). Tres Amigas allows for a national transmission hub to be positioned where the three power interconnects are closely located. Via the use of voltage source converters (the latest proven technology of alternating current – direct current converters) at each of the nodes connected via a closed looped direct current transmission system, Tres Amigas controls the direction and magnitude of energy flow between the Western Electric Coordinating Council Interconnect, Eastern Interconnection (via the Southwestern Power Pool), and ERCOT in Texas, thereby increasing the efficiency of all three grids. The Tres Amigas Superstation promotes and facilitates the infusion of energy from various renewable projects to multiple high demand load centers located in the three grids, and it enables the diversified renewable energy sources to follow hourly demand fluctuations throughout a large portion of North America. This allows strategic decision making by load serving entities to meet the demand with appropriate energy (where it is coming from and when it will come), thereby optimizing energy resources. The Tres Amigas Superstation and the new renewable development projects will bring additional green jobs into the state. The first facility of its kind in the world, the Tres Amigas Superstation was granted permission on March 19, 2010, to negotiate price of transmission services to ensure fair prices. Governor Bill Richardson expects that the project could generate the spending of billions of local dollars and significant construction jobs throughout eastern New Mexico (Barbara 2010).

Solar. New Mexico has targeted the state’s solar manufacturing industry for development in its green economy roadmap (State of New Mexico 2009). New Mexico State University hosts the Southwest Regional Experiment Station-Southwest Technology Development Institute, which does solar research, and Northern New Mexico College, which is located near the Los Alamos National Laboratory, hosts the Solar Energy Research Park and Academy. The Sandia National Laboratories performs solar testing and manages the Concentrating Solar Power Program. In the sustainable community of Mesa del Sol, near Albuquerque, two new solar research facilities were added in 2010 (Office of the Governor 2010d). New Mexico’s solar manufacturing industry includes Schott Solar, Advent Solar, Emcore, Skyfuel and Sundrop.

Wind. New Mexico has in place 596 megawatts of online wind capacity with 545 megawatts of wind capacity planned to go online in the future (Mesalands Community College 2010). New Mexico ranks twelfth in the nation for wind production and has the highest per capita wind energy usage throughout the U.S. The Public Service Company of New Mexico generates 4 percent of annual energy production from wind, which is considered one of the highest of any utility (State of New Mexico 2009).

Albuquerque and Santa Fe

Sustainability Plans. The city of Albuquerque has received high rankings as a sustainable city, with especial attention given to its achievement of receiving 20 percent of its energy from wind. In 2005 the city launched its Renewable Energy Initiative (R-05-329). The initiative included an effort to green public buildings, a rebate program for renewable energy use by residents, an amendment to the industrial revenue bond process to allow points for renewable energy use, and green purchasing guidelines for the city government (Gordon et al. 2006). In 2009 the city's Climate Action Task Force issued recommendations for a climate action plan that included forty-nine recommendations for initiatives to promote carbon neutral buildings, increased levels of renewable energy, public and bicycle transportation, local food, and zero waste (City of Albuquerque 2010a, 2010b). Whereas Mayor Martin J. Chávez was a strong advocate of sustainability, after the transition to Mayor Richard Berry a new conversation emerged that focused on attracting new businesses evaluating green projects based on their return on investment. The "return on investment" framework has tended to replace the traditional sustainability approach to reducing large-scale ecological impacts as in global warming.

Green-Building Initiatives. With respect to buildings, in 2007 Albuquerque launched the Energy Conservation Code, which requires that new buildings be 30 percent more energy efficient than past benchmarks. New and renovated city buildings will also achieve a 50 percent energy reduction in fossil fuel usage in comparison with the average for similar city buildings as established by the U.S. Department of Energy. For the private sector, the city issues voluntary certificates for buildings that meet its green standards (City of Albuquerque 2010a, 2010b).

Santa Fe has a low-interest program through HomeWise that allows participants to borrow money at an attractive 4 percent fixed interest rate for up to a thirty-year term. Income qualified homeowners within city limits can borrow up to \$30,000 for both energy-efficiency and renewable-energy projects. Over \$750,000 has been loaned out through the program on projects such as increased insulation in walls and roofs, solar air and water heating systems, photovoltaic systems, and energy-efficient windows and doors. An important stipulation of the program is that the contractors hired to do the work must be from Santa Fe County. The program logic allows for the relatively "low hanging fruit" of energy conservation and efficiency upgrades to be made before more expensive renewable-energy purchases are set. Nick Schiavo, Santa Fe's Energy Specialist, notes the importance of growing jobs locally for both manufacturing and service sectors. His belief in having higher tax credits for various renewable and efficiency products made nationally creates the incentive or motivator towards bringing jobs back to America. Unfortunately, under the current federal tax credit setup for renewable energy, many dollars leave the country to purchase photovoltaic panels manufactured overseas. An example of how

General Electric reinvested in the American worker can be attributed to the ARRA stimulus funds, because ARRA dollars stipulated that the lamps and ballasts for lighting projects must be manufactured in the U.S. General Electric modified one of its existing U.S. manufacturing facilities to begin production of lamps and ballast to meet this criteria.

Santa Fe County continues to work on launching New Mexico's first Property Assessed Clean Energy (PACE) Program, which, pending federal approval, allows homeowners and businesses to obtain loans for renewable energy systems and repay them through property taxes (New Mexico Business Weekly 2010).

Green Jobs Training. In 2008 the city of Albuquerque developed a green jobs corps modeled on the one in Oakland, California, and Mayor Martin Chávez introduced a green jobs pledge for mayors at the International Council for Local Environmental Initiatives (ICLEI). Mayor Richard Berry's approach to green job growth is through an emphasis on energy efficiency and solar.

Green Business Initiatives. The city of Albuquerque has worked with the state government to develop a solar industry. The 2005 Renewable Energy Initiative included an allocation of up to \$1 million in tax credits and incentives for solar firms that located in the city. The city has also benefited from the state government initiatives by becoming the headquarters of the some of the solar energy companies that have located in the city, such as Advent Solar. The city helped to recruit Schott AG, a German firm that relocated its solar manufacturing facility to the city starting in 2008. The city's economic development office foregrounds the solar energy research and economic development assistance of the Sandia National Laboratories (City of Albuquerque 2007). As a result, the elements are in place for the region to transition from a solar energy manufacturing cluster to a solar energy innovation cluster.

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Oregon

Summary and Analysis

Oregon is considered a leader in energy efficiency requirements, green buildings, and related financing mechanisms. Among the policy innovations at the state level are the following:

- Oregon is conducting a first-of-its-kind pilot program for five years to offer income for home generation of power through a solar feed-in tariff. The program rewards home-energy production instead of subsidizing installation, as in other states.
- Oregon's Business Energy Tax Credit (BETC) provides a variety of mechanisms for financing green businesses and has resulted in the attraction of businesses to the state. It offers credit to those who invest in energy conservation, recycling, renewable energy generation, and less-polluting transportation fuels.

Portland, the largest city in Oregon, is known for its leading green-building ordinance, light-rail system, urban growth boundary, and unified city government office of planning and sustainability. Increasingly, the various efforts to green the city have translated into green job development. Among the most innovative aspects of Portland's initiatives and policies are the following:

- Clean Energy Works Portland (CEWP) develops weatherization and energy efficiency retrofit projects for up to 100,000 homes in the greater Portland area, with on-bill financing. The program has been such a successful model that it is being scaled up to the statewide scale with Clean Energy Works Oregon (CEWO).
- The Community Workforce Agreement requires hiring and training from a diverse workforce for green jobs under CEWP, with features including a "living wage" requirement.
- The green-buildings policy for city-owned buildings requires new construction and major renovations of all city facilities to meet the LEED gold standard. The policy also ensures that existing buildings meet the required LEED EBOM Silver.
- The city has sponsored local manufacturing. Oregon Iron Works is building the country's first streetcar made by an American firm in over fifty years. This development has attracted national attention as an example of unionized, green manufacturing.
- Portland has also analyzed its industrial strengths and developed a plan for green-jobs growth and business development that matches its unique industries.

General Policy Background

Energy Goals. In 2007, the State of Oregon approved an ambitious, “25 by ‘25” renewable portfolio standard, that is, 25 percent of the state’s electricity from large distributors must come from renewable energy sources by 2025. The Oregon Renewable Energy Act (SB 838C), signed into law on June 6th, 2007, includes stepwise goals of 15 percent of total state energy from renewables by 2015 and 20 percent by 2020. The goal of the legislation is to create a stable market for new renewable energy development. It is expected to support the development of 1,500 average megawatts of new renewable energy, enough energy to meet the needs of 1.25 million average Pacific Northwest homes. Climate change legislation passed that same year on Global Warming Actions (HB 3543) codifies the greenhouse gas (GHG) reduction goals of a 10 percent reduction of 1990 levels by and 75% below 1990 levels by 2050. (EPA 2008).

Previously in 2005, the state government announced the Oregon Renewable Action Plan (REAP). REAP’s goal is to encourage and accelerate the sustainable production of energy from renewable sources, stimulate economic development (which focused on development in rural parts of the state), and generally improve the environmental future of the state. Under the plan, utilities are required to make renewable energy options available to customers who want to support the building of more renewable-energy mechanisms. Both Portland General Electric and PacifiCorp have run successful programs that are often at the top of lists naming top programs in the country (Citizen’s Utility Board 2010). The short-term goals of REAP for electricity generation were as follows:

- 1) 300 megawatts of new wind energy resources developed with 10 percent coming from community or locally-owned wind energy projects;
- 2) implementation of effective solutions to the transmission capacity bottleneck(s) between eastern and western Oregon in order to provide access from renewable and other resources in eastern Oregon to load centers;
- 3) a “stable-price” renewable-energy product offered by all Oregon utilities;
- 4) 500 additional solar photovoltaic electric systems installed in the years 2005 and 2006 for a total of about one megawatt;
- 5) five megawatts of new biogas generation facilities obtained from wastewater treatment, dairies, and landfills;
- 6) twenty-five megawatts of new biomass-fueled electric generation built or under construction by 2006, in addition to the aforementioned five megawatts of biogas facilities;
- 7) twenty-five megawatts of new combined heat and power (CHP) generation systems that are at least 10 percent better than the state standard for siting exemption built or under construction by 2006;
- 8) 200 five-kilowatt fuel cells;
- 9) twenty megawatts or more of geothermal electric generation to be in the process of being developed by 2006;
- 10) one to four megawatts of new environmentally sustainable hydroelectric generation on line or in the process of being developed (primarily irrigation piping channels) by 2006; and
- 11) an assessment of the feasibility of a renewable portfolio standard for the state completed by 2006.

The long-term goals of REAP (2007-2025) include goals for electricity generation as well as for transportation fuels. Requirements include renewable generation to meet 10 percent of Oregon's total load by 2015, roughly about 1 percent growth in renewable generation per year increasing to or to exceed 25 percent of the load by 2025 and 25 percent of state government's total electricity needs to be met by new renewable energy sources by 2010 and 100 percent by 2025.

Under REAP, ratepayers can also voluntarily purchase renewable energy certificates (RECs) to support renewable-energy projects and help them to get built. RECs are registered to confirm that certificates are coming from actual projects and ensure that RECs are not sold more than once. REAP also has various goals for the state government's sustainable procurement policies. REAP established the Renewable Energy Working Group to oversee the goals and to prepare regular progress reports to the governor's office and stakeholders.

