

The Civic Shaping of Technology: California's Electric Vehicle Program

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Constructivist technology studies have often cast government as one "social group" among many, reflecting a liberal pluralist view of politics. This article argues, in contrast, that due to the conceptions of citizenship conveyed by policy designs, governments have a special role to play in the shaping of new technologies. This argument is illustrated in the case of the controversial 1996 decision by the California Air Resources Board to significantly revise its electric vehicle program. The article shows that the board's decision changed the image of citizenship conveyed by its policy design, thus influencing the civic values embedded within electric vehicle technology.

Students of technology and democracy have often shown that, given the necessary institutional context, lay citizens can play a constructive role in government technology policy (Sclove 1995, 209-38; Laird 1993; Fiorino 1990). A promising but largely unexamined complement to these studies appears in recent policy research that examines the reciprocal influence of public policy on democratic citizenship (Soss 1999; Schneider and Ingram 1997; Ingram and Smith 1993). Building on a tradition of research on the political implications of different types of policy design (Wilson 1980; Lowi 1964), policy scholars have argued that in addition to citizens shaping policies, policies shape citizens. Some of this research draws on constructivist theories of science and technology (Schneider and Ingram 1997, chap. 6), but it has not gone very far in exploring the effects of policy design on the shaping of technology.

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This article argues that governments, unlike most private associations, convey implicit conceptions of citizenship through their policy designs and that these conceptions become embedded within technologies. Even in the absence of public participation, therefore, governments have a special role to play in shaping the civic characteristics of technology. This argument does not deny the centrality of grassroots movements for efforts to democratize science and technology (Feenberg 1999). But it suggests that such movements will be most successful when they (warily) enlist the support of sympathetic governments.

The claim that governments play a different role than other actors in shaping technology speaks to ongoing debates within science and technology studies (STS) about the character of politics and political action. As internal critics have repeatedly noted (Wynne 1996; Winner 1993; Russell 1986), STS case studies often treat government as either a neutral arbiter of group competition or simply one “social group,” “system component,” or “actant” among many.¹ This conception of government echoes the liberal pluralist notion that public policy develops as an automatic output of interest group competition (Dahl 1961). Liberal pluralism provides an important counter to unitary conceptions of political sovereignty and usefully illuminates government responsiveness to diverse social groups. But it underestimates the capacity of governments to design and implement policies that challenge dominant groups (Skocpol 1992). Liberal pluralism also tends to neglect the empirical effects of the distinctive normative claims placed on governments ostensibly committed to democratic principles (Connolly 1969).

This article advances an alternative to the pluralist conception of policy and technology by examining the 1996 decision of the California Air Resources Board (CARB) to revise its Zero-Emission Vehicle (ZEV) program, a technology-forcing regulation that included a controversial sales mandate for electric vehicles (EVs). During the early years of the ZEV program, between 1990 and 1994, CARB’s policy design promoted a participatory conception of citizenship, both in its explicit solicitation of public involvement and its implicit endorsement of short-range EVs conducive to New Urbanist programs for civic renewal. By 1996, however, CARB had made two significant changes in the ZEV policy design. The agency changed the relative importance of the various technical criteria according to which it evaluated EV technology, and it changed the factors according to which it assessed public willingness to purchase EVs. These changes culminated in CARB’s decision to postpone its 1998 EV sales mandate. Each of these policy changes, although made in a context of limited information and various political and ideological pressures, was in part the result of autonomous decisions by CARB policymakers.² These changes in the ZEV policy design

shifted the conception of citizenship it conveyed toward a view of the public as passive consumers of public policy. This shift, in turn, pushed EV development toward high-performance technologies that cater to consumers' existing expectations and narrow self-interest, thus also promoting a consumerist conception of citizenship. The empirical analysis is preceded by an overview of the ZEV program, a brief consideration of alternative explanations, and a discussion of the concepts underlying participatory policy design.

Overview of the Zero-Emission Vehicle Program

CARB, a unit of the California Environmental Protection Agency, is the principal agency responsible for regulating air quality in the state. Established in 1967, the board today employs more than one thousand scientists, engineers, and other staff members. CARB sets and enforces emission standards for motor vehicles, fuels, and consumer products; monitors air quality and sets air quality standards; conducts and sponsors research; offers compliance assistance to business; conducts public outreach programs; and oversees and assists local air quality districts.³ In September 1990, CARB adopted a Low-Emission Vehicle and Clean Fuels program requiring that, among other things, by 1998 a minimum of 2 percent of the vehicles offered for sale by major automakers in California be ZEVs. The ZEV mandate was to increase to 5 percent in 2001 and 10 percent in 2003. Automakers were to pay a fine of \$5,000 for each vehicle by which they fell short of the quota. Since EVs represented the only near-term option for building a vehicle with no tail-pipe emissions, the regulation created a surge of international interest in EVs.

Although the ZEV mandate was only one element in the agency's overall clean air strategy, many observers believed it would eventually provide large air quality benefits for California.⁴ Unlike gasoline cars, EVs do not produce more emissions when old or when driven erratically. Nor do they have emissions control technologies that can malfunction or be disabled. They have fewer moving parts than conventional cars, require less maintenance, produce very little noise, and can be recharged over night at home. And, of course, EVs produce no emissions from the vehicle itself.⁵ Despite their high initial price, advocates argued that economies of scale, as well as lower operating costs, would soon make EVs cost competitive with conventional vehicles (Hall 1995). Many observers also thought the ZEV mandate would stimulate the creation of high-tech jobs for recently displaced aerospace workers in Los Angeles (Wolff et al. 1995), suggesting to some a model for integrating environmental and industrial policy (Brown et al. 1995).

