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***TH!NK city – ELECTRIC VEHICLE
DEMONSTRATION PROGRAM: SECOND
ANNUAL REPORT 2002—2003***



TECHNICAL REPORT

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July 2004

***Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC***

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PROGRAM: SECOND ANNUAL REPORT 2002—2003***

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ABSTRACT

The TH!NK *city* Electric Vehicle (EV) Demonstration Program, initiated late 2001, is in its second full year in the United States. Partners include Federal, state, and municipal agencies and commercial partners.

Phase I, placing the vehicles in demonstration programs, was completed in 2002. Phase II, ongoing monitoring of these programs, is underway.

The Program has successfully placed 195 EVs with customers (including Hertz) in California, 108 in New York (including loaner and demonstration vehicles), 15 in Georgia, 8 to customers outside of the United States, and 36 in Ford's internal operations in Dearborn Michigan—362 vehicles total. The Program is the largest operating urban EV demonstration program in the United States.

Phase II, ongoing monitoring of an operational field fleet, has now been underway for approximately one year. The United States Department of Energy's (DOE's) Advanced Vehicle Testing Activity (part of DOE's FreedomCAR and Vehicle Technologies Program) is highly involved with the monitoring of the TH!NK *city* vehicles in the New York Power Authority / TH!NK Clean Commute Program through the Advanced Vehicle Testing Activity's partnership with Electric Transportation Applications (ETA), which provides separate reports to DOE. The remainder of the TH!NK *city* fleet is monitored through Ford's internal operations.

This report is the second TH!NK *city* Electric Vehicle Demonstration Program annual report, which summarizes the Program activities and states the accomplishments met toward the stated goals and objectives, which are:

- Enhancing public awareness of urban EVs
- Defining the unique urban EV market and niche applications
- Enhancing EV infrastructure
- Investigating the economic sustainability of urban EVs.

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***TH!NK city* – ELECTRIC VEHICLE DEMONSTRATION PROGRAM: SECOND ANNUAL REPORT 2002 – 2003**

INTRODUCTION AND BACKGROUND

"TH!NK" was formerly Ford Motor Company's brand dedicated to emission free vehicles—originally launched in January 2000. Two main TH!NK products were available: the TH!NK *neighbor* Low-Speed Vehicle (also considered a neighborhood electric vehicle) and the TH!NK *city* urban electric vehicle. The *neighbor* was sold through authorized Ford TH!NK dealers; the *city* vehicle was placed in pilot programs in California, New York, Michigan, and Georgia and leased to individual customers and municipalities.

The TH!NK *city* was manufactured in an emission-free Ford Motor Company production plant located in Norway. Over 1,000 TH!NK *city* vehicles have been produced for sale in Europe and for placement in the United States Demonstration Program. The Demonstration Program TH!NK *city* vehicle meets all European certification standards, but not all United States standards, and the vehicles were imported into the United States for the Demonstration Program by way of a special Federal importation program waiver.

In August, 2002, Ford announced discontinuation of the TH!NK vehicles and subsequently sold the TH!NK *city* model, the TH!NK name, and the manufacturing facility in Norway to KamKorp, a microelectronics firm in Switzerland, which also owns Fraser-Nash of the United Kingdom.

The Demonstration Program TH!NK *city* is a two-seat battery electric urban vehicle with a hatchback for convenient access to the cargo area (Figure 1). The vehicle has a top speed of 56 mph and a certified urban range of 46 miles per full charge. The *city* is 95% recyclable.



Figure 1. Rear view of the TH!NK *city*.

The TH!NK *city* Demonstration Program includes some notable firsts, including the Vandenburg Air Force Base Shared Use Vehicle Management System (SUVMS), the New York Power Authority (NYPA) Clean Commute Program, Long Beach Bike Station Mobility Center, Hertz BART Shared Car Program, and San Francisco *city* Car Share (SFCCS) usage of TH!NK *city* vehicles in shared use applications. Subsequent shared car projects started in late 2002/early 2003 included the University of California-Riverside and the Premier Automotive Group in Irvine, California.

