Case Studies of the Greening of Public Transit and Municipal Electricity

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Table of Contents

Alameda-Contra Costa Transit District

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Alameda-Contra Costa Transit District (AC Transit) is the public transit system for thirteen cities in the East Bay area, including Oakland and Berkeley. The system operates as a separate unit from the passenger rail system BART (the Bay Area Rapid Transit system), but BART stations are interconnected with AC Transit bus lines. Founded in 1960 from an earlier bus and rail system (The Key System), today AC Transit operates with 105 bus lines and approximately 700 vehicles, and it serves 64 million passengers per year. It is governed by a publicly elected board of directors. I interviewed Jaime Levin, the Director of Marketing and Communications, who has been at the agency for seven years and has a background in planning, energy transportation, and land use. Bob Bithell, the Manager of Technical Services, also joined the interview and added some information on the technical issues involved in greening the bus fleet.[1]

AC Transit is known as a well-run agency, and it has won the American Public Transportation Association's national competition for driver and maintenance proficiency in five out of the six previous years. It is also recognized as a leader in the greening of public transportation. Some of the changes were driven by regulatory mandates from the California Air Resources Board (CARB), but AC Transit has consistently been ahead of regulatory mandates. As Mr. Bithell noted, "Our repowers were ahead of any requirements, we were at least six months ahead on getting ultra low sulfur fuel, and we're currently ahead of exhaust after-treatment, the Cleaire Longview treatments."

Mr. Levin added, "We were among the first transit systems, certainly the largest system, to embrace the concept of repowering older systems." In 1999 and 2000 AC Transit completely overhauled its old buses by putting in new engines, drive trains, wires, and hoses to make their 1993 buses more efficient and less polluting. Throughout the 1990s diesel buses were undergoing improvements in emissions reductions. One major improvement occurred in 1991 and another in 1994. The agency no longer has any buses with pre-1991 emissions levels in service (the ones that became the focus of controversy in San Francisco's Muni system). The repowering or retrofitting of the 1993 buses reduced emissions by 20% for nitrogen oxide (NOx) and 50% for particulate matter (PM).[2]

In 2002 the agency made another significant change in emissions reductions: it shifted to ultra low-sulfur diesel fuel, a change that resulted in additional reductions for hydrocarbons, carbon monoxide, and PM. The next step, which the agency was working on at the time of the interview, was installing Cleaire Longview emissions filters on all of its buses. As Bithell added, "We tested two buses with Cleaire Longview a few years ago, and then the California Air Resources Board gave them their verification based on the tests that we and a couple of other transit agencies did. We then got funding from the Metropolitan Transportation Commission, and we're going to retrofit every bus in our fleet, except for the old 1991 buses that we're going to sell." Funding for the traps is coming from the Metropolitan Transportation Commission, a state-created agency that governs planning for the nine-county Bay Area, and from the federal CMAQ program (Congestion Mitigation and Air Quality Improvement).

The agency has also been involved in various tests of other types of new vehicles. One issue has been evaluating the trade-off between compressed natural gas (CNG) and the new diesel, diesel-hybrid, and gasoline-hybrid technologies. As Bithell noted, "With CNG there are emissions and maintenance problems. On the emissions side, it's questionable whether the PM is worse than a diesel, because the particle size is much smaller, and they only measure particulates by weight. So if you have larger particles, it's going to weigh more and have a higher rating. We were concerned about the ultra-small particulates in the CNG, the formaldehyde (it's much higher), the cost of the purchase, the infrastructure investment, and the high maintenance cost. If you put after-treatment on diesel, it's as good as or better than CNG."

Levin expanded: "There were a lot of companies that saw clean-air value with CNG, and they geared up and made capital investments. We were pushed very heavily. Many of the companies that pushed it did not reflect the same interests, if you look at their own fleets. We had some interesting early struggles politically over why AC Transit wasn't building CNG fleets, but we had some major reservations about it. If a CNG engine isn't maintained and tuned properly, it can make as much or more noise as diesel, and it certainly doesn't have any emissions benefits.

"In the initial period when CNG was being pushed, there were significant reliability issues. Frankly, they ran right up against our number one objective, which is to provide reliable transit service. Diesel engines are far more reliable and less expensive, and when ultra-low sulfur fuel and after-treatments are used with diesel engines, they are almost at the same level as CNG in terms of emissions. As testimony to that point, the California Air Resources Board has come down firm on the comparison and concluded that this a reasonable pathway in terms of emissions. I would also venture to argue that any mechanic would say that any new diesel technology is far more reliable than CNG. So now it looks like the hybrid technology will skip over the CNG, and I say that partly because you don't have any infrastructure demands that CNG has."

Because of the problems with CNG, the agency views hybrid diesel and hybrid gasoline engines as the next near-term step beyond standard diesel, but conversion is an expensive process, so it will take some time. According to

Bithell, “Back in 1998 or 1999, we did test an electric hybrid vehicle that had a Wankel gasoline engine in it, and the test was pretty successful, but it didn’t meet our power needs. We’ve had gasoline and diesel-powered hybrids here off and on. The capital investment is great.” The agency was in the process of adding ten hydrid gasoline-powered, 30-foot buses, with a grant from the Bay Area Air Quality Management District. The hybrid-gasoline buses have comparable fuel economy to diesel-powered buses, but they significantly lower PM and NOx emissions in comparison with even the diesel buses with the Cleaire Longview traps. [3]

AC Transit has also been testing and operating zero-emission, hydrogen fuel-cell buses, which it has done with the support of various public agencies and in partnership with a number of private companies, including ISE Corporation, UTC Fuel Cells, Van Hool Bus, ChevronTexaco, and Hydrogenics/Stuart Energy. The agency had tested several hydrogen fuel cell buses in 1999 and 2000, and an extended demonstration of one 30-foot hybrid fuel cell bus in 2004.They have purchased three 40-foot hybrid fuel cell buses, which are expected to arrive the latter part of 2005. One measure of reliability is the percent of time in service. The overall spare ratio for AC Transit’s fleet—that is, the number of buses in maintenance—is 17%. As Levin noted, “A brand new diesel is in the 90-95% range. The 30-foot hydrogen, hyrbrid, fuel-cell bus was in the 83% range, which was phenomenal, and it doubled our fuel efficiency. We ran it for about six months last year. It was designed to run on flat land and on routes that averaged 18 miles per hour. We put it in service on routes running 11-13 miles per hour, and it ran on the 65 Line up the hill where Lawrence Hall of Science is. We put it on that line three days a week. It climbed 1200 feet, including a two-block section that was 21% grade and many blocks 10-15% grade. On some trips we carried 300 people per trip. The fuel cell system was designed for a thousand hours, and we ran it almost 1500 hours. That makes us feel really good about the forty-foot bus, which follows on the same design.”[4]

AC Transit is not merely testing hydrogen buses; it has assembled three partners to design and build new buses: UTC (United Technologies), Van Hool (a European bus company), and ISE, a local California company. “Originally the idea was that we were going to take a Van Hool diesel bus and ISE would convert it, but there were a lot of issues that we all had with that. In the end they built a whole different design structurally. This project has expanded ISE as a company. There were ten people in the firm and now there are thirty, and they are growing.” AC Transit also partnered with ChevronTexaco to build a hydrogen energy station in Oakland, which will use natural gas as the source. AC Transit is also exploring with other vendors the possibility of installing a smaller hydrogen station at its Emeryville operating division, where it will generate hydrogen from solar power.

Another innovation of the transit agency is bus rapid-transit (BRT), which has dedicated bus lanes and station structures similar to those used for light-rail vehicles. Pioneered in Latin American cities such as Curitiba and Bogota’, BRT is slowly emerging in North America as a more flexible and less costly alternative to light rail. AC Transit is developing plans for a BRT system that would begin in

Berkeley. The agency has also developed a rapid service bus line from Jack London Square in Oakland to Richmond and San Pablo in the north. Although the rapid service line does not have dedicated lanes and stations as in BRT, it has stops set at two-thirds of a mile apart, buses running every 12 minutes, electronic signs that let riders know when the next one is coming, and traffic signal prioritization. As Levin commented, "We were able to speed up the travel time by over 20%, and we've had a 77% increase in ridership comparing the old limited with the new rapid, and it's clearly an increase in ridership from new users." [5]

Equity and Sustainability

In some cases, transit agencies may prioritize neighborhoods with high pollution levels for the buses that have the new technologies, in order to reduce the toxic load on the neighborhoods. However, AC Transit has a different approach. As Levin described it, "We're very conscious of Title VI and environmental justice concerns, and our board policy does not target particular neighborhoods. If you look at our route map, virtually all of our routes run north-to-south, from poor and working-class neighborhoods to upper-income neighborhoods. We spread the changes throughout. There is no favoritism. This makes it a challenge with three fuel cell buses that are primarily research vehicles and the ten (planned) hybrid buses."

When asked if there was a trade-off between access and sustainability issues, Levin commented: "That's the challenge for any public service agency. We have had the opportunity to pursue the hydrogen program strictly because we were able to get grants separate and apart from our operating funds. If we had to translate operating money from frequency of service to R&D on cleaner, greener technology, it wouldn't sell very well to our public. When all is said and done, and I say this as a transit user every day, if the bus doesn't show up and I'm late to work, I don't care whether it's a diesel bus or a zero emissions bus. It's a challenge to us, and we're aggressively going after additional funding. We're trying to get the federal government interested in the program and ramping it up, so we're not just running three hydrogen buses but building fleets of 10, 20, or a hundred."

As Bithell explained, "When we go to buy buses, we have a fixed sum of money to buy buses. Let's say a bus costs $300,000 and you have $3,000,000, so you can buy ten buses. If you change something on the bus—an example would be the gasoline hybrids that we're going to get, which cost about $100,000 extra—we're not going to reduce the number of buses that we'll buy. Instead, Jaime goes out and gets extra funding to pay for the incremental cost."

Levin amplified on the trade-off involved in the economics of greening: "An example is the 1991 buses. They are 30-foot diesel buses, and they emit about six grams of NOx, which is high, and they're old. We have to get rid of them, but we need 61 buses or we threaten our service commitment to the community. So we will buy 61 buses. We then went out for a clean air grant that will allow us to buy 10 gasoline-hybrid buses that we can test and run in service. If we can find

more money, we'll add more. But we cannot sacrifice the service." If they do not get the extra money, the remainder will be state-of-the-art diesel buses that will be retrofitted with the Cleaire Longview emissions trap at a later date. To give a sense of the range of premiums for clean energy, Levin described some of the costs above the current average of $300,000 for a new diesel bus: "CNG buses run at $380-400,000, hybrid diesels are in the $500-600,000 range, depending on the size; the trolley buses used in San Francisco were about $850,000; the forty-foot trolley buses that Boston purchased recently were over $1 million; our fuel cell bus was $3 million; and the original fuel cell buses that we tested were $9 million. The hydrogen fuel cell bus that we designed is a hybrid, and you can take the fuel cell out and plug in a gasoline, diesel, or a hydrogen internal combustion engine. We would like to get funding to put an ICE hybrid hydrogen bus out on the streets, which would be about $800,000 or comparable to a trolley bus. But again we would have to test for reliability and durability."

Policy Issues and Recommendations

Clearly the overriding policy issue that public transit agencies face is funding their greening process. As Levin described it, "The money that we typically use for 80% of capital procurement is federal dollars. I would contend that we are throwing the gauntlet down to a national perspective and asking, 'Do we have a concern about energy and emissions issues?' Most of our initiatives are health-related emissions issues, which doesn't necessarily translate into energy savings, although we're showing that we will deliver on it. It also doesn't translate into CO_2 reductions. I would contend that the federal government has a responsibility to step up to the plate and say that transit systems have service needs and cannot back off their service needs. So who's going to make up the gap between a $300,000 diesel bus and the cost of a clean fuel bus? At the federal and the state level, someone has to help public transit bridge the gap in order to provide cleaner, more efficient vehicles. There need to be two initiatives. One is emissions based and the other is fuel economy based.

"Along with increased funding there has to be recognition at both the federal and state level departments of transportation that government does have to help to push along initiatives. We've also been fortunate to bring some very big private partners to the table—ChevronTexaco and United Technologies—but it really stems from the public policy initiatives from the government. I think that public policy has to be driven by essentially three public good perspectives. One is health: what is it going to take to improve the health of our communities? The second is quality-of-life commitments. What's wonderful about hydrogen is that it's also going to reduce noise levels, and we have two communities in Berkeley suing us about noise levels. And the third concerns fuel efficiency measures that will help address the nation's energy needs and global climate change problems related to CO2 emissions."

In addition to external funding support, Levin noted that codes, standards, and tax laws were another area in need of policy analysis and reform: "The decision-making processes in local and state government are very conservative

and make it very difficult to move forward with new technologies and design. They don't embrace much latitude with respect to code and standards. There needs to be a reform to help support new technology in these areas. I would also suggest that tax laws and other kinds of state restrictions should be reviewed and modernized to advocate and support these new technologies. It's somewhat ludicrous that we're expected to pay sales tax on these new R&D vehicles, and we're arguing that we shouldn't have to. I think we'll win that, but not easily. So in terms of tax reform and permitting processes, there could and should be changes in those areas to help facilitate new technology development."

Finally, Levin added that there has to be an internal vision for the processes of change to be successful. "You have to have a vision and a nucleus of employees, not just in one area but throughout the organization. If the maintenance department said, 'I don't want to deal with it,' then you would go nowhere. And you have to have a general manager who is willing to take the risks. Any new program is going to run up against institutionalized obstacles such as bureaucracy and narrow thinking. It also helps that every time we need political support, we can go out and get the support of thirteen mayors."