Given the uncertainties in the rate and nature of technological development for EVs, CARB provided for biennial reviews, during which the agency would hold both internal meetings and public hearings to analyze the program's implementation. At the 1992 and 1994 reviews, CARB decided that EV development was on course to meet the 1998 deadline. The press reported that CARB faced "intense lobbying" from the auto industry but that the agency "unequivocally upheld its revolutionary mandate" (Cone 1994). Indeed, the major players in the auto and oil industries lobbied aggressively against the mandate from its inception, going so far as to publicize inflated EV price quotes to stimulate public opposition to the mandate (Shnayerson 1996, 213, 247).

The third biennial review was preceded by a series of public workshops on the ZEV program, during which CARB received more public comment than on any other program in CARB history, the vast majority opposing any change to the ZEV program (Evashenk 1999). Nonetheless, the agency decided to eliminate the 1998 and 2001 ZEV mandates, retaining only the 2003 requirement that 10 percent of all cars sold in California have zero emissions.⁶

Alternative Explanations

Technical Imperatives

One explanation for CARB's decision to abandon the 1998 ZEV mandate holds that it was simply an acknowledgment of technical necessity. Defending the decision at a press conference, CARB Chairman John Dunlap remarked, "This is not a political decision, it is a technical decision. Quit looking under every rock for a deal, because there isn't one" (Cone 1996). Similarly, CARB's (1996a) final statement of reasons states,

Reasonable minds may differ about the Board's determination as to the most likely outcome if the existing regulatory requirement was retained, but the Board has been charged by the Legislature with responsibility to make this decision and is constituted of members with special expertise necessary to make such a decision. (CARB 1996a, 77)

CARB's Battery Technical Advisory Panel had found that production-ready lead-acid and nickel-cadmium batteries could achieve only about half of the targeted 100-mile EV range.⁷ Enforcing the mandate would therefore taint the public image of EVs and "poison the market" for years to come (CARB 1995, 149-50; cf. Kalhammer et al. 1995, III.2-10).

Technical factors no doubt strongly influenced the agency's decision to eliminate the 1998 deadline. But STS research has long made clear that the policy implications of technical information are rarely straightforward (Ezrahi 1980). As the following discussion shows in detail, CARB's inference from the Battery Panel's report to the policy change depended on non-technical and highly questionable assumptions about probable consumer behavior. Moreover, CARB was well aware that some experts contested the Battery Panel's findings.⁸ Technical imperatives, therefore, could not have been the sole cause of the agency's decision.

Economic Imperatives

Another potential explanation, also advanced by CARB, sees the agency's decision as dictated by the need to avoid jeopardizing economic growth. CARB recognized, of course, that mandates and subsidies can help correct the market's bias against new technologies such as EVs. But the board repeatedly argued, "For the ultimate success of the program, EVs must stand on their own and successfully compete in the marketplace" (CARB 1996a, 51). The agency's concerns were heightened by the claim that meeting the 2 percent mandate would require automakers to subsidize the sales price of EVs by increasing the price of new conventional cars. Mandate opponents argued this would constitute a drag on the California economy (Lyons 1995).⁹ This argument gained force with the mid-1990s revival of the California economy, which robbed the mandate of its rationale as a job creation program. In these respects, the agency's decision might be seen as an instance of what Lindblom (1982) called the "market as prison" phenomenon. Because government regulation tends to produce a decrease in business investment, political reform is necessarily constrained by the "prison" of the market.

Lindblom (1982) also argued, however, that the conflict between government regulation and economic efficiency is as much a matter of free-market ideology as actual economic constraints (pp. 333-34). Indeed, credible predictions about the ZEV program's economic impact varied enormously (Lyons 1995; Hall 1995; Huang 1995), depriving CARB of clear expert guidance on this issue. In addition, an increase during the mid-1990s in the influence of market-oriented approaches to politics—as seen in the emergence of state and federal efforts to "reinvent government" by reducing its scope and increasing its efficiency, the 1994 ascendancy of the Republican Party in the U.S. Congress, the 1996 presidential campaign of deregulation advocate and California Governor Pete Wilson—may have led CARB to emphasize concerns about the ZEV program's economic merits. CARB's appeal to economic

constraints thus concealed a necessarily political decision, shaped in part by free-market ideology.

Interest Group Lobbying

Perhaps the most common explanation for CARB's policy change focuses on the extraordinary pressure brought to bear on the agency by the auto and oil industries. According to a *Los Angeles Times* reporter, the agency's decision marked "the first time in three decades that the board has rescinded a regulation under pressure from the auto and oil industries it regulates" (Cone 1996). Although interest group lobbying was an important factor, assuming that it tells the whole story reflects a liberal pluralist view of politics, described above, accompanied by characteristic limitations.

First, the liberal pluralist interpretation mistakenly discounts CARB's autonomous decision-making capacity. CARB's initiation of the ZEV program is difficult to explain with pluralist theory, since leading environmental groups did not begin lobbying for government promotion of EVs until after CARB had established the program. Nor can pluralism fully account for the program revision, precisely because it was "the first time in three decades" that CARB had failed to resist the auto industry, which suggests that other factors played a role. Although state environmental bureaucracies were long the playthings of powerful interests, during the 1980s, partly in response to the devolution of federal environmental policy, state environmental agencies made major improvements in their effectiveness and independence (Ringquist 1993). Like the federal Environmental Protection Agency (Landy, Roberts, and Thomas ([1990] 1994), many state environmental agencies today possess the necessary resources to competently evaluate technical claims, to promote informed public participation, and to provide democratic leadership in the public interest. Indeed, CARB is widely recognized as the world's leading air quality regulatory agency (Lowry 1992, chap. 4). From this perspective, the pluralist explanation gives too little credit to the relative autonomy of CARB policymakers.

