California's Zero-Emission Vehicle Mandate
Linking Clean-Fueled Cars, Carsharing, and Station Car Strategies

Susan A. Shaheen, John Wright, and Daniel Sperling

To meet transportation emissions and energy consumption, policy makers typically employ one of two approaches—changing transportation behavior or changing behavior. These strategies include demand management tools, such as rideharing and vehicle control technologies that involve cleaner buses and fuel economy. Despite the benefits of a coordinated policy approach, these strategies are not normally employed separately. Nevertheless, they have been linked occasionally, for instance in the electric vehicle program that began in the 1990s. Station cars are vehicles used by transit riders at the start or end of a trip. In 1996, the California Air Resources Board (CARB) funded a study redesigning walkable air pollution by mandating that automakers introduce zero-emission vehicles (ZEVs) into the market. In 1998, significant variability was introduced in the empirical ZEV credit for very low-emission vehicles. In 2000, CARB left the ZEV mandate intact, but began considering new approaches, including station cars and carsharing. Carsharing is the short-term use of a shared-use vehicle fleet. In January 2001, recognizing the potential for station cars and carsharing to further improve air quality by reducing vehicle miles traveled—particularly with transit rotations—CARB proposed additional ZEV credits for vehicles to such programs. Thus, the mandate would formally link demand management and clean vehicles. Explored are carsharing and station car development, benefits reported, the ZEV mandate, and the government credit structure. Finally, policy and research recommendations are discussed for enhancing the success and effect of this combined approach.

An expanding economy and population means expanding travel demand. The benefits of increased travel are large. But the environmental and often unpalatable costs are also large, especially when travel is for single occupants in light-duty vehicles. Vehicle travel is expected to double by 2010 to 55,200 miles in California and increase more than 50% across the United States, resulting in more congestion, wasted time, and worsened air quality (1). Meanwhile, total highway capacity in the United States is increasing, with only about 2% added in the last 30 years. The next few decades will present a significant challenge—how to accommodate growing traffic demand while limiting vehicle emissions and energy consumption.

One response is enhanced transit. At present, only 4 to 5% of the nation's 118 million commuters use transit (2). One reason for low transit usage is the seasonality of public service; most people do not have easy access to transit services at the hours or destinations of a trip. Carsharing and station cars offer an innovative solution to transit access; they provide service with short-termin use of a vehicle to drive in and out of a transit station and offer locations (3).

Innovative policy approaches are needed to address energy, air quality, and congestion concerns. The universality of strategies may be grouped into those that change behavior and those that change technology. Travel-demand-management (TDM) strategies, such as rideharing, parking restrictions, and road pricing, are examples of behavioral strategies. TDM strategies reduce and eliminate auto trips and improve the efficiency of the transportation system. Technology-targeted strategies aim to eliminate the variables of a specific technology. These strategies include requirements to use cleaner fuels, reformulation of more stringent emission standards, and government-funded technology research and development. Typically, these two policy approaches (TDM and technology-targeted strategies) are employed separately (4). These are several exceptions, however. For instance, utilizing high fuel costs in Los Angeles provides a price-competitive alternative for low- and zero-emission vehicles. ZEVs are allowed to use high-occupancy-vehicle lanes in many regions. It is widely understood, though, that these synergies result from a combined approach (5).

A potentially attractive synergy can be examined for integration of clean vehicles with carsharing and station cars. The policy mechanism is California's Zero-Emission Vehicle (ZEV) Mandate. The motivation and historical precedent for the integrated ZEV initiative was a series of electric vehicle car programs launched in the 1990s (7-9). The linkage between the ZEV mandate and carsharing and station cars is the topic discussed.

CARSHARING AND STATION CARS

The principle of shared-use vehicles is simple: individuals gain the benefits of private car use without the cost and responsibilities of ownership. Instead of owning one's own car, a household or business accesses a fleet of shared-use vehicles and an on-demand basis. Individuals gain access to vehicles by joining an organization that maintains a fleet of cars and light trucks in a network of locations. Generally, participants pay a fee each time they use a vehicle (7).