As Levin concluded, "With all this technology, our biggest challenge as a community is stopping the onslaught of vehicle miles traveled. All of this technology won't do a bit of good if we don't make communities accessible. It's not mobility; it's accessibility. What you see in the corridors is the desire to build more housing and mixed use development that is perfect for fixed route transit." For additional information, he pointed readers to a study on their web site that presents an integrated vision of public transit, land use, and infrastructure development.[6]

Web site:

http://www.actransit.org

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Austin Energy

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By David J. Hess

Austin Energy is the tenth largest publicly owned municipal utility in the U.S., with 360,000 customers. As a department of the city of Austin, the utility reports to the city manager and city council rather than to a separate, publicly elected board of directors. The city benefits in many ways from having a publicly owned utility, one of which is the $1.6 billion in profits that Austin Energy has provided to the city since 1976. Austin Energy has also developed a national reputation in emissions reduction, renewable energy, and energy efficiency. I spoke with Roger Duncan, the Deputy General Manager for Distrubuted Energy Services for Austin Energy. He served on the Austin city council from 1981 to 1985, when he ran on a platform in support of energy efficiency and renewables and in opposition to nuclear energy. During the early 1980s he helped start many of the green programs in the utility. From 1989 to 1996 he served as the director of the city's environmental department, and he joined Austin Energy in 1998.[1]

The utility owns 2700 MW of generation capacity and has a peak load of about 2100MW. Within the city, the utility operates three natural gas power plants (Holly at 400MW, Decker at 926MW, and Sand Hill at 480MW). When fully operational, the new, high-efficiency, combined-cycle plant at Sand Hill will allow the city to close the older Holly Power Plant in 2007. Outside the city the utility is co-owner of the Fayette coal plant in LaGrange (570MW) and a nuclear plant in South Texas (400MW). The utility has installed emissions reduction equipment at its natural gas plants that go beyond state standards. Retrofitting in the two older plants resulted in NOx reductions of about 50%, or 1,000 tons, from 1998 to 2003. The utility is also contributing to pollution reduction retrofits at the coal plant in LaGrange.[2]

I began by asking Mr. Duncan how Austin Energy defines eligible renewables. "My degree is in philosophy, so every time somebody asks me, I have to explain that the term 'renewable' is just an arbitrary term relating to the time frame that you're looking at. Ultimately, everything or nothing is renewable. We define renewables primarily as wind, solar, biomass, and geothermal. Right now biomass is landfill methane, but we're also looking at other dedicated

biomass. We just don't have access to hydro—we only have about 1MW of hydro in our system—so that's not a factor."

Part of the funding for the transition to renewables comes from the utility's green pricing program, which is called "GreenChoice®." The utility claims that its green pricing program is the most successful in the country.[4] Although the program is relatively new, it has attracted some large contracts from commercial customers. Duncan explained why the green pricing program has grown very quickly: "One of the reasons it's been successful is that we have a strong environmental community here. For a lot of reasons we are a green oasis in Texas in terms of environmental support. But in my opinion the primary reason we've been successful is that we hit upon a pricing scheme that made renewables an effective fuel hedge against rising fossil fuel prices. In Austin you have two line items on your utility bill that relate to electricity. One is the base charge and the other is the fuel charge. The fuel charge is a straight pass-through from our utility and is the aggregated price of all the fuel that we use. So the fuel costs (primarily gas and coal) are averaged out, and on an annual basis we set the fuel charge. Obviously, as fossil fuel prices go up, that's going to go up. When we were looking at pricing our renewable energy, I made the decision that since we were signing long-term, ten-year contracts for our renewable energy for a fixed price—and almost all of our renewable energy is coming from West Texas wind—I decided that we were going to pass our fixed price along to our customers. We decided that when customers sign up for GreenChoice®, we would remove the fuel charge from the bill and replace it with a GreenChoice® charge. That price would stay fixed for ten years.

"At the time we did it, I think the fuel charge was 2.79¢ and the green choice price was 2.85¢. We started selling it, and we have a lot of environmentalists, so it was selling well, but then some of the larger businesses started to realize that this was an effective fuel hedge. They started buying really large quantities of green energy. I like to joke that it didn't matter to them if it was green energy or purple energy. From their risk management approach, they decided to lock in the price for ten years, and we started getting very large orders. It's been very successful, and that's why we've led all utilities in the nation for the last three years now in green power sales. I've been mentioning this on the talk circuit for a couple of years, and everyone is excited about it, but we're waiting to see if other utilities follow suit."

Austin Energy derives about 6% of its capacity from renewable energy, and its strategic plan sets a goal of 20% by 2020. As of 2005 the utility purchased 89MW of wind energy capacity from the King Ranch Wind Farm near McCamey, Texas, and it had a generating capacity of 13MW of methane gas from landfills in Austin and San Antonio. In January 2005 the utility signed a contract to add 128MW of generating capacity from the new wind power source in Nolan County. To date Austin Energy's wind capacity is entirely purchased, but the utility is discussing ownership. As Duncan explained, "There's discussion right now. We feel like we need to start moving into owning wind as opposed to purchasing it." [4]

To encourage distributed generation of solar energy, Austin Energy offers a rebate of about $5 per watt, which pays for about 50-80% of the installation cost. According to Duncan, the utility has added about 200kw in the past year: "It's starting to pick up with our new solar program. We have a total of about a half MW of solar. It's about half residential or commercial rooftops, and the other half is what we put up earlier on parking garages and other city buildings." The utility has a goal of 100MW of solar capacity by 2020, and it has partnered with city departments and builders to develop the first "zero-emission" housing subdivision in the country. The 100-home division will be powered by solar energy.[5]

The utility is also known for its energy efficiency programs, and it has a target of 15% reduction by 2020. Its Green Building Program, which provides consulting and educational services to contractors and builders to make residential and commercial buildings more energy efficient, has won national acclaim and awards. Another program, Home Performance with Energy Star®, provides low-interest loans and rebates so that customers can make energy efficiency improvements to their homes. In 2005 the utility opened the state's first refrigerator recycling center, which will pay customers $35 per old working refrigerator. The various energy efficiency programs were estimated to reduce peak load by 30-40MW per year.[6]

Finally, Austin Energy is working with the city to develop a plan for the city to convert its fleet of vehicles to plug-in hybrids.[7] Duncan is the primary architect of the new program, and he explained it in more detail as follows: "The city council came to me last year and asked, 'What can we do to crank things up even further in terms of being the clean energy capital of the world?' I responded that we were very progressive in conservation and renewables, but generally we haven't done anything in the transportation sector. Furthermore, I told them that eventually there would be a unification of the transportation and electric sectors. There were two or three fundamental forces out there that were creating a perfect storm: cheap oil was running out, the solution that had been touted in the hydrogen economy was going to be coming even more slowly and at a greater cost than we thought, and there was going to be a gap between that and the oil economy. As a result, we need to look at alternatives to petroleum. When you look at the various alternatives such as biofuels, electricity turns out to be a very attractive alternative in terms of cost, supply, and existing infrastructure. I told them that the hybrids that are already on the road are the first step toward the unification of the sectors, and the next step would be expanding the hybrid's battery capacity and rewiring it so that we could charge it from a wall socket in addition to its gasoline engine.

"Furthermore, where there is true unification of the sectors, there would be a lot of benefits for the city of Austin. First, there would be lower cost to our customers, because we calculated that they would get the equivalent of about 56 cents per gallon from our electric grid from charging. Second, it would clean up air quality; we're an air non-attainment city. Removing emissions from the streets, even if we remove them to a power plant, is helping our ozone situation. Third, it would help us with renewables because we're having problems finding

storage capacity for wind and solar, and if we can take in wind at night and in essence store it in automobile batteries, we can take in more wind and have essentially wind-driven cars. Fourth, it would be revenue for the utility, and since we are a public utility, that translates into revenue for parks and libraries. Finally, in the far future when we get the technology worked out, we can use automobile batteries in the transportation sector as storage capacity to avoid future peaking plants. That is, I can wire parking garages, reverse the flow, and on a hot summer afternoon take down a little on all the batteries and avoid a peaking power plant. So for all of those reasons I said this is something we should pursue.

"The city council then said to go ahead with it, and I drafted a plan that was an incentive package of utility rebates and fleet orders. We will provide a rebate for gas-optional hybrids that come onto our system, and we will also work to get soft orders from government fleets, businesses, and individuals. We will package the incentives of rebates and fleet orders and see if we can replicate it in the fifty largest cities in the country. Austin by itself isn't going to move the automobile market, but we feel that there is potential to create large consumer demand. I certainly have interest from other cities, utilities, and organizations, but this is just starting and I'm trying to focus on putting the package together in Austin correctly."

Equity and Sustainability

As with other greening efforts for electricity, Austin Electric experiences trade-offs between the costs of renewable energy and the goal of developing more renewable energy. As Duncan commented, "What did Thomas Jefferson say? 'Do only as much good as the people can handle or afford.' The way we've handled this is to set up priorities in our strategic plan: energy efficiency first and cost effective renewables second, before we go to gas, coal, and others. Every year we very carefully calculate a break-even point on our energy conservation programs to make sure that the costs of those programs are less than the avoided costs on the supply side. We look at our supply side alternatives and then target under that for our conservation programs. On the renewable side, GreenChoice® is being passed through to the customer to sign up for, but we recognize that for some renewables programs, we're just promoting the technology. For example, we do not expect solar to be cost effective at this time. Recognizing that, we limit the amount of money we invest in it. That's not the same philosophy as just getting supply for our energy load."

In addition to the broad issue of balancing the higher cost of renewables and conservation programs with the customer's need for a low price, Austin Energy has also faced the trade-off between keeping its older, in-city plants and community concern with their health and environmental effects. As a result, Austin Energy has faced some environmental justice concerns, but it is working to solve them. When I asked about this issue, Duncan responded, "We have a problem plant in a low-income neighborhood (the Holly plant). The plant isn't run very much, and we're in the process of closing that plant for neighborhood and

community reasons. Other than that, we're not experiencing emissions problems."

For low-income customers, including renters, Austin Energy also offers some model programs. For example, the utility offers free home energy improvements, including attic insulation, sealing and repairing ductwork, caulking, weather stripping, and solar screens on windows. Through the Plus One program, Austin Energy also contributes to the City of Austin Customer Assistance Program to provide a fund to low-income customers who are not able to pay their utility bills.8

Policy Issues and Recommendations

When asked about barriers to renewables and policy issues that the utility is facing in the conversion to renewables, Duncan noted that transmission congestion was a significant problem for wind energy coming from west Texas. "Getting the transmission problem handled out of west Texas is probably our major problem. It's wind now, but if we wanted to tap into the concentrated solar power in west Texas, we'd have even worse transmission problems. That's the main barrier." He added that ERCOT (the Electric Reliability Council of Texas) controls transmission construction, but it takes time to build the infrastructure to meet the new demand for west Texas renewables: "We are pressing ERCOT, as is everyone else, to build transmission lines. You can put up a wind turbine in six months, but it takes a transmission line about five years to get through the process."

He described the other major barriers as mostly related to cost and the stage of technology development, such as the cost of solar and the intermittency of wind: "Right now we have a big problem with the intermittency of wind. Sometimes when we get too much wind in the night, we have to close down a coal plant in order to take it all. We've looked at compressed air energy storage and other possibilities, and nothing works well economically for us. That's why we're looking at the possibility of automobile charging. A second problem is that eventually the utility industry will become hybridized, so that thirty or forty per cent of the utility will be going on site. The major issue to solve is to have a distribution system that can flow two ways intelligently. When you start getting a lot of on-site generation in place, that will be a major problem to solve."

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Chattanooga Area Regional Transportation Authority

By David J. Hess

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The Chattanooga Area Regional Transportation Authority (CARTA) was formed in 1973 from the purchase of a private bus company. As a regional transit authority, its board of directors is appointed by the mayor or an elected body from the member cities. CARTA has achieved national recognition for its early development of electric buses and its use of its procurement power to develop a local, electric bus manufacturer.[1]

Chattanooga's history of electric public transportation dates back to electric streetcars, which lasted from the late nineteenth century until the end of World War II. Interest in converting part of CARTA's fleet to electric vehicles grew out of two, linked problems: a downtown in need of revitalization and high levels of air pollution in the central city. Because of the city's location in a valley and its high number of manufacturers, in 1969 the city earned the dubious honor of having the country's worst particulate matter pollution. As residents and businesses left the dirty downtown area, the city responded in 1969 by passing an air pollution control ordinance. By 1972 the industries had met the targets, and the city had significantly reduced air pollution. The success of the Air Pollution Control Board led to reforms of the city government structure during the 1980s, when the city shifted to a mayor-council structure. Environmental issues emerged as a priority in the new city council, and a task force developed a riverfront master plan to reform the use of land along a twenty-two mile stretch of the river. In 1984, a foundation funded the Vision 2000 process, which created a grassroots planning process for the city. One of the outcomes of the process was the development of an electric circulator bus for the narrow and congested downtown corridor. In turn, the circulator became a key to the significant and largely successful revitalization of the downtown area and riverfront.[2]

As part of the planning processes for the downtown electric circulator, CARTA and city officials visited Santa Barbara, California, where that city's transit authority had developed a partnership with a local manufacturing firm to make electric buses for the city. CARTA then conducted a national search and decided that there was no manufacturer for the type of bus that they needed and that the city had the resources to help establish a company to do so in Chattanooga. In 1992 CARTA initiated its first purchase of electric buses, and

the local company, Advanced Vehicle Systems (AVS), got its start from making buses for CARTA.[3]

In addition to visiting Chattanooga and riding on the electric bus, which was quiet and comfortable, I interviewed Ron Sweeney, the general manager of CARTA. Sweeney has worked in public transit since 1970, when he joined the Memphis Area Transit Authority. In 1981 he joined American Transit Enterprises, a firm that manages transit systems across the country. By working for that company, he gained experience in a variety of transit systems in cities such as New Orleans; Stockton, California; Durham, North Carolina; and Jackson, Mississippi. He joined CARTA in 1995, when the Chattanooga agency was having problems with their new electric buses. The buses were being run out of the CARTA headquarters, which is located at some distance from the downtown. "The buses weren't doing well," Mr. Sweeney explained. "They had to have the power to get downtown and then get back. Little pieces of were falling off, and they weren't very reliable. So the chairman of the board, Rick Hitchcock, and the director, Tom Dugan, realized that they needed someone who could champion those buses. They said to me, 'Make them work.'"

Sweeney inaugurated major changes, both technical and organizational, that were crucial to the turn-around for the electric buses. One key technical change was to move the bus maintenance area downtown to a parking garage located next to the former train station (now a Holiday Inn) and the tourist site for the Chattanooga Choo-Choo. The buses now run on the route from the charging station and maintenance area through the downtown shopping and hotel district to the aquarium area by the riverfront. As a result, they connect tourists and downtown shoppers to hotels, sites, and businesses, and they provide a key ingredient to the city's downtown revitalization. The buses are free of charge, and they are paid for with fees from the parking garages, which CARTA constructed.

The other major change involved the organizational structure. As Sweeney recalled, "One of the big problems was that the technicians didn't want to work with the buses. The director of maintenance didn't want to have anything to do with them. They felt that they didn't know anything about them, and they were scared of the high voltage. So we taught them that the electric batteries are flooded lead-acid batteries, and they aren't any different from the batteries in your car. You just need to take the same precautions: eye cover, rubber aprons, and rubber gloves. After questioning some of the employees, I also found out that they were scared that they were going to lose their jobs. We decided to divide the maintenance department into a diesel bus division and an electric bus division, and we put a foreman over the electric bus division. At that time we only had about five or six electric buses, but as the electric fleet grew and the diesel fleet shrank, we took the diesel mechanics, retrained them, and moved them over to the electric fleet. That did wonders, because they saw that they weren't going to get fired, and instead they would be cross-trained. Now the electric buses are where everyone wants to work; the highest seniority people are with the electric buses.

