

Case Studies of the Greening of Local Electricity:

Sacramento Municipal Utility District

By David Hess

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The Sacramento Municipal Utility District (SMUD) is the sixth largest publicly owned utility in the country and is an independent local government entity that is governed by an elected board of directors. Its experiments with “green electricity” date back to 1895, when two businessmen built a dam on the Sacramento River to provide electricity to the city. In 1923 the city voted to establish the public utility, but it took another twenty-three years for SMUD to acquire the funding to purchase the distribution system from the privately owned company Pacific Gas and Electric and to win a court battle to make the purchase possible. At that point, shortly after the end of World War II, the infrastructure was in disrepair and there were stacks of requests for new service. Over the decades, SMUD built up its resources to become one of the nation’s leaders in energy innovation and renewable energy.¹

By 2003 SMUD had 553,000 customers and a peak load of 2809 MW. As with most utilities, SMUD’s power sources in the early 2000s included both its own generation and grid purchases. The overall mix in 2003 was 34% large hydro, 45% natural gas, 5% nuclear, 7% coal, and 9% renewables. The nuclear and coal percentages were imputed (based on statewide averages) from grid purchases; SMUD’s own generating capacity was 57% hydro, 41% natural gas, 1.2% wind, and 0.7% solar. About 20% of SMUD’s demand was met by the Upper American River project, which has multiple sites of hydroelectric generation and reservoirs on the river.²

During the 1970s, when the antinuclear movement was at its peak, SMUD’s Rancho Seco plant (935MW capacity) was a target of demonstrations. Although the utility did not close the plant during the height of the antinuclear movement, in 1989 the public voted in a referendum to close it. Since the closure, SMUD has acquired a reputation as one of the nation’s leading utilities in the area of renewable energy. To answer questions about SMUD’s renewable energy program, I spoke with Michael DeAngelis, the Program Manager for Advanced, Renewable, and Distributed Generation Technologies. He has decades of experience in renewable energy, including positions as Deputy Chief of the Technology Systems Division, and before that Deputy Chief of the Technology Development Division, of the California Energy Commission. He also worked for the National Renewable Energy Laboratory and British Columbia Hydropower Authority.

Although DeAngelis was relatively new to SMUD, he explained that the utility’s transition into renewable leadership during the 1990s was partly a result of the utility’s reaction to the public referendum to close Rancho Seco. However, he added, “I believe SMUD has been an innovative utility for many years, since its formation. One of the initial innovative projects was the development of the stepped hydroelectric system (the Upper American River Project). As an innovative utility, SMUD also embraced nuclear

energy when it emerged from research as a new technology. This was one of the first nuclear plants built in the state of California. I was living in the Sacramento area when the advisory vote occurred and contributed to Board closure of the plant. I'm sure that it was a traumatic event for this organization. The plant was having operational problems, and the district had just spent a lot of money to refurbish the plant when the vote happened." He added that the closure, dismantling, and clean-up of the site was also breaking new ground for utilities.

Even before the nuclear power plant was closed, SMUD had been providing leadership in the development of renewable energy. For example, in 1984 it built the nation's largest photovoltaic plant (1MW) at Rancho Seco. "One of the impressive things about that installation," said DeAngelis, "is that it is still operating at over 80% of its rated output, better than expected performance for a new technology with undetermined durability at the time." He noted that under the leadership of S. David Freeman and subsequently under SMUD's current General Manager, Jan Schori, SMUD developed a focus on energy efficiency programs and renewable energy, especially solar. "When S. David Freeman came in, we had a very strong start to the solar energy program, particularly in distributed generation applications. We now have almost a thousand installations in the Sacramento area. We have a significant solar program that has been in existence for twenty years, probably longer than any utility in the country. We showed substantial leadership during a period when there was very little growth in that industry, at least for domestic, grid-connected installations." By 2005 the photovoltaic capacity was about 9 MW AC and the utility was adding about 1 MW per year in new installations.

Although solar is very popular with customers and continues to grow, it represents less than 1% of SMUD's renewable energy portfolio. Larger contributions are estimated in 2006 to come from wind (45%), geothermal (26%), biomass (22%), and small hydro (6%). Since 1995 the utility has operated a wind generating plant in the Montezuma Hills of Solano County. As of 2005 the capacity was about 15MW, and the utility planned to expand the project to 100MW over the next several years. DeAngelis noted that one of the problems with wind capacity is that it is intermittent. "Wind is low cost, and we're doing a lot of work to integrate it with the traditional utility operations. The issue with wind is intermittency. Wind starts up and then it stops, right away. The issue with the power schedulers is that they have to meet their loads. Yes, we want to shut down or reduce equivalent fossil generation when the wind blows, because it is free fuel, but the problem is that it is difficult to do this instantaneously, and wind forecasting is in the development stage. It is also a real challenge to plan for how much generation capacity a utility system can have with an intermittent source like wind. Some people think we can't grow more than 100 MW of wind for our small size, but there are some German utilities that have 12%, even 32%, of their peak load. We have a proposal for a pumped storage facility as part of our hydro facilities, which could add another 400 MW of dispatchable power generation and would give us the ability to use wind electricity generated when electricity demand is low. The pumped system would be about a 70% efficiency, which isn't bad."