Second, the liberal pluralist account gives too much credit to the direct exercise of political power, neglecting the subtle effect of ideologies on political decisions (Lukes 1974). The influence of ideology is often most apparent in the reasons policymakers offer for their decisions (cf. Fischer and Forester 1993). I thus argue below that much of the reasoning underlying CARB's revision of the ZEV program was grounded in the ideology of "automobility"—the conceptual, political, and material framework that makes the gasoline automobile a fundamental component of daily life in advanced

industrial societies (Rajan 1996, 6-8). This ideology is promoted by the auto industry, to be sure, but it is also deeply ingrained in contemporary culture. As we will see, the ideology of automobility greatly restricts prevailing views on what a motor vehicle is in the first place.

Policy Design, Citizenship, and Public Goods

Although each of the above explanations illuminates important aspects of why CARB revised the ZEV program, they neglect both political ideology and political action. The following account includes elements of each of the above, but it emphasizes (1) the ideological context within which CARB established and revised the ZEV program, (2) the agency's autonomous capacity to challenge powerful interest groups and ideologies, and (3) the impact of the ZEV program on the relationship between EV technology and citizenship.

Support for this perspective appears in recent studies on policy design, cited in the introduction, which have shown that the methods, aims, and public justification of a policy convey messages about the nature of citizenship. People derive their conceptions of citizenship from multiple and diverse sources, but direct and indirect experiences with public policy are among the most influential. A policy design's image of citizenship generally has the greatest effect on its explicit "target population" (e.g., union members, immigrants, the elderly, etc.). But some policies have very broad targets (e.g., women and minorities), and even narrowly targeted policies may convey images of citizenship that filter through the mass media into the general public (cf. Schneider and Ingram 1997, 84-89).

A welfare policy, for example, that makes excessive use of economic incentives to direct behavior may encourage recipients to act according to their narrow self-interest; a crime prevention policy that targets a particular racial group may foster distrust of government within that group; a job-training program with biased entrance criteria may convey the message that some types of people are incapable of learning new skills; and any policy design justified solely on the basis of technical expertise, especially when expert recommendations contradict public input, may convey the message that lay citizens are not welcome participants in the policy process. In sum, poorly designed policies may foster a "weak" conception of citizenship, according to which the private pursuit of personal happiness leaves little room for public involvement in the discovery and pursuit of shared goals.

In contrast, policy designs that treat citizens as equals, encourage their capacity to learn, and elicit their participation can contribute to the develop-

ment of “strong” conceptions of citizenship among those who come into contact with the policies. The idea of strong democratic citizenship can be loosely defined as the view that, given the necessary context, individuals can cooperate with others to create and pursue common goals through the exercise of political power (Barber 1984, chaps. 8-9). The strong conception of citizenship is implicit in the widely endorsed, if frequently neglected, notion that governmental legitimacy rests on the expressed will of the governed. In a democratic society, governmental legitimacy cannot be secured by merely satisfying the substantive needs of the population. Legitimacy also depends on the perception that procedures exist through which ordinary citizens play a role—not always, not on every issue, but at least some of the time, on some issues—in the creation of public policy. If governmental legitimacy depends, in part, on such procedures, democratic governments have a responsibility to develop policy designs that not only address substantive problems but also foster the norms, practices, and institutions that sustain lay participation in politics.

The idea of participatory policy design depends on a somewhat problematic distinction between the roles of consumer and citizen (Sagoff 1988, 7-14). As consumers, some have argued, individuals make decisions according to self-regarding preferences, aiming to maximize their private welfare. As citizens, people base their decisions on shared values, aiming to promote the public good. This distinction has been helpful in revealing the flaws of the widespread assumption that both economic preferences and political decisions obey the same logic of personal utility maximization and can be ranked in a single hierarchy (cf. Sen [1978] 1990). The consumer/citizen distinction has made it easier to understand how, as citizens, people might support policies that contradict their consumer interests—for example, support for increased public school funding among parents who send their children to private school. A key problem with the consumer/citizen distinction, however, is that it usually relies on the implausible assumption that self-interested consumers radically transform themselves simply upon entering the public sphere. This has left defenders of the distinction open to the objection that, when it comes to *acting* on expressed preferences, the consumer role usually dominates (Diekman and Preisendörfer 1998).

Lewinsohn-Zamir (1998) has persuasively addressed this objection by arguing that the distinction between consumer and citizen rests not on the distinction between private preferences and public values but on the degree to which individuals believe a political environment exists that supports other-regarding action.¹⁰ People maintain both self-interested and other-regarding preferences in both private and public life, but they only act on their other-regarding preferences if they trust others to do the same. Other-regarding

behavior is more frequent in political than market settings to the extent that people believe political institutions provide an effective means of realizing their other-regarding preferences.

This raises the obvious question of what counts as a political setting. Lewinsohn-Zamir (1998) defines political and market settings according to the goods with which they are concerned (pp. 399-402). Politics deals with public goods—streets, parks, clean air, and so on—that are indivisible and nonexcludable, and must therefore be shared. Markets deal with private goods—food, houses, cars, and so on—that are consumed by individuals and cannot be shared. Because people must share public goods with others, Lewinsohn-Zamir (1998) argues, they tend to think of public goods in terms of their other-regarding preferences (p. 400).