"We then started looking at the battery technologies and manufacturers. We decided to stay with the flooded lead-acid even over the gell lead-acid. They

work really well for us, and we found that the design of the battery, and even the plates, can make a big difference for us. We run about 100 miles per day with each bus. The bus will go out at 6 a.m. with a fresh set of batteries in it, and it will run until about noon, then it will get a low power light. The driver will bring the bus in, and in about six or seven minutes the shop will put a new set of batteries in it, and the bus will go the rest of the day. A few years ago we calculated that by having those electric buses downtown, versus a small gasoline or diesel bus, we were saving thirty or forty thousand dollars a year in fuel costs. Today, the fuel costs have gone up much more, and the electricity costs have only gone up a marginal amount, the savings would be much greater. Even though we enjoy a low electric power rate, because of the Tennessee Valley Authority, we still do not charge the batteries during the daytime, when the peak is high. We do all of our charging at night."

Another problem that Mr. Sweeney needed to tackle was the reliability of the buses. "One barometer of reliability is the number of miles between road failures. The national average is about 3500 or 4000 miles between road failures, and here at CARTA we're enjoying 8,000 or 9,000 miles on our diesel buses, and we're at 12-15,000 on the electric buses. When I was in New Orleans, we got the electric streetcars up to 20,000 miles between a failure, and my boss wanted me to do that for the diesel buses. I told him that it's not possible, because the streetcars are much simpler. It's the same thing here: the electric buses have so few moving parts. There's no transmission, and they don't have six or eight pistons going up and down. So we finally got the reliability solved, and we worked closely with AVS to do that."

Each of the twenty-two foot electric buses costs about $180,000, in comparison with $75,000-$80,000 for a similar, small diesel bus. Over several years, the electric buses become cost competitive with diesel due to lower maintenance and fuel costs. However, the electric buses also offer other, less easily quantified benefits. As Sweeney commented, "The primary motivation is clean air and the environment." He added that the electric buses are very popular. They run every five minutes, so people know that they do not have to wait very long. "People love to get on those buses. When I first came here, we didn't have enough electrics to cover all the service, so we ran both electrics and diesel to keep the five-minute frequency. People would be standing at the bus stop, and they'd see the diesel coming, and they'd stand back away from the bus stop, let the diesel go by, and wait for the electric."

Although Sweeney and CARTA solved the problems that were plaguing the electric buses, in 2004 they faced a new problem: AVS went bankrupt. The loss of the local private-sector partner has thrown a wrench into CARTA's plan to expand its electric bus fleet. "I'm so sad that AVS went bankrupt. From a distance I saw what happened. AVS was building a good bus for a shuttle route. They saw that it was a niche market, and they weren't going to be able to make money with a niche market. They looked at what the larger cities wanted, and they decided to build large, thirty-five foot, hybrid-electric buses. AVS sold some of them on the West Coast, and they sold us ten, but they went bankrupt before we got them all. We have about five of them now. They're good buses, but they

had problems with them. They had twin turbines, and the idea was for the bus to have a small battery back, and when the electricity supply got down to about 60%, one turbine would kick on then bring it up to 90%, then shut off until it goes down to 60% again. If it got into a situation with high speeds or climbing hills, and one turbine wouldn't be enough, then the second turbine would kick on. They work, but not without problems. We tried to get them to sell them first to us, and let us be their guinea pig until they had the problems worked out. I think they'd still be here and be a viable company if they had the government as their partner. They did the research all on their own, and that's one of the things that the government should be doing. "

Until 2004 CARTA ran an Electric Vehicle Information Center located in the downtown garage and maintenance center. Although CARTA closed the center due to budget cuts and the demise of AVS, there are other, more hopeful signs of an emerging alternative fuels cluster. For example, CARTA also created the Electric Vehicle Transit Institute as a spin-off organization, which has since diversified into alternative fuels in general. In 2003 it was renamed the Advanced Transportation Technology Institute, and the organization became a founding partner in the East Tennessee Clean Fuels Coalition. There are various alternative energy projects underway, including a fuel cell project, hybrid-diesel projects, and biodiesel. Both the Knoxville and Chattanooga campuses of the University of Tennessee are providing research and expertise for the alternative energy projects, and the Tennessee Valley Authority, which provides much of the electricity to Chattanooga, has been a supportive partner of various energy and transportation initiatives. The city's Enterprise Center—which is headed by Joe Ferguson, the founder of AVS—links various organizations that can contribute to the development of Chattanooga as part of a technology corridor. One aspect of the technology corridor may be high-speed magnetic levitation rail line between Chattanooga and Atlanta.[4]

CARTA is also examining the possibility of picking up the pieces from the demise of AVS by contracting the manufacture of electric buses locally. As Sweeney noted, "We may put out a request for proposals for an entity to build the buses, and we may provide the building and management of the project. Maybe something can start again. That's what happened the first time. AVS got started when we put out a request for proposals and gave them a purchase order for twelve electric buses."

Another current problem that CARTA is attempting to solve is how to green the diesel portion of the bus fleet. As of 2005, the entire bus fleet was about 81 vehicles, of which about 34 buses were electric. The electric buses work well on the flat, downtown terrain, where they run at a low speed. However, the city also has highways and hills, and it has used the diesel buses for the longer, faster, and more challenging routes. The long-term plan is to have all electric buses on the downtown routes and large hybrids for the fixed route fleet. Sweeney explained, "Our oldest bus is a flexible bus. We have nine of those left; everything else is a clean diesel. In 1998 we bought ten with a series 50 Detroit engine, and we bought 24 more that are even cleaner. So we have 34 really clean diesels. We have a bid out to replace the older buses. If AVS hadn't gone

out of business, the new buses probably would have been hybrids with the capstone turbines. As clean as the Detroits are, the capstone turbines are a lot cleaner." Despite the setback, the long-term plan is to convert the diesel buses to diesel hybrids; the main roadblock is the cost factor.

Biodiesel is also attracting considerable interest in eastern Tennessee. For example, in 2004 CARTA's sibling transit agency, Knoxville Area Transit, was named a "clean bus leader" by the Environmental and Energy Study Institute for its use of biodiesel and other alternative fuels.[5] CARTA is also planning to start testing biodiesel in its fleet. As Sweeney explained, "We're cautious. We're going to get the B20 or 20% mixture, and we're going to run it in each type of diesel engine for a period of time. We have a good maintenance software program that lets us track problems. We don't want to put it in our whole fleet and then have a disaster."

Equity and Sustainability

Even though Chattanooga is a relatively small city, it is surrounded by mountains on three sides, and it has air quality problems similar to those of California. Consequently, air quality issues are a primary concern and driver of the greening of the bus fleet. However, CARTA has not been the target of criticism from environmental justice or environmental organizations, as has occurred with transit agencies in other cities. As Sweeney explained, "We enjoy a very good reputation for being on the cutting edge. They know how we feel about it, and they trust us to be looking at what is best for the environment, and we do." Although the low-income, African-American neighborhoods tend to be located near the downtown area, and I could see that residents from those neighborhoods were using the downtown circulator, the circulator benefits a broad spectrum of the population, including tourists using the downtown hotels and other residents doing business downtown. CARTA has not targeted low-income neighborhoods as priorities for cleaner buses, and in fact Sweeney says that doing so would be in violation of federal regulations: "Years ago transit systems would have 100 buses, and they would get twenty new ones and run them in the better part of town. The Federal Transit Administration stopped that; they don't allow transit agencies to target a certain area with a type of bus. The only exception is for a technical reason. For example, if I have a bus that has a retarder on the transmission (which saves on brake shoes), and we need to run buses up Lookout Mountain, we could earmark those buses for retarders, because there is a technical reason for doing so."

The main barrier to moving more rapidly with conversion of the bus fleet is that rising fuel costs have severely impacted the operating budget of the agency. As a result CARTA has not been able to move ahead as rapidly as it wanted to implement its plans to convert the diesel fleet and to increase the number of electric buses. One interesting and positive side-effect of the rising fuel costs is that biodiesel is becoming more competitive. "I've been watching biodiesel for a year and a half," said Sweeney. "It never was close to diesel fuel; it was always twenty to thirty cents per gallon higher. Now, it might be a few cents more or the same price, and some days it's even a few cents cheaper than diesel. That's

why were looking at it even harder right now. It can be cleaner and cheaper. Furthermore, the twenty-percent diesel is local; it's not coming from overseas."

Another way that CARTA is thinking about equity issues is using its purchasing power to start local businesses. The AVS experience is the most obvious case, and biodiesel is being manufactured in the region. Sweeney added yet another example: "We were buying bus batteries at $15,000 each from Great Britain. I started asking if there was anyone here in the U.S. who was making them. We found a company in California that makes good batteries for fork lifts. As it turned out, their batteries worked well for about 10 months, but that was all the life we could get out of them. Finally, we found a company here in Tennessee, and they made us batteries. So now we get our batteries either from this company or one in Pennsylvania."

Sweeney noted that at one point AVS had over 100 jobs, some of them were very high-tech with good salaries. Sustainability issues were a key part of the enthusiasm that CARTA and AVS had for their partnership: "They were dedicated to a cause. They were doing something to help our country, to help the environment, and to help our country's dependence on foreign oil. We were all part of it—AVS, CARTA—and it was really rolling. That's why when we get ready for new buses, we're thinking of contracting out with some local people here."

Another equity issue is that the downtown circulator tends to improve small businesses that are located along the circulator route, so the circulator can be a means not only to revive the downtown but also to help small, storefront businesses located in the downtown area. "CARTA is looking at having another garage on the north shore (on the other side of the river) and expanding the shuttle over there. The merchants and the residents on the other side of the river would love to have the shuttle come over there. Everyone wants the shuttle, because businesses prosper along the shuttle. The businesses south of the Aquarium (along the river) are trying to get the shuttle to run that way. We just need to get the funds."

Policy Issues and Recommendations

One key lesson from Sweeney's experience involved organizational change: "For any agency that is getting into alternative fuel, I recommend that they spend time with the people who are handling the vehicles. Make sure that they understand that you need them to buy in and that they're going to be part of the whole change. They need to know that you're not going to be cutting jobs. That was a very strong problem here."

Sweeney also thinks that the electric buses are a viable option for many cities for specific types of uses: "The all-electric buses are working in Chattanooga. We've got over four million miles that we've covered since 1992, and we've carried over a million people a year on them. If you have a service that is low-speed and level, I don't recommend the hybrid. I recommend an all-electric vehicle. Keep it simple, with flooded lead-acid batteries and a battery change-out."

The electric buses can also provide a substantial reduction in air pollution in crowded, downtown areas. "Valerie Powell, who ran the Electric Vehicle

Information Center, did a study with the Tennessee Valley Authority to see what the impact of the buses was. We figured a comparison rate of two people per year, so we were keeping 500,000 cars off the street, and we included the pollution generated from the energy we use. They showed that we reduced tons of particulate matter and other emissions."

Another lesson learned is that the downtown electric buses can be offered as a free service when connected to a parking garage. "We put the parking garages on the arteries that come into downtown. We put the signage up so that we could catch the cars as they come into down, and put them in the garage. We make our money when they park in the garage, and we let them ride in the shuttle for free. So the way we may expand to the north shore is by having another garage over there."

A more general policy issue is that the government could help the partnerships that local transit agencies such as Santa Barbara and Chattanooga have formed with bus manufacturers. Sweeney thinks that there is a missed opportunity here for government support: "I know the government wants us to find ways to reduce our dependence on foreign oil, but when they have a company like AVS, or E-Bus out on the West Coast, they need to help those companies with their research and development. If that had happened here, AVS would probably still be in business. We would have an all-electric downtown, and our diesel fleet would have been probably fifty percent hybrid right now. It tore my heart out when that company fell apart."

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Interview by David Hess, April 11, 2005.

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Sacramento Municipal Utility District

By David J. 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 intermittentcy. 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 'Greenergy' 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 Greenergy program. Our projections on growth show that by 2006 we should be able to get 2% of our supply from the Greenergy 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 Greenergy, we will purchase extra green electrictiy." 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 efficency 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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San Francisco's Muni

By David J. Hess

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In many ways the city of San Francisco has been a leader in the conversion to clean energy for its vehicles. By early 2005 the city claimed to have over 600 alternative fuel vehicles in its city fleet, or about 15% of its entire fleet. The alternative fuels and power systems included natural gas, hybrid electric, electric, and even two hydrogen fuel cell vehicles. A city ordinance passed in 1999 mandated that all new passenger vehicles and light trucks owned by the city had to be ultra-low or zero emissions. Likewise, the city's transit agency, the San Francisco Municipal Railway (MUNI), is said to be over half zero-emission vehicles, mostly due to electric streetcars and trolley buses. Notwithstanding the good record overall, the issue of old diesel buses became quite contentious during the early 2000s.[1]

Pockets of the San Francisco Bay Area have a serious problem with smog, and although residents of the city like to think their air is clean because coastal winds blow the pollution down over to the East or South Bay, the City and County of San Francisco has ranked poorly on other air quality measures. In a 2004 study by the American Lung Association the county received an "F" grade on particle pollution. Studies have linked particle air pollution with increased risk for lung and cardiovascular diseases, and the major sources of particle air pollution are power plants, wood burning, and diesel emissions. A generally cited statistic is that for air pollution caused by motor vehicles, diesel emissions consist of about two-thirds of all particulate emissions and about a quarter of all nitrous oxide (NOx) emissions. Diesel emissions also contain about forty carcinogens as recognized by the State of California and contribute 70% of the toxic air contaminants for cancer in California. Increasingly, public health studies have linked diesel emissions from buses and trucks to lung disease, especially asthma in children, as well as a variety of other diseases, including cancer, pneumonia, and heart disease. Although aggregate figures suggest that trucks may generate the bulk of diesel-related pollution, individuals experience variable rates of exposure, and residents living near diesel bus lines or using diesel buses frequently would have cause for concern.[2]

Given the concern with air quality in the Bay Area, the high level of environmental consciousness, the city's good record overall on environmental issues, and the general trend toward the greening of bus fleets across the country, one might expect that MUNI would be a leader in the conversion of its diesel buses, which comprise about half of its fleet. In many ways the

expectation is born out, and MUNI has a plan to shift its entire transit fleet to zero-emissions electric vehicles by 2020. However, MUNI also had a substantial number of relatively old, very polluting diesel buses, including some buses built before 1991, the year bus manufacturers made significant changes to reduce emissions. A controversy erupted when various health and environmental organizations called upon MUNI to “Dump Diesel” by converting to compressed natural gas (CNG). The differing perspectives of the environmental coalition and MUNI on the controversy can be of general interest to students and policymakers who are looking at community involvement in decision-making over the greening of transit fleets.