The state has also developed standards that have enabled it to be ranked as the leader in net metering in the country (Network for Energy Choices 2009), and it has set an energy-efficiency resource standard of 20 megawatts for electricity. The Oregon Energy Efficiency and Sustainable Technology Act of 2009 (EEAST, HB 2626A) includes provisions for energy audits and an energy savings plan. It also include goals for weatherizing existing residences and small businesses, production of renewable energy, increasing local demand for energy efficiency in order to develop the state's green building industry cluster. Once implemented, the cost of the plan is deducted from the owner's future energy bills. EEAST modifies the Oregon Department of Energy's Small Scale Energy Loan Program, which it authorizes to accept dollars from many different sources, both public and private, for loans and grants.

HB 2181, a bill related to energy conservation improvements in existing buildings, authorizes local governments to establish local improvement districts within which owners on record of qualifying residential and commercial property may receive loan financing for energy-efficiency and renewable-energy projects for the purpose of paying cost-effective energy improvements to property. It also authorizes the State Department of Energy to make loans to finance cost of energy-efficiency improvements to existing real property in local improvement districts.

Public Benefits Fund. The state's Public Purpose Fund provides about \$70 million annually in revenue for the Energy Trust of Oregon, which funds renewable-energy, energy-efficiency, and low-income energy-assistance programs (DSIRE 2010). Created as part of the electricity restructuring legislation (SB 1149) in 1999, the Energy Trust of Oregon combined the separate energy-efficiency offices that had previously existed in each utility into one office. The change made the process of running energy-efficiency programs much more efficient and cheaper for ratepayers. It also removed the inherent conflict of interest among utilities regarding energy efficiency: encouraging customers to use less of the product (energy) that they produce and sell. Energy goals, the public purpose fund, and green buildings are the essence of Energy Trust (Menashe 2010). Investor-owned utilities supply the Energy Trust with monies from the public purpose fund to support energy-efficiency projects. The Energy Trust works upstream with manufacturers and distributors for energy-efficiency products, and it also works downstream by creating incentives for energy efficiency (Smith 2010). By developing contracts

and setting standards, the process creates uniformity in the energy-efficiency market. The Energy Trust also serves as an information clearinghouse to residents, business, agricultural communities, manufacturing sector and food storage facilities. In that role it provides technical assistance, package solutions as well as cash incentives for weatherization, heating and cooling upgrades, appliance standards, lighting, and energy-efficiency and renewable-energy technologies such as solar electric and solar water heat, small wind, and hydroelectric. Not only has the Energy Trust raised awareness of energy efficiency in the commercial, residential, business sector, but has generated a lot of renewable energy and energy-efficiency savings which translates into green jobs in the clean-energy sector for Oregon (Menashe 2010)

Oregon's Business Energy Tax Credit (BETC) provides a variety of mechanisms for financing green businesses and has resulted in the attraction of businesses into the state (Trummer 2010). The BETC, administered through the Oregon Department of Energy, gives a financial reward to those who invest in energy conservation, recycling, renewable energy resources, and less-polluting transportation fuels. Trade, business, or rental property owners who pay taxes for a business site in Oregon are eligible for the tax credit and must use the energy conservation or renewable energy equipment for the project, or they can lease it the equipment for use at another site in Oregon. The tax credit is 35 percent of eligible project costs (the incremental cost of the system or equipment that is beyond standard practice) and 50 percent of the eligible project costs for 1) high efficiency combined heat and power, 2) renewable energy resource generation, or 3) renewable energy resource equipment manufacturing facilities. A project owner also can be an Oregon non-profit organization, tribe, or public entity that partners with an Oregon business or resident who has an Oregon tax liability. This can be done using the pass-through option, which allows a project owner to transfer their BETC project eligibility to a "pass-through partner" for a lump-sum cash payment (Oregon Department of Energy 2010). The BETC has been structured in such a way that it has allowed some firms to "double dip." Because it was popular, it ran into budgetary limits, and consequently state legislation in 2010 restructured the tax credit to correct some of the problems. The changes include a tiering category system for the renewable energy aspect of the credit in which projects are put in queue and there are limited available funds in each category. The legislature also established an overall program cap for BETC (Trummer 2010).

Green-Buildings Policy. Oregon has had energy-efficiency provisions for state government buildings since 1991. In 2001, the mandated State Energy Efficiency Design Program (SEED) expanded those provisions to include a goal that all new state government buildings exceed the existing energy-efficiency code by 20 percent, and that all existing government buildings reduce their energy consumption by 20 percent against a 2000 baseline. The BETC also provides 35 percent credit on investment to owners of LEED-certified buildings where the size of credit is matched to the building size and level of LEED certification. The state Department of Energy administers the program and provides technical expertise on each project, helping agencies identify and design the most cost-effective energy conservation measures.

Clean Energy Works Oregon (CEWO) is based on the notable program first piloted in Portland. Currently in the planning stages, CEWO will operate under the Portland Bureau of Planning and Sustainability as its fiscal agent. The plan is to start with the upgrade of 6,000 residential units around the state in energy efficiency (Smith 2010). Similar to Clean Energy

Works Portland (described below), CEWO will oversee the training, weatherization, and heating improvements in homes throughout the state. Financed initially with ARRA funds, payment is made via a line on the homeowners' utility bill that is paid into a revolving loan fund and is repaid on the homeowner's utility bill over fifteen to twenty years. CEWO will offer homeowners low-cost financing for energy-efficiency home improvements, like new insulation or the installation of a high efficiency furnace or water heater. As in the Clean Energy Works Portland model, participants in CEWO will receive the assistance of an "energy advocate" throughout the process to help make decisions about which upgrades and financing options make sense. Low-income households pay the lowest interest rate, with higher-income households able to lower their interest rate by electing more comprehensive energy retrofits. Also like Clean Energy Works Portland but on the state level, the program will provide a range of career path for opportunities for Oregonians in the clean-energy sector and is also focused on historically disadvantaged communities. According to Derek Smith, formally of Portland's Bureau of Planning and Sustainability, now to head CEWO, CEWO is catalyzing more than energy-efficiency work, roofing, siding, and windows; it is also integrating solar and other technologies into residential and some commercial buildings (Smith 2010). In this, CEWO is also building a local supply chain of manufacturers, installers, contractors and inspectors. The key benefit of CEWO is in building demand within Oregon for Oregon's workforce in the clean-energy sector.

Green Jobs Training. As of 2008, 3 percent of Oregon's workforce fell under the category of green jobs. The three industries with the most green jobs (47 percent of the total 3 percent of all jobs in Oregon) are construction, wholesale and retail trade, and administrative and waste services (State of Oregon 2010b). The five occupations with the most green jobs (27 percent of the three percent of total jobs) are carpenters, farm workers, truck drivers, hazardous materials removal workers, and landscaping and grounds keeping workers. Green jobs training programs are available from community colleges, unions, and nonprofit organizations.

In 2009, HB 3300 was passed to deepen the state's clean-technology efforts by establishing a green jobs workforce development plan and training programs. HB 3300 instructs the State Workforce Investment Board to develop a plan for the promotion of green jobs, requires the plan to identify high-demand green industries and promote certain workforce development activities to promote growth of green jobs and to define terms related to green jobs and green economy. HB 3300 also requires the Economic and Community Development Department to develop criteria for and make recommendations about promoting green industries, technology and innovation. The state received \$6 million in ARRA funding in 2010 for green jobs training programs.

The Oregon Economic Revitalization Team, housed within the governor's office, acts as a liaison between state agencies, local governments and other partners to facilitate communication about regulatory barriers and challenges. The Economic Revitalization Team develops mechanisms to increase coordination among the departments and agencies that have overlapping regulatory authority on common local government programs, and it proposes ways to create regulatory efficiencies and problem solve during the rulemaking activities. The priorities include "promoting innovative and coordinated approaches to economic and community development, particularly those that solve problems and create public benefit by integrating land use, transportation, infrastructure, and natural resource planning to achieve

sustainable economic development”; and “supporting state and local government efforts to grow renewable energy and the green jobs portfolio throughout Oregon” (State of Oregon 2010a).

Clean-Energy Industries

General Background. The numerous laws and regulations discussed above have created local demand to develop the state’s green building industry cluster. As discussed, the BETC provides a 50 percent tax credit for new renewable energy facilities up to \$20 million, with \$400 million in tax credits. Between 2006 and 2009, the state spent nearly \$400 million in tax credits, making it one of the leading states for clean-tech industry growth (Knutson 2009).

Oregon has a number of offices and programs that coordinate economic development and clean energy industry development that go beyond training (as mentioned in the Green Jobs Training section) to build on existing industrial strengths as well as to promote emerging areas of research and development in the clean energy and green building sectors. To support clean-energy companies, in 2007 the state legislature established the Oregon Built Environment and Sustainable Technologies Center, a nonprofit organization that develops the research infrastructure in the environment and renewable energy fields. Programs such as the University of Oregon’s Energy Studies in Buildings Laboratory, the Oregon State University Wood Innovation Center, and the Oregon Institute of Technology Renewable Energy Center have amplified the knowledge base for clean-energy and technology industries. Oregon Solutions, a program of the National Policy Consensus Center at Portland State University, has fostered the development of over sixty energy-efficiency projects around the state.

Biofuels. The 2005 Renewable Action Plan includes targets for biofuels for the state’s vehicle fleets, and in 2007 the state government approved a renewable fuel standard that mandated blends of ethanol in gasoline and biodiesel in diesel fuels (HB 2210). The legislation provides tax incentives for the producers, refiners, and consumers of biofuels. The mandate expands the property tax exemptions for facilities producing ethanol, biofuel, or certain fuel additives; allows a taxing district to opt out of exemptions; limits the period of time for which new facilities may claim exemption; creates a tax credit; establishes renewable fuel use standards; prohibits the sale of gasoline that contains certain additives; and modifies energy facility siting requirement exemptions. The Colorado-based ZeaChem is building a large cellulosic biofuel refinery in the state. However, because the majority of biofuel production is corn-based ethanol, the industry remains concentrated in the Midwestern and Southern states (Trummer 2010).

Smart-Grid and Building Technologies. Oregon is poised to develop smart-grid technology strength, partly because of its location between Seattle and Silicon Valley. In addition, the state has a traditional strength in the lumber and wood products industry that is gradually being transformed into a green building industrial cluster (Allen 2006). The Oregon Energy Efficiency and Sustainable Technology Act of 2009 (EEAST) gives home and business owners a state-designated project manager for an energy audit and energy savings plan of their properties. The law will help produce local demand to develop the state’s green building industry cluster. Some of the businesses and other organizations in this industry include the Pacific

Northwest National Laboratory, Cascadia Green Building Council, Columbia Forest Products, Gerdlin/Edlen, Interface Engineering, Serra, Boora, ZGF, Brightworks, and Northwest Research. The state's strength in green buildings is further supported by the university research facilities mentioned above.

Solar. Oregon has a half dozen solar photovoltaic manufacturers (Peak Sun Silicon, Solaicx, Mr. Sun Solar Enterprises, PV Powered, Solar World and Sanyo Solar), and the solar manufacturing industry appears to be growing. The German company Solar World built a large manufacturing facility in Hillsboro, where Intel is located. The large chip manufacturer has also made investments in the solar industry. Solar energy research is also conducted at the state's four research universities in collaboration with the Pacific Northwest National Laboratory and the Oregon Built Environment and Sustainable Technologies Center (Kleiner 2009). The state-sponsored center also has formed the Oregon Support Network for Research and Innovation in Solar Energy.