The Demonstration Program targeted a wide scope of customer applications for the TH!NK *city* vehicle, including emphasis on placing vehicles with select retail customers to gather consumer feedback. These unique applications, including both station and shared car projects, are well matched to the TH!NK *city* and its target market of urban commuting missions.

ACCOMPLISHMENTS

The New York Clean Commute Program

The TH!NK *city* Demonstration Programs have achieved a high level of public acceptance now that targeted customers have had the vehicles for a period of time. NYPA has conducted ongoing surveys, and recently released results from their New York participants (see below).

The New York Clean Commute Program is a Station Car type of program, with charging infrastructure at eight suburban New York City train stations. The program was designed to have 100 customers drive TH!NK *city* vehicles from their residences to local train stations. The customers have charging stations installed at their residence and at the train stations, which permits customers to maximize commuter distance from the participating train station and thereby maximize usage of the vehicles. Appendix A shows pictures of the TH!NK *city* vehicles at the four train stations north of New York City:

- Brewster (Southeast)
- Chappaqua
- North White Plains
- White Plains.

The initial infrastructure plan started with a one-on-one structure (one charger per vehicle) at each station to ensure charging availability for all of the program participants. Each station was assigned an allocation of vehicles, and the same number of parking spaces and charging units. Over time, however, it became apparent that not all customers commute every day, resulting in empty parking spaces with unused chargers. NYPA reported that charging station usage averaged only 50 to 70% per day, and less during the summer months, presumably when participants were vacationing.

New York Clean Commute Program Statistics

From the survey conducted over the summer of 2003, NYPA released the following statistics:

- 52% of the participants have a combined annual income of \$150,000 or greater
- 79% are age 41 or older
- 86% are male
- 48% have two or three vehicles in the family
- 35% travel between 20 to 90 miles each week, both commuting and running errands
- 45% rated the program highly satisfactory
- 57% have previously leased a vehicle
- 43% were introduced to leasing versus purchasing through the Clean Commute Program.

Program participants indicated they would like to see additional public charging stations in other areas (in order of preference):

- Malls
- Grocery stores
- Movie theaters
- Office complexes
- Schools
- Cultural and sports complexes.

As of September 15, 2003, twenty Clean Commute Program participants have returned their vehicles, and three vehicles that were never leased were returned to Dearborn, Michigan. The reasons customers gave for the twenty early lease returns are summarized as follows, with the number of vehicles returned per reason:

- No longer commutes or lost a job (8)
- Service-related issues (2)
- Accidents (2)
- Could not adjust to the vehicle or had efficiency issues (4)
- Unknown reasons (2)
- Deceased (1)
- Vehicle repossessed (1).

The insurance companies chose not to repair the two vehicles involved in accidents (no injuries were reported for either accident). One Program participant took another vehicle from another lease return, the other participant dropped out of the program.

A recent report from the Advanced Vehicle Testing Activity (AVTA) indicates that 80% of the Clean Commute participants are actively providing data to the AVTA (*NYPA/TH!NK Clean Commute Program Report – Inception through February 2003*, INEEL/EXT-03-00846). The report states that the TH!NK *city* vehicles in New York have been driven almost 150,000 miles using electricity to charge their cars, which saved almost 7,000 gallons of gasoline. The report also calculated a higher frequency of repairs for the *city* vehicles when the TH!NK *city* repair record is compared to the pure electric Toyota RAV4 and to a normal internal combustion engine vehicle.