This case study is based on various sources of information, and it was more difficult to write than others because of the divergent perspectives. First, I tried to gain an interview with representatives of MUNI on the conversion of their fleet, but the representative I contacted did not return repeated phone calls and emails prior to the trip to California in March 2005. I was able to obtain an interview with Linda Weiner, who is the Director of Communications and Air Quality Advocacy of the American Lung Association of San Francisco and San Mateo Counties and the Vice President of the American Social Marketing Association. Drawing on her many years of experience in the civil rights movement, anti-Viet Nam War movement, and as the first VISTA volunteer in Pennsylvania, as well as her work in public health communications at Stanford University and other organizations, Weiner was able to play a leadership role in the coalition to get MUNI to convert its diesel fleet. The coalition included the chapter of the American Lung Association, the San Francisco-based environmental foundation Our Children’s Earth, the Union of Concerned Scientists, the Sierra Club, and the Natural Resources Defense Council, with Jon Goligner serving as the spokesperson for the Dump Diesel campaign.

I also interviewed Tom Ammiano, who is currently a supervisor (the equivalent of city council member) in the city of San Francisco, where he has served since 1994 and has also served as president of the board of supervisors. Ammiano worked closely with the coalition and has worked with MUNI over the years. He provided some additional insight into the controversy and especially into the issues of equity and sustainability.

After returning from my trip, I received an email from a MUNI spokesperson suggesting that I contact Joe Speaks, who is the Special Projects Coordinator of the Senior Administrative Analysis Department. Speaks is an environmentalist and has worked for the greening of the fleet within MUNI. Although he joined MUNI after the controversy had been underway for some time, he subsequently worked as a liaison between the environmentalist coalition and the transit agency. As a result of contact with him, the case study was revised to have two sections. The perspectives were different enough that it made sense to present them in two different sections. Together they provide some instructive background on how transit agencies and community groups can come into conflict, and also how technology design plays a role in the conflicts and in their resolution.

An Advocate's Perspective

According to Ms. Weiner, the controversy began when MUNI was considering a purchase of new buses: "The bus contract was coming up for a purchase, and MUNI made clear that they were interested in purchasing diesel buses. Even though we were technology-neutral, our research indicated that CNG was the cleanest technology for transit buses at the time, used in many other cities in California, the United States, and internationally. A CNG bus came to San Francisco, and even though MUNI kept saying that it couldn't go up the hills (because of a heavier fuel load), it did just fine. Nonetheless, we told MUNI that even if they weren't satisfied with the uphill drive, there were flat routes where the buses could be used. They were supposed to implement a pilot test for CNG, but it was delayed for four years."

It became clear to the coalition that MUNI did not want to use CNG. In a press statement, MUNI spokeswoman Maggie Lynch stated that the CNG buses break down more often than diesel buses. However, according to the environmentalist coalition, that was a problem with new buses in general, and problems with breakdowns could also be due to lack of appropriate training for mechanics. The environmentalists also claimed that the drivers and mechanics were resistant to change. Cost was also a factor in MUNI's resistance to purchasing CNG buses, and the agency was facing budget problems. Furthermore, during the late 1990s and early 2000s the agency was also facing criticism from other corners. For example, in 1999 voters approved Proposition E, which reorganized MUNI under the new Metropolitan Transit Agency. The new agency put MUNI and the city's Department of Parking and Transit under one roof, and it created an independent transit agency, with the board of directors appointed by the mayor. The reform gave more room to the director of MUNI to hire middle managers outside civil service, but it also allowed the supervising board to institute performance standards to assess the agency. Another goal of the reform was to stabilize the budget for the agency. However, MUNI's budget problems continued up to the time this study was written. In March 2005 MUNI proposed raising the fare by 25 cents, an increase that followed on a similar 25 cent rate hike a year earlier. The proposed rate hike was generating a new wave of controversy.[3]

Eventually the coalition of environmental organizations and the Board of Supervisors, led by Supervisor Ammiano, worked out an 11-point compromise with MUNI. One issue was to have a more staggered procurement process. Ammiano noted that a major problem with MUNI was its antiquated procurement system: "They wait for years until the stock is really in the toilet, then they order everything at once. Bus ordering is really difficult, because there are people waiting in line." The agreement reached between MUNI and the Supervisors/environmental coalition was that instead of buying 200-300 new diesel buses, MUNI would buy 100 new diesel buses immediately and pilot the CNG buses, then later buy either CNG buses or newer diesel buses with particulate matter traps. After some delays, MUNI finally did pilot the CNG buses, but the agency concluded that there was little difference in emissions

between the CNG buses and the new diesel buses. The coalition thought that MUNI's methodology of evaluation was flawed. "In the meantime," Weiner continued, "the local air district and the state had off-set money available for transit districts to purchase clean fueled buses. In addition, the natural gas companies came to hearings and said that they would build an infrastructure if there was a large enough contract. But MUNI missed every deadline. It was clear that they did not want to do CNG. So we went to the Board of Supervisors, and they passed a resolution that MUNI would buy no more diesel buses."

Meanwhile, MUNI had not yet retired the older, pre-1991 buses that were quite dirty and of great concern from a health and environmental perspective. The environmental coalition could not get a clear answer from MUNI about how many of the older diesel buses were in service. As Weiner continued, "So with a very small grant for the Dump Diesel campaign, Jon Golinger (the campaign's coordinator) did a small study: he got up every morning at 5 o'clock, went to the bus yard, counted the buses, and found out that one third of their fleet was old diesel. He developed little fast pass cards that said, 'Toxic pass: this bus is dangerous to your health.' On the back it had the statistics on asthma, lung cancer, etc. He and the people at Our Children's Earth took photos of the sooty buses and made posters the size of a Buick. He then contacted an advertising agency to have the posters placed on bus shelters all around the city, but the head of the bus shelters alerted the director of MUNI, who said no." When MUNI refused to let the coalition put up the posters in paid advertising space, the coalition cried foul and pointed to the first amendment. The story soon appeared in the papers and drew more attention to the problem of the old diesel buses.

The next step was a voter ballot initiative, Proposition I of 2004, which required MUNI to replace all of its pre-1991 diesel buses with cleaner buses. The only opposition to the campaign came from Rescue MUNI (a small organization of MUNI supporters), the Chamber of Commerce, and the *San Francisco Chronicle*. During the kick-off new conference, in order to visualize the pollution from diesel, two members of the Board of Supervisors emptied a three-gallon bucket of soot, which is approximately the amount of particulate matter that one old diesel bus emits in one day. The San Francisco Medical Society also supported the initiative as a public health issue.[4]

Since the passage of the proposition, the controversy has continued. The California Air Resources Board, which sets air standards for the state, mandated that all cities phase out high polluting old diesel buses by 2006, and it approved new hybrid-electric diesel buses as meeting the new standards. At the time the original campaign began, in 1999-2000, CNG was a viable clean energy alternative for buses. However, during the following half decade improvements in diesel technology—including particulate matter traps, ultra-low sulfur fuel, and hybrid engine designs—had solved many of the emissions issues with diesel.

In September 2004 MUNI announced that it would purchase two lots of 56 hybrid-electric diesel buses to replace its old diesel buses, with delivery of most of the buses planned for 2006 and 2007. The agency also announced a plan to have a completely zero emissions transit system by 2020, based on an all electric fleet. The choice of hybrid-electric diesel buses was acceptable to the

environmental and health coalition because the new buses have very low emissions, so to some extent the new technology has allowed a resolution of the conflict.

However, the coalition continued to express reservations about the time schedule and the continued delays. In February 2005 the issue was again in the news, when MUNI failed to meet the first of three deadlines for phasing out the old buses. Furthermore, MUNI had agreed to install particulate matter traps on its post-1991 buses, but there were delays in installing the traps as well. Weiner noted that the traps were in great demand and the company was not able to keep up with the demand at the time. "It's now three years past when we made the 11-point agreement, and only half the buses have the traps on them."[5]

A MUNI Perspective

NOTE: Ms. Weiner offered some comments on Mr. Speaks' version, and Mr. Speaks suggested that the final draft be left in a form that showed her comments. Her comments appear in italics.

According to Mr. Speaks, the controversy resulted from misunderstandings on both sides, even though they shared a common goal of reducing emissions from diesel buses: "The MUNI fleet engineering staff was asked by management to replace the oldest and most polluting diesel buses as quickly as possible and within realistic technological and financial constraints. Advocates of CNG technology did not share MUNI's engineering opinion that CNG was an inferior bus technology, nor did they understand the financial and operational obstacles that would need to be overcome if a CNG program were to be attempted." *(Comment from Ms. Weiner: We understood well; we just disagreed, especially since many other cities had managed to overcome a similar situation. The discussions from 2000 to 2002 occurred before Joe was on board.)*

Speaks went on to ask: "Should MUNI staff have done a better job of keeping community stakeholders better informed so that they would have understood why we thought we were making the best choices for clean air? San Francisco has a wonderful tradition of strong community involvement and a willingness to try new things: MUNI shouldn't have expected that advocates would, or should, have just sat back and let staff maintain what appeared to be the status quo of more diesel buses.

"In the end dirty buses continued to be on the streets when both sides thought they were moving to get them off as fast as possible. What they couldn't see is that they were blocking each other from doing anything—that's what I was able to see from my unique vantage point as someone standing 'on both sides.'" *(Comment from Weiner: Joe always, and understandably, represented MUNI's position. That's what he is paid to do, that's the way he presented himself, and that's the way he was perceived. In his personal life, he does walk the talk: he rides a bicycle and takes public transit.)*

From his perspective, one of the key problems in the controversy was a lack of technical expertise from the environmental coalition, but MUNI also failed

to provide the education and communication to bridge the gap in perceptions. As Speaks explained, "The environmental community, in this case, lacked the technical expertise and the dedicated resources to really understand the transit agency's operating realities, funding requirements, and technology. Conversely, MUNI was not proactive enough in providing staff to help the advocates grow to understand these realities. This disconnect continued to erode understanding and trust and ended up costing the citizens a lot of time, money, and missed opportunities to realize emission gains." *(Comment from Weiner: This is rather puzzling, to say the least. We had a number of technical experts in our group. Aside from the experts from PG&E—which we understand was somewhat of a conflict of interest since they sold CNG—we had a diesel techhie from NRDC and some folks from the Dept. of the Environment and the Public Health Division of the City, who were not allowed to take a political position, but did offer technical advice. Again, I believe this was before Joe was there.)*

From a MUNI perspective, the environmental coalition's focus on CNG led to the consequence of blocking MUNI from purchasing cleaner diesel buses that would have resulted in lower emissions. As Speaks explained, "MUNI had prior organizational and management problems that stalled fleet replacement plans in the early 1990s and resulted in an aging fleet. *(Comment from Weiner: Agreed, MUNI has had a history of mismanagement, which contributed to the aging fleet.)* Upon the arrival of a new management team, immediate steps were taken to initiate bus turnover and by new clean-diesel buses before the California Air Resources Board deadlines would no longer allow the purchase of these proven, and much-improved buses. While MUNI was successful in replacing most of the buses with newer, 'clean,' diesel buses, the final purchases were blocked by a coalition of CNG advocates including both environmental groups and Pacific Gas and Electric, the natural gas fuel provider. MUNI had minimal experience with CNG, but lots of technical awareness and contact with other jurisdictions running CNG. While the evidence was flimsy at the time *(Comment from Weiner: The evidence was 'not flimsy'—there was much information at the time to suggest CNG was the best alternative),* MUNI's resolve to resist a conversion to CNG was strong. History has proven MUNI's staff decision to be right: CNG has fallen out of favor and is being abandoned even by transit agencies that have already sunk huge investments into CNG infrastructure." *(Comment from Weiner: It's true that some problems have developed with CNG, and some agencies have opted out—but others are still using the technology with little problem. The scientist from the National Resources Defense Council was the techhie on the group and knows much more than I about CNG/diesel transit. I would also add that the new diesel hybrids—as with any new technology—are still working out its problems. It has been noted—I think in Seattle—that, even though the hybrids were touted to be very fuel efficient there is little, if any, fuel efficiency gain, although they are good at reducing emissions.)*

He also notes that the offers from the private sector to cost-share by providing CNG infrastructure for "free" had some strings attached: "We met with companies claiming to provide the infrastructure for 'free.' This was not a real offer. In Washington, D.C., where the transit agency that choose to convert to

CNG, the agency pursued these 'free' infrastructure offers but chose instead to pay for the infrastructure themselves because the contract terms of the 'free' deals were so bad in the long run. Note that Washington abandoned its CNG program just a few years after spending millions of dollars on infrastructure due to poor performance, higher costs, and minimal emissions gains."

According to Speaks, MUNI did not delay its tests of CNG, and it conducted the tests fairly: (*Comment from Weiner: Joe is talking about the CNG test that took place a few years ago, and that was timely. What we are referring to—which was before his time—was the fact that in 1999 a pilot study for CNG was approved, and it did not take place until 2003; that is the time lag. MUNI publicly admitted this at a hearing, and has no explanation for the delay.)* "There was no delay, though the test took time. It's actually strange that we had to do first-hand tests to verify facts that were already well-documented in the industry. We tried to do good science under the circumstances. Then when we reached the same conclusions as our previous assertions that CNG had problems, we were criticized for 'cooking the books' and being resistant to change." *(Comment from Weiner: I don't believe we ever said they "cooked the books." We just disagreed with their methodology.)*

From MUNI's perspective, the Board of Supervisors' decision to block the purchase of new diesel buses resulted in higher levels of emissions for the city, because the effect was that the old, dirty buses will remain on the streets for as much as five years longer than in the original replacement plan: "Had the original bus replacement plan not been blocked at the Board of Supervisors, all old buses would have been retired in mid 2002. The overall fleet particulate matter numbers would have been reduced by 95% per bus, and as much as 98% when emissions reduction devices were installed. Because the replacement project was blocked, with heavy support from CNG proponents, fleet emissions remain much higher than they could have been." *(Comment from Weiner: Fifty percent of these PM traps have never been installed, primarily because of backorders by the manufacturer. We would prefer to be referred to as alternative fuel proponents; that's how we began the discussion with the research pointing us to CNG.)*"

From the perspective of the transit agency, the shift toward CNG was a high risk option, because it would have required a heavy investment in infrastructure and a shift toward an unproven technology: "The advocates had no idea of the risks involved in pursuing CNG and no way to approach the technology and business issues. Sure, they had a clear mind of the fact that they wanted CNG buses (right or wrong), but they neglected to consider what technology would be available if CNG proved unworkable. The fact is there was no other technology that could serve as a backup. We were at a strange time in history where transit bus options were either: 1) get very clean and reliable diesel buses very quickly and clean your fleet up by 98% but still be using diesel, which does have a lot of toxic emissions (*Comment from Weiner: As with any new bus purchases, there are always kinks to work out, including issues related to reliability, so one cannot say categorically that there would have been reliable diesel buses, and note the reference to toxic emissions, which is the key point)*; 2) fly in the face of the emerging industry consensus that CNG has some real

operational problems and has no clear consensus from air quality regulators that it improves the pollution problem *(Comment from Weiner: That is not true. When the California Air Resources Board (CARB) gave transit districts a choice of fuel paths a number of years ago, CNG was uppermost in their minds, with documentation to prove it);* or 3) just wait and leave the oldest, most polluting diesel buses on the road, and hope that hybrid buses, which were only experimental at the time, would develop fast enough to become a realistic alternative.