In May 2010, Oregon revealed a five-year pilot program to offer income for home generation of power. Under this program, the first of its kind in the nation, residents who install solar panels are eligible for premium-rate reimbursement from their utility companies based on their power generation for a period of fifteen years. The program rewards home energy production instead of subsidizing installation, as is done in other states. The program relies on revenue from increased electricity rates from customers of Portland General Electric and Pacific Power and Oregon customers of Idaho Power to finance the project rather than relying on state tax credits. There is some hesitation with respect to the program; one of the factors behind the hesitation is that residents fear that the increased fee to customers will make utility bills unaffordable. The Public Utilities Commission has the ability to cap the program before the fifteen megawatts are reached if the overall impact on rates is too high (Trummer 2010). The pilot program is overseen by the Oregon Public Utility Commission and is limited to a maximum 25 megawatts of production, roughly enough energy to serve 2,500 homes (Read 2010).

Oregon's Built Environment and Technologies Center (BEST)'s faculty are located at Portland State University, Oregon State University, and University of Oregon and are involved in solar energy research. Oregon BEST helps advance solar research that ranges from cutting-edge thin-film technologies and associated materials to exploring how green roofs and solar panels might co-benefit renewable energy and energy-efficiency projects. Recently established solar energy shared-user research labs, the Photovoltaics Laboratory of the Oregon Support Network for Research and Innovation in Solar Energy (Oregon SuNRISE) at the University of Oregon, and the Oregon Process Innovation Center (OPIC) for Sustainable Solar Cell Manufacturing at Oregon State University were funded from Oregon BEST (Built Environment and Sustainable Technologies Center 2010).

The Oregon Solar Energy Industries Association (OSEIA) provides training and information resources to professional about tax credits, incentives, feed -in tariffs and utility information. For students, OSEIA offers volunteer opportunities and research links. They also act a clearing house of contractor information, incentives, tax credits and training for energy consumers.

Transportation and Energy Storage. In 2008 the state introduced the country's first standards for electric vehicle charging stations, and Nissan followed the announcement with a decision to introduce its electric vehicles in that state. The state also introduced a \$1,500 electric vehicle tax credit. The state tax credit for plug-in hybrid electric vehicle (PHEV) and battery electric vehicle (BEV) is up to \$1,500. There is a federal tax credit of up to \$7,500 (Trummer 2010). Although the state is home to the electric motorcycle manufacturer Brammo, and light-rail manufacturing in Portland, there is no energy storage and transportation group of similar size to those in the Midwest and New York.

Wind. The American Wind Energy Association (2009) reports that Oregon was fifth in the country in installed wind capacity at the end of 2009. After the first quarter of 2010, Oregon was ranked fourth in installed capacity wind capacity. In 2002, the state attracted the Danish company Vestas to locate its headquarters in the state. However, much of the manufacturing of the new wind turbines has taken place outside the state, and Oregon has yet to transform the advantages into a strong wind manufacturing industry.

Portland

Sustainability Plans. Portland is often recognized as a leader in local sustainability initiatives, and it has had a sustainability plan since 2000. The Portland City Council has adopted an economic development strategy that prioritizes sustainability as a key economic engine of the Portland region. The city has also merged the sustainable development and planning functions into the single Bureau of Planning and Sustainable Development. The twenty-five-year strategic plan for the city, called the Portland Plan, aligns government spending from the U.S. Department of Housing and Urban Development and the Department of Energy.

Portland's Climate Action Plan, recently passed in 2009, has eight focus areas: buildings and energy, urban form and mobility, consumption and solid waste, urban forestry and natural systems, food and agriculture, community engagement, climate change preparation including green infrastructure, and local government operations (City of Portland and Multnomah County 2009). In addition to energy savings and energy self-sufficiency, the Climate Action Plan will create local jobs because money previously spent on fossil fuels will stay in Portland for energy-efficiency upgrades and renewable energy projects like home insulation, lighting retrofits, solar panels, engineering, and design and construction. The plan also aims to improve social equity by ensuring that communities most vulnerable to climate change are given priority for green jobs, healthy local food, energy-efficient homes and affordable, efficient transportation.

The Solarize Portland project, another initiative of the city, is focused on bulk buying of non-utility scale solar products for quadrants of the city of Portland. According to Debbie Menashe of the Energy Trust of Oregon, solar installation contractors are coming from all over to work in the city (Menashe 2010). The project enables a group of people from the city to get together to invest in solar electric systems for their homes. They are educated with free workshops offered by the Portland Bureau of Planning and Sustainability. They then work with the Energy Trust of Oregon to get an approved, state "tax credit certified" solar contractor

chosen by the project coordinators. The contractor installs solar panels for all participants, and usually participants receive a bulk-purchasing benefit or price break. Then, participants receive their free solar site-assessment with the contractor, including costs allowing them to make the best decision for their community. If a decision is made to buy the contractor coordinates equipment purchases and the install schedule so as to conserve resources. After installations, inspections are required. Paperwork is submitted to Energy Trust of Oregon for the appropriate state and federal tax credits (Solarize Portland 2010).

Green-Building Initiatives. Portland continues to be recognized as a world leader in green building. Jurisdictions from all over the country use Portland's green building, climate change, and sustainability policies as models. Clean Energy Works Portland (CEWP) was a successful pilot project of the City of Portland in collaboration with Multnomah County, Shorebank Enterprise Cascadia, Energy Trust of Oregon, NW Natural, Pacific Power, Portland General Electric, Worksystems Inc., and Green For All. The project offered homeowners access to low-cost financing for energy-efficiency home improvements such as new insulation or the installation of a high efficiency furnace or water heater. The project is the nation's only consortium that offers on-bill financing for clean-energy upgrades and retrofits to customers. In doing so, it addresses the common hindrance to sustainability: the lack of financing for clean technology upgrades for residential, commercial, and industrial buildings and facilities.

CEWP oversees the training, weatherization, and heating improvements in homes around the Portland metro area. The program was financed initially with ARRA funds with on-bill repayment. CEWP participants receive the assistance by a qualified Energy Advocate to help decide on upgrades and financing option. Thirty homes participated in the early phase of this pilot from June through August 2009. Approximately 100,000 homes are planned for CEWP, spread out over five phases (Jacobs 2010). CEWP is a simple and easy program that combines the loan processing, energy assessment, and contractor selection. Low-income households pay the lowest interest rate, with higher-income households able to lower their interest rate by electing more comprehensive energy retrofits. A core component of the program is its commitment to creating quality jobs and advancing social equity. The project has been so successful that it has been federally funded to expand to the state level.

Another model program is the Community Workforce Agreement (CWA), which the city of Portland approved in 2009. The agreement includes a plan to develop weatherization for up to 100,000 homes that will also create green jobs for low-income workers. The family-supporting jobs (including a 'living wage' and health insurance requirements) will include diversification of the workforce. The Community Workforce Agreement was a product of successful collaboration between a broad base of community stakeholders to help ensure equity for women, people of color, and other historically disadvantaged or underrepresented groups in the implementation of Clean Energy Works Portland. The Community Workforce Agreement "living wage" requirement is for those employed through the home energy retrofit pilot program. A unique feature of the Community Workforce Agreement is the establishment of a stakeholder Evaluation and Implementation Committee, which joins the city and the Energy Trust in executing the key elements of the pilot project and making recommendations for the scale-up. The Community Workforce Agreement has the following requirements: at least 80 percent of employees used in the CEWP pilot program be hired from the local work force; workers participating in CEWP

retrofits to not earn not less than 180 percent of state minimum wage; ensure that employees on CEWP pilot project jobs have access to adequate and affordable health insurance as well as assure that the financial burden to small business owners of providing health insurance to their employees is minimized; and historically disadvantaged or underrepresented people, including people of color, women, and low-income residents of the city perform not less than 30 percent of total trades and technical project hours in the pilot. To meet these goals, contractors are asked to have a first source hiring agreement with qualified training programs; businesses owned by historically disadvantaged or underrepresented people make up not less than 20 percent of all dollars in the CEWP pilot project; provisions of resources for continuing education and; and mobility within the clean-energy industries assured through registered apprenticeship and other career pathways trainings in the region (Coalition for a Livable Future et al. 2009).

A third area of leadership is that Portland has gone beyond the usual best practice of a LEED silver standard for public buildings to require a LEED gold standard. The City of Portland adopted a Green Building Policy in 2001 and amended it in 2005 (Resolution Number 36310) to require that all new construction and major renovations of city facilities meet the LEED Gold standard. The rules also require a 30 percent energy savings beyond LEED baseline requirements and LEED EBOM Silver for existing buildings. The policy was further amended in April 2009 (Resolution Number 36700) to incorporate the Green Building Policy and green building principles into all city operations. All tenant improvements to city-owned facilities must be LEED for Commercial Interiors (CI) Silver and/or follow the Bureau of Planning and Sustainability's (BPS) High Performance Tenant Improvement Guide. All new commercial or mixed-use buildings over 10,000 square feet that meet certain requirements (they receive financial assistance from the Portland Development Commission of \$300,000 or more, and the support also equals 10 percent of the total project cost) must achieve LEED silver certification. All new city-owned facilities and existing city-owned buildings installing a new roof must include an ecoroof, which is specified in the policy.

The Green Investment Fund (GIF) was established in 2005 and sponsored by the City of Portland Bureau of Environmental Services, Bureau of Planning and Sustainability, Water Bureau, and Energy Trust of Oregon, Inc. as a 5-year, \$2.5 million competitive grant program that supported innovative green building projects within the City of Portland. A total of \$425,000 was awarded annually from 2005 through 2009 to thirty-six high-performance public and private industrial, multifamily, residential, commercial, mixed-use, and non-profit projects either completed or still in development. The GIF was used to help offset the incremental costs of green building measures or strategies of exemplary and comprehensive green building and site-related project activities that contributed to meeting the GIF goals and priorities.

Green Jobs Training. Under the Portland's Climate Action Plan (CAP) as well as the CWA, 80 percent of employees must be hired from local work force. There are also rules to support the hiring of women and people of color at a living wage. Furthermore, 20 percent of the pilot project work go to contractors who demonstrate particular focus on creating pathways out of poverty and into green jobs for local residents, including through employing social enterprise models and/or partnering with nonprofit community-based organizations (City of Portland 20091, 2009b). In addition to various green jobs training programs available from community colleges, unions, and nonprofit organizations, the Portland-based Oregon Tradeswomen, Inc. and

its partners are working to help low-income minorities and women move out of poverty and into high-wage green collar work in the building, construction, mechanical, technical and utility trades with the Constructing Green Futures Program. The program provides job training, career education and jobs search assistance for low income minorities and women from the Greater Portland region who are “returning to work from unemployment or welfare, single mothers, and those reentering society from incarceration” (Apollo Alliance 2009).

Green Business Initiatives. The city has supported green-business development and job creation through several other significant programs. The PDX Lounge—a virtual as well as actual space for collaboration of local government, businesses, and non-profit organizations to come together to share ideas and research in green industries futures—grew from a consortium of green building companies in 2006 to a broader effort to develop and network the city’s green business sector. Under the city’s Businesses for an Environmentally Sustainable Tomorrow Program, Portland provides a single source of financial and technical assistance. In 2009, the city’s economic development strategy under Mayor Sam Adams was centered on developing green businesses as a way for the city to leverage its previous sustainability efforts into a competitive position in the global economy. The economic development plan included a focus on developing specific clusters of industries. The plan identified four main clusters: clean tech and sustainable industries, activewear and design, software, and advanced manufacturing. Within clean tech, it identified solar, wind, and green-buildings manufacturing. The solar industry would build on connections with the region’s software and information-technology industries, the wind industry would build on corporate headquarters of European firms that are located in Portland, and the green buildings industry would build on the state’s strong wood products industry and current green buildings efforts. In short, the plan is a model of thinking about what kinds of clean-energy businesses make sense in a region (City of Portland 2009a). Another development is the use of stimulus funds that enabled a subsidiary of Oregon Iron Works to build the country’s first streetcar made by an American firm in over fifty years. Local demand was an important ingredient in establishing the company’s manufacturing. The development attracted national attention as an example of unionized, green manufacturing (Wheeler 2009).