SMUD is also working with regional farmers and the Sacramento Solid Waste Authority to explore using local biomass energy resources. Application of new technologies can solve significant local waste problems, not only for municipal sources

but also from agricultural sources. SMUD estimates that Sacramento's largest dairy farms with over 1,000 total cows can generate about 2 MW in capacity and more than 16,000 MWh hours annually using anaerobic manure digesters. By combining incentives and matching funds from the U.S. Department of Agriculture, the payback period for farmers is about five years or less. As DeAngelis noted, "We think that if we focus our biomass program to address problem wastes and residues which exist locally, we can create benefits to the community by diverting these problem wastes and residues to produce green electricity. We have forty-three dairies in Sacramento County, and in 2004 we helped several dairies to prepare grant proposals to the USDA. Three dairies were awarded USDA grants, and we expect the manure digester systems to be constructed this year. We also developed a net metering rate for dairies, and we have agreed to expedite the interconnection to the SMUD grid. A healthy dairy cow produces 125 pounds of manure and urine per day, so manure management becomes an important issue with large dairies. We believe that this program will significantly reduce odors and air emissions, and improve water quality issues, with a dairy. "We're also looking at green waste and food waste. We found that anaerobic digestion for these problem wastes is commonly done in Europe. Right now we have 260,000 tons per year of green waste, much of which is transported eighty miles south of here to composting facilities. Much of our food waste is transported over 100 miles to a landfill in Nevada. In addition, we've found that aerobic composting facilities release a huge amount of VOCs (volatile organic compounds) and some are actually exceeding permit levels. The anaerobic digestion systems eliminate over 90% of the ammonia and VOC emissions. What comes out is high value compost and a gas that can be burned cleanly for electricity generating. We are considering using this at one of our natural gas co-generating plants to off-set some of the natural gas used at the facility."

SMUD has many other programs related to energy efficiency and renewable energy. For example, it cosponsors research, development, and demonstration projects for photovoltaics, wind, and other renewable energy sources; offers rebates and other incentives for purchases of energy-efficient products; supports free shade tree plantings around the city; certifies homes as meeting the standards of its energy efficiency program; works with builders to develop new homes with solar roofs; uses a biodegradable transformer oil and low-polluting pole wood; and provides charging stations and assistance for electric vehicles.⁴

In addition to innovative new projects and its development of utility-owned renewable generating capacity, SMUD is also increasing its purchases in renewable energy. As DeAngelis notes, "In June we released a request for offers. We asked the independent power community in the renewables area to give us proposals to meet goals that we have. We have two programs, a renewables portfolio standard and a 'Greenery' program (a voluntary green pricing program for customers). SMUD adopted a renewables portfolio standard about a year before the state legislature approved one. We adopted 10% for the RPS in 2006 and 20% in 2011. What we decided to do from a policy perspective is to count this separately from the Greenery program. Our projections on growth show that by 2006 we should be able to get 2% of our supply from the Greenery green pricing program, and 3% by 2011. We decided to keep the two goals separate for a variety of reasons, including an accounting system to assure our customers that if they contribute to Greenery, we will purchase extra green electricity." To get a sense of what

the goals mean in terms of the scale of renewables, 23% of retail electricity load in 2011 for SMUD is about 2,800 GWh of electricity, or enough electricity for more than 340,000 new homes.

DeAngelis pointed out that SMUD also has a strict definition of renewable energy: “There are various creative definitions of what qualifies as renewables, everything from the state of Pennsylvania saying that the use of waste coal piles are eligible for their RPS to others including existing large hydro. Our definition is closely consistent with the state of California’s eligibility requirements for the renewable portfolio standard. We don’t count large hydro, any fossil source, and direct combustion of municipal solid waste. So really what’s eligible are solar, wind, biomass (as long as its not direct combustion of municipal solid waste), small hydro (less than 30MW), geothermal, and the other innovative resources, such as ocean energy. So I think it’s a very honest definition of renewable energy.”

