

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 Adolfson & 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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