The Portland Sustainability Institute was founded in 2009 to bring together “business, higher education, nonprofit, and municipal leaders to drive a set of next generation urban sustainability initiatives” of “community livability, ecological resiliency, and broad-based prosperity” for the Portland metro region. Their expected outcomes include encouragement of business and policy innovation, the enhancement of residents’ quality of life, and restoring cities and neighborhoods in a sustainable way (Portland Sustainability Institute 2010).

Civil Society and Policies

At the state level, Apollo Alliance has played an active role in some of the landmark programs and legislation, including the Community Workforce Agreement and EEAST. The Community Workforce Agreement included a wide range of civil society organizations and businesses that worked together (City of Portland 2009b). Likewise, Clean Energy Works Portland is a collaborative project of the City of Portland, Multnomah County, Shorebank Enterprise Cascadia, Energy Trust of Oregon, NW Natural, Pacific Power, and Portland General

Electric, Worksystems Inc. and Green For All bringing public and private sectors together with benefit to the Portland community in energy-efficiency investments and local development of clean-energy jobs. Another organization that has played a role behind reforms is the Renewable Northwest Project (RNP). Started in 1994, the coalition of public interest groups and energy companies works with local organizations and energy companies to support renewable energy projects and develop green jobs (Renewable Northwest Project 2010).

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Washington

Overview and Summary

In many ways Washington deserves its reputation as a leader in the green economy and in clean-technology research. It is already an industry leader in wind-energy generation, green buildings, and biofuels research, and it is currently pursuing the integration of alternative fuel vehicles into its transportation infrastructure. The prospect of another year of budget shortfalls in the legislature will likely continue to limit the state government's direct investment into green economic development programs, but advances will likely continue due to the state's efforts at coordination combined with abundant private sector investment and a strong network of interconnected industry and civil society organizations interested in clean energy. Beyond the programs and policies described below, Washington is distinct for a political culture that is sensitive to green issues and is apparent in state officials who lead with new policies, educators who wish to incorporate environmentally sound principles into curricula, and industry leaders who find what will end up being fixtures of the state's green economy in a situation that remains very fluid today (Hardcastle 2010, Ranken 2010). Among the government initiatives that build on the foundation are the following highlights:

- Washington has green jobs growth legislation that favors members of the military and disadvantaged citizens and has ordered ongoing study of green job creation in the state through the Evergreen Jobs Initiative
- A state government plan includes audits for nonresidential private buildings.
- The state was able to pursue successfully a place in the U.S. Department of Energy's Electric Vehicle Project and integrated this into its plans to participate in the regional West Coast Green Highway Project.
- Seattle has developed an accelerated permitting process for clean-energy and other businesses.
- Seattle has an aggressive weatherization plan that is supplemented by federal funding.

General Background Policy

Energy Goals. In 2006 Washington voters approved Initiative 937, a progressively increasing renewable portfolio standard that will reach a 15 percent requirement by 2020. Acceptable forms of generation include wind, solar, geothermal, tidal, and the combustion of some forms of landfill gas, sewage gas, and biomass. This initiative also requires all utility companies in the state to undertake all cost-effective energy conservation measures, with mandatory reassessments every two years and a non-compliance penalty of \$50 per megawatt-hour to be paid into a public facility energy conservation fund (State of Washington 2006). Executive Order 02-03 directed all state agencies to submit sustainability plans every two years and established the Interagency Sustainability Committee to coordinate the sharing of information and practices from these plans (State of Washington 2002). Taking the benchmarks

set out in Executive Order 07-02, the 2008 Climate Action and Green Jobs Act (E2SHB 2815) established the following requirements on greenhouse gas emissions in the state: by 2020 they must be no higher than 1990 levels, by 2035 they must be 25 percent below 1990 levels, and by 2050 they must be 50 percent below 1990 levels. The aforementioned executive order also mandates a 20 percent reduction in spending on state energy imports by 2020 (State of Washington 2007, Washington State Legislature 2008b).

In 2009 the Department of Community, Trade, and Economic Development (subsequently renamed the Department of Commerce) released its Green Economy Strategic Framework, offering a set of fundamental recommendations to the state government. Salient points include allowing the market, not policy, to select what technologies are implemented, keeping a “broad definition of green economy” to avoid excluding certain jobs, companies, and industries, and answering industry concerns about the state’s convoluted permitting process by expanding the Governor’s Office of Regulatory Assistance (State of Washington 2009b). Washington’s Clean Energy Leadership Council, established by SB 5921, is currently compiling its own strategic briefing on clean-energy technology for the governor that should be delivered by the end of this year. A strategy presentation was given to the Council in June, 2010, broadly recommending support for smart-grid implementation as a means to encourage both better renewable energy integration (particularly for wind power) and more efficient building projects. The other major policy recommendation was increased support for the state’s emerging bioenergy sector, specifically promoting the development of biofuels for aviation as an entry point into cultivating a larger market and more mature technology (Washington Clean Energy Leadership Council 2010). Both of these reports use a mix of supply- and demand-side language, albeit broadly, which is a subtle shift from the primarily demand-side policies that Washington has implemented, as detailed above.

Public Benefits Fund. The state does not have a public benefits fund.

Green-Buildings Policy. In 2001 the state passed three laws (HB 1859, EHB 2247, and SB 6107) that required state government buildings to undertake energy audits, enabled electricity consumers to opt for green electricity sources, provided tax credits for renewable energy generation, and provided tax incentives for distributed energy generation and pollution control equipment (State of Washington 2001). In 2005 Executive Order 05-01 and SB 5509 set guidelines for state government buildings. The executive order required that all new buildings of state agencies and major renovations meet green building standards. Projects of over 25,000 square feet for state buildings were required to meet the LEED “silver” certification level or a designated equivalent. The legislation also set LEED “silver” certification goals for all projects of over 5,000 feet for state agencies, K-12 schools, and other organizations receiving higher education funding. In 2009 the state passed the “Efficiency First” legislation (SB 5854), which required state agencies to reveal the results of energy audits of their buildings, the state government to develop a general plan for energy efficiency, state agencies to sign new leases in private buildings with an Energy Star rating above seventy percent, nonresidential building owners to conduct audits and reveal the results to prospective buyers and lessees, and buildings to be seventy percent more efficient by 2031 (Gregg 2009). In that year the state also began to spend \$14.5 million of federal stimulus funding to support a goal of weatherization projects for 100,000 buildings over a five-year period (Green for All 2009, Washington State Legislature

2010e). Additionally, in April, 2010, EHB 2561 was passed by the legislature, proposing a \$500 million energy-efficiency retrofit of school facilities at all levels of education. The proposal awaits final approval by voter referendum in November (Washington State Legislature 2010d). The Northwest Power and Conservation Council's Sixth Power Plan projects that 85 percent of energy demand growth over the next 20 years can be accounted for by efficiency improvements, and lays out a plan of action for utilities and trade organizations related to energy efficiency to meet its projections (Northwest Power and Conservation Council 2010).

Green Jobs Training. The Climate Action and Green Jobs Act of 2008 issued two key directives with regard to green job development in Washington: it instructed the Employment Security Department (ESD) to conduct a study of the status and disposition of green jobs in the state, and set the goal of raising whatever number was found by that study to 25,000 jobs by 2020 (Washington State Legislature 2008b). Rather than relying on previous research that only considered clean energy employment, the 2008 study by the ESD began with a new definition of a green job: those that fall into the areas of increasing energy efficiency, preventing or cleaning up pollution, or generating renewable energy. By surveying over 9,500 employers in the state this study was able to estimate that 47,000 green jobs existed in the state, mostly falling into the first category of energy efficiency, making the original growth goal defunct (State of Washington 2009a).

The next year the Evergreen Jobs Initiative (E2SHB 2227) was passed, directing the ESD to perform additional studies, while creating the Evergreen Jobs Leadership Team to oversee the creation of new 15,000 green jobs by 2020, with the ultimate goal of making Washington a net exporter of green products. The Leadership Team will work towards the goal by coordinating efforts to secure both private and federal funding to invest in projects to create green jobs (or make existing jobs green) and train workers to fill those positions. In addition, the Green Industries Job Training Account was established under the direction of the Treasury Department to issue competitive grants for training programs. The legislation further specified that 30 percent of the new jobs should be set aside for veterans, national guard members, and the economically disadvantaged (Washington State Legislature 2010b).

The second study performed by the ESD expanded the number of industries and firms surveyed and sampled public service green jobs. The 2009 estimate was roughly 76,000 private-sector green jobs in the state, compared with 23,000 in the public sector, with the majority still residing in the energy-efficiency category (State of Washington 2010a). The studies intentionally used a short survey questionnaire to achieve higher response rates, but this does limit their ability to provide greater detail and explanatory power, and it also necessitated the use of pre-existing data to draw economic impact conclusions. Even so, the research team suggested that the numbers did not represent an emergent sub-sector that could be called a green economy, but rather they represent a shift in the practices of some occupations toward greening, as well as a greater recognition of some existing positions as being green. These studies have attracted national attention, and the Commonwealth of Pennsylvania is expected to conclude an agreement with Washington's ESD to conduct a similar study on its own green jobs situation (Hardcastle 2010). The provisions of the Evergreen Jobs Initiative also require that the ESD continue using similar surveys every two years as well as performing other, more narrowly focused investigations, such as current studies of the energy efficiency and forest products sectors. Other

2009 reports from Washington State University's Extension Energy Program show ongoing concern by renewable-energy and energy-efficiency businesses about the availability of well-trained workers to match the anticipated growth in both areas (Washington State University 2009a, 2009b).

Clean-Energy Industries

General Background. The state does not have a program specifically to provide financial support for the clean-tech industry and clean-tech research. Washington Technology Center, one of the state's economic development agencies, supports the high-tech industry generally, and the state has some venture capital support for the clean-tech industry, including Cascadia Capital, Northwest Energy Angels, OVP Venture Partners. In 2007 the state's Department of Community, Trade, and Economic Development designated a series of Innovation Partnership Zones (IPZs), including three that have strengths in clean energy or energy efficiency. The Grays Harbor IPZ specializes in bioenergy, the Pullman IPZ is home to research into efficient IT infrastructure, and the Tri-Cities IPZ houses solar and fuel-cell innovators and contains both the Pacific Northwest National Laboratory and Washington State University's Bioproducts, Sciences, and Engineering Laboratory. The Department of Community, Trade, and Economic Development recommends that the state give additional support to IPZ locations like these that focus on clean-energy and other green technologies, but otherwise most of the state's incipient clean tech clusters rely on the efforts of individual laboratories and the federal funding (State of Washington 2009b, 2010c). More broadly, the state offers a sales tax exemption for all renewable energy generation equipment rated for over one kilowatt in capacity, and it offers up to \$5,000 per year in renewable generation incentives to residential, small business, local government, or community scale systems (DSIRE 2010).