Station cars are often shared, although not always. They facilitate transit access either on the home or destination end of a trip.
Carsharing can be thought of as organized short-term car rental — often located near transit stations — accessible in a convenient location throughout neighborhoods, office parks and college campuses. Car-sharing organizations (CSOs) are not often found in dense metropolitan areas, distributed throughout a dense network of neighborhood lots. Built and shared, in a similar way to a car, car-sharing programs are more flexible and attractive when seen as transportation modes that fill the gaps between transit and private cars and can link to other transportation modes and services. For long-distance travel, one might use a hotel's vehicle, or a car rental, or rail or bus, or a rental car, and for short-distance, one might walk, bike, etcetera. Bus or intercity travel, even routine activities, one might drive a shared rental vehicle. Shared cars provide the same customer benefits: they can also serve as mobility insurance in emergencies, and as a way of satisfying occasional vehicle needs and desires such as going grocery, pleasure driving in a sport car, etc., taking the family or kids (J. 10). The focus here is primarily on European car-sharing history and lessons learned and U.S. activities. Nevertheless, carsharing and car rental cars have gaining increasing popularity in Canada and Asia, particularly the use of advanced technology and electric vehicles in Japan.

Early History of U.S. Carsharing and Car Sharing Programs

During the United States, two formal carsharing demonstration research projects were undertaken in the 1980s. The first was Mobility Enter- prise, operated as a Purdue University research program from 1983 to 1986 in West Lafayette, Indiana (12, 13). Each household leased a very small "mini" car for short local trips and was given access to a shared fleet of "special purpose" vehicles (i.e., large sedans, trucks, and recreational vehicles). In this field test, the dedicated minivan was leased by participants with an average of 78% of the hours of the public vehicle miles traveled (VMT). In contrast, the carsharing fleet was used only 35% of the time that it was available to households throughout the experiment. A second U.S. carsharing program was the San Francisco Auto Rental (STAR) demonstration in San Francisco (12). The STAR company operated as a private venture from December 1983 to March 1985, providing individuals in an apartment complex use of a short-term vehicle (for less than five minutes up to seven days). Feasibility study funds were made available from the Urban Mass Transportation Administration and the California Department of Transportation. Users paid on a per-minute and per-mile basis until a maximum daily rate was reached. The members leased a fleet of 51 vehicles (44 cars, 5 wagons, and 2 light-duty trucks), with 2 additional vehicles available at backup during periods of peak demand. Membership peaked at approximately 350 participants (14).

This project failed halfway through the planned 3-year program. The primary problem was that many tenants were students who shared apartments and were not actually listed on the lease. Thus, it was often difficult to obtain vehicle payments from "unaffiliated" tenants. Another failing was the pricing structure of STAR's encour- aged long-term (more than 24 hours), as well as short-term (less than 24-hour) rentals. Long-term customers rented in long-distance tow- ing charges when the old, often poor-quality cars broke down several hundred miles from San Francisco. STAR's management tried to car courts by purchasing used economy-class vehicles, but this resulted in high repair costs. Also, STAR apparently offered too many models in each vehicle class, leaving members dissatisfied when a particular car was unavailable (Martin Russell, unattributed data).

Since then, General Motors research project was a 2-year program (1995-1997) study of shared car rentals in Bay Area Rapid Transit (BART) stations. For this BART project, Cooperwoman et al. (15) conducted an early market assessment of car sharing using a mail survey. Nearby 50 electric vehicles were used, including forty Personal Independent Vehicle Company City Buses from Norway, two Toyota electric double-decker vehicles with four-wheel-drive (2SV-4), and five Kew Savs from Denmark (17).

In conclusion, several station car programs were launched in the mid-1990s by rail transit operators in response to parking shortages at stations (and denying to the high cost of building more park- ing infrastructure). Electric utilities (relying on a potential market for battery-owned electric vehicles), and air quality regulations (seek- ing to reduce vehicle emissions and pollution) were among these programs. Of these programs have struggled with the high cost and low reliability of first-generation electric cars. Although there has been progress in the field of many electric car programs, as of early 2002 only a few had aggressively incorporated shared-use practices (i.e., the programs typically have few user-to-vehicle ratios). Nonetheless, it has seen experiments of "zero- emission" battery electric vehicles, considerability in use to reduce travel, encourage transit, and reduce pollution that inspired California
reigns to integrate the car-sharing and station car concepts into the ZEV managed corridor

Current Status of U.S. Carsharing and Station Car Programs

In the United States today, there are 7 active CSOs (Table 1), 4 station car programs (Table 2), 3 carsharing research pilots (GolConn, Intelligent, and ZEV Network Enabled Transportation (ZEV-NEET)), and over 10 programs currently planned for 2002 and 2003. Most CSOs follow the predominant European operational model: private individuals access cars from nearby neighborhood lots, renting them to the same kind. Several of these programs use advanced technology (i.e., multichannel, internet-based reservations, and vehicle tracking) to facilitate reservations, operations, and key management. Four are new to commercial business, six are integrations on a cooperative, and three are research pilots.