Many ostensibly private goods, of course, have salient characteristics of public goods. Green (1992) thus classifies goods along a continuum between fully public and fully private, according to four criteria: excludability, individual or collective payment, personal or social consumption, and contribution to the public welfare (pp. 132-33). Electric vehicles fit into Green's category of "mixed" goods. Like the consumption of gasoline that is taxed to fund public roads, the consumption of EVs is personal and exclusive, and payment is individual, but by reducing air pollution, EVs also contribute to the public welfare.

Combining Green's notion of mixed goods with Lewinsohn-Zamir's analysis of other-regarding behavior, we can say that people are more likely to act toward a particular good in light of their other-regarding preferences when (1) they believe the good is either a public or mixed good, and (2) they trust others to do the same. This holds true regardless of whether action takes the public form of voting or the private form of purchasing something in the market. Indeed, there is a long history of efforts to effect political change through consumer boycotts, socially responsible investing, environmentally sound products, and other forms of publicly interested market activity. Consumer purchasing decisions, of course, are no substitutes for more collective forms of political action. Public-interest consumerism also risks obscuring the need for more fundamental political change. But given the political dimensions of many consumer products, and the centrality of consumerism to contemporary conceptions of personal identity, it makes sense to see politically informed consumer choices as acts of democratic citizenship.

Although any association involved in shaping new technologies might convey a strong image of citizenship, political associations have a special obligation to do so.¹¹ Most people are members of many different associations, but for citizens of a democratic state, political memberships have "a certain practical pre-eminence" over other memberships (Walzer 1992, 105).

This does not mean that citizenship is or should be valued over other social roles, many of which appropriately elicit greater time, energy, and affection than citizenship. But only political associations have as their primary purpose the establishment of rules and conditions that govern citizens' interactions in the other associations to which they belong. In a democratic society, fulfilling this purpose depends, in part, on promoting a strong conception of citizenship. Of all the associations involved in shaping technologies, therefore, only political associations have the distinct purpose of shaping their civic characteristics, that is, their implications for conceptions and practices of citizenship.

The claim that policy designs affect public conceptions of citizenship does not imply a neglect of policy's instrumental effectiveness. Effective policy implementation depends on public compliance with the law and often relies on active public involvement as well (Schneider and Ingram 1997, 81). Public officials, therefore, have not only normative but also instrumental reasons for promoting strong conceptions of citizenship. Sometimes, of course, the instrumental and civic goals of policy conflict, in which case policymakers should aim to strike a balance. Policymakers should adopt a policy actively supported by informed citizens, as long as it is not entirely ineffective, even if it is somewhat less effective than an alternative policy. Citizens do not become responsible without being given responsibility, and democracy depends on the freedom to make mistakes.

Finally, it is important to recognize that the voluntarism reflected in the notion of participatory policy design need not exclude consideration of structural factors. The design of public policy is always constrained by an "issue context" composed of political interest groups, institutional cultures, and prevailing constructions of political problems. The issue context is itself shaped by a broader "societal context" defined by established values and practices. The societal context in turn is shaped, in part, by policy designs and the conceptions of citizenship they convey (Schneider and Ingram 1997, 73-81).

The Rise and Fall of the 1998 ZEV Mandate

Automobility and the Politics of Criteria

Before examining CARB's revision of the ZEV program, it is important to understand how the program initially challenged the prevailing conception of automotive technology and the ideology of individualism and privatism it supports. As EV advocates often point out, during the early years of automotive

technology, it was entirely unclear whether future automobiles would run on electricity, steam, or gasoline. Indeed, most observers believed all three options would coexist indefinitely, each finding its own market niche in a “hybrid” transportation system (Kirsch 2000, 216-21). Gasoline engines had a number of technical advantages, but their eventual dominance over the entire transportation system owed much to the efforts of wealthy sportsmen and businessmen who pushed for a technology that fit their purposes of automobile racing and long-distance demonstration runs (Hård and Knie 1994). EVs, in contrast, were favored by women who lacked the power to promote their preferred technology.¹² Once the very definition of an “automobile” had become equated with the gasoline engine, it became increasingly difficult to challenge its societal dominance. Indeed, for the past eighty years, automotive technology has remained almost exclusively within the image of a “race-travel-limousine”: a vehicle that can transport individuals in comfort at high speeds for 300 miles on a single tank of gas (Canzler and Knie 1994, 40-45).

Today this conception of automotive technology is intertwined with an infrastructure and ideology of automobility that poses serious obstacles for democratic citizenship. People have become highly dependent on their cars for both work and leisure, and total driving time increases every year.¹³ Automobiles thus impose compulsory privacy on growing portions of daily life, fostering a lack of concern with public affairs (Rajan 1996, chap. 3). In addition to being a major source of air pollution, conventional automobiles contribute to suburban sprawl, which sucks population and investment capital out of core urban areas. This exacerbates economic inequality and racial segregation, imposing further burdens on democratic citizenship (Bullard and Johnson 1997). Despite these social and environmental costs, the privatism fostered by automobile use is compounded by the prevailing tendency to see automobiles themselves as strictly private goods. Car-sharing programs have had very limited success, and compared with other areas of environmental politics, transportation policy and automobile regulation have rarely evoked much public involvement. The privatism fostered by automobility seems to discourage popular participation in automotive politics itself (Rajan 1996, 70-71, 156-60).