Biofuels. The Energy Freedom Program was established in 2006, setting up a revolving loan fund under direction of the Department of Community, Trade, and Economic Development. This fund was allocated \$23 million and can issue up to \$5 million loans to biofuel projects in the state (State of Washington 2008b, Washington State Legislature 2006). In 2007 E2SHB 1303 was passed, requiring all diesel-powered state vehicles to use a B20 biodiesel blend by 2009. The law further ordered all state government vehicles that used biofuels to be supplied by feedstocks that are recycled or grown in-state (Washington State Legislature 2008a). The law was followed by HB 1481 in 2009, which mandated that all state and local government vehicles use electricity or biofuels (Washington State Legislature 2010a). There has been some delay in compliance with those standards, but the delay has not prevented the proposal of ESHB 2504, which would mandate a B2 blend for all diesel fuel sold in the state (Washington State Legislature 2010c). A variety of other legislative actions have granted tax incentives to bioenergy projects, including the use of anaerobic digesters (State of Washington 2010d).

Washington State University has laboratories working on biofuels and partnerships with industry via the Washington State Algae Alliance, a group that includes biotech companies Inventure and Targeted Growth Inc., and is being funded by \$2 million out of the Senate Energy and Water Development appropriations bill (New Energy World Network 2009). The university's Bioenergy Program is also supported by the Pacific Region Bioenergy Partnership, a

group that includes five northwestern states and has U.S. Department of Energy funding to do technology promotion and transfer (Pacific Region Bioenergy Partnership 2008). The Department of Energy has further granted \$1.1 million to be divided between the Bioproducts, Sciences, and Engineering Laboratory and the College of Agriculture, Human, and Natural Resource Sciences of Washington State University (Washington State University 2010). These programs collaborate with the Pacific Northwest National Laboratory, which has its own bioenergy program amongst other clean-energy research.

A 2008 Washington State University study identified 135 million gallons per year of biodiesel production capacity in Washington, 100 million of which were accounted for by the Imperium Renewables plant at Grays Harbor (Washington State University 2008a). Actual output levels, however, are not nearly that high. AltAir Fuels is currently converting an oil refinery at Anacortes and has reached an agreement with fourteen airlines to deliver 750 million gallons of bio-based aviation fuel (Business Wire 2009). Metro King County Transit of the Seattle area has also pioneered the use of biodiesel in its bus and ferry system, and there is widespread grassroots interest in biodiesel. The biofuels industry further includes many more high-tech start-ups, some of which are university spin-offs (Timmerman 2009).

Smart-Grid and Building Technologies. Another clean-energy industrial cluster in the state is smart-grid technology. In 2009 the Department of Energy awarded the Pacific Northwest smart-grid demonstration project a grant of about \$178 million (including matching funds) for a five-state project (Batelle 2009). The project includes several utilities as well as the Bonneville Power Administration and the Pacific Northwest National Laboratory. Although only one of the six primary corporate partners for the Pacific Northwest Smart Grid Demonstration Project had headquarters in the state, there is an emerging cluster of smart-grid companies in the state, including Alerton, Alstom, Itron, Microplanet, Optimum Energy, Outback Power Systems, Schweitzer Labs, V2 Green, Verdiem, and Xantrex. Itron is the largest smart-grid meter producer in the U.S. Microsoft, which is headquartered in Redmond, recently entered the field in a partnership with its Hohm online energy management application (Sibley 2009).

Washington's interest in smart-grid development might be considered unusual in light of the 2008 study "A Smarter Grid for Washington," published by the Department of Community, Trade, and Economic Development. This study claimed that the state's historical reliance on an abundance of hydroelectric power gave it little incentive to invest in the rapid deployment of smart-grid technology and ultimately advised that Washington should let other states take the risk of early adoption and learn from their experience, despite the fact that the state has the research and development strengths that would give it an advantage in implementing a smart-grid system (State of Washington 2008a). In 2010 the state's Clean Energy Leadership Council recommended that Washington pursue smart-grid implementation; aside from repeating an assessment of the state's technological advantage in that pursuit, they also suggested that a smart grid would be able to better integrate the variable generation provided by both wind turbines and solar photovoltaic arrays (Washington Clean Energy Leadership Council 2010).

Solar. Solar power equipment manufacturing in Washington is given a 43 percent tax reduction incentive, and 2009's SB 6170 raised the state's private solar generation incentive to 30 cents per kilowatt-hour (DSIRE 2010). That act also established a separate incentive category

for community or local government solar arrays (Washington State Legislature 2010f). In a more dramatic move, permit applications were filed with Kittitas County in 2009 for the construction of Teanaway Solar Reserve, a photovoltaic array with a planned capacity of seventy-five megawatts. The developers claim that this project will generate 225 jobs over a three year construction period, ultimately establishing thirty-five permanent positions once the array is completed (PR Newswire 2010). Washington State University and Shoreline Community College have also partnered to sponsor the Northwest Solar Center. This center provides education and advocacy for communities looking to deploy solar arrays, supports the solar installation training at both schools, and operates out of a zero energy demonstration building on the Shoreline campus (Northwest Solar Center 2010).

Transportation and Energy Storage. Washington is home to several significant fuel-cell research and manufacturing facilities. The most prominent is Pacific Northwest National Laboratory, with research into both hydrogen and solid oxide fuel cells (Pacific Northwest National Laboratory 2007). Washington State University, the University of Washington, and Innovatek have partnered to develop hydrogen production processes. ReliOn is already a major manufacturer of fuel cells for backup power supplies, having sold products with a combined output of 1,450 kilowatts worldwide (Washington State University 2008b).

In 2009 HB 1481 was passed, requiring the Puget Sound Regional Council to apply for outside funding to develop an electric vehicle infrastructure for its jurisdiction, as well as directing the state Department of Transportation to prepare a pilot project for an alternative fueling infrastructure (Washington State Legislature 2010a). Later that year the Puget Sound region was selected as one of the sites for the U.S. Department of Energy's Electric Vehicle (EV) Project, which will install over 2000 charging stations to serve a deployment of over 900 Nissan LEAF cars. The state's Department of Transportation received \$1.3 million in ARRA funding to support its Electric Highway project, which will provide an electric vehicle charging infrastructure along a 276 mile stretch of Interstate 5 between Canada and Oregon. Upon projected completion in 2011, this will link the Puget Sound and Portland sites of the EV Project and serve as a component of the West Coast Green Highway Project, a program that will provide alternative fuel support for the entire length of I-5 and connect to a third EV Project site in Los Angeles (State of Washington 2010b).

Wind. The American Wind Energy Association reports that Washington ranks fifth among states in electricity generation from wind, with a capacity of roughly 1,900 megawatts and turbines with approximately 170 megawatts of capacity under construction. Most of the state's wind power generation sites came online in 2008 or 2009 (American Wind Energy Association 2009). In May 2010 an agreement was reached between Puget Sound Energy and the Siemens Renewable Energy Division to provide turbines for Phase I of the Lower Snake River Wind Project, totaling up to an additional 343 megawatts of production capacity (Puget Sound Energy 2010). Two factors, however, make the future of wind power in Washington somewhat uncertain. First, the Northwest Power and Conservation Council's 2007 report on wind claimed that insufficient data on the wind potential of the region existed to make reliable projections about the economics and logistics of further developing generation capacity (Northwest Power and Conservation Council 2007). Second, there have been ongoing concerns about how to integrate the intermittency of wind energy into the region's transmission

infrastructure and demand schedule. Implementation of a smart grid has been suggested, but no decisive steps have been taken so far.

Seattle

Sustainability Plans. Seattle has long been at the forefront of urban sustainability issues. Metro King Country Transit has earned a leadership position for its use of hybrid-electric buses and biodiesel fuels, and Seattle City Light, a department of the city government that provides electricity to the city, has been a consistent leader on a wide range of environmental initiatives, including its status as the country's first carbon-neutral electric utility. In 2005 former Mayor Greg Nickels announced the Seattle Climate Protection Initiative, which would reduce the city's carbon emissions to seven percent below 1990 levels by 2012, and he subsequently led a similar initiative within the U.S. Conference of Mayors that by 2009 had achieved commitments from over 900 cities representing more than eighty million Americans. Although the mayor's environmental initiatives were popular, in 2009 he was defeated in a primary election and was ultimately succeeded by Mike McGinn, former head of the local Sierra Club chapter. McGinn's campaign platform included opposition to a \$4.2 billion downtown tunnel and support of transit-oriented development and green jobs programs. McGinn also promised grassroots participation and a strengthening of the neighborhoods, in contrast with Nickels' more centralized leadership style, and he was able to win based on a volunteer campaign.

The city's current comprehensive plan was released in 2005 and is currently undergoing revision for a new edition in 2011. As of now, there are no explicit green job goals in the plan, but the plan does explicitly attempt to balance economic development with environmental stewardship through what it calls the "urban village strategy." The strategy aims to cultivate neighborhood sectors that provide a broad spectrum of housing and employment opportunities, one effect of which would be to reduce the need for lengthy commutes or private vehicle use in many cases, while enhancing civic engagement and responsibility for the community environment (City of Seattle 2005).

Green-Building Initiatives. In 2008 Mayor Nickels also announced plans to make the city the country's "green building capital" based on energy-efficiency improvements, and he formed the Green Building Task Force. A year later the task force issued a report with a variety of goals, including a plan for financing residential energy-efficiency improvements as a source of green jobs. In 2009 Seattle launched the Green Building Capital Initiative, which provides inexpensive home energy audits and incentives to improve building efficiency for residential and business buildings. The program's goal is to audit 5,000 homes within eighteen months (Muro and Rahman 2009). In addition, a city government ordinance passed that year (CB 116731) expanded on the state government requirements for the greening of buildings. The following year the city passed the Energy Disclosure Ordinance, which requires owners of large buildings to report on energy use and ratings for tenants, buyers, and lenders. Also in 2010 the city received a \$20 million grant from the U.S. Department of Energy through its "Retrofit Ramp Up" program, funding the city's Neighborhood Weatherize Every Building Initiative, which is projected to create 2,000 "living wage green jobs" (City of Seattle 2010). Seattle's Department

of Planning and Development also offers a priority building permit program for projects that meet certain sustainability criteria (City of Seattle 2009b).

Green Jobs Training. Seattle offers a wide range of green jobs training programs, but they are based mainly in the community colleges, technical schools, and the local of the Laborers' International Union of North America (Houghton 2008). The city of Seattle also has a partnership with the Environmental Outreach and Stewardship Alliance, which provides green jobs training and weatherization services.

Green Business Initiatives. In 2007 Mayor Nickels launched the "industrial jobs initiative," which supported easier permitting and other efforts to recruit and retain businesses in a wide range of industries, including clean tech. For example, in 2009 the engineering and construction firm McKinstry Company received a permit from the city to allow an expansion of their Innovation Center that would create 500 new jobs in energy efficiency (City of Seattle 2009a). In May 2010 McKinstry reached a lease agreement for space in this facility with two emerging energy companies, General Biodiesel and Hydrovolts (McKinstry 2010). The firm provides a model of "good green jobs" because of its use of labor unions and focus on serving its employees, and many of its projects involve retrofitting buildings. The firm's head, CEO Dean Allen, has referred to himself as "Dean the Plumber," a blue-green alternative to the nationally known figure of Joe the Plumber. At a broader, four-county scale, the Puget Sound Regional Council developed the Prosperity Partnership, which has supported building a clean-tech cluster as part of its cluster-based industrial development strategy. One of the goals of this cluster is developing a product testing and demonstration space to assist in the commercialization of clean technology research (Puget Sound Regional Council 2005).