**Table 1: U.S. Carsharing Programs**

<table>
<thead>
<tr>
<th>Program Name, Location &amp; Website</th>
<th>Launch &amp; Business Model</th>
<th>Program Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dancing Rabbit Vehicle Cooperative (Ridgeline, MT)</strong></td>
<td>Cooperative</td>
<td>15 Members</td>
<td>Program is operated in the Dancing Rabbit Cooperative. Vehicles are fueled with biodiesel.</td>
</tr>
<tr>
<td><a href="http://www.dancingrabbitcoop.org">www.dancingrabbitcoop.org</a></td>
<td></td>
<td>1 Vehicle</td>
<td>1 Location</td>
</tr>
<tr>
<td><strong>Zipcar</strong></td>
<td>Commercial</td>
<td>2,500 Members</td>
<td>Program is located in community of 15,000 residents. Approximately 10 of 30 members are active users.</td>
</tr>
<tr>
<td>Boston, Massachusetts; Washington, D.C.; Auckland, New Zealand</td>
<td>Commercial</td>
<td>2,500 Members</td>
<td>Program is located in 15 community of 15,000 residents. Approximately 10 of 30 members are active users.</td>
</tr>
<tr>
<td><a href="http://www.zipcar.com">www.zipcar.com</a></td>
<td></td>
<td>96 Vehicles</td>
<td>88 Locations</td>
</tr>
<tr>
<td><strong>Carsharing Traverse</strong></td>
<td>Commercial</td>
<td>30 Members</td>
<td>Program is located in community of 15,000 residents. Approximately 10 of 30 members are active users.</td>
</tr>
<tr>
<td>Traverse City, MI</td>
<td>Commercial</td>
<td>30 Members</td>
<td>Program is located in community of 15,000 residents. Approximately 10 of 30 members are active users.</td>
</tr>
<tr>
<td><a href="http://www.carsharingtraverse.com">www.carsharingtraverse.com</a></td>
<td></td>
<td>250 Vehicles</td>
<td>17 Locations</td>
</tr>
<tr>
<td><strong>Boulder CarShare</strong></td>
<td>Non-profit</td>
<td>30 Members</td>
<td>This CSO operates a neighborhood carsharing program, with one, electric vehicle.</td>
</tr>
<tr>
<td>Boulder, CO</td>
<td>Non-profit</td>
<td>30 Members</td>
<td>This CSO operates a neighborhood carsharing program, with one, electric vehicle.</td>
</tr>
<tr>
<td><a href="http://www.carshare.org">www.carshare.org</a></td>
<td></td>
<td>4 Vehicles</td>
<td>1 Location</td>
</tr>
<tr>
<td><strong>City CarShare</strong></td>
<td>Non-profit</td>
<td>1,200 Members</td>
<td>City CarShare is a neighborhood carsharing program with household and business memberships. Vehicles are solar-powered battery electric vehicles.</td>
</tr>
<tr>
<td>San Francisco, Oakland, CA</td>
<td>Non-profit</td>
<td>1,200 Members</td>
<td>City CarShare is a neighborhood carsharing program with household and business memberships. Vehicles are solar-powered battery electric vehicles.</td>
</tr>
<tr>
<td><a href="http://www.citycarshare.org">www.citycarshare.org</a></td>
<td></td>
<td>40 Vehicles</td>
<td>17 Locations</td>
</tr>
<tr>
<td><strong>Racine Park Valley Vehicles (Racine, WI)</strong></td>
<td>Non-profit</td>
<td>20 Members</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td>Racine, WI</td>
<td>Non-profit</td>
<td>20 Members</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td><a href="http://www.racineparkvalley.com">www.racineparkvalley.com</a></td>
<td></td>
<td>4 Vehicles</td>
<td>1 Location</td>
</tr>
<tr>
<td><strong>Geo-Car</strong></td>
<td>Non-profit</td>
<td>2 Members</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>Non-profit</td>
<td>2 Members</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td><a href="http://www.geo-car.org">www.geo-car.org</a></td>
<td></td>
<td>2 Vehicles</td>
<td>2 Locations</td>
</tr>
<tr>
<td><strong>Clean Mobility CarShare</strong></td>
<td>Commercial</td>
<td>Before April 2002</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td>Long Beach, CA</td>
<td>Commercial</td>
<td>Before April 2002</td>
<td>This program operates a neighborhood carsharing program, with one, solar-powered battery electric hybrid vehicle.</td>
</tr>
<tr>
<td><a href="http://www.carshare.org">www.carshare.org</a></td>
<td></td>
<td>1 Vehicle</td>
<td>1 Location</td>
</tr>
</tbody>
</table>
TABLE 2 U.S. Station Car Programs

