

Case Studies of the Greening of Urban Transit:

Chattanooga Area Regional Transportation Authority

By David Hess

Copyright © 2005 David J. Hess All rights reserved. Permissions and restrictions are listed at the end of this document.

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 Detroit 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 we 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.”

Interview by David Hess, April 11, 2005.

References

1. CARTA. 2005. "General Information on the Chattanooga Area Regional Transportation Authority." Retrieved March 31, 2005 (http://www.carta-bus.org/CARTA%20Web%20Site/Home%20Page/General_Info_CARTA.html#Anchor-Genera-10377).
2. CARTA. 2005. "The Chattanooga Story." Retrieved March 31, 2005 (<http://www.carta-bus.org/CARTA%20Web%20Site/Chattanooga/Chattanooga%20Story.html>).
Lerner, Steve. 1997. *Eco-Pioneers*. Cambridge, Ma.: MIT Press, pp. 171-196.
3. CARTA. 2005. "Chattanooga's Electric Bus Story." Retrieved March 31, 2005 (<http://www.carta-bus.org/CARTA%20Web%20Site/Electric%20Shuttle/CARTA%20Electric%20Bus%20Story.html>).
4. ATTI. 2005. "ETVI Pledges \$20,000 to East Tennessee Clean Fuels Coalition." Retrieved April 19, 2005 (<http://www.att-info.org/p5.htm>).
City of Chattanooga. 2005. "The Enterprise Center." Retrieved April 19, 2005 (http://www.chattanooga.gov/138_1863.htm).
5. Environmental and Energy Study Institute. 2005. "EESI Recognizes Clean Bus Leaders." Retrieved April 19, 2005 (http://www.eesi.org/publications/Newsletters/Clean%20Bus%20Update/oct_nov2004.htm#eesi).

Permissions and restrictions:

An individual has permission to make one electronic or print download of this case study, provided that the copy is for personal or educational use, that the person does not sell the copy, and that the person does not further distribute the copy by any means, electronic or mechanical. An individual in an educational setting may make additional print copies for one-time distribution to a limited group, such as a classroom, for educational purposes, provided that the copies are not further distributed, that the individual does not profit from selling the case study, and that the copyright notice and this permission statement are included. Authors of a review or scholarly publication may include brief quotations, provided that full acknowledgement is made of the source, including the URL. Otherwise, no part of this case study may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by information storage and retrieval system, without written permission from the copyright holder(s) listed above. No individual or organization is permitted to repost this case study

on other web sites; instead, there should be a link to this document on the web site of the copyright holder(s).