To be sure, conventional automobiles are not essentially antidemocratic technologies. In Progressive Era Los Angeles, for example, gasoline automobiles provided a quasi-democratic alternative to the poor service and corrupt practices of the trolley companies (Bottles 1987). To adopt a phrase from Winner ([1980] 1986), conventional automobiles are “strongly compatible with” individualism and privatism (p. 32). But the extent to which automobiles foster these values, and the extent to which these values threaten democracy, depends on the material and ideological context. Individuality and privacy,

after all, are among the key values of any liberal democracy. In contemporary advanced industrial societies, however, automobility tends to foster the dominance of these liberal values over the democratic values of cooperation, community, and commitment to the public good.

By compelling the auto industry to develop EV technology, and by publicly defining EVs as mixed public-private goods, the initial ZEV program posed a significant challenge to the ideology of automobility. Since the 1970s, of course, various hobbyists, businesses, and governments have shown renewed interest in experimenting with EVs (Fogelberg 1998, 48-54). But these precedents do not detract from the fundamentally innovative character of CARB's ZEV program, which becomes clear in light of two considerations.

First, as mentioned above, CARB's establishment of the program owed little to interest group lobbying. The public hearings that preceded the adoption of the ZEV program focused on the other three emissions classifications included in the Low-Emission Vehicle program and included very little discussion of ZEVs (CARB 1991; Fogelberg 1998, 57). Indeed, both public debate and private investment followed rather than preceded CARB's announcement. According to a CARB staff member, "It appears there was a pent-up demand to start developing electric vehicles and advanced batteries that was unleashed by the ZEV mandate" (Cackette 1995, 54). Moreover, given CARB's history and reputation, it seems reasonable to accept the agency's claim that it adopted the ZEV program to reduce air pollution (CARB 1991).

Second, the initial ZEV program employed a set of technical criteria that challenged the "race-travel-limousine" image of automotive technology, according to which cars are strictly private goods. From the beginning, CARB evaluated EV technology with the standard criteria of range, acceleration, battery life, and cost. In the early years of the program, however, CARB (1994) argued repeatedly that in addition to these criteria, "it is important to consider features like efficiency, maintenance, safety, durability, and environmental impact" (p. 12). Indeed, in 1994, CARB undertook an explicit comparison of EVs and internal combustion engines according to the criteria of economic cost and environmental impact (pp. 39-51).¹⁴ In this comparison, EVs came out far ahead. Even when defending its program revision, the board emphasized the importance of using a wide range of criteria to evaluate EVs:

Staff believes that the differences between EVs and gasoline vehicles are likely to become their strongest attraction. . . . [W]hile early market EVs may not offer ranges comparable to gasoline vehicles, they will offer the new convenience of home recharging (no trips to the gas station), along with other differences that

make them unique, such as a quiet motor, long life, less maintenance (e.g., no oil changes or tune ups), reliable and durable electronic components, and peppy in-city acceleration, as well as the clean air benefits of zero tailpipe and in-use emissions. These benefits will be especially attractive to today's new car buyers, who typically own at least one other vehicle, and therefore may be interested in a vehicle with these advantages even if it does not offer the range of a gasoline car. (CARB 1996b, 19)

By defending the importance of alternative technical criteria, the ZEV program partially reopened what STS scholars have called the "interpretative flexibility" of a technological artifact (cf. Pinch and Bijker 1984, 419-24; Fogelberg 1998). It became more possible than at any time during the past eighty years to think realistically about an alternative to the race-travel-limousine. Moreover, by emphasizing the social and environmental benefits of EVs, CARB helped define EVs as something more than a consumer product. The agency effectively presented EVs as mixed public-private goods.

Automakers and entrepreneurs around the world responded to CARB's defense of alternative criteria with the promotion of a wide variety of EV technologies. At least one of these alternative technologies, the "neighborhood electric vehicle" (NEV), challenges the individualism and privatism associated with conventional automobiles (Sperling 1995, chap. 4). NEVs are lightweight, low-cost, low-speed, short-range EVs, designed to balance the values of environmental protection, individual mobility, and local community. Their low cost and ease of operation promise increased mobility and social membership for poor people, the elderly, and people with handicaps. Their short range (25-30 miles) and low top speed (25 mph) make NEVs a perfect complement to New Urbanist models of city planning that emphasize mixed-use development, pedestrian safety, and public space (Duany, Plater-Zyberk, and Speck 2000). Insofar as political participation is fostered by an urban setting with these attributes, NEVs may be said to embody strong democratic values.

Given their performance limitations, NEVs are intended to complement rather than replace conventional vehicles, just as many multicar households currently use a pickup, van, or sports car for purposes not served by a midsize sedan. NEVs thus revive the turn-of-the-century notion of a hybrid transportation system, mentioned above, in which different automotive technologies serve different purposes. NEVs are not a panacea, of course, for the problems associated with conventional automobiles. But in combination with other policy measures, NEVs could be a key ingredient in a near-term strategy to reduce air pollution *and* a long-term strategy to combat the erosion of civic life associated with urban sprawl.

Unfortunately, during the course of the ZEV program, CARB made significant changes in its criteria for evaluating EV technology. Despite its repeated acknowledgment that potential EV buyers would consider a variety of criteria, the statements quoted above and in the next section suggest that CARB increasingly emphasized the criteria of range and cost.¹⁵ This narrowing of criteria necessarily put all types of EVs at a disadvantage in comparison with conventional automobiles.