<table>
<thead>
<tr>
<th>Project Name, Location &amp; Web Site</th>
<th>Launch &amp; Business Model</th>
<th>Program Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Commute Program (New York, NY) <a href="http://www.amap2030.org">www.amap2030.org</a></td>
<td>2005, expansion</td>
<td>40 Members 40 Vehicles</td>
<td>This program initially began operations in 1995 with six electric vehicles. Serves a train station and-IBM facility. In fall 2001, new efforts were launched to expand to a total of 100 Ford Think electric vehicles along a commuter rail line.</td>
</tr>
<tr>
<td>Power Commute (Mountview, NJ) <a href="http://www.powercommute.org">www.powercommute.org</a></td>
<td>2007</td>
<td>20 Members 10 Vehicles 1 Location</td>
<td>Power Commute deploys electric vehicles to test areas in traveling on peak and off-peak, and sharing vehicles among ride-to-work sites. (Expected to serve local transit in future).</td>
</tr>
<tr>
<td>Anaheim Transportation Network RAV Program (Anaheim, CA) <a href="http://www.anaheim.org">www.anaheim.org</a></td>
<td>2000</td>
<td>18 Members 8 Vehicles 1 Location</td>
<td>Weyer can be used to replace vehicles that are currently on the road with electric vehicles.</td>
</tr>
<tr>
<td>Hertz-BART Program (San Francisco, CA)</td>
<td>2000</td>
<td>Commercial</td>
<td>6 Members 500 Vehicles (depending on demand) 1 Location</td>
</tr>
</tbody>
</table>

In 2001 and grew to 24 vehicles in its first 6 months. In the fall of 2001, City CarShare contracted to expand its operations into the East Bay communities of Oakland and Berkeley; several locations will be near BART stations. Other programs that launched in 2001 include Boulder City Smart Car and Rusting Fork Valley Vehicles & Aspen. As of Spring 2002, two more CSOs have recently launched; one in Chicago, Illinois, 10-gas station in New York City, and the other in Long Beach, California, publicly announced its launch in April 2002. They will provide electric vehicles, bikes, and scooters for short-term use on the Metrolink rail line.

The Clean Commute Program began as a demonstration in 1995. In June 2001, they reported seven members and five vehicles. In Fall 2001, this program announced plans to expand to 100 Ford Think vehicles along the commuter rail line in the New York City suburbs. Power Commute launched its station car operation in 1997. This program is operated by a transportation management association and maintains a stable ownership of 20-35 vehicles. In 2006, the Anaheim Transportation Network and Hertz-BART programs began. Both focus on providing transportation links to commuters and employment sites.

These "smart" car-sharing research projects are currently in operation in California. CarLot II was launched in Northern California in July 2001; it builds on the 1999 CarLot I field test and is a transit-based commuter program with 20 Honda Civics (Je-20). Southern California’s VillagetransitWrangels, which incorporates 25 Honda EV Plus electric vehicles,smartride, and unhoused computer technolo-gies, operates under the direction of University of California, Silver-side researchers. The third, ZEV-NET is a public-private partnership between Toyota and University of California, Irvine (UCI), consisting of 15 e-3s and smart technologies, shared among six employers located in the UCI office park. ZEV-NET plans to link with install 10 e-cars, 30 RAY-4 electric vehicles, and 10 Frix vehicles 2002.

As of March 2002, U.S. car-sharing and station-car programs collectively claimed 8,869 members and operated 419 vehicles from 227 locations. Strong interest in carsharing is continuing in other U.S. cities. In 2002 and 2003, additional efforts are planned in San Diego, Los Angeles, Sacramento, and San Francisco (California), Denver, Colorado; Newark, Delaware; Atlanta, Georgia; Silver Spring, Maryland; Minneapolis, Minnesota; Philadelphia, Pennsylvania; and Madison, Wisconsin.