City Society Organizations and Policy

The predominant civil society organizations in Washington that are interested in clean energy and the green economy are tightly linked in cooperative regional-level networks. The Northwest Energy Coalition has over 100 member organizations spanning Washington, Oregon, Idaho, Montana, Alaska, and British Columbia. It is partnered with the Northwest Energy Efficiency Council, the Northwest Energy Efficiency Alliance, the Renewable Northwest Project, and the Northwest Sustainable Energy for Economic Development (SEED) group. The SEED group offers consulting services for communities and energy advocates, the Council is a trade association for energy-efficiency businesses, and the Alliance is a utility-funded group that offers educational and planning services in cooperation with the other groups (Northwest Energy Coalition 2010, Northwest Energy Efficiency Alliance 2010, Northwest Energy Efficiency Council 2010, Northwest SEED 2010, Renewable Northwest Project 2010).

The Washington Environmental Council also works with those organizations, and it also provides voter education on environmental and energy issues for citizens in the state (Washington Environmental Council 2010). Another of their allies in the region is Climate Solutions, a nonprofit that focuses on promoting clean transportation and energy initiatives, such as the national iSky project that developed from their collaboration with the Washington Environmental Council (Climate Solutions 2010). One of the major industry partnerships in the

state is the Washington Clean Technology Alliance, which includes companies like McKinstry and Battelle as well as Washington State University, the University of Washington, Puget Sound Energy, and the City of Seattle. (Washington Clean Technology Alliance 2010). The Puget Sound Clean Cities Coalition is a geographically and topically more narrow group, working with the governments of Seattle, King County, and many nearby cities to replace petroleum with cleaner and more renewable vehicle fuels. It offers grant application assistance to its members, which has resulted in \$15 million in ARRA funding being awarded for distribution among several of its programs (Puget Sound Clean Air Agency 2009).

Further Reading

Washington State University's Extension Energy Program has an immense online database of energy-related reports, software, state code documentation, and legislation analysis (www.energy.wsu.edu). Seattle's Office of Sustainability and Environment offers substantial resources for citizens looking to learn about policies, sustainable practices, and opportunities for community involvement (www.seattle.gov/environment/). All of the civil society organizations listed above also maintain a strong online presence in tracking green issues through the news, publishing their own reports and proposals, and organizing community events.

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Other Western States

Many of the other Western states have small populations and lack the university resources to become centers of industrial innovation, but the states are often engaged in clean-energy production such as electricity generation from wind, solar, and geothermal. There are signs of a developing solar industry in Arizona and Nevada, and Nevada has strong geothermal resources. Hawaii has also developed strong clean-energy demand policies, and there is also some evidence for industrial development and innovation there as well. As a result, we selected Arizona, Hawaii, and Nevada as the next tier of states for further discussion.

Arizona

Arizona has a renewable portfolio standard (15 percent by 2025), with 30 percent of that amount from distributed renewable energy sources. The state also has a target of 20 percent energy-efficiency savings for electricity utilities by 2020. The state does not have a public benefits fund. With respect to green buildings, Governor Janet Napolitano signed Executive Order #2005-05 that required all state-funded buildings to be LEED-silver certified and new buildings to incorporate renewable energy.

Arizona is the home of a global leader of solar manufacturing, First Solar, as well as other solar manufacturing firms. The proximity of the state to California and strong solar-energy resources make the state a prime candidate for building start-ups and innovation in the solar industry. However, the state government's policies toward renewable energy have been mixed. For example, in February 2010 the state legislature's House Government Committee approved a bill (HB 2707) that would have redefined renewable energy to include nuclear energy. The change would have absolved the state of any need to increase its energy supply from solar, wind, and other renewable-energy sources, and it would have also increased the regulatory burden for solar companies by adding a separate layer of regulation from the Arizona Corporation Commission. After substantial uproar and protest, the bill was withdrawn, but it does send a signal to the renewable-energy industry about the climate for investment in that state. Furthermore, in the same month Governor Jan Brewer issued an executive order that prohibited the state from participating in the regional cap-and-trade system for carbon emissions (Sustainable Business 2010).

Hawaii

Hawaii has a renewable energy portfolio of 40 percent for electricity by 2030. The state's energy-efficiency standard is 15 percent (reduction in net electricity sales) by 2015 increasing to 40 percent by 2030, and the state approved a 10 percent ethanol standard in 2004. The state also has a public benefits fund, the Hawaii Energy Efficiency Fund, which has a budget of \$20 million per year. Legislation passed in 2006 (HB 2175) established extensive green-building goals for state government buildings, including LEED silver certification for new buildings. The state building code also requires solar hot-water heating on new construction. The state received

a \$6 million ARRA grant for green jobs training. The Hawaii Clean Energy Initiative of 2008, which was announced as a partnership with the U.S. Department of Energy, has set a wide range of goals for renewable energy and energy efficiency. The goal is to provide 70 percent of the state's energy from renewable resources by 2030.

Hawaii shows some signs of new industrial development in the clean-energy sector. The state's strong aquaculture industry has become a basis for some developments in algal biodiesel, such as the partnership between HR Biodiesel and Royal Dutch Shell. The Natural Energy Laboratory of Hawaii Authority has 45 tenants who are working on aquaculture, renewable energy, and marine biotechnology, and the University of Hawaii hosts the large Hawaii Natural Energy Institute, which is known for research on biofuels, marine renewable energy, hydrogen, and fuel cells. The company Better Place has selected Hawaii as a target for developing its electric vehicle infrastructure, and the U.S. Air Force has partnered with the state to develop the Hawaii Center for Advanced Transportation Technologies.

Nevada

Nevada has had a renewable portfolio standard since 1995, and legislation in 2009 increased the standard to 25 percent of sales by 2025, with a solar energy set-aside of 6 percent by 2016. Energy-efficiency reductions can be included in the renewable portfolio standard. State government buildings must reduce grid-based energy consumption by 20 percent by 2015. Legislation passed in 2005 (AB3) requires all state-funded and government buildings be LEED certified or higher, and two buildings per year must be LEED-silver certified. The state has the highest per capita solar-electricity production in the country, and the state has some solar photovoltaic manufacturing as well. Nevada is also home to the largest concentrating solar-energy plant in the world, and it was selected by the U.S. Department of Energy to host a twenty-five-square-mile area demonstration zone for concentrating solar. Those developments plus proximity to the California solar industry may mean that the state will become a center for concentrating solar energy manufacturing and generation. The state also has the country's strongest concentration of geothermal resources. The Nevada Southwest Energy Partnership links together government, industry, and university research and development for geothermal, hydrogen, solar, and wind energy.

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Conclusions

As the transition toward a cleaner and more energy-efficient economy occurs, environmental and energy policies have increasingly been connected with job creation goals. The convergence has become especially pressing after the Great Recession that began in 2008, but it was evident during the previous decade.

The general economic importance of green jobs depends in part on the definition. At one extreme, any business that engages in some kind of energy-efficient production might be categorized as having green jobs. Any workplace that is undergoing a greening process might be said to have green jobs, and in this sense most of the 150 million people who are employed in the U.S. might eventually be said to have green jobs. In contrast, if one uses a more restricted definition such as the ones discussed in the introduction, a much smaller estimate of the number of green jobs emerges (such as one million out of the total of 150 million jobs). Even when the category of green jobs is defined in a narrow way, there is evidence that rate of growth in green jobs is much higher than for most traditional jobs. Furthermore, the overall number of green jobs is rapidly approaching the number of jobs in comparison industries such as fossil fuels or even high-technology industries such as software.

Green jobs can be important in other ways. For example, many programs that help to create and develop green jobs have been linked to training for persons with employment barriers. Demand policies such as green-buildings policies and renewable-electricity standards help to create green jobs in construction, installation, and maintenance. Those jobs can be important pathways out of poverty when connected with the appropriate training programs. But the category of green jobs should not be restricted to construction, installation, and maintenance jobs. Many organizations involved in the development of green jobs, such as the Apollo Alliance, have pointed out that there are also opportunities to connect the green transition with the revitalization of manufacturing in the U.S. and with the growth potential of the high-technology industries. The jobs in green manufacturing and clean-energy innovation industries also tend to have higher wages, with most estimates showing that manufacturing wages are about twice as high as average service-sector wages. Manufacturing is also important because it connects the upstream innovation and design work with customer needs and the problems of scaling up an innovation. Furthermore, new businesses retain profits and high-end jobs for



clusters of software and hardware firms in California and the Pacific Northwest have played a role in the transition of those regional economies to include smart-grid and solar photovoltaic technologies. New clusters of manufacturing and research are emerging throughout the country, and as a result a new landscape of clean-energy industries is coalescing across the country.

We have focused especially on five technology industries for clean-energy jobs: biofuels, smart-grid and building technologies, solar, transportation and energy storage, and wind. There are many controversies associated with the emergent industries, and before discussing the new industrial clusters, we flag some of the controversies:

- Corn-based ethanol is generally viewed as a bridge technology to cellulosic ethanol, which itself is a longer-term bridge technology to transportation power based on batteries and fuel cells. The environmental and social effects of using corn for fuel are highly controversial.
- Smart-grid technologies have a number of technical and privacy issues that need to be worked out before gaining consumer acceptance.
- Green-building technologies have yet to coalesce into innovation clusters, with some emergent exceptions.
- Solar energy is largely an installation and maintenance industry in the U.S. Although some manufacturing and high-end innovation is retained in the U.S., much of photovoltaic manufacturing has moved to China and other countries. It would take strong domestic-content requirements from the U.S. government to bring solar manufacturing back to the U.S.
- Transportation and energy-storage industries often involve batteries for automobiles, which continue the inefficient automobile-centered culture, but they can also involve new forms of powering public transportation and rail. Batteries and fuel cells have a number of economic and technical hurdles before widespread adoption is possible.
- Wind energy faces problems of storage, transmission, avian risk, and intermittency. Turbine manufacturing in the U.S. faces high levels of foreign competition, and because many of the leading manufacturers are foreign companies, there is a risk that the higher-end jobs will remain abroad.

Although jobs in manufacturing and biofuels refining are precarious due to international competition, manufacturing and technological innovation will be important for the U.S. and its regional economies to create new industries and maintain industrial competitiveness.

Biofuels

The national renewable fuels standard established a target level of ethanol in fuels of 7.5 billion gallons by 2012 and 36 billion gallons by 2022. All the states that we reviewed have a biofuels industry, and for some states the industry has become economically important. There is also considerable hope that the social, environmental, and economic problems associated with corn-based ethanol will subside when the next generation of cellulosic ethanol becomes available. Given the political power of agricultural states, especially swing states in the Midwest, and the national goal of reducing imported petroleum consumption, neither political party is likely to upset the trend toward ever-greater levels of biofuels production.

Biofuels production can be found nationally, but the strongest industrial clusters are in the Midwest and California. Other states and regions with emerging strengths in biofuels include Colorado, Florida, Georgia, Massachusetts, North Carolina, and Washington. One would expect Texas to be a major center of biofuels production, because of its related-industry strengths in oil and natural gas. It is true that some of the state's major oil-and-gas companies have invested in biofuels, and there are many biodiesel refiners in the state. However, their investments have tended to be in out-of-state companies, and the state government has not been as supportive of the industry as other states.