"MUNI management carefully weighed these alternatives and chose option 1, looking forward to hybrid buses as a future 'backup plan.' MUNI even hedged its bets by pushing for the development of a possible LNG (liquified natural gas) option that one major manufacturer had plans to develop. We chose a course with great emissions gains, and very little risk—a good choice for the public and a great management decision. CNG advocates chose to place all their money on CNG and left MUNI with no backup plan.

"CNG advocates used an environmental message to prevail in the political arena. But without funding or any belief that CNG could be effective, there was no bus technology that could be purchased. *(Comment from Weiner: Again, at the time we proposed CNG, there was plenty of documentation and experience to show CNG was effective. For example, New Delhi, India, changed their entire bus system from diesel to CNG, and air pollution improved dramatically with, as far as I know, few problems in implementation.)* The oldest, dirtiest buses remained on the street while MUNI staff turned its attention to hybrids, which were still several years away from commercial viability. From a local environmental perspective, the communication breakdown between advocates and MUNI proved very harmful. It pushed particulate matter emissions into the air that both sides wanted to get rid of. From a local perspective, it has forced MUNI to spend countless staff hours and large amounts of money to put us on the bleeding edge of hybrid bus technology. MUNI is, whether we like it or not, now leading the country in our pursuit of hybrid buses because of our extreme need to remove our oldest buses from the fleet. For many of the national environmental groups and national corporations that pushed this agenda, perhaps it is a great benefit to have a major transit property like San Francisco MUNI spending huge amounts of dollars and putting large amounts of staff time to break new ground in emerging technology. If that was the objective of these national organizations, they have succeeded—hybrids may sweep the country a little faster because of our push. For the local citizens, it has been costly*." (Comment from Weiner: And one could say the same about the fact that if they had purchased alternative fuel buses for some of their major routes, we wouldn't be in the position we are today. I think we need to stop beating this dead horse.)*

Speaks sees both the environmentalists and MUNI as having made some mistakes. From his perspective, the environmentalists were focused on health risks and air quality, but they were slow to recognize the financial and technical risks of CNG. *(Comment from Weiner: We understood the financial and technical issues, but we could not understand why MUNI could not do what many other transit districts had done.)* According to Speaks, they even opposed hybrid

diesel until recently: “They were against this for over a year because it is still diesel-based technology at this time. They have only dropped their opposition to hybrid technology as CNG has continued to be abandoned throughout the country and the push toward CNG has waned.” *(Comment from Weiner: We abandoned any opposition, not because we were so wedded to CNG, but because our goal was to reduce emissions, and after a year or so, it has been documented that diesel hybrids do indeed do a good job of reducing emissions.)* However, MUNI also made mistakes, such as the decision not to let the posters be aired: “It just looked bad and bred more ill-will between advocates and management.”

He believes that positive steps have now been taken to solve the problems. First, communication is better with the environmental coalition: “I’m proud to tell you that outside advocates now understand how to read our complex spreadsheets and have a lot more trust in how we manage our bus fleet to California Air Resources Board, Federal Transit Administration, and other rules and standards*. (Comment from Weiner: This is a bit insulting. MUNI continually—over the past five years—gave us conflicting graphs and charts, which changed from one meeting to the next, and the explanations were difficult to understand, both from our part, and from the explanations themselves.)* Second, MUNI now has in place a plan to convert its entire fleet to electric buses by 2020, making it the first zero emissions transit agency in the country *(Comment from Weiner: This would indeed be exciting news, except for the fact that no one has any idea if these buses will be available by then. We were promised such buses last year, but the manufacturer bailed.)* Speaks adds, “The plan would have been impossible with a fossil fuel-based CNG strategy.” The plan will also reduce particulate matter emissions—due to new buses and emissions traps—by 2007 to a level that is 98% less than the level in 1997. “I’m very happy that MUNI is on the right track now. It’s interesting that the advocates are coming to support MUNI’s long term fleet management plan including our procurement of hybrid buses. It has taken a lot to bridge that gap and come to a common understanding.”6 (*Comment from Weiner: We’ve come to support their plan to buy diesel hybrids, and for the most part, the rest of their plan, because the diesel hybrids have very low emissions and because MUNI has to have a long term plan to conform with CARB regulations. I am glad that technology presented us the hybrid option, an option which works for all parties*.)

Equity and Sustainability

Because MUNI, like other public transit agencies, has a tight budget, it was important to position the coalition so that environmental issues and ridership access were not set up as a trade-off. During the Proposition I campaign, the coalition shifted its name from “Dump Diesel” to “Coalition for a Clean and Reliable MUNI.” The coalition also made known the availability of matching funds for transit agencies that were converting to cleaner fuels.

A second way in which the sustainability and environmental justice issues intersected involved the low-income community of Bayview/Hunters Point. In the United States, the prevalence of active asthma doubled from 1980 to 1992, and continued to rise during the 1990s. Asthma rates are higher among African Americans, low-income families, and people living in large cities. In a survey of the low-income neighborhood of Bayview/Hunters Point, the prevalence of childhood asthma was 15%, compared with about 6% nationally, and 10% for all the people in the neighborhood, compared with 7% for the state of California. The Bayview/Hunters' Point rates were the highest in the city of San Francisco.[6]

As Weiner commented, "Five years ago, MUNI had five diesel bus routes in Bayview/Hunters Point, which already has a huge amount of industrial pollution. They have a power plant, manufacturing, cement, and bus yards. So we were successful at that time in getting MUNI to substitute those buses with cleaner buses." One of the outcomes of the coalition was to form the Bay Area Clean Air Task Force, which has obtained funding from the San Francisco Foundation. The group—staffed by Ms. Weiner and comprised of over twenty-five environmental, public health, and transportation organizations—works proactively to shape regional clean air policy and to highlight environmental justice issues.

Supervisor Ammiano noted that a change in districting also contributed to the visibility of the environmental justice dimension: "We now have district elections, which means that every supervisor represents a district. When you have a person accountable to the district, some of the things that got lost in city-wide elections then become predominant. This one district, which is very underserved and heavily African-American, has the highest rate of cancer in the city. Their supervisor has become active on that issue and has communicated it to the rest of the supervisors. It's been good to have a supervisor who represents that district and works with the other supervisors."

Policy Issues and Recommendations

The case study of the conversion of the MUNI fleet suggests that some transit agencies may resist conversion, especially to fuels other than diesel. One of the factors behind the resistance was the unfamiliarity with fuels and machines other than diesel. However, the emergent hybrid diesel technologies are also seen as a bridge between fossil fuels and hydrogen-powered vehicles. Where there is resistance, constant vigilance from community-based health and environmental groups may be needed to make sure that the transit agency sets clear conversion goals and then follows through in a timely way. The combination of diesel-hybrid technologies with low-sulfur diesel and effective emissions traps appears to offer an alternative that is more familiar to transit agencies and their workers, and as a result hybrid-diesel may encounter less resistance from transit agencies but still answer environmental and health concerns. The redesigned diesel systems may also offer opportunities for the use of biodiesel and development of local energy-agricultural tie-ins. However, for a number of environmental groups, the jury is still out on biodiesel. It works

best at 100%, and most buses use between one and twenty percent, and even at 100%, according to Weiner, the NOx is higher when using biodiesel.

A second policy issue is the cost of conversion and the dilemmas that some agencies will face when they are grappling with budget deficits. To some extent various matching funds will offset the additional costs of clean fuel vehicles, but the matching funds will not cover the entire cost. As a result, it is important to help the agency develop new sources of funding to clear up deficits and make new investments possible. In San Francisco, one of the more creative proposals currently under discussion is to increase MUNI's revenues by charging a toll on traffic entering the downtown area. The proposal would also alleviate congestion by raising the cost of driving to work downtown, and as a result it would increase the relative attractiveness of public transit for commuting. Such a development is facilitated by the new organizational structure of the Metropolitan Transit Authority, which includes the transit system and parking and traffic management under one supervising board.[8]

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Permissions and restrictions:

San Francisco Electric Power

By David J. Hess

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San Francisco's energy is provided by the investor-owned utility Pacific Gas and Electric (PG&E). The energy crisis of 2000 caused rolling blackouts in the Bay Area and other parts of California, led to huge ratepayer increases, and resulted in a taxpayer-funded bail-out of the investor-owned utilities. As a result, consumers were angry and very open to different plans to take back control over their electricity. In California some cities are controlled by publicly owned municipal utility districts, and a fierce battle erupted in San Francisco over plans to municipalize the city's electricity. In November, 2001, San Franciscans voted on two, similar propositions: F, to create a San Francisco Municipal Water and Power Agency, and I, to create a San Francisco-Brisbane Municipal Utility District. Either proposition would have created local ownership of transmission (poles and wires), distribution, and some generation.

Neither proposition won, but Proposition F lost by only 500 votes, even after PG&E spent about $1.2 million, many magnitudes above that of the supporters, to sink the measure. In November, 2002, the coalition tried again with Proposition D, which would have created municipalized public power and closed the old power plant in Bayview Hunters Point. The low-income neighborhood had significant toxic risks and the highest rates of cancer and asthma in the city. However, the utility spent $2.1 million in comparison with $50,000 spent by the coalition of supporters, and the proposition lost, this time with only 41% of the vote.[1]

Two other measures on the November, 2001, ballot did pass. Proposition B, which had a 73% positive vote, authorized a $100 million revenue bond for the city to construct renewable energy generation and conservation technologies on city-owned property. For example, solar panels were planned for rooftops of city-owned buildings, and wind turbines were planned for city-owned property in other counties. The bond authority provided for about 40MW of capacity in the new technologies out of the city's load of 160 MW. Proposition H, which won with 55% of the vote, changed the city's charter to give it the authority to issue revenue bonds for renewable energy and conservation, rather than require that the city seek approval from the voters each time it wants to issue a bond for green energy.[2]

Proposition H was sponsored by Supervisor Tom Ammiano and written by Paul Fenn as part of his broader strategy to bring “community choice” to San Francisco. At the time of the interview, Ammiano was a supervisor (the equivalent of city council member) in the city of San Francisco, where he has served since 1994 and has also served as president of the board of supervisors. Fenn has been the leader in state level legislation to develop community choice aggregation as an option for cities in the era of electricity supply deregulation. In 1993, while serving as the Director of the Massachusetts Senate Committee on Energy, he wrote the first community choice law, which was passed in 1996. He also worked on similar laws that were passed in Ohio in 1999 and New Jersey in 2003. After propositions B and H passed, Fenn proposed in 2002 that the city fold the 10MW of solar generation in Proposition B into a larger, 60MW solar works project under Proposition H, which could be combined with community choice aggregation. I spoke interviewed both Supervisor Ammiano and Paul Fenn about the efforts to transform electricity in San Francisco.

An alternative to municipalization, community choice allows cities or other local units to aggregate their ratepayers into a single block and then bid for electricity provision on a competitive basis. Unlike public power, community choice does not require that cities step into a management role, nor does it require them to take over transmission infrastructure. Instead, the city acts as a broker for all the ratepayers in its jurisdiction. Unlike green pricing schemes, which allow ratepayers to opt in to an alternative electricity provider, usually for a premium, community choice operates with an “opt out” structure. In other words, ratepayers are given a window of opportunity to choose not to join the aggregation, and once the aggregation has gone into effect they cannot leave without paying a penalty. The aggregation of customers places new power in the hands of city governments, or coalitions of governments and small public utilities, to win lower rates and cleaner energy for their customers.

As Supervisor Ammiano put it, “Yes, we should have public power, but after spending two draining losses at the ballot, one by 500 votes, I think people wanted to regroup and rethink before we go to the ballot again, because we’re always going to be outspent. Basically we needed interpreters so different people from different class backgrounds could understand what we were talking about. The environmental justice piece could have been stronger the first time around. In the second campaign, we thought, ‘We got so close last time; we’re going to really do it this time,’ but it was an even worse defeat. So one of the things suggested was community aggregation, which I had been working on. It’s not so much either or, as much as a step towards. Community aggregation does establish a certain amount of local control that does not exist now, and it could have an effect on rates and improve service. It could also be a launching pad toward public power. So aggregation is a good thing, and PG&E is pretending that it’s not so bad and that they’re not going to interfere, but they’re nervous about it. Unfortunately it takes a little education to let people know what it is, because it is a little complicated, but I am glad that we are on that path.

“Community choice is more internal, and it’s more deliberative. It doesn’t take, like the Sacramento Municipal Utility District, five people to be elected.

Whenever you have an election, you have your constituencies. So this way it is a little cleaner, but it's a little more Byzantine, because of regulations. We have to deal with the California Public Utilities Commission, which lately has been very unpopulist in terms of its bias toward the utility companies. However, as we're doing this, we're educating people and we're also getting a handle on what public power is."

Fenn had been working some time at the state level in California, and he wrote the state legislature's community choice law. In 2002 the law, which was sponsored by San Francisco Assemblywoman Carole Midgen, passed, so the door was opened to community choice in the state. In January 2004 the California Public Utilities Commission adopted a procurement framework that allowed community choice to go into effect, and in May of that year the San Francisco Board of Supervisors issued its "declaration of energy independence," which was a vote to enact community choice for San Francisco. It directed the San Francisco Public Utilities Commission to develop a plan for community choice aggregation. According to Fenn, implementation of the community choice plan could occur as early as 2006.

As a former historian, Fenn gave a broader historical context for public power and community choice. "Generally speaking, we are not in an era of increased government activism. We are in an era of privatization, roll-backs, reduction of expenses, and deunionization: that's the de rigueur of American local politics right now. So I would never put hope in public power as a political movement. However, you do have 90-plus percentile of the public supporting increased funding for renewable energy, a big buy-in on climate change among the public, recognition that it is caused by humans, and proof that electricity is the single largest cause of the problem. So from my point of view that's where the stars line up and you have the opportunity to do something about it politically. In the United States right now, city governments are the leaders in dealing with climate change. States are just beginning to do something about it, but cities have been doing it for ten years. So you have something like five hundred-plus cities in America that have signed on to climate reduction targets, and that's a significant fact. They have no way to meet those targets through conventional means, and they know that."