Moreover, the attributes of long range and low cost primarily benefit individual EV owners. CARB's shift in criteria thus conveyed an image of EVs as private rather than mixed public-private goods. As suggested above, people are less likely to govern their behavior toward a private good according to their other-regarding preferences. In addition, studies have found that willingness to pay for private goods is more sensitive to price than willingness to pay for public or mixed goods (Green 1992). This suggests that the initially high price of EVs may pose less of an obstacle if EVs are seen as mixed goods. Ironically, the agency's concern for consumer preferences led it to emphasize technical criteria that could be expected to weaken consumers' resolve to purchase EVs.

The board's shift in technical criteria was driven by neither technical necessity nor consumer demand. Several studies have found that EV drivers are generally satisfied with EVs that do not meet the performance criteria established by conventional automobiles. In a 1997 study of Swiss EV drivers, for example, 50 percent reported that they were either "absolutely satisfied" or "rather satisfied" with the range of their EVs (Knie et al. 1997, 88). Satisfaction with EV range among drivers of Kewet and Microcar models reached 60 and 70 percent, respectively. Among EV drivers in Berlin, 62 percent said they were satisfied with the range of their EVs (Knie et al. 1997, 70). Even General Motors's own PrEView test program, which between 1994 and 1996 loaned prototypes of GM's EV1 to 700 drivers in 11 U.S. cities for two-week periods, found that 80 percent of test participants were satisfied with the range of their EVs (Purcell 1995). These studies are admittedly biased by their reliance on current EV owners, who are presumably predisposed toward EVs. Nonetheless, the studies suggest that although range is an important issue in many drivers' minds, it is often not the most important issue. Nor has limited range prevented a high degree of overall satisfaction among EV drivers.¹⁶

More than technical or economic necessity, CARB's narrowing of criteria was a response to industry lobbyists who pressured CARB to emphasize criteria of range and cost. Environmentalists lobbying for the preservation of alternative criteria, although supported by most of the public, lacked the

industry's political clout. This explanation also remains incomplete, however, until it is made clear that the industry's clout owed much to the infrastructure and ideology of automobility. Moreover, CARB has repeatedly shown its capacity to challenge both automobility and the auto industry. Despite various constraints, the agency had the capacity to continue giving due weight to social and environmental criteria. It instead gradually focused its attention on range and cost, thus helping to define EVs as strictly private goods.

Consumer Surveys and Public Deliberation

CARB reinforced the effects of its shift in technical criteria with a corresponding shift in its assessment of public willingness to purchase EVs. Whereas the ZEV program initially emphasized the civic capacities of California citizens, especially their potential to engage in public deliberation and experiential learning, over time the agency became fixated on a narrow conception of short-term consumer preferences.

The original 2 percent ZEV mandate would have required the sale of about 20,000 EVs in California in 1998. From the beginning, both critics and defenders of the ZEV program commissioned consumer surveys to predict whether automakers would be able to sell that many EVs. In its April 1994 Staff Report, CARB drew a very different conclusion from consumer surveys than it would in justifying the program change two years later. According to the CARB (1994) report,

Surveys that are based upon stated preferences of consumers have limited use for a new product line such as electric vehicles, as they tend to measure consumer uncertainty rather than informed opinions. As consumer knowledge of electric vehicles increases, market studies may be better able to capture the value of electric vehicles attributes. . . . Once survey participants reflected on their travel patterns and the potential benefits of home recharging, their perceived range needs were substantially lower than previous market surveys would suggest. (Pp. 34-35)

In this statement from 1994, when the agency was still defending the 1998 ZEV mandate, CARB discounted surveys that showed low consumer enthusiasm for electric vehicles. It argued that surveys only showed consumers' lack of information. CARB claimed that once consumers were properly informed and had reflected on the issues—that is, once they had deliberated as citizens—they would buy EVs.

In 1996, CARB again discounted consumer surveys as unreliable predictors of consumer behavior. This time, however, the board ruled out the possibility of creating “informed opinions.” Instead, CARB (1996a) argued that

actual consumer behavior would not support the sale of enough EVs to meet the 2 percent quota in 1998:

Certainly, public surveys indicated that the majority of Californians supported the original ZEV regulation and comments received at public workshops and hearings demonstrated that the majority of vocal stakeholders were against modifications to the regulation. But this does not necessarily indicate how the majority of Californians, *as consumers* [emphasis added], would view the ZEVs produced by manufacturers in 1998. Political polls and public opinion surveys may not accurately reflect actual consumer purchase behavior. (Pp. 34-35; see also 42, 77)

While this statement from 1996 shows the same distrust of consumer surveys as in 1994, the later statement extends this distrust to citizens themselves. The board explicitly discounted citizens' own statements regarding their willingness to purchase existing EVs. The agency thus conveyed an image of its constituents as self-interested consumers rather than as citizens potentially capable of acting in accord with their self-described other-regarding preferences.

Despite agency statements to the contrary, CARB documents suggest that this change in the agency's use of consumer surveys was in no way dictated by the results of the surveys themselves. At the June 1995 CARB public workshop on EV marketability, workshop participants presented CARB with 1998 EV sales estimates ranging from 3,500 to 98,000 units (CARB 1995, 122). These studies were generally of two basic types: technical constraint studies, which assess the number of households that could, in theory, meet their daily range requirements with an EV; and stated preference surveys, which ask respondents hypothetical questions about the type of vehicle they would consider buying. The former tend to produce very high estimates and the latter very low estimates of EV sales (Kurani, Turrentine, and Sperling 1996).