It is likely that we are going to see an increasing division between biofuels innovation clusters and biofuels production and refining. The innovation clusters will exist where there are strong, pre-existing biotechnology clusters of research and business enterprises that have shifted into biofuel technology development. The strongest example to date is the diversification from biotechnology into algal biodiesel in the San Diego area, but there are other bioenergy firms throughout California and in Massachusetts. The technology clusters in Massachusetts and California will probably locate much of their production elsewhere, but they will retain high-end jobs and profits in their headquarters. The significant investments in biofuels and bioenergy research in Colorado, Iowa, and Wisconsin, and also but to a somewhat lesser degree in Minnesota and Missouri, may also enable that part of the Midwest to become both a high producer of biofuels and a hub for the innovation of biofuel biotechnologies. Some of the southern states, notably Florida and Georgia, are also assembling the triple helixes of government, industry, and university partnerships that will enable them to be both technology innovators and biofuel producers. The southern states also have the advantage of proximity to the cellulosic ethanol research group at Oak Ridge National Laboratory. Some states with great potential in terms of research resources, agricultural resources, and a biorefining base, such as Illinois, may lose opportunities due to a failure of the state government to provide adequate support to the innovation side of the industry.

To promote in-state biofuel refining, some states have gone beyond a renewable fuel standard and assistance to biorefiners to set goals that include local content. For example, in 2006 Governor Schwarzenegger announced an executive order (S-06-06) with a target of producing 40 percent of the state's biofuels within the state by 2020 and 20 percent of the state's renewable electricity from biomass produced within the state. Florida is also of interest because the state government has explicitly adopted the goal of producing 25 percent of the state's energy needs from the state's agricultural industry. To support the goal, the state launched the "Farm to Fuel" initiative in 2006. In addition to holding an annual summit, the state government also offered \$25 million in grants to the bioenergy sector between 2006 and 2009. There are also efforts to develop particular strengths based on crops that are relatively unique to the region, such as citrus and sugar.

One can see from this brief overview that it would not be correct to assume that biofuels companies will continue to emerge from the biotechnology clusters on the East and West coast, and that production will focus in the agricultural states of the South and Midwest. Rather, there is evidence that state governments in the Midwest and South are investing in their research capacity and attempting to encourage business innovation rather than simply developing biorefiners. It is

likely that biorefineries will be located throughout the country wherever the biomass resources are available, but the innovation clusters will become increasingly focused in the regions outlined here.

Smart-Grid and Building Technologies

The smart grid with net-metering capabilities promises to enable two-way communication between homes and the grid via digital electricity meters and appliances that can interact with the grid. Customers who use appliances such as washing machines, electric clothes dryers, air conditioners, and dishwashers during off-peak hours will be able to take advantage of lower electricity rates that are designed to shift consumption away from the hours of peak demand. Grid operators will be able to turn off or turn down appliances, such as air conditioners, during periods of peak demand, and homeowners will be able to turn appliances on during periods of low demand. In 2009 the U.S. Department of Energy awarded over \$3 billion for smart-grid and related projects, and many states were engaged in plans to install smart meters and other technologies associated with the smart-grid system.

Although many states and cities were involved in projects to install smart meters and serve as demonstration sites, only two states, California and Washington, had significant clusters of businesses in the manufacturing and software side of the industry. California has very strong research resources in the Bay area, and some of the large technology companies (such as Cisco, Google, and Oracle) have also entered the business. Two other California companies, Silver Spring Networks and GridNet, are in competition over a standard for smart appliances, and U-SNAP Alliance, a company that will develop standards for appliances, is also in California. Likewise, the Electric Power Research Institute, which conducts research and development for the utility industry, is in the state, too. The state of Washington has a smaller but nonetheless significant industrial cluster of smart-grid companies in the state. The primary research resource for the state is the Pacific Northwest National Laboratory. Itron is the largest smart-grid meter producer in the U.S., and Microsoft recently entered the field in a partnership with Hohm for an online energy management application.

The state of New Mexico has shown interest in developing a smart-grid industry, and it has made some inroads toward that goal. In 2008 the state government launched the “smart green grid” initiative, which involved collaboration among the state government, utilities, electricity cooperatives, and research centers at government laboratories and universities. The state also partnered with Japan’s New Energy and Industrial Technology Development Organization, which agreed to provide up to \$30 million in funding. The state is also attempting to use its geographical position at the intersection of the country’s three grids to develop a superstation to link the grids.

In summary, the smart-grid industry appears to be more concentrated than biofuels, with only California and Washington showing signs of industrial clusters. The established firms of the Northeast, such as IBM, General Electric, and Honeywell, have entered the market, but they have tended to do so by forming partnerships with smaller firms that are often headquartered

elsewhere. The pattern of investments suggests that California's prominence in the industry will increase.

However, as the industry grows, it will include companies other than software management and smart meters, and in any case there is an associated industry of green-building technologies that ranges from the relatively low-tech (e.g., caulking and insulation) to high-tech building-control systems technologies (such as programmable thermostats) and smart appliances. The smart grid may also enable distributed energy storage, such as small fuel cells that are located in backyards and can adjust local demand and supply needs more efficiently than a centralized grid. There is some evidence that Oregon and Pennsylvania have developed industrial clusters in the green building areas, and there are strengths in building control systems in New York. However, these industrial groupings have not yet developed into innovation clusters with close ties to regional research centers. The manufacturing of the technologies and products affords a wide range of green jobs opportunities, from assembly-line positions to design and engineering.

Solar

Manufacturing for solar photovoltaics in the U.S. is more geographically diverse than the smart-grid industry, and there is also an emerging division between locations where manufacturing is taking place and locations where research and business start-ups are clustered. Unlike the biofuels industry, which tends to locate refineries close to production sources, the photovoltaics industry tends to locate manufacturing in states with lower wages and also in foreign countries. Once the technology is established, it is easy to outsource the technology because solar panels are light and relatively easy to transport. Conversely, the weight and size of wind turbines, rail, rail cars, and even concentrating solar favor domestic manufacturing. The prospects for domestic manufacturing of solar photovoltaics could be improved if there were stronger federal policies that favored local content. Whereas in the biofuels industry there are explicit policies in California and Florida that favor local production of biofuels, import-substituting industrialization policies are not evident for the solar industry. As a result, it seems likely that as the industry evolves, manufacturing will continued to be sent to foreign countries, and green jobs will be concentrated in the upstream research and development side of start-up companies and in the downstream solar installation industry. The development is dangerous to the extent that close connections with manufacturing may be essential for the success of upstream research, development, and technology transfer.

The solar installation industry can be found in all states, but the manufacturing of solar photovoltaics is more concentrated, and the clusters of research, innovation, and business start-ups are even more concentrated. Three states that have developed research and innovation clusters are California, Florida, and Ohio. Among the other states where there are signs of both manufacturing and research are Colorado, Georgia, Massachusetts, New Mexico, North Carolina, Oregon, Tennessee, and Texas. Some states have very high levels of solar installation, such as New Jersey, but as of 2010 they lacked a strong manufacturing industry. As in the case of biofuels, Texas lost opportunities due to lack of support from the state government.

California is the national leader of the solar energy industry, and the synergies with the software and smart-grid industries are likely to underlie continuing leadership in innovation. There has been state government support for solar installation since the 1970s, and the support grew in momentum after 2000. California also has research strengths in photovoltaics, both in the universities and in the related industries of advanced manufacturing, such as semiconductors. For example, in 2009 the University of California system funded the California Advanced Solar Technologies Institute at three of the state universities, and in the same year the California Energy Commission helped to form the California Solar Energy Collaborative to identify roadmaps for solar energy research and policy. California has also done well at capturing large federal grants and taking advantage of the energy research at the Lawrence Berkeley National Laboratory. The industry is located throughout the state, but there is a concentration of manufacturing firms in the San Francisco Bay area, and Silicon Valley venture capital has also supported the industry's development.

In comparison with California, solar energy research and innovation in most other states is much less advanced. The state of Florida is an example of one state with credible ambitions to become a solar industry innovation center. Although the state government has not facilitated the industrial cluster through the formation of research consortia, it has supported the industry and solar energy research. Ohio has a nationally recognized solar industry innovation story, due largely to concentrated efforts by the state government through the Ohio Third Frontier program. The innovation cluster emerging in the northwestern part of the state was built on Toledo's heritage as a glass manufacturer and auto-industry supplier that was connected with photovoltaics expertise at the University of Toledo. In New York there is a strong nanotechnology research cluster and relatively high levels of investment from the state government in clean-energy and business development. As a result, there is great potential for the state to become one of the centers of the next generation of nanosolar technology.

In the absence of policies that require solar photovoltaic manufacturing to remain in the U.S., it is possible that manufacturing at the lower-end of technological complexity, especially for silicon-based photovoltaics, will continue off-shore. As a result, the potential of the industry to generate green jobs in manufacturing is low. Instead, it will generate jobs at the upstream end, where there are university-based research strengths and associated manufacturing facilities for start-up companies. Likewise, the industry will generate jobs in the downstream end of solar energy installation and maintenance. The missing middle is far from ideal, because manufacturing can be a crossroads where innovation is tested and ideas flow back from installers and customers.

Transportation and Energy Storage

The category is a mixed one, but it makes sense to consider the group of related industries together because of the interconnections among firms, research projects, and government policies. In this category we include hybrid and electric vehicles (automobiles, rail, and buses), fuel cells, and batteries. Increasingly the commercial end of the fuel-cell industry has shifted from automobiles into stationary and consumer products, whereas the automotive industry has shifted from fuel-cell vehicles to electric and hybrid-electric vehicles. As a result,

previous convergences between vehicles and fuel cells may diverge for some decades before converging again. Nevertheless, there is considerable overlap among the categories and some justification for discussing them together as a group.

The interest in fuel cells for vehicles has waned some since the early 2000s, when President George W. Bush had called for a conversion to a hydrogen economy. The conversion proved to be short-lived, and in retrospect the support at the federal government level for hydrogen vehicles was a mistake that slowed the introduction of electric vehicles. Under the administration of President Barack Obama, federal government support shifted to electric and hybrid-electric vehicles as well as to flex-fuel engines to enable higher levels of biofuels. Hydrogen-fueled vehicles have turned out to be too expensive for short-term development, but they have long-term potential. For hydrogen vehicles, refueling is faster than recharging an battery-powered vehicle, and the weight of the automotive machinery is lighter than for a similar battery-powered vehicle. Meanwhile, the fuel-cell industry has diversified into various fuel sources other than hydrogen, and manufacturing has turned to other uses than vehicles, such as units for buildings and for small appliances.

Our research identified strong fuel-cell and energy storage industries in California, Connecticut, Massachusetts, Michigan, New York, Ohio, and South Carolina, as well as initiatives in electric vehicle and/or battery manufacturing in those states and in Tennessee. Although California has many elements of a successful innovation cluster in place, state government investments have been more concentrated in several of the other states. The industrial strengths with respect to fuel cells and energy storage appear to be emerging in the rustbelt of the Northeast and eastern Midwest. There is a corridor or arc in fuel-cell and energy-storage companies that runs from Massachusetts and Connecticut through New York and Pennsylvania to Ohio and Michigan. However, the state governments have to date worked separately and even in competition with each other, and there is no regional consortium in place to develop synergies and coordinate policies. A federal government investment in Kentucky for battery manufacturing will also pull this arc southward and encourage some interstate cooperation based on linkages to national-government facilities.