It became apparent early in the New York Program that many of the customers leased their city vehicles solely for the purpose of having guaranteed parking in close proximity to the train stations (Figures 2 and 3). Some felt that better parking alone was worth the lease payment. However, during random informal interviews, both Ford Corporate and the Ford dealerships learned that the customers had developed a true liking for the vehicles, and most indicated that they liked the car better than they thought they would. When asked if they would lease another electric car, most answered favorably. Later in the sign-up phase, more customers indicated they had chosen to sign up for environmental reasons rather than for the parking. The last customers to be signed up gave various reasons for participation: preferential parking, appearance of the car, and favorable reports from participants in the program. Word of mouth was apparently not a large factor for sign-up. The reason surmised is that friends and family had different driving habits, destinations, and needs and thus did not qualify for this particular Program. Also toward the end of the vehicle deployment phase of the Program, a marketing effort was launched to reward participants for signing up a friend or family member, but only one New York commuter signed up a new commuter through this campaign.



Figure 2. Think *city* parking close to the Brewster Train Station.



Figure 3. Think *city* parking close to the Chappaqua Train Station.

Varying methods of marketing were used to promote the Clean Commute Program. Most notably, was having the vehicle parked at the individual train stations with a marketing team handing out literature and a product specialists explaining the program. Commuters were invited to look over the car, sit in it and ask questions without having to visit a dealer for more information. This, by far, appeared to be the most effective method of gaining serious interest in the program.

All New York TH!NK dealers that leased the *city* vehicles reported that the relationship between the commuter and the salesperson was significantly stronger than during a normal vehicle sale or lease process. TH!NK *city* dealers in New York reported speaking regularly with their *city* owners about all aspects of the program and the vehicle (not a commonality with the purchase of a gasoline-powered vehicle). This relationship is worth noting, following, and exploring. The unique aspects of the car and the program are cited as reasons the customer stays in contact with his/her dealer—it is the source they feel most comfortable going to with questions or testimonies of their experiences.

During the early months of the Program, the media sought out participants of the Clean Commute Program to interview. Almost all participants/customers obliged and even welcomed the media into their homes and work places. They indicated they were proud to drive an environmentally friendly vehicle and had positive opinions of the vehicle and the program.

Late in 2002, *Popular Science* held a closed focus group at their office in Manhattan and asked that Ford/TH!NK invite seven or eight participants to the morning meeting. Everyone that was invited attended—a 100% show—which is not common for busy Manhattanites, and they had a heavy rainstorm that morning. To date, Ford/TH!NK has not seen the results from this focus group published.

University of California Riverside

The University of California in Riverside, California has ten TH!NK *city* vehicles in a fleet shared-car program at their campus. Ten vehicles retrofitted with ITS electronics by IntelliShare, in cooperation with the university, have been donated for about a year. The vehicles are placed in five pods around the campus, and they have plans to expand with two more pods within the year.

IntelliShare installed hardware/software electronics into each vehicle that permits the user to schedule a vehicle at one of the five kiosk stations, unlock and start the electric car, and, using GPS, track the car for location and energy levels. Ford Motor Company contributed \$1,500 per car for the retrofitting.

Early statistics from the program estimate there will be 400 registered users and 100 trips and nine vehicle relocations per day, with an average 21-minute trip of about of 4.7 miles.

Premier Auto Group Shared Car Program

The Premier Auto Group (PAG), a division of Ford Motor Company, submitted a request to test market the *city* vehicles in a shared car program at their Irvine, California headquarters. They requested ten vehicles to start with and the option to take additional early-lease returned vehicles later in the program. The project was approved because it offered an outlet for California TH!NK *city* vehicles as they came back early from leases, and it further tested the development of installing shared car projects in work environments. The program started with only nine vehicles being available at the time.

The Reverse Commute program idea is to have PAG employees take an electric vehicle from the office to a commuter train station for travel home. Upon arriving back in Irvine in the morning, the commuter uses the *city* to travel from the train station to the office. Infrastructure consists of charging stations at the office building. No chargers were installed at the train station, as the commute is short.

In April 2003, the facility manager inquired about additional vehicles and took two more by early summer, bringing their total to 11. They report that their employees are also using these vehicles to run short errands during their lunch hours. The vehicles are due back between June and December 2004.