Lessons Learned

Until the past decade, almost all efforts at organizing CSOs resulted in failure. For a variety of reasons, a new era began in the late 1990s in Europe. Armatures of CSOs are now firmly embedded and on steep growth trajectories. These organizations appear to provide social benefits and can increase the number of people to use car-sharing services, which is a great advantage in vehicle with virtually any other demand management strategy known. Particularly appealing is that car-sharing represents an enhancement to mobility and accessibility for many people, especially those who are less affluent.

Some lessons in how and when to launch car-sharing programs are becoming apparent. On the basis of a review of the literature, car-sharing programs can be modeled as most likely to be economically successful when:

1. They provide a network and variety of vehicles, serve a diverse mix of users, create joint-marketing partnerships, develop a flexible yet simple site system, and provide for easy emergency access to taxis and long-term car rentals. They are more likely to thrive when environmental consciousness is high, driving disincentives such as high parking costs and no congestion. The programs remain car-changing, car-occupancy costs are high, and alternative modes of transportation are easily accessible.

2. An even more important lesson, though not well documented, is the need for partnerships and mobility providers to offer enhanced products and services. More business-oriented car-sharing programs thrive by aspiring those that fail or lack strong leadership. But to
retain customer loyalty, they may improve services and reduce costs. Two linked strategies are being followed:

1. Coordinate and link with other mobility (e.g., smart parking systems) and mobility (e.g., employers and residential developers) services; and

2. Incentivize advanced commoditization, automation, and building technologies in conjunction with significant membership management.

Just advanced technologies are expensive and taking with other ser-
vice acquisitions. The question is how to make the customer base is, smart, so that smart-
car sharing programs have either sustain quite small or followed a
number of growth trajectories. This is a longer-term question.

For a manufacturer, the sharing program may be a model for
an entirely new business activity: innovative mobility service com-
panies. A vehicle ownership preferences and vehicles become more
modular and specialized, entrepreneurial opportunities may arise
an opportunity to assume the full costs and services of a household for
an individual's mobility needs in neighborhoods, work sites, transit
stations, and shopping centers, on the basis of mobility management.

These innovative mobility companies might have their insurance, regis-
трация, existence, and parking management, and could help
vehicle's a household's situation changes. One can imagine a future
in which pioneering carsharing programs combine their operational expertise with the entrepreneurial capabilities of advanced technol-
ogy suppliers to create mobility services that enhance our social,
economic, and environmental well-being. Although experience and evidence are not conclusive, there is reason to believe that "smart"
carsharing concepts and technologies provide the foundation to cre-
ate a new transportation solution. It is impossible to know what the future market size and its duration will be, although some signs
new directions are emerging (e.g., billing to employees, residential
and commercial managers, developers, and parking management
facilities). It is difficult to estimate demand for new technologies and
new attributes when consumers have experience with these prod-
utes and preferences and when automobile manufacturers are unsure of
the future. Further, understanding the demand for carsharing is especially
difficult because it implies some reorganization of a household's travel
patterns and lifestyle. People use and view their cars in many different
cutters, but they are incredibly flexible. They can be used as a
option for stressful travel, but also for leisure, quiet time away from
family and work, and office space. How important are these and activities
of how much, how much is the opportunity to use a car for leisure travel.

It is also unclear how much these preferences and their mobility
the incentives for carsharing will have in the future. Easy evidence from
Europe suggests up to 30% reduction in vehicle travel for the result
of travel patterns, new socioeconomic patterns, and urban work.

One would expect the net effect of these new patterns of ownership pat-
terns and innovative mobility services to be less vehicle travel, for
the numbers cited above. Indeed, this belief is the majority of the
people and sponsored companies in carsharing and station car programs.
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people and sponsored companies in carsharing and station car programs. 
• An additional credit multiplicative factor is offered based on the vehicle's energy efficiency.

• Beginning in 2007, new figures were used to calculate each automobile's ZEV requirement. This change is expected to increase the number of ZEVs required.

• Increased credits are provided for vehicles placed in "transit-oriented" systems (27).

This last change was made to recognize the potential for car-sharing and station car programs to improve air quality by reducing total VMT and cold-start emissions because of shared-use and the linkage of clean-fuel vehicles to transit. The staff proposal, which was approved on January 12, 2001, provides a general description of the transportation system's credit mechanism.