In addition to political feasibility, another advantage of community choice over public power is that municipalization can saddle cities with huge debts that create an incentive for them to maintain electricity sales in order to generate revenue. As Fenn explained, "If you look at most utilities, whether public or private, their main issue is debt service. They are debt managing entities, and debt managing entities see to it that their revenue streams are not interrupted, because if they are interrupted, they have debt problems. Their credit ratings drop and their cost of capital increases. If you own infrastructure and debt associated with infrastructure that depends upon sales and through-puts of power, then institutionally under the sustainability model over the long term you are going to oppose reductions in through-puts. In fact, I would challenge you to find any statistical evidence that public power agencies are any cleaner than investor-owned utilities. I'm a proponent of public power, but I don't have any

illusions about that. I'm very aware of the fact that there are leaders, and power is cheaper because it is nonprofit, but if you look across the board, public power agencies are not cleaner. It's very disappointing, but we should not ignore the fact that they are not. Over the course of working on this for fifteen years, my conclusion is the reason that they're not is that they own debt, and their debt is in the generation, distribution, and transmission of fuel contracts, so that they need to sell energy to continue."

Fenn's primary goal is reducing emissions that cause global warming and health risks, and as a result he views community choice as a mechanism for funding large-scale public works around renewable energy generation and conservation. In the earlier cases in Massachusetts and Ohio, community choice was not coupled with bond authority and construction requirements. Even so, significant advances toward Kyoto compliance were achieved, in effect as a side effect of the competitive bidding process that was aimed at securing rate reductions for customers. For example, the community aggregator NOPEC (the Northern Ohio Public Energy Council) "had no environmental goals at all. It was not seeking clean power at all. So they had their request for proposals, looking for cheaper power, and Green Mountain came in and underbid the utility price. They basically offered 3-5% in the energy component of the bill below the utility. It was 98% natural gas and 2-3% renewables, but they were getting coal and nuclear before that. So they got a 33% reduction in their greenhouse gas emissions with lower rates."

As Fenn worked on community choice in different states, he learned that community choice needed to be coupled with the bond authority of local governments, such as that granted by Proposition H to the city of San Francisco. Coupling community choice with bond authority allows governments to link aggregated procurement bids with requirements to build renewable energy generation and conservation projects at a significant scale. His plan for San Francisco is as follows: "The public works project that is necessary for San Francisco is a billion dollars in capital. It will take a third of the city off grid and it will cause Kyoto compliance. The H bond is going to fund a billion dollar contract. It will be built over a three-year period and it will be embedded in a $4 billion power purchase agreement, which will be paid in bonds. It will be the largest power conversion in the history of the world. It will be in the city. Community choice is used with the H bond so that you have a bidding requirement with the companies that come in that will bid rates against PG&E's rates. The company will have a portfolio requirement, which is not merely buy 10% of this and 40% percent of that. It's a build requirement. Embedded in the power purchase agreement is a requirement to design, build, operate, and maintain a capital project. So they have to bid against a commodity tariff and achieve within their bid rates, which are fixed and cannot be increased, a large capital project. Within the capital project is included 360MW of capacity and load reductions, and that breaks down as a 150 MW wind farm outside the city (probably on Hetch-Hetchy property), 107 MW of conservation and efficiency load reductions, and 104 MW of distributed generation. The distributed generation will include a minimum of 31 MW of photovoltaic installations (200 in

larger KW installations of wharehouse scale) and 73 MW of other distributed generation (5-15MW scale, renewable or hydrogen scrubbed natural gas). That's out of a city that consumes between 650MW and 850MW at any time. So one entity will sign a contract with the Board of Supervisors, and the contract will be enforced by the city attorney." The exact details of the construction are left up to the electricity provider.

To make the construction effective, the city needs access to load data, and the issue became another battle that Fenn fought, this time at the state level. "One of the things that I fought hard for and won from the state regulator was cities will have access to all utility data all the way down to the customer. On December 16, 2004, the CPUC ordered utilities to release all the data to community choice aggregators. They've protected the data as a gold mine from the beginning. The data are customer data, interval meter data, and substation data. So any city in California will be able to map its energy use and identify the appropriate sources to target for new resources and load reductions. So that's 3-D power. You're not just providing this generic product blindly to the community. You're actually looking at the grid and asking where the low and high congestion areas are, so we know where to put the solar and the distributed generation and where to reduce the loads. That's the problem with solar. If you just put a panel up randomly, as on solar homes, no one is at the house during the daytime, unless they work at home. There really should be solar at work. That's where you use energy in the afternoon. So if you put it on homes, then you have to wheel the power to use it. Utilities don't want to use it; they don't want it to impact the substation through-puts. But if you identify the right locations, then you can have measured impacts at the substation. If you can have measured impacts at the substation, then you can unschedule the purchase across the grid. You're buying less power."

The attraction of Fenn's approach is that it will result in a significant scale shift in the construction of renewable energy generation, and it will be configured in a way to allow the city to reduce its purchases from the grid. Even progressive publicly owned utilities are building solar and wind at a much lower rate, whereas Fenn's plan will result in 31 MW in three years, at no increase in taxes. Furthermore, community choice scales in a second way, by replication across communities: "There are 22 cities and counties in California that want to go to 40% green, including San Diego and Los Angeles county. Already 11½ % of the investor-owned utility's load is seeking to depart to a 40% green RPS. There are another 26 jurisdictions interested, which is 20% of California. If this happens, then we're moving toward a solution on a level that is even beyond Europe. But is also has the quality of being under control and under a market structure. All of the energy companies are bidding. I told someone at the Shell Center for Sustainability about this, and he shook my hand and said it was great. The problem from their point of view is that there are not enough zeros. They don't do little things. They only do big things. So let's give them big things to do, and cities are needed for that."

Equity and Sustainability

There are several major ways in which community choice for San Francisco will affect low-income customers: the public works project of constructing new generation and conservation facilities in the city will provide new jobs, the 360MW of new generation will allow the closure of polluting fossil fuel plants within the city, and rates will be lowered over the long term and possibly over the short term. There is also a ratepayer bill charge, which is standard across the state, that provides funds for weatherization, including weatherization for low-income residents. As Fenn added, "I would say that the major political motivator is less the climate change and more to close the power plants. The 360MW number was specifically gauged to what would be necessary on the grid level to satisfy the transmission operator so that they would revoke the reliability-must-run contracts (the grid reliability status, which basically extents the licensing of the plant forward). If you can get the independent system operator to revoke the reliability-must-run contract, then you're in a position to close the plants legally. Otherwise, you're under the broader, preemptive mandate of the transmission operator, and you cannot close it legally. Bayview Hunters' Point is a cancer/asthma cluster, and there are a lot of reasons. When they put ships around the Bikini Atoll and blew it up, they put animals on the ships and brought them all back, tested them, and dumped them into the water. Some people believe that there is a ring of radioactivity around the Bay, but that area is very harsh." By substituting the city's old fossil fuel plants with new renewable generation and conservation, it will be possible to close the plants.

Fenn also noted that he is working on trying to get the unions to define the public works project in a way that provides new jobs to low-income residents, especially in neighborhoods such as Bayview/Hunters Point. "I said to the union, 'Make this a win-win situation. Make this a new union member situation. Get a training program based in Hunters Point. Make it their game.' But this deal is yet to be done. That's going to be one of the last things that's going to be negotiated.

Policy Issues and Recommendations

One of the key lessons of the San Francisco case is the political difficulty of converting to public power and the attractiveness of community choice as an alternative model. In contrast with other community choice programs already in existence, the innovation of the San Francisco case is that community choice is coupled with the city's bond authority (which required a charter amendment) in order to construct renewable energy and public power on a much larger scale than before. The change would allow cities to go beyond incremental increases in renewable energy or showcase demonstration projects, such as the construction of solar panels on the Moscone Convention Center. As Fenn notes, "When do we get out of this incremental politics mode and into emergency, public works mode? For me it's all about preparing the public works paradigm because

you need these multi-billion conversions in every metro area, or we're not going to get there."

Another lesson that Fenn has learned is to place the authority for decision-making in the hands of the city council, not a government agency. For example, he has kept an eye on the San Francisco Public Utility Commission, which the city council charged with developing an implementation plan for community choice, yet at the time of the interview had not drafted a plan. The broader issue is to make sure that the implementation cannot get bogged down by city agencies and departments. As Fenn notes, "I've known this for years, so I've drafted these laws to give the city councils all the control. They give the staff zero control. The bonds must be authorized directly by the city council, the creation of the aggregator has to be by ordinance, the plan adoption has to be by ordinance, and the award of contract has to be by ordinance. I believe that if you want sustainability, that has to be job one. It has to be democratic. If you give it agencies, you're wasting your time. Agencies don't do anything."

Another obstacle can be the preservationist side of the environmental movement. In addition to the familiar concern with bird kill, which has largely been corrected by changing the design and location of wind turbines, some environmentalists and homeowners are concerned with the effects of wind turbines on the "viewshed" or even the "glare" associated with solar panels. Fenn says that this misplaced environmentalism must change: "So the North Pole is melting, and the Audoban Society in Berkeley is stopping a wind project on the Berkeley pier because there's a bird sanctuary nearby. So I said, 'We'll put up a 5MW big one. They go very slowly.' They said, 'I don't care. We hate it.' So we'll have a little sanctuary here, and the Auduban Society can run it, while the North Pole melts and we're all at war in the Middle East."

Overall, Fenn sees community choice as a viable option for cities in an era of deregulation, privatization, and devolution. It can also appeal across the political spectrum, both in Republican and Democratic states, because it addresses the problem of local government powerlessness. As he comments, "Local governments have been systematically reduced to a condition of penury. They have no taxation powers. They are subsidiary to state taxation collection, and they have almost no discretionary funds. They are reduced to $50 parking tickets and harassing small businesses and big-box retail for cash. And what are they doing? More privatization, more cost cutting. And you have Republicans saying, 'More decentralization, more devolution.' So they gut the federal government and they gut the state government, but no one, including the Democrats, is trying to build up local government, which is the central component to make devolution work. I believe in devolution. I believe it is critical. I think the reason that we're having oil wars now is that we have too much power in our federal government, too much money, and too much lobbying influence. I believe that federal government should be reduced, but I don't believe that if you simply do that and leave out the energy companies—from Peabody Coal to Chevron Texaco in tact—that you will achieve devolution. All you will achieve is corporate governance. That's what we have. We live under corporate control. So

in my view local power is not even about energy; it's about the empowerment of local governments. But it also means having any illusions about their limitations.

"There *is* a public mandate for renewables, for things that are not being done. Democratically the best chance for getting it done is in the city council. There is a very good likelihood of success at the local level. I've had incredible success at the local level. I've never had trouble passing things. I've passed all these laws alone. It's effortless. So I find one politician who has brains and a little power, and I work with him or her for five or six years. After five or six years the council is on board, and once the council is on board, the legislative delegation is on board, then the Congressional delegation is on board, and everybody is on board. I'm not trying to take over PG&E; I'm not trying to take somebody out. I'm trying to achieve something everybody wants, which is large-scale renewables. It's kind of an apple-pie formula."

Update: May 17, 2005. LAFCO (the Local Agency Formation Commission) approved the Community Choice Implementation Plan that Fenn has advocated was approved, and it was sent to the Board of Supervisors for the final vote.

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Permissions and restrictions:

Seattle City Light and Public Power

By David J. Hess

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Seattle City Light and Public Power was founded in 1902, when voters approved a bond measure for a hydroelectric facility on the Cedar River. As a department of the city of Seattle, Seattle City Light is accountable to the voters through the mayor and city council, who govern the appointment of the superintendent as well as approval of the budget and general policies. In the early 2000s, the city council passed resolutions that mandated compliance with the Kyoto Protocol, required that the utility meet any load growth with conservation and renewables, and also required that the utility become climate neutral by the end of 2005 (that is, to have no net emissions of greenhouse gases). Even before that point, Seattle City Light was developing innovative projects around green electricity, but the mandates from the city government have increased the national visibility of this large public power agency. Seattle's mayor also led a national initiative for American cities to adopt the Kyoto Protocol.[1]

I interviewed Marya Castillano, director of the Energy Management Services Division (which was in the process of becoming the Conservation Resources Department); Michael Little, energy planning supervisor; and Bob Royer, director of the Communications and Public Affairs Department. Each was able to give a unique perspective on the greening process and sustainability issues as they have emerged at Seattle City Light. Before reviewing the greening process in detail, it is helpful first to get a sense of some general statistics. As of 2003 the utility supplied electric power to 365,000 customers, making it one of the ten largest public power agencies in the U.S. Throughout the twentieth century, Seattle City Light continued to develop hydroelectric power on various rivers, and in 2003 about half of the utility's power supply (or 1900MW of capacity) was from hydroelectric facilities that the utility owned. The utility also purchased power, and almost all of the contracted power supply came from the federal government's Bonneville Power Administration, for which the source was mostly hydroelectric power but included some nuclear energy, coal, and natural gas. The utility had a small contract with a natural gas fired plant in Oregon, but that contract was scheduled to end in 2006. As a result of the mix of city-owned power and purchased power, about 90% of Seattle City Light's total power supply was hydroelectric, making it one of the greenest utilities in the country in terms of greenhouse gas emissions. The remaining sources were 5% natural gas, 3% nuclear, 2% wind, and 1% coal and other. In other words, only a small

percentage of the overall power was generated from fossil fuel energy. To offset the small percentage of the portfolio that generates carbon emissions, the utility has three main mechanisms: increased renewable energy, mostly through wind power contracts; funding of carbon offset programs, such as the conversion to biodiesel in public transit, garbage haulers, the city vehicle fleet, and state-run ferries; and energy conservation programs.[2]

As Mr. Little explained, "Carbon mitigation is the last resort due to its cost and the uncertainty of costs in the future. We would prefer to take actions that truly reduce our greenhouse gas footprint rather than mitigate it. Energy conservation and renewable energy provide the preferred actions for the utility because it results in a smaller footprint. An added benefit to this path is that energy conservation keeps the dollars here in our community and builds a great relationship with our customers." City Light's conservation programs are among the most extensive in the country. In 2003 the utility's conservation programs saved 7.09 average megawatts (aMW, or annual MW hours divided by the number of hours in a year), equal to the power needed for about 5,720 homes. The utility offers a wide range of programs for both residential and commercial-industrial customers. The largest programs (in terms of average annual MW load reduction) for residential customers are multifamily conservation, water savers, and Built Smart (for new multifamily construction). The commercial programs provide larger amounts of savings. One of the leading commercial programs is Energy Smart Services, which provides incentive funding for lighting and energy efficiency technologies. A large portion of the conservation programs are funded by contracts with the Bonneville Power Administration.[3]

As Ms. Castillano explained, "The conservation programs started in 1977, in response to a citizens' group and local appointed and city officials. Instead of investing in nuclear energy to meet our needs, we decided to invest in energy conservation. In the last couple of years, our budget has been about $21 million and our staff has been about seventy-people, making our conservation program one of the largest of its kind in the United States. We look at energy conservation as a resource."