Even though CARB defended the proposed elimination of the 1998 mandate by referring to EV market research, *the agency never stated which studies it considered most reliable*. Indeed, interviews with CARB staff suggest that board members did not rely on market research at all but took the wide range of EV market estimates as an excuse to make their own intuitive best guess of what most drivers would expect in an electric vehicle.¹⁷ The Battery Panel appears to have done the same thing.¹⁸

The board was certainly right to note that consumers, as discussed above, often fail to live up to the environmental-protection beliefs they express in surveys. But in presenting its decision to revise the ZEV program, CARB failed to acknowledge the comparative merits of different survey techniques. Although survey research has become increasingly sophisticated, numerous

studies have shown how the individualized, unreflective setting established by the question-answer format of most polls tends to give an exaggerated picture of citizens' self-interest (Davison, Barns, and Schibeci 1997; Fishkin 1995). In the case of EV market studies, the stated preference method does not account for most respondents' utter lack of familiarity with EVs. Indeed, EV market surveys rarely account for the effect on range preference of consumer learning processes, recharging infrastructure, household fleet composition, or improvements in fuel gauge instrumentation that enable drivers to feel more secure with less range (Turrentine, Kurani, and Sperling 1995).

In an effort to more accurately predict EV sales, one innovative study encouraged survey participants to reflect on their travel habits and needs with the help of a detailed questionnaire, three-day travel diary, informational video, and a balanced series of articles on EVs. This study, presented at one of CARB's 1995 public hearings, estimated that purchases of *existing* EVs with a range of only 60-120 miles could account for 7 percent of annual light-duty vehicle sales in California, increasing to 15 percent with the availability of advanced batteries (Turrentine, Kurani, and Sperling 1995).¹⁹ General Motors' PrEView test program took a similar approach, requiring drivers to complete travel diaries in which they reflected on their EV experiences. As noted above, General Motors concluded that the vast majority were satisfied with their EVs (Purcell 1995).²⁰ Although these studies did not require participants to discuss the merits of EVs with other citizens (except perhaps with family members), they differed from stated preference surveys by providing an opportunity for informed thinking about a public issue. In this respect, they encouraged participants to engage in *public deliberation*.

Public deliberation is widely regarded as one of the most effective ways of creating social trust, which as suggested above helps people bridge the gap between expressed other-regarding preferences and actual behavior (Gundersen 1995). In addition to creating more informed opinions and a sense of political membership, public deliberation can reassure citizens that others share their views, providing an impetus to act according to their other-regarding preferences. Experimental psychologists have thus found that communication among strangers increases cooperation, even when the choices that follow are made anonymously and without binding or enforceable agreements (Lewinsohn-Zamir 1998, 398). Although CARB did not explicitly endorse individualized consumer surveys over deliberative surveys, the agency's shift after 1994 to a more pessimistic prediction of consumer behavior implicitly endorsed the individualized approach.

The change in CARB's use of consumer surveys was compounded by the declining importance it accorded to *experiential learning*. Several studies have found that driving an EV usually changes people's opinions about

electric vehicles, as well as their driving habits and general views on transportation issues. A California study of driver responses to the 1991 Solectrica Force and Solar Car Festiva, for example, found that 96 percent of respondents had a “better” opinion of EVs after driving one (Turrentine, Kurani, and Sperling 1992). A study of self-reported changes in driving habits among EV purchasers in Berlin, Germany, found that 66 percent became more defensive drivers, 23 percent planned their trips more carefully, and 26 percent reduced their total number of daily trips. Thirty-one percent claimed that since becoming EV drivers they had become more aware of the social implications of their transportation choices (Knie et al. 1997, 70-71). These results have led some observers to argue that EVs might function as a transition technology, helping drivers get over their “addiction” to individualized forms of transportation in the same way methadone helps drug addicts (Knie et al. 1997, 73).

Consideration of experiential learning suggests that by justifying the program change with reference to *existing* consumer expectations, which had been shaped in response to conventional automobiles, CARB gave a false picture of how people would respond to EVs. The board did occasionally acknowledge that citizens’ views on EVs could be expected to improve with experience (CARB 1996b, 20). For the most part, however, after 1994, the board increasingly discounted the possibility of citizen learning, arguing that “many consumers, even after they have participated in a demonstration program or have closely examined their driving patterns, are still concerned about the limited ranges offered by currently available lead-acid batteries” (CARB 1996b, 19).

Finally, CARB appears to not have considered how its public predictions of consumer behavior could easily become self-fulfilling prophecies.²¹ CARB admittedly faced a paradox in this regard: a successful EV market launch *did* depend in part on correctly estimating probable EV sales, but any public indication by a governmental agency that sales would be lower than hoped could itself be expected to lower sales. If one evaluates CARB’s decision solely according to the goal of maximizing near-term EV sales, the board might have been justified in erring on the side of caution. But if the mission of government agencies is in part to promote strong conceptions of citizenship, as suggested above, the board could have justifiably erred in the direction of assuming a potentially other-regarding public. Similarly, if trust in political institutions strengthens people’s willingness to act as citizens, then the board’s reversal on the mandate could be expected to undermine whatever trust it had managed to create during the previous five years. The board thus reinforced its own pessimistic assessment of expected consumer behavior.

Conclusion

This account of CARB's revision of the ZEV program will be of limited interest unless it addresses the question, "Did CARB make the right decision?" No conclusive answer is possible, but the above account supports three responses that at least clarify the question. First, it is important to emphasize that CARB did, in fact, make a decision. The decision was made in response to various political and ideological pressures, in a context of limited information about the probable outcomes of different options. And it was to some extent the incremental product of previous decisions regarding the use of technical criteria and consumer surveys. But the decision to revise the ZEV program was not a passive reaction to technical necessity, economic imperatives, or interest group lobbying.