Additional proposed changes released on August 10, 2001, expanded and further defined the program. Under the most recent proposal, gasoline-electric hybrid ZEV vehicles placed at approved car-sharing programs or transit stations would receive additional credits as shown in Table 3. Yet, that scenario is not required to link "smart" car-sharing vehicles to transit in such programs but are eligible for additional credits if they do so. Furthermore, ZEV vehicles placed at transit stations are eligible for additional ZEV credits, without sharing use or access to advanced technology (27).

**LINKING ZEV VEHICLES TO CAR-SHARING AND STATION CAR PROGRAMS**

The motivation for the "transportation system" portion of the ZEV program is to encourage transit usage, which may be leveraged to include sport utility vehicles, pick-ups, and vans, thereby increasing the actual number of ZEVs required.

The percent increase in the number of ZEVs will gradually increase, from 10% in 2003 to 18% in 2018.

Additional credits are provided for vehicles placed in "transit-oriented" systems (27).

This last change was made to recognize the potential for car-sharing and station car programs to improve air quality by reducing total VMT and cold-start emissions because of shared-use and the linkage of clean-fuel vehicles to transit. The staff proposal, which was approved on January 25, 2001, provides a general description of the transportation system's credit mechanism.

Additional proposed changes released on October 1, 2001, expanded and further defined the program. Under the most recent proposal, gasoline-electric hybrid ZEV vehicles placed at approved car-sharing programs or transit stations would receive additional credits as shown in Table 3. Yet, that scenario is not required to link "smart" car-sharing vehicles to transit in such programs but are eligible for additional credits if they do so. Furthermore, ZEV vehicles placed at transit stations are eligible for additional ZEV credits, without sharing use or access to advanced technology (27).

**TABLE 3 ZEV Credits for Vehicles Placed in Car-sharing and Station Car Systems (Proposed)**

<table>
<thead>
<tr>
<th>Program Elements</th>
<th>ZEV (i.e., battery electric vehicles)</th>
<th>Advanced Technology - PHEV (i.e., compressed natural gas vehicles and hybrids)</th>
<th>FEVE (i.e., super ultra low emission vehicles with no evaporative emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrate Shared-use Veh and Advanced Technology</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Transit Linkage</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total Possible Additional Credits</td>
<td>9</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>
effects outside California result in part from the technology and con-
cepts being demonstrated and publicized — has also become other
states are also adopting the ZEV mandate. In fact, New York, Mass-
achusetts, Vermont, and Maine adopted California’s original ZEV
mandate, and others may follow in the future. If other states adopt
the mandate, then they must adopt the entire package of embedded
rules (although flexibility is available with regard to the timing and
phasing of the various requirements). This requirement is noted in a
federal law that requires all states to adopt either the national emission
standards (as promulgated by the U.S. Environmental Protection
Agency or California’s). There is no "third" standard allowed at all.
Thus, California’s ZEV credits for combining and station-car
vehicles will have a significant effect externally. Widespread growth
in demand for hybrid vehicle programs in California will, if successful,
provide a highly visible model for the nation, automakers, information
technology companies, and third-party service operators interested in
expanded market opportunities. And the transposition systems pro-
visions of the ZEV mandate will likely influence how those initiatives
evolve, perhaps sharply.

SUMMARY AND RECOMMENDATIONS

Smart carsharing and station cars provide a promising opportunity
to reduce vehicle travel, and the ZEV mandate we have been perhaps
the zero effective policy arguments for accelerating the development
and commercialization of clean-propulsion technology. The inte-
gration of carsharing and station cars with the ZEV mandate could
have important implications. This is an illustration of how creative
policy making can be used to integrate behavior and technology
strategies, and it also illustrates the need for regulations and pol-
icy makers to be flexible and sensitive to new knowledge and chang-
ing circumstances. The ZEV mandate of 2001 has greatly changed
since the mandate of 1990. And with the integration of carsharing
and station cars, the technology transformation implied by the ZEV
mandate may now spread more broadly into the design and use of
passenger mass-transport systems.