ENHANCING ELECTRIC VEHICLE INFRASTRUCTURE

Electric vehicles have a limited range on a single charge and thus highly depend on the available charging infrastructure. Therefore, considerable preprogram attention and planning went into the development of the charging infrastructure.

Each Demonstration Program vehicle includes a single-vehicle conductive charging power distribution box (model EVI DS-50) typically installed at a home residence by the customer or, in the case of New York participants, by NYPA, at no cost to the consumer. This home installation scheme permits the customer to drive locally and recharge at home, independent of public conductive charging infrastructure.

Typically, the availability of public conductive charging at Demonstration Program test sites is limited. San Francisco has a variety of publicly available charging locations, although most are located in public garages, where customers are required to pay for parking while recharging their vehicles. It is anticipated that locations where substantial public charging is available will have higher Demonstration Program vehicle use and higher average vehicle mileage. In California, EV users can contact individual municipalities to request that charging stations be installed in high traffic areas.

Fleet-based Demonstration Programs, such as the Clean Commute Program and Vandenburg Air Force Base Shared Use Vehicle Management System (Figures 4, 5, and 6) have unique infrastructures.



Figure 4. TH!NK *city* charging infrastructure at Vandenburg Air Force Base.



Figure 5. TH!NK *city* vehicles in the Vandenberg Air Force Base fleet.



Figure 6. Charging infrastructure at the Brewster Train Station.

Residential infrastructure in the Clean Commute Program was deemed necessary but may receive less use than anticipated. Observation of vehicles arriving at the New York train stations in the morning indicates that the vehicles arrive at relatively low states of charge. Most customers live close to the stations, so it is likely these vehicles were not recharged at home before arriving at the stations. This may be due to reluctance of customers to incur residential electricity costs for charging when it is available free at the stations.

Vehicles shared among a presubscribed membership (e.g., Vandenburg Air Force Base Shared Use Vehicle Management System (SUVMS)) have special infrastructure requirements. One charger per vehicle is required to ensure proper charging and recharging of the vehicle for maximum use of the vehicle. The one-to-one vehicle-to-charging unit relationship ensures that the *city* vehicles maintain the highest level of battery state-of-charge, and therefore state-of-readiness, for membership mobility.

Service of the EVI charging units used in the Demonstration Program is complex, due to the interrelationship of the charging unit and the vehicle. When a vehicle fails to charge, the root-cause of the problem could be the charging unit, installation of the charging unit, or the vehicle itself. A process was developed to diagnose the issue and direct the appropriate solution.

The first step in the service process is for the customer to report the problem on the toll-free EVI service hotline; the hotline representative walks the customer through diagnostic steps to isolate the root-cause problem. If the issue is:

- The charging unit, the EVI selected local service provider is dispatched to repair the unit
- The installation, the customer is given repair options, including
 - Dispatching the EVI local service technician to repair faulty installation at customer expense
 - Reporting the problem to the original installation contractor for repair under original warrantee
- The vehicle, the customer reports the problem to the local Ford THINK dealer for service and repair.

INVESTIGATING ECONOMIC SUSTAINABILITY OF URBAN EVS

Despite the availability and use of public grants and incentives, the Demonstration Program as a whole is not a sustainable market for electric vehicles. However, several applications do appear to offer better economic sustainability than others.

The *city* vehicles used in the Demonstration Program were purpose-built small electric vehicles developed to maximize consumer value given the current state of battery technology. The vehicles had a base manufacturer suggested retail price (MSRP) of \$26,000 and an air-conditioned version MSRP of \$30,000. These vehicles are probably the lowest-cost electric vehicles available in the United States to date (excluding low speed/neighborhood electric vehicles).

In order to test economic sustainability of electric vehicles under optimum conditions, the vehicles were offered only in states with electric vehicle incentives. In addition, second-tier public grants (e.g., Air Quality Management District, Congestion Mitigation and Air Quality Improvement Program, etc.) were proactively acquired to support placement of these vehicles.

