Case Studies of the Greening of Public Transit:

Alameda-Contra Costa Transit District

By David Hess

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

Sources:

Interview by David Hess of Jaime Levin and Bob Bithell, March 21, 2005.

1. AC Transit. 2005. “History.” Retrieved March 17, 2005 (http://www.actransit.org/aboutac/history.wu).
AC Transit. 2005. “Facts and Figures.” Retrieved March 17, 2005 (http://www.actransit.org/aboutac/ridershipbusfleet.wu).
AC Transit. 2005. “Public Ownership Introduced.” Retrieved March 17, 2005 (http://www.actransit.org/aboutac/publicownership.wu).

2. AC Transit. 2005. “Reducing Emissions.” Retrieved March 17, 2005 (http://www.actransit.org/environment/reducing_emissions.wu).

3. AC Transit 2005. “Hybrid Drives.” Retrieved March 17, 2005 (http://www.actransit.org/environment/hybrid_drives.wu).

4. AC Transit. 2005. “AC Transit’s Hydrogen Fuel Cell Program.” Retrieved March 17, 2005 (http://www.actransit.org/environment/hyroad_main.wu).

5. AC Transit. 2005. “Bus Rapid Transit.” Retrieved March 17, 2005 (http://www.actransit.org/planning_focus/mis.wu).
AC Transit. 2005. “Ride the Rapid.” Retrieved March 17, 2005 (http://www.actransit.org/riderinfo/sanpablo.wu#).

6. AC Transit. 2005. “Designing with Transit.” Retrieved March 17, 2005 (http://www.actransit.org/pdf/designing_with_transit.pdf).