As Little amplified, Seattle City Light is different from other public utilities because it does not have a problem with peak loads (that is, the total energy consumption at a high point, such as during a heat wave and/or at certain hours during the day). "We're actually trying to reduce the base load, whereas the conservation programs at other public utilities across the country are typically trying to reduce the peak load due to the cost of generating or purchasing power at peak periods. City Light does not face this situation from a generation perspective. The utility is in a unique setting, surrounded by mountains, with three dams on one river. When we need power for peak purposes, we open the gate at the dams little bit more."

Because City Light can generate more power than is currently needed, it sells the excess power to the grid and generates revenue for the utility. The utility has a separate charter, so the revenue (other than the utility taxes) does not directly flow into the city government's general fund. However, the net revenue allows City Light to fund programs in other city departments. As

Castillano explained, “For instance, the Office of Housing administers our low-income program, and we give them in excess of $1 million for low-income conservation, plus an administrative overhead charge. We also have what is probably the most aggressive municipal building code in the nation, certainly in the northwest, and we pay for positions in the Department of Planning and Development to do building and safety inspection, including for the energy code.”

Another mechanism for achieving net zero emissions has been to amplify purchases of wind power, which are also allowing the utility to replace a contract with a coal-fired plant. In 2002 the utility started receiving power from the Stateline Wind Project, a large commercial facility on the Washington-Oregon border that is owned by Florida Power and Light. Purchases have increased from 50MW of capacity in 2002 to 100MW in 2003 and 175MW in 2005. As a result of the contracts, the utility could claim to lead all public utilities nationally in the purchase of wind power. As Little explained, “It might be more expensive than other sources, but it matches the values that the city has: politically, culturally, and societally. If you dig deeply in the policies that guide us as a city and utility, you’ll see that those values are reflected by the people who live here.”[4]

Unlike in other utilities, the wind power purchases are not contingent on the city’s green pricing program. Because the main source of power is hydroelectic, Seattle does not have the same level of concern with price volatility that is found in public utilities that are more dependent on fossil fuel energy. As a result, offering long-term lock-in rates on wind energy, similar to the program of Austin Energy, is probably less attractive to Seattle’s commercial customers. Seattle does have a green pricing program, called Seattle Green Power, but the program was relatively small. Statistics from 2003 indicated that only about 1% of the customers were enrolled.[4] At the time of the interview, the program design was undergoing revision. As Little explained, “The existing green power program is dedicated to putting solar demonstration projects on nonprofit and public service buildings here in the service territory, and to fund local renewable projects that need an infusion of cash to get going. For example, we’re funding a relatively small wind farm and a biogas facility. We are moving to a program design that would allow us to sell green tags from renewable resources. This program design is more in line with other programs, where customers can ‘green up’ a certain percentage of their energy consumption.”

City Light is not investing in new hydro facilities, but it is investing in upgrading existing facilities. Although hydroelectric power is a renewable source of energy that does not generate greenhouse gases, it can become environmentally controversial, especially when it is generated by large facilities that affect aquatic ecosystems. In response to environmental concerns and a federal relicensing process, in 1991 Seattle City Light developed a $100 million agreement with government, tribal, and NGO groups to mitigate environmental and other damage from three hydroelectric dams on the Skagit River. As a result of the mitigation and the utility’s shift toward a policy of stewardship on the Skagit River, Seattle City Light has won environmental awards for its salmon protection. Likewise, in 2003 Seattle City Light’s Skagit River facilities became the first large

hydroelectric facilities to earn certification from the Low Impact Hydropower Institute.[5]

Equity and Sustainability

As in other utilities, City Light faces the trade-off between investing in greening programs and keeping the price per kilowatt hour affordable to customers. The issue of price rates is particularly sensitive in Seattle, because rates went up dramatically in the wake of the electricity crisis of 2000-2001, when the spill-over effects from the California-Enron crises combined with capacity shortage from drought to generate price hikes and debt. Even Bonneville Public Administration raised rates. During that period, Seattle City Light received substantial public criticism for its rate hikes and debt, and the city government responded by appointing a new superintendent and a new advisory board, whose mission was to reestablish the financial health of the utility.[6]

As Mr. Royer explained, "We're just coming out of the energy crisis. Normally, a MWh is about $40, but for about fourteen months in 2001-2002 our net cost of energy was $250 MWh—six times the normal amount. We had to raise the rates by 58%, but even that couldn't cover the costs, so we had to borrow funds. Yet, even during that period we exempted our low-income customers from about half of the rate increases." Royer added that the financial picture was much healthier in 2005.

Even with the legacy of the high rate increases in 2001 and 2002, the rates at City Light are lower than those for most of the customer classes served by investor-owned utilities in the region. As Castillano explained, "We used to advertise that we had the lowest rates in urban America, but we can't say that anymore, because of what happened after the energy crisis. However, the rates are still low in comparison with our neighbors and in comparison with the rest of the country." Because rates are relatively low, the utility does not experience pressure from low-income groups for the utility to make rate cuts. Instead, public pressure is more toward keeping the momentum going on the greening process.

As Little explained, "Politically, our customers support what we're doing, so if they have to pay a little bit more, they're willing to do it. Since 2001 electricity prices have gone up substantially, demand has gone down, and revenues have probably stayed about the same, but people want us to make investments in green energy." Recently, City Light held focus groups to get a sense of what the public priorities were. They explained that the utility had reduced most of its debt acquired as a result of the energy crisis of 2001, and they asked if the customers wanted the utility to lower the rates. As Little noted, "They said no. They wanted us to keep the rates where they were and to keep on doing what we were doing. Politically, there was an interest in determining whether our customers wanted rates lowered, and the customers said no."

In addition to keeping the prices low, City Light assists low-income residents through various programs. For example, seniors, low-income customers, and persons with disabilities may qualify for rate reductions of 50% for electricity as well as other city services. City Light also offers emergency low-income assistance, and it manages Project Share, a program of low-income

support that is funded by customer donations. Furthermore, the utility offers programs through other city departments. For example, the HomeWise Program of the city's Department of Housing offers weatherization grants to low-income residents.[7]

Policy Issues and Recommendations

State and federal energy policies could have been very helpful, but Seattle City Light has implemented its ambitious greening program mostly on its own. According to Castillano and Little, state-level funding has not significantly assisted the utility's greening process. Likewise, the State of Washington does not have a renewable portfolio standard. Even if the state did have a renewable portfolio standard, it was not clear to them how helpful it would be, and there was even some concern that a renewable portfolio standard or other state mandates could interefere with the utility's greening process and conservation programs. As Little explained, "Depending on the structure, we might be challenged in meeting such a mandate For example, in the State of Oregon, instead of a portfolio standard they require that a percentage of all utility revenues go into conservation, and there is typically a low-income weatherization component to it. We've been doing low-income weatherization for almost thirty years, and we'll continue to make investments in this market segment whether it's required by the state or not. However, we've already tapped a significant portion of the conservation potential, and it is taking more effort to reach the remaining potential; the existing program offerings are significantly more expensive to operate than our other programs. So, we might be challenged in meeting the targets established in a portfolio standard There is also an issue of local control. Like many entities, we would prefer to have some parameters, but we don't want the state to tell us that we have to meet our load with a specific mix of renewable sources."

Royer added a similar comment on the risks of a renewable portfolio standard for public utilities in general: "I'm ambivalent about portfolio standards. In some ways they're good, because they lead to more development of renewable resources. However, in other ways they can hit the small utilities in areas where there are high unemployment rates. It's very hard for them to have to develop ten percent of their portfolio with wind. As a consultant, I used to work in rural areas, and I know what it's like."

Regarding federal funding, there was some significant support for the utility from 1979 to 2002, but in recent years the federal programs have been cut. As Castillano explained, "The Department of Energy's Municipal Energy's Management Program provided funding, but the program ended with the energy crisis of 2001. The funding helped cities to develop energy efficiency and conservation programs. They're going to close the entire regional office for the Department of Energy, so it will not have a local presence, not only for energy efficiency programs, but also for smart growth, energy, and other issues."

Royer added another concern: the federal government may require public utilities to divest their generation from their distribution: "We would not do what

we do if we had to divest our generation and buy our energy in ten-minute increments off the grid. The FERC—the Federal Energy Regulatory Commission—wants one big market in the U.S., except for Texas. It is tremendously dangerous. We've been very aggressive in fighting it. Our system is different from those of others across the country. For example, we can use our hydroelectric system to store electricity that makes our wind more stable. In the early 1980s we poured money into conservation. We went to communities all over the northwest and convinced them to adopt a building code. We now have the Northwest Building Code for residential customers, and we have commercial building codes in the region. We wouldn't have been able to do that if we had been centrally directed by the federal government."

Although one might expect that the American Public Power Association (APPA) would take a strong stand against the divestiture of generation, Royer explained that the situation is more complicated: "A lot of the public utilities in the Midwest don't have generation, so they have to buy power from private entities. They think they're not getting a fair price from the private utilities, and they're probably right. The large utilities within the APPA are a minority, but there is a group of the largest twenty public utilities, the Large Public Power Council, that is opposed to FERC intervention."

One area where the federal government could help is the problem of transmission congestion. According to Little, "The states of Oregon and Washington have significant wind potential, and developers continue to make investments. The challenge is that the resource potential is not located where the loads are, and the region has some transmission constraints in getting that wind-generated (and Columbia River hydro) power from eastern Washington and Oregon to the load centers west of the Cascade mountains. And unlike many generating resources that produce predictable output, wind doesn't necessarily blow when you want energy. It fluctuates seasonally and hourly. So, the region could use some assistance in addressing the topic of transmission congestion that would help further the creation of renewable energy projects."

As a result, the utility's future vision—its ideas that would take it beyond net zero emissions—include looking at future investments in distributed resources. During the week that I was visiting, there was a conference on plug-in electric hybrids, the idea that the sister public utility, Austin Energy, has been developing (see the case study on Austin Energy). As Royer explained, "We need to look at cars and buildings. Most of our resources go to large buildings, and in Vancouver they have deep heat exchangers for cooling, so the need for electricity is mostly for lighting and running the pumps."

Finally, a somewhat unique policy issue for Seattle City Light has to do with its high level of dependence on hydroelectric power. The high level of dependence has made the city particularly concerned about the effects that climate change may have on the electricity supply.[8] Royer explained that the utility has risks on three river systems: the Skagit, Columbia, and the Pend Oreille. "We have water records, and we have a plan based on those water records. If those water records don't mean anything now, or if they mean something different, it adds a huge element of risk. We've had some dry years

before—1928 to 1932 were critical water periods—but eight out of ten of the last years were poor water years. It's very unusual. In the North Cascades there are a lot of glaciers, and we've living off those glaciers. Our customers are getting melted glacier water that is two or three thousand years old that we probably don't want to be using up. To me it's getting more and more real, and more and more immediate."

Based on interviews on June 7, 2005, with Marya Castillano, Michael Little, and Bob Royer.

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Metro Transit of King County

By David J. Hess

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Metro Transit of King County (Seattle) traces its transit history back to the 1850s, when ferry boat service across the Puget Sound began. A variety of privately owned streetcar companies operated during the nineteenth century, and in 1914 the first city-owned streetcar line went into service. During the Depression the financial status of the city-run streetcars became precarious, and the city reorganized the system as the Seattle Transit System, which quickly tore up the rail lines and put in trackless trolleys and buses. In 1972 Seattle Transit merged with another system, Metropolitan Transit, to become Metro Transit. As of 2005 the agency has a fleet of about 1,400 vehicles, and it serves 100 million riders per year. [1]

In the late 1980s Metro Transit built a 1.3-mile transit tunnel to ease congestion in the downtown area. Because voters had not approved rail transit, the tunnel used dual mode buses that could convert from diesel to electric power when they were inside the tunnel. In 2004 hybrid buses began replacing the dual mode buses in the tunnel. Metro Transit worked with General Motors/Allison to reprogram the hybrid buses so that they could run on “hush mode” within the portions of the tunnel between the underground stations. The hush mode utilizes mostly electricity and has minimal fuel consumption and emissions, so that air quality within the station equals ambient conditions even though the tunnel is heavily used by buses. In 1990 the county’s voters approved light rail, and in 2000 the transit agency worked out a plan to convert the tunnel to add light-rail vehicle use. The hybrid buses and light rail cars will eventually run together in the tunnel; however, the long-term plan is to phase out bus use in the tunnel as light-rail traffic increases.

Metro Transit attracted national attention for a large order of hybrid-electric diesel buses in 2003. The purchase of 213 buses for Metro Transit and another 22 for its partner Sound Transit gave the Seattle area the distinction of having the largest fleet of sixty-foot hybrids in the country (New York may have the largest fleet of forty-foot hybrids). In June, 2004, when the hybrids began operation, the city won an award as a National Clean Bus Leader from the Environmental and Energy Study Institute (ESSI). Each hybrid bus cost $645,000, or about $200,000 more than a standard diesel bus, and federal funds helped cover the marginal cost of about twenty-five of the new buses.[2]

I interviewed Jim Boon, the manager of vehicle maintenance, a section manager for the county government. Mr. Boon has been with the county for

twenty-three years and has worked the entire time in vehicle maintenance, with the exception of a few years when he worked on other projects. He is very happy with the performance of the new hybrids. The buses utilize a parallel drive, which is a heavy-duty system that can operate on a range of urban streets. The buses perform well from slow city streets to the highways and from flat terrain to the many hills around Seattle.

As Boon explained, "The hybrids work better than the diesel buses on the hills, because they have much more torque. They're using the electric motors in the drive units and the battery energy, so they far outperform a conventional bus. They're also phenomenally reliable. In the transit industry, we measure reliability as miles between trouble calls, or breakdowns in revenue service. The whole hybrid bus fleet is operating at over 6,000 miles between breakdowns, and that's incredible for a new technology. You just don't take this level of sophisticated technology out of the box and get great performance and high reliability. This is a very pleasant experience."