The maximum economic sustainability in the Demonstration Program resulted from a combination of all available sources: 10% Federal tax incentive, state incentives, a \$300,000 DOE grant, and locally available grants. Under these conditions, these vehicles approached economic sustainability, but they reportedly did not actually achieve this goal.

Demonstration Program vehicles leased in California included the Federal 10% tax credit, a California \$8,500 cash incentive, and locally available grants. Ford reports that these vehicles incurred for them a significant per vehicle loss when leased in California at customer-driven pricing of \$199/month and no down payment.

The Demonstration Program vehicles in the New York Clean Commute Demonstration Program enjoyed optimum conditions for economic sustainability but did not realize this goal. The New York vehicle MSRP was \$30,000 (including air-conditioning) and were leased at \$199/month and no down payment. The net lease point reflected the 10% Federal tax incentive, the \$5,000 New York State tax incentive, and a per vehicle grant from NYPA, yet never reportedly realized the goal of economic sustainability.

Even at consumer-driven price points, direct sales to consumers are much more complex and time-consuming than regular gasoline vehicles. In California, it took over one year to successfully place 170 *city* vehicles; in New York it took over 9 months to place 97 *city* vehicles. Urban EVs may be, at most, an emerging niche market, and they are very difficult to effectively target with media and press campaigns.

On a fully accounted basis, including research and development costs, Ford reports the Demonstration Program vehicles are even further removed from economic sustainability. Traditionally, vehicle manufacturers recover research and development costs with the profit from individually sold vehicles. Inasmuch as the Demonstration Program electric vehicles were not profitable, no such investment recovery was possible.

In addition, unique investment in support of demonstration programs is often required. For example, Ford designed a unique air conditioning system for the 115 Demonstration Program vehicles in the Georgia and New York Programs. Such unique investment for limited numbers of vehicles is a significant financial hurdle facing future demonstration programs.

Cost and timing of installation of the required power control station complicated the customer leasing process. In order to charge their vehicles at home, customers were required to install their power control station before taking possession of the vehicle from the dealer, and some customers encountered significant installation costs and complexity, often more expensive and time-consuming than initially anticipated.

It is important to note that cash incentives such as those used in California are far more useful in supporting economic deployment of electric vehicles than tax incentives. Tax incentives are available only to profitable for-profit businesses; they cannot be directly applied to financing mechanisms, such as vehicle lease agreements. The Demonstration Program used unique vehicle lease agreements in order to offer the customer a low-risk option and to maintain control of the Demonstration Program Fleet. Ford reports that changing the available tax incentives to cash incentives would further support achieving electric vehicle economic sustainability.

In order to continue to support economic sustainability of electric vehicles, it is vital that high levels of economic stimulus and financial support continue. Certain states, such as California, have begun reducing electric vehicle incentives, starting in 2003. This reduction in available per vehicle incentives may be premature given the current state of electric vehicle economic sustainability. However, with the currently pending Energy Bill, new incentives could open up niche markets that encourage adopting alternative-fueled vehicles into the mainstream.

In addition, nonmonetary consumer incentives continue to be required to help consumers make the switch to electric vehicles. These consumer incentives help support a market-based approach to increased electric vehicle use. Such incentives might include:

- Access to single-person high-occupancy vehicle (HOV) lanes
- Reduced registration fees
- Reduced road-toll fees
- Preferred reserved parking
- Reduced parking fees
- Reduced home or business electric rates for EV use
- Increased public charging infrastructure.