By the early 2000s population growth and demand were continuing to increase, and recently portions of neighboring Yolo County—including the cities of Davis, West Sacramento, and Woodland—were requesting to be annexed to SMUD. The new electricity demand projections and the advantages of increasing the amount of local generation owned by the district led SMUD to develop plans to redevelop the Rancho Seco site, which has an existing infrastructure and transmission lines. SMUD opted to build a natural gas-fired plant. The first phase of the Cosumnes power plant, which will be operational in 2006, will add about 500 MW of capacity, and a second phase may be added by 2010 to generate another 500 MW of capacity.⁵

Given the utility’s commitment to renewable energy and the expected price volatility for natural gas, I asked why the utility had opted to invest more in fossil fuels, albeit one of the cleanest and most efficient of the fossil fuel options. DeAngelis replied, “I’m not the expert on Cosumnes, but I think the reasoning was as follows. Part of the issue that was raised during the California energy crisis was whether there was enough generating capacity of significant size in the state. As an innovative utility, SMUD took a number of actions. First, right on the heels of the energy crisis in 2001-2002, SMUD formed its own control area. It separated out from the independent service operator and now balances its electricity demand with control of electricity supplies. The other thing that it felt it needed to do was to increase its local generating capacity, and to do that in a way that was substantial. Decisions on the second phase Cosumnes plant have not yet been made, and there will be considerable evaluation and discussion before a decision is made. It was clear there were not a lot of power plants being built during the 1990s, and it was clear that there was an aging generation fleet in the state that was more polluting and less energy efficient. The technologies for natural gas fired generation have also improved substantially. You can now get gas-fired combined cycles with almost 60% energy conversion efficiency, where thirty years ago conversion efficiencies were in the low to mid- thirties. In addition, emissions control technologies have vastly improved, where with selective catalytic reduction (SCR) you can get emission controls down below 3 ppm NOx. And natural gas is considered the cleanest of the fossil fuels. So SMUD was buying a large percentage of its electricity from merchant plants. Given what had occurred with electricity pricing during the electricity crisis of 2001-2, the stable state of natural gas supply at the time, and the advancement in technologies for making power plants cleaner and more efficient, there were a lot of arguments for building the

plant at that time. We also own natural gas wells in New Mexico, and we have pipeline capacity to get that gas to us. So there was a decision that the plant was best for the customers.”

Equity and Sustainability

SMUD offers a variety of programs and help for customers to connect with energy assistance programs, including the federal Home Energy Assistance Program, weatherization for low-income customers, and an “energy assistance program rate” for low-income customers. The latter program allows about a 30% discount for a family of four with an annual income of up to \$32,000. The utility also encourages customers to make a tax-deductible contribution to its EnergyHELP program, which assists customers through the Salvation Army and Sacramento Food Bank Services.⁶

To date SMUD has not experienced a cost versus sustainability dilemma as it moves toward its goal of 23% renewable energy by 2011. One reason is that SMUD’s rates are low (25-33%) in comparison with Pacific Gas and Electric, which has recently gone through an expensive bankruptcy procedure. The lower rates and leadership in renewables and energy efficiency are two reasons why some neighboring cities in Yolo County have requested annexation. Another reason is that the cities want to have local, elected representation in electricity decisions.

Another equity issue is geographic; customers located near the Rancho Seco plant may have experienced higher health risks when the nuclear facility was operational. A public health study, the validity of which SMUD could not confirm, documented that after the plant closed, there was a decline in mortality among fetuses, infants, and small children located in the vicinity.⁷

Policy Issues and Recommendations

When asked what is holding back the conversion of utilities to renewable energy, DeAngelis noted that much of the current leadership is occurring at the state level. He pointed to the state renewables portfolios standards as one key policy development that is occurring at the state levels. “I think in the long run that is going to help, but there are a lot of issues along the way, and it’s going to take a lot of flexibility to make it happen. For example, one of the key issues in California is the problem of how to increase transmission capacity to have access to a lot of good renewable sources. There are multiple examples. Edison and other utilities are working on transmission for the Tehachapi wind resource area. Wind is one of the cheaper renewable energy resources, and the price continues to decline. Tehachapi is one of the areas that is constrained by transmission, and it’s a difficult issue as to who pays for transmission and whether the resources will be developed. If you don’t have the transmission, you can’t get the electricity out. It’s also a problem for some of our geothermal resources, particularly in the southern part of the state.. We’ve looked at a number of other wind resources that have transmission problems. Transmission is expensive, and the issue of who pays for it, particularly after electricity restructuring, is a tough question. So that’s a major constraint. It needs to be solved at the state and regional levels, but there can be leadership at the state level to address this problem.”

Web site: <http://www.smud.com>

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Interview by David Hess of Michael DeAngelis, March 18, 2005.

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