There are electric-vehicle manufacturing companies located across the country, but it should not be surprising that Michigan has established leadership in electric vehicles, batteries, and to some degree fuel cells. In 2009, the state government approved \$555 million in tax credits for battery manufacturing, which could be used to match federal grants of \$2 billion from the ARRA, and in the same year the state received \$1.35 billion in ARRA funds to support twelve projects in advanced battery and electric vehicle manufacturing. The high levels of government support have helped the state to repatriate some battery manufacturing from Asia. In addition to the state's prominence in electric vehicle and battery technologies, the state has also established leadership in fuel-cell research, again as part of its automotive industry. Michigan is also home to fuel-cell research centers in its universities and testing grounds for hydrogen vehicles and related technologies. Five of the state's leading research universities formed the Consortium for Advanced Manufacturing of Alternative and Renewable Energy Technologies to advance research collaborations. All three of the major U.S. automotive companies, as well as some of the suppliers, have some research and development in fuel-cell vehicles, and both General Motors and Ford selected Michigan as the site for building their first electric vehicles.

The discussion of Michigan is not intended to underplay the developments in other states. States with smaller populations and more limited resources, such as Connecticut and South Carolina, have also invested heavily in the fuel-cell industry and with some success. As in the case of the solar industry in Ohio, the Third Frontier Fuel Cell Program has invested substantially in the industry and shown results in terms of growth of the number of businesses in the cluster. In New York, the state's very strong research base, its automotive research centers, investments by General Electric, support from the Brookhaven National Laboratory, and industrial producers across the upstate region make the state a contender with Michigan for the capital of the battery and energy-storage industry. However, the state's transportation manufacturing is stronger in rail than automobiles. The state has the leading number of rail manufacturers in the country, due to the high demand from the region around New York City, and there are some overlaps in battery and locomotive manufacturing. The state government has identified the broader "energy storage and transportation" sector for investment, funding, and an industrial consortium.

More generally, federal government initiatives for high-speed rail should also reinvigorate the domestic rail manufacturing industry. ARRA funding has entailed \$8 billion in grants to aid high-speed rail corridors in thirty-one states. Some cities have also connected purchasing for public transit with local manufacturing. For example, Portland used its purchase of city streetcars to enable Oregon Iron Works to set up manufacturing within the city.

Perhaps the most interesting aspect of the fuel-cell, battery, vehicle, and energy-storage industries is the fluidity of their boundaries. Fuel-cells and batteries link the automotive industry with energy storage needs for buildings, and there is growing discussion of the need for the smart-grid to accommodate not only distributed energy production but also distributed energy storage. In fact, as distributed energy production increases, having small-scale energy storage facilities will become increasingly important in order to manage the variation in load caused by solar, wind, and other intermittent sources of energy. The industry is strategically located to connect transportation, green buildings, renewable energy production, and smart-grid management. Furthermore, it is one industry where there is still significant manufacturing located in the U.S., mainly in the transportation industry.

Wind

Industrial wind turbines are very large and difficult to transport, and consequently wind energy manufacturing tends to be relatively dispersed geographically. A substantial portion of wind-energy manufacturing for the U.S. is located abroad, but the number of wind manufacturing companies in the U.S. has grown since 2003. There has been growing interest among the Midwestern states in diversifying the automotive supply-chain manufacturers into production for wind turbine components, and the skills, parts, and manufacturing techniques are potentially transferable in many cases.

Several states have significant wind-energy manufacturing, but the research clusters and testing facilities that could be the basis of an innovation cluster were not evident. Because the

industry is very international, and many of the leading companies are European, Europe has retained many of the high-end green jobs associated with research and development. California has had a wind industry that dates back to the windmills used to power irrigation pumps in the early twentieth century, and it has several large manufacturing companies, but with the exception of some wind energy research groups, there was no critical mass of prominent wind energy research similar to the ones for other clean-energy industries. Likewise, Pennsylvania has successfully recruited wind manufacturers and has targeted the industry for development, but it has not linked the recruited manufacturers to a university-based research cluster. Texas has a strong industry of wind generation and some research, but the state government has not connected those elements with the state's wind manufacturers. In contrast, Massachusetts has strong legislative support, a federally funded wind energy testing center, and a graduate program in wind energy research, but it does not have the large concentration of wind manufacturing operations found in other states.

Nevertheless, there are some states where manufacturing, research, and development appear to be coming together. Under Governor Bill Ritter, Colorado has shown leadership in renewable energy generation and attempted to connect its research resources to industry. In 2009 the state's Renewable Energy Collaboratory launched the Center for Research and Education in Wind to conduct research on turbine modeling, electrical systems, and controls. Testing is also available through the National Wind Technology Center of the National Renewable Energy Laboratory, and Siemens established a research and development center in Boulder. Other national centers include the National Center for Atmospheric Research and the Earth System Research Center in Boulder. On the side of industry, the state courted the Danish wind turbine manufacturer, Vestas, which established manufacturing in the state and was attracted to the state due to the proximity of the National Renewable Energy Laboratory and the state's research universities. Although employment from Vestas suffered retrenchment during the recent recession, the state is establishing the foundation for a broad wind manufacturing industry that includes research and development.

In the Midwest, the states of Iowa, Michigan, Minnesota, Ohio, and Wisconsin all have emerging wind-manufacturing industries. There are efforts to build freshwater wind farms in several of the Great Lakes, and those efforts may be accompanied by research and technological innovation that is needed to accommodate off-shore wind to freshwater environments where the water freezes. Iowa and Wisconsin are models in the sense that they have three important elements: research in the state's universities, a strong renewable portfolio standard, testing and siting of wind farms, manufacturing companies, and state government support for innovation and development of the wind industry. There are also plans in Illinois, Michigan, Ohio, and New York for freshwater wind farms, and on the East Coast the state of New Jersey has engaged in an extensive planning process for off-shore wind energy generation that is linked to local manufacturing.

South Carolina has many of the elements of a successful wind industry. For example, it has General Electric's large wind turbine design and manufacturing center in Greenville, several bearing manufacturers in the state, and a federally funded drive-train testing facility for wind turbines. There is some hope that the off-shore wind resources could enable the state to establish a wind industry cluster, but the demand side of the industrial cluster will require a commitment

from the state government to develop offshore wind. Meanwhile, the testing facility has begun to attract companies, such as a German wind-turbine manufacturer.

Although the examples discussed here suggest some places where wind turbine manufacturing could evolve into an innovation cluster, the wind industry is more like the automotive industry, in which a few large firms dominate the global industry. University-based research and development may be less important than large corporate research and development facilities, and other than General Electric the leading companies are mainly European and Asian. There may be greater possibilities for the development of small-scale wind turbines, an industry that is potentially more susceptible to disruptive innovation. The U.S. has considerable potential in this segment of the wind industry, but state governments have not yet looked at the potential of small wind as a promising industry for green job development.

Final Note

Our research suggests a deep tension in the goal of creating more green jobs. One type of green job involves the service industries such as installation, construction, and weatherization. The jobs require a relatively short period of training and offer work in a time of high unemployment. One of the significant benefits of the service-oriented green jobs programs is that they often connect women, ethnic minorities, and the unemployed in low-income neighborhoods to new job opportunities. The best programs link training with industry demand and provide a career ladder into better-paying jobs. The crucial programs in weatherization have been very promising in this regard, but they have been upset by the unfortunate ruling of the federal housing agencies. The better jobs (such as maintenance and repair for wind turbines) require longer periods of training and higher levels of skill, offer more substantial opportunities for family-supporting wages, and constitute a higher rung on the green jobs career ladder. Together, both the entry-level and better-paying jobs in the service sector are an important component of green jobs, and they can emerge as the result of a well-orchestrated group of demand policies and green-jobs training programs.

However important the service-sector jobs are (and we saw one estimate that was as high as half of all green jobs), they have some shortcomings. First, the multiplier effect by which one new job creates another new job is low in comparison with manufacturing jobs. Second, the wages in the service sector tend to remain lower than those in manufacturing. Third, if the U.S. does not go beyond a service-sector strategy for green jobs development, it will lose its potential to connect its strong research resources with industrial innovation. In effect, the country will increasingly become an importer of the innovations in clean-tech that are made elsewhere.

Manufacturing jobs and especially the jobs in the upstream side of manufacturing (research, development, design, and marketing) require a set of policies that build on but are distinct from the demand policies. The policies for manufacturing and innovation jobs must provide the capital needed for new business development; the incentives for recruitment and retention; the research base for continued innovation; and the connections needed among firms, government agencies, customers, and universities. We have provided evidence that some states have put together this second piece of the green jobs puzzle, at least for specific industries.

Creating and maintaining good manufacturing jobs requires ongoing innovation, and consequently the state and city government must increasingly concentrate on building a regional innovation system that attracts, retains, and generates new jobs. A dynamic regional innovation system will enable a clean-energy industry to retain its manufacturing jobs because it continually stays ahead of competitors in other parts of the world.

Investment in innovation has been painfully lacking at the federal government level, with the exception of the American Recovery and Reinvestment Act. Whereas research funding for the National Institutes of Health is at \$30 billion per year, research for clean-energy is much lower. Some state governments have attempted to use their limited resources to fill in the gap, and there have been some extraordinary success stories. In contrast, other state governments are way behind in this sector. Their failure to invest in clean-energy research and business development will mean that the other states will likely have to import their technologies and be content with only the lower-end, service jobs in the clean-energy sector. But without a much stronger level of federal government support as well as additional domestic content protections for clean-energy manufacturing, even the best efforts of state and local governments will have only mixed results. Other countries will continue to develop their clean-energy industries and export their advanced technologies to U.S. Americans should think carefully before giving away their precious manufacturing jobs in the clean-energy sector.

About the Authors

David J. Hess is a professor of Science and Technology Studies at Rensselaer Polytechnic Institute. He is director of the Program in Ecological Economics, Values, and Policy and advisor for the 100 students in the Design, Innovation, and Society program. The author of over a dozen books and fifty articles, his recent work focuses on sustainability, publics, and science and technology. He is the recipient of various grants and awards, including the Robert K. Merton award for the best book in science and technology studies. He is currently working on a book project based on this research that will explore the relationship between green jobs policies and mercantilist thought.

David A. Banks is a Ph.D. student in Science and Technology Studies at Rensselaer Polytechnic Institute. His research involves new urbanism, urban sustainability, and related issues of urban design.

Bob Darrow is a Ph.D. student in Science and Technology Studies at Virginia Tech. He studies political theory, social inequality, and mountaintop removal in Appalachia.

Joe Datko is a Ph.D. student in Science and Technology Studies at Rensselaer Polytechnic Institute. He studies public policy, political theory, and democratic participation.

Jaime D. Ewalt is a Ph.D. candidate in Environmental Sciences and Policy Studies at New Jersey Institute of Technology and a Senior Environmental Specialist at the New Jersey Department of Environmental Protection (NJDEP). She currently serves as the chair and founding member of the NJDEP's Sustainability Action Group for the Environment (NJDEP SAGE). She received her M.S. degree from the Ohio State University in Biochemistry and B.S. degrees in Biology and Biochemistry from Syracuse University. Her doctoral research is on socio-ecological resilience of megapolitan regional systems.

Rebecca Gresh is a Ph.D. student in sociology at the University of Illinois Urbana-Champaign. She studies space, power, and food.

Matthew Hoffmann is a Ph.D. student in sociology at Loyola University in Chicago. He studies social movements, food, and regionalism in the U.S..

Anthony Sarkis is a Ph.D. student in environmental studies at Antioch University New England. His dissertation research is on energy consumption in households, with a focus on the acceptance and use of home-energy incentives in Massachusetts. He also holds an MBA and is the founder and principal of Visionary Solutions Consulting LLC.

Logan D.A. Williams is a Ph.D. student in the Science and Technology Studies Department at Rensselaer Polytechnic Institute. She studies technology transfer, development, and health in South Asia.