CONCLUSIONS

- Phase II—the ongoing monitoring of an operational field fleet—has been underway for about a year, and DOE’s Advanced Vehicle Testing Activity (AVTA) is highly involved with the monitoring of the Clean Commute Program units through a partnership with Electric Transportation Applications (ETA). AVTA/ETA’s implementation of this customer data collection and reporting on the Clean Commute Program will provide further information and insight into these areas of study.
- The THINK *city* Demonstration Program has achieved a high level of public awareness and level of acceptance by current owners, especially in the areas where the vehicles are located, as a result of significant and focused multifaceted campaigns on behalf of Ford and its partners. Such high levels of media exposure are required to implement large-scale Demonstration Programs such as the THINK *city* Electric Vehicle Demonstration Program Project.
- The Program has advanced economic sustainability of EVs but sustainability has not been fully realized. Despite the availability and utilization of public grants and incentives, the Demonstration Program as a whole does not indicate a sustainable market for EVs. However, selected applications do offer better economic sustainability than others. The most sustainable program in the Demonstration has been the New York Clean Commute Demonstration Program, with NYPA staying in touch with participants through e-mails and newsletters. Also, NYPA has been able to monitor the usage and behavior of the customers through periodic surveys conducted by AVTA/ETA.
- In order to continue to support economic sustainability of electric vehicles, it is vital that high levels of economic stimulus and financial support continue, as well as nonmonetary incentives (e.g., preferred reserved parking). States, such as California, began reducing electric vehicle incentives in 2003. This reduction in available per-vehicle incentives is considered premature given the current state of electric vehicle economic sustainability. The pending Energy Bill may stimulate niche markets in the adoption of alternative-fueled vehicles.
- Cost and timing of installing the required power control station complicated the customer leasing process. In order to charge the vehicle at home, installation of the power control station was required before taking possession of the vehicle from the dealer. Some customers encountered significant installation costs (outside of New York – NYPA paid for home installations) and complexity, which were often more expensive and time-consuming than initially anticipated.
- Finally, only extended programs such as these, along with ongoing monitoring and customer feedback, will engender feasibility and consumer acceptance for a full-scale public launch, and they will offer insight into other pilot-program opportunities in the future.

APPENDIX A
Photographs of TH!NK *city* VEHICLES

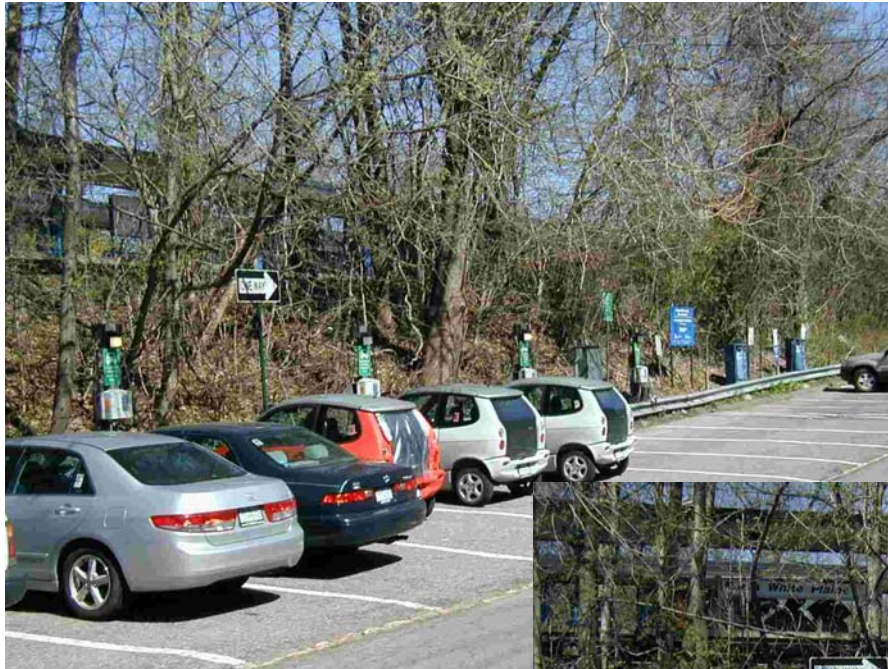
Brewster (Southeast) Train Station



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