CARB has taken a broad responsibility. It has been respectful
of its role in the past by periodically revising the ZEV mandate to
reflect new knowledge and understandings. To play an effective and
beneficial role as CARB proceeds into broader transportation issues,
it will need to broaden and deepen its expertise and develop new
partnerships and networks of information gathering. In 2002, CARB
plans to finalize this regulation and begin developing strategies to
support these efforts in California. As present, CARB is exploring a
joint memorandum of understanding with two other state agencies
(California Department of Transportation and California Energy
Commission) to support the ZEV—carsharing/station car program
linkages. Issues that CARB will need to explore further include

• Role of advanced technologies in facilitating use and program
operations,
• Model agencies (e.g., carsharing and station cars),
• Economic viability,
• Legal and policy factors,
• Need for large-scale and coordinated efforts (e.g., inter-
operability among systems for users),
• Guidelines for acquiring ZEV credits,
• Public-private partnerships, and
• Effect assessment (e.g., societal and environmental system
effects).

The potential of this combined approach—demand and technol-
ogy management—is significant. In upcoming years, piloting, col-
laboration, and creativity will be needed to realize the benefits of this
approach. In working together, government agencies, local decision
makers, and private industry have the potential to create large-scale
carsharing/station car programs. Lessons learned will aid in this
process, as well as comprehensive measuring and evaluation. In
the final section, several policy and research recommendations are
outlined for the future.

RECOMMENDATIONS

As present, little is known about the social and environmental effects
of carsharing and station cars. A statistically significant database on
carsharing/station car program effects does not yet exist. We cannot
accurately assess how behavior, visibility, and actual social ben-
efits. Furthermore, there has yet not been significant “selling” in any
U.S. test. Indeed, several carsharing programs failed in Europe be-
cause they lacked economic of scale (i.e., few vehicles and high
overhead rates made profitability difficult to achieve). The hypo-
thetical that will scale (e.g., 1,000 vehicles and supportive policies
(e.g., ZEV mandate, reduced or canceled “permits” parking spaces,
partnerships with employers and de-staplers, and start-up subsidies),
carsharing programs can become economically sustainable.

Current and future efforts should focus on increasing vehicle and
member numbers and, in introducing the latest labor-saving technologies to reduce overhead and provide more-friendly services.
To gain a statistically valid data set on system benefits and costs.
Key questions should be answered:

• Can carsharing and station car systems facilitate transit access
and encourage use?
• Can they reduce parking needs at transit and work?
• Can they help attract and retain employees?
• Can they have a positive effect on air quality and other environmental goals?
• Can they encourage more careful tripmaking with regard to
distance and database traveled?
• Finally, can they become economically sustainable?

To answer these questions will require travel behavior analysis,
market research, and economic analysis, as well as investigation of
environmental and social effects, technologies and services needed,
technology standardization, and institutional (vest, e.g., insurance).
Finally, in linking the ZEV mandate to carsharing and station car
programs, an assessment of this policy should be conducted, which
looks at the role of subsidies and incentives that can help support
these programs, as well as the role of creative partnerships (e.g.,
transit discounts, parking space collaborations).

Over the next decade carsharing and station car systems may depend
on how well such programs can integrate advanced technologies—electric and wireless systems and cross-cut vehi-
cle and infrastructure. On the operations side, advanced technologies
need to be further developed to make carsharing services economi-
cally efficient to manage. Key research components include analy-
sing institutional issues (e.g., decentralizing the local institutions for
managing such programs, for instance, nonprofits or commercial),
deployment barriers (e.g., insurance costs), and vehicle technologies
and solutions are necessary for an operational perspective.

On the user side, carsharing services aim to provide as much flexi-
ibility and mobility as the private auto. Thus, advanced technologies

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are needed to make an individual's tripmaking more seamless, so users can easily access carsharing and station cars vehicles (even spontaneously) or switch modes quickly with little hassle. Information technologies will be critical to facilitating modal connectivity and improving reservations, real-time, and fleet management systems to enable convenient vehicle access and billing. Furthermore, user-friendly interfaces could be expanded to provide real-time travel information to users, so they will know vehicle locations, traffic conditions, time and travel costs, and how to use each system.

To conclude, the long-term potential and viability of carsharing and station cars programs could be strengthened through a combination of approaches, including:

- Cost-reduction strategies (e.g., scale, advanced technologies, and insurance);
- Policy incentives (e.g., parking management);
- Public-private partnerships;
- Partnerships with employers and developers;
- Increased user retention; and
- Local program support.

Although these fundamental issues and questions are noteworthily independent, a focused agenda is needed to help coordinate individual efforts and to concentrate research and evaluation in needed areas.

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