He added that before Metro Transit signed the contract for the large order, it bought a bus to test: "We wrote a bus spec for a sixty-foot bus, and we bought it. We ran it twenty hours a day, seven days a week, for almost six months. My goal was to get a year's worth of wear as fast as I could. We operated on regular routes but filled the bus with tanks of water that represented 130% capacity load, and we had a dozen drivers who worked on shifts. Our goal was to hit 37,000 miles, and we actually went to 47,000 miles. We monitored everything about the bus: oil, tires, brakes. When we finished, we took the hybrid drive unit out and flew it back to the factory. I went with two other guys, and we tore it apart. It didn't have any wear on it. It doesn't have a torque converter or an integral retarder, so it has no temperature swings and runs cool."

I asked if he was able to figure out if the savings on maintenance and fuel economy justify the extra cost of $200,000, and he replied, "We keep a bus for twelve years. I'll probably keep this bus for fourteen to sixteen years. Our initial cost model showed that with labor, fuel, and maintenance, we thought we'd get our money back in about eight years, and we're well on target to do that. Because of the reduced maintenance, we reduced our mechanic workforce about 10%, which is about twenty-four positions. We don't need as much staff in the parts department and rebuild center. We eliminated a truck driver because we're not hauling as many parts from building to building. All of the sudden we were able to shed a huge portion of the operating cost and labor."

As for fuel economy, he went on to describe their experience: "When we started, we didn't have any particular ideas in mind about what our fuel improvement would be. We were looking at the overall ownership package. Fuel was one component, maintenance another, other consumables such as replacement oil and disposal of oil, and brake wear. People ignore brake wear in urban environments as a source of particulate matter (PM) and pollution. Because the PM from brakes is larger and heavier particulate, it gets down in the streets, and other vehicles blow it around. People ingest it, and people with asthma really struggle with it. So we were looking at a number of issues, but to

stay focused on fuel, in the beginning we hoped to get a 20% savings over the buses that we were replacing. We need to compare the hybrid with a similarly built bus with the same engine and a conventionally built drive train. We have conventional articulated buses and hybrid buses with identical engines; they're built on the same production line on the same purchase order. When we look at the identical buses, with one hybrid and the other conventional, we get about a 50% improvement. That's the good news.

The bad news is that in 2004, when the federal government implemented the emissions standards for the engine we're using, fuel economy went down. We are getting about 2.6 miles per gallon on a conventional bus, and we're getting about four on a hybrid. Prior to the implementation of the emissions standards, I was getting four miles per gallon on the older conventional buses."

Boon went on to explain how it could happen that adding the hybrid technology has only resulted in a relative savings of fuel, but not an absolute savings. He needed to back up and explain the history of the Clean Air Act, which was first passed in 1963 and then modified again in subsequent decades. The early versions of the Clean Air Act focused on emissions and air quality, not technology design. As Boon explained, "In the 1980s the Clean Air Act gave tailpipe emissions standards, then it handed the problem to the engine manufacturers and told them to figure it out. . Although they were part of the problem, they were only one element of the solution. Today emissions are managed three ways: fuel formulation, combustion technology within the engine, and exhaust after treatment at the tailpipe. It's now a three-legged stool, and we're getting somewhere. We reduced sulfur content and went to ultra-low sulfur diesel. Originally the limit was 5,000 ppm (parts per million); in the mid to late 1980s it was decreased to about 500 ppm, and in 2006 it will go down to 15ppm. In 2004 the Environmental Protection Agency also implemented a rule reducing both NOx (nitrous oxide) and PM. If NOx are up, you can get PM down, and if PM comes up, you can reduce NOx, but because NOx is a gas, you can't capture it at the tailpipe. The way to reduce NOx is to lower the combustion temperature, but in doing so, more fuel is used. So you blow the excess PM out the exhaust and trap it in the diesel catalytic particulate filter, catalyze it into ash, and blow clean air out the tail pipe. That reduces emissions, but we have to burn more fuel to do it. That's why we get terrible fuel economy. In 2007 the NOx/PM levels go down again, and again in 2010. One promising technology to reduce NOx is urea injection. They'll spray urea—which is what farmers use to reduce nitrogen in the soil—into the exhaust stream, and that will neutralize the NOx as it comes down the tailpipe."

Because biodiesel results in increased NOx, I asked if the changes had implications for their use of biodiesel, but he was only aware that various people were trying to figure out additives to reduce the NOx in biodiesel. Metro Transit's experience with biodiesel is very recent. It's current use of B5, a 5% biodiesel blend, was funded by Seattle City Light, the city's publicly owned municipal electricity department, through its environmental mitigation program. The program was set up because the city has established a goal of making Seattle City Light a net zero emissions electricity provider (see the case study of Seattle

City Light). To achieve the goal, the city's electricity department purchases carbon offset credits for the small part of its energy supply that is coming from fossil fuel sources. Biodiesel is considered carbon neutral because the carbon released on burning the fuel is recaptured by plants that are grown to create the fuel. Because Metro Transit consumes about ten million gallons of diesel fuel per year, the purchase of 5% (or 500,000 gallons) for its entire fleet will help spur the biodiesel industry in Washington state.[3]

Boon was careful to explain that although the purchase of biodiesel may be valuable for its carbon credits and its impact on the developing biodiesel industry in the state, the use of biodiesel did not have emissions benefits for his transit system. "Biodiesel has some appeal for older engines, and the transit industry has some engines that are twenty years old. It has some appeal if people are just trying to clean up the black smoke. We don't have that problem. I don't have any buses older than 1995. Our average fleet age is 5.5 years. When we went to ultra-low sulfur diesel, we retrofitted about 500 or 600 buses with diesel particulate filters, and our hybrids all have diesel particulate filters. Our buses are so clean that, in our mind, there's no emissions gain with biodiesel. Our PM is .01. We're 90% under the standard. We're as clean as a natural gas vehicle, and we're not putting out the same level of greenhouse gases."

When I asked if they had any plans to shift to higher levels of biodiesel, such as B20, Boon replied, "B20 is about the breakpoint for what we know we can burn reliably. Engine manufacturers look at B5 as a fuel additive, and they look at B20 as a fuel form. They say that if we ever have problems with our fuel system, they'll void the warranty if they trace it back to biodiesel as the source. However, the biggest problem with biodiesel is the cost. Around here B100 costs about $3.00 per gallon, and there are enough people around here using biodiesel that sometimes we can't get it. It's not an inconvenience, because we can just use regular diesel, but it shows that the B100 suppliers are not where they need to be. They need to get in the market and become a force."

Historically, King County also looked at compressed natural gas (CNG) as an option during the early to mid 1990s, but ultimately the county decided not to go that route. The reasoning behind the decision not to convert, both from a technical and economic perspective, are of general interest, because some transit agencies made the decision to convert. As Boon explained, "In the 1990s everybody was getting a full-court press from the gas lobby. To the gas companies, a bus consumed an amount of natural gas equal to about sixteen houses, and if you multiply that by the size of a transit fleet, it was like adding a new city. We were a huge new market at a time when their market had flattened out. They were competing with oil and electricity and barely making progress. At the time the gas companies were also willing to put up several hundred thousand dollars to help offset the compressor station costs, and the federal government had demonstration grant money available. Some transit agencies didn't have capital money for new buses, so it was a way for them to buy buses.

"Also in the early 1990's we were getting ready to buy about 360 new buses, and the gas company tried to convince the county council that we should

buy all compressed natural gas buses. We were concerned with the amount of time that it would take to fuel 360 buses with natural gas. We only have from about 11pm to 4am to service our vehicles and get them back on the road. If we were to extend that to the fleet of 1200 to 1400 vehicles, they couldn't supply us with enough gas. There weren't enough hours in the night, and the compressor stations would have had to be huge. The gas supply lines were too small, and they would have had to bring in bigger lines; however, they were unable to share in the cost. To level the flow on their distribution system, the gas company wanted us to fuel in the middle of the day and the middle of the night, but not one or the other, because we'd strain the system and we'd be sucking pilot lights out of people's furnaces. They couldn't supply the gas. I have seven locations throughout King County, and it was a monstrous problem to get the gas to every one of them in the volumes we needed at the time of day we needed.

"So I said, 'Why don't we look at liquified natural gas?' but the gas company said that wouldn't work. I said, 'Why not? Gas is gas. It's coming out of the pipe." Following that approach we could have bought gas off the main line and bought it up in Canada, then we could have liquified it and trucked it in, but the local gas company would have lost the business. I said, 'As soon as it hits the engine and is reformulated from liquid to vapor, gas is gas.' The infrastructure impacts for LNG wouldn't have been as bad, but there were still huge facility impacts. A lot of our bus barns were built in the mid 1970s, and they were built for diesel equipment maintenance or heavier-than-air fuel vehicles. When you introduce lighter-than-air gas vehicles in the maintenance shops, you have the capacity to have gas migrate in the shops and offices, go up into the light fixtures, go in the walls, and get into the telephones. In a perfect situation the phone could ring and blow up. So we brought in some consultants, and they estimated that we would need to spend $50 million (1990 dollars) to retrofit our facilities to make them safe to work in with lighter-than-air gas. The incremental cost on the vehicles was another $45 million to go out and build up the fleet to natural gas. We were looking at almost $100 million.

"However, the county council said to go ahead and do it. We signed the contract and ordered 360 LNG buses and began engineering and design for our fueling facilities, but within six months, there was an election. The Republicans were voted out of office, and the Democrats took over. They said that if we had $100 million—and we had to borrow most of it—we were better off taking the cleanest available technology off the shelf, putting more service on the street, and having people get out of their cars. They said, 'Follow that path.' That was in 1992, and we haven't looked back. We fired the consultants and cancelled the contracts for the fueling facilities and new LNG buses."

Today, the environmental advantages of CNG are much weaker than they were in the mid 1990s, because the technology and fuel for diesel has improved. As Boon commented, "I'm not an expert, but I believe the greenhouse gas emissions are cleaner in hybrid diesel than in CNG buses. The PM for both are below detectable levels." He added that more information about the emissions levels for the new hybrids is under development: "The Environmental Protection Agency is now developing a test protocol for hybrids to measure emissions. I am

testing both a new, 2004 conventional bus and a sixty-foot hybrid back at the National Renewable Energy Laboratory in Colorado. When the report comes out, it will be the first side-by-side data."

One other area of note is that Metro Transit has also provided national leadership in its programs and efforts to get people to shift from single-passenger commutes to alternative forms of transit. In addition to making public transit as attractive as possible, Metro Transit has developed ridesharing programs. Its Regional Ridematch System is a large database that matches drivers and riders for carpooling and vanpooling. The VanPool program is the oldest and largest of public transit programs of this type in the country. Metro Transit provides guidelines and support to people who wish to organize a van pool, then it trains the driver and a bookkeeper, and finally it loans them a van. The driver rides for free, the bookkeeper collects the fees for Metro Transit, and the van is allowed to use high-occupancy diamond lanes on the highways.[4]

Equity and Sustainability

Because transit agencies have limited funds, they often face the equity-sustainability trade-off when making decisions about investing in projects that green the fleet and those that would develop more transit lines or keep fares down. When I asked if such issues had emerged at Metro Transit, Boon replied, "We faced that issue when we took the lead in moving to ultra-low sulfur diesel and putting on the diesel particulate filters. We funded that out of our pocket, without any grant money. The question emerged, because people who get on the bus don't know what's in the fuel tank. They're just happy that it's on time and that it takes them where they want they go. We're trying to do a little bit of both without raising the fares.

"We work to make the public aware that we believe strongly that we want our buses to be as clean as they can be using available technology. We're not doing a lot of R&D work with fancy fuels. It was luck that cars led the way in terms of educating the public about how green hybrids are, and then we ended up buying the hybrid buses. We happened to be in the right place in the right time, and the press and public picked up on it. Letters poured in from the local community, and there were articles in the press saying that we had finally done something smart."

Another equity-sustainability issue that at this point may be unique to Seattle is threat of job loss that occurs when a transit agency converts to hybrid. As discussed above, the hybrids are so much more reliable than the conventional buses that if the changes are not implemented carefully, maintenance workers can risk losing their jobs. However, Boon was careful to avoid this problem. As he explained, "I went to the union a year and a half before we got the buses. I said, 'Here's what my testing and cost model show.' The way I calculate for labor is in units of labor hours needed per thousand miles on the road. I said, 'Right now my old fleet is using about twelve hours for every thousand miles, and I think the hybrid is going to come in around nine hours. That represents in the worst case about thirty employees, but probably about twenty to twenty-four, so we need to partner to tell the employees up front that we can work our way through

it.' Over that eighteen month period, we leveraged every vacancy that we could, and no one went out the door."

Another equity issue that may be unique to Seattle is the governance structure of Metro Transit. When the organization was originally formed in 1972 from the merger of the city and suburban transit systems, it was set up as a municipal corporation. As Boon described, "We had a council with forty-two people that included citizens and mayors from throughout the county. You would think that they couldn't reach a decision, but they did a great job. However, as the county grew, the demographics shifted, and in 1990 there was a court case that claimed we no longer had equitable representation. The judge ruled that we were in violation of the one-person, one-vote rule. To fix the problem, the transit system was merged into the county government, which was already structured to meet the one-person, one-vote rule by its very definition. That was completed in January, 1996. We're now governed by the county council of thirteen, who are all elected officials, and the county executive."

Policy Issues and Recommendations

One policy issue that sometimes emerges in urban transit systems is the decision to invest money in existing bus lines versus rail. In some cities, rail transit has been accused of siphoning money to commuter lines at the expense of bus lines that are more heavily used by low-income residents. Seattle is currently in the process of building light rail; however, light rail is under the jurisdiction of another agency. Boon was aware of some of the issues that had emerged in other cities, such as Los Angeles and Atlanta, and he noted, "Rail is very expensive. It gets a lot of attention and is glitzy, and buses aren't fun anymore. However, we're two separate agencies with separate funding sources, and we have no way to comingle funds." Although Seattle's experience of negotiating rail versus bus transit is still very much in the formative stage, the decision to have the two set up as separate agencies may allow the bus system more room to continue to grow and prosper.

Another policy issue, and really the main one from Boon's point of view, is the need for more support from the federal government. As he explained, "When we first started the hybrid program, there was no state or federal funding. It was our feeling that if we wanted to show a reduction in emissions and fuel consumption, the federal government should help reduce that $200,000 delta that we were paying per bus. We did get a $5 million earmark, but that was from our senator, who earmarked the funds in the transportation budget. The entire purchase was $160 to $170 million, so $5 million doesn't buy that much. We're just not seeing the support from the Federal Transit Administration. We hear that they're happy that we're doing this, but they're not offering to help. They offered a lot of subsidies and grants for natural gas, but they haven't done the same for hybrids." Even Seattle, which is a national leader in the green of urban transit, can only do so much without badly needed federal support.

Based on an interview by David Hess of Jim Boon, June 7, 2005.
Web site: http://transit.metrokc.gov

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