Second, even assuming the very limited goal of promoting EVs, CARB *may* have made the wrong decision.²² Credible evidence at the time suggested that advertising, public learning, and growing economies of scale would stimulate large numbers of consumers to buy existing EVs. Automakers would have probably fallen short of the 2 percent quota in 1998, but not by as much as they predicted, and they might well have made up the difference within a reasonable time. Indeed, if CARB had consistently portrayed EVs as mixed public-private goods and its public as potentially responsible citizens, it would have been perfectly defensible for the agency to have maintained the 1998 sales mandate.

Finally, even if CARB did what was necessary to maximize long-term EV sales, the policy revision directed EV development toward high-performance technologies that reinforce the existing transportation infrastructure and the weak conception of citizenship it fosters. CARB further reinforced this weak conception of citizenship by publicly justifying its policy revision with reference to technical experts as the voice of the public good, discounting the very statements it had solicited from the public itself. CARB's influence on EV technology is already apparent in the recent shift in priority, by both CARB and the major automakers, toward long-range hybrid gas-electric vehicles over pure EVs.²³ On one hand, hybrids offer an effective way of promoting consumer familiarity with EV technology. On the other hand, however, they lack the civic benefits associated with short-range EVs.

In the end, given the ideology and infrastructure of automobility, CARB's attempt to promote an alternative conception of automotive technology may have been doomed from the start. Nevertheless, from both a civic and technological perspective, the original ZEV mandate was a truly promising policy innovation. The history of the ZEV program suggests that government promotion of alternative vehicle technologies can contribute to both transportation

and civic reform. It also suggests that the implicit conceptions of citizenship conveyed by government policy designs can have a powerful influence on the shaping of technology.

Notes

1. Bijker (1992), for example, discusses the role of “the social group of the government” in constructing a technological artifact without considering whether governments exert the same kind of influence as other groups (p. 81). Hughes (1987) suggests that “legislative artifacts, such as regulatory laws, can also be part of technological systems” (p. 51) but does not explore the qualitative differences between government regulations and other components of technological systems. A similar conception of government appears in Callon’s (1980, 1987) studies of the electric vehicle (EV) in France.

2. The term *decision* is not meant to imply an instrumentally rational choice based on complete information, a conception often criticized as “decisionism” (Majone 1989, 12-20). As shown below, California Air Resources Board’s (CARB) decision is best understood as a prudential choice made in a context of informational, political, and ideological constraints. Moreover, the claim is not that CARB policymakers *self-consciously* sought to promote particular conceptions of citizenship. The article shows only that the Zero-Emission Vehicle (ZEV) program revision was, in part, the result of autonomous decisions by CARB policymakers and that the revision changed the implicit conception of citizenship conveyed by the policy.

3. See CARB’s Web site: <http://www.arb.ca.gov>

4. The Natural Resources Defense Council (1994) calculated that in Los Angeles, replacing even the cleanest gasoline cars with electric vehicles would reduce hydrocarbon and carbon monoxide emissions by 99 percent, nitrogen oxides by 73 percent, particulates by 61 percent, and carbon dioxide by 66 percent, even when taking the emissions of both in-state and out-of-state power plants into account. EVs also reduce the pollution associated with petroleum refinery, storage, and transport.

5. Although EVs may cause increased emissions at electric power plants, these emissions can be more easily controlled through advanced filter technology than the widely dispersed emissions of millions of conventional automobiles. EVs may not be appropriate for regions that rely on highly polluting coal for their energy needs or for colder regions where EV battery performance is low. But in California, the moderate weather and relatively high reliance on renewable energy make EVs a viable means of reducing air pollution. On these issues, see also Fogelberg (1998, 72-80), who provides an interesting discussion of the various redefinitions undertaken since 1990 in the apparently simple notion of “zero” emissions.

6. In place of the interim deadlines, the agency signed Memoranda of Agreement with the seven largest automakers. These memoranda committed the manufacturers to continue research and development of EV technology; to provide biennial reports of their progress; to allow periodic CARB inspection of their facilities; and to offer for sale, in accord with “consumer demand,” a total of up to 3,750 advanced-battery EVs in demonstration programs in California by 2001. Because the ZEV mandate was an essential part of California’s 1994 plan to meet the requirements of the federal *Clean Air Act*, the automakers also agreed to introduce cleaner cars voluntarily nationwide by 2001 (CARB 1996b).

7. This is the midterm range target established by the United States Advanced Battery Consortium, a research group formed in 1991 by the major U.S. automakers and the federal government.

8. At a CARB public hearing in November 1995, for example, a spokesperson for the Advanced Lead-Acid Battery Consortium (ALABC) stated,

Existing and commercially available lead-acid batteries are capable of daily commuting ranges of 75 miles, recharging times of a few minutes, and cycle life in excess of 500 cycles, approximately three years. Most importantly, the fuel cost per mile of running an EV powered with lead-acid battery has already dropped by an order of magnitude during the course of ALABC's program. By 1998, the projected cost will drop further to 5 cents per mile and, thus, will be comparable with the cost of fueling conventional engines. . . . ALABC takes strong exception to any suggestion that advanced batteries will not be available by 1998. (Efrus 1995, 222-23)

9. Some commentators also used this point to argue that the ZEV program would actually increase air pollution, by slowing the rate at which consumers exchanged more highly polluting old cars for cleaner new cars (Lyons 1995). This claim was countered by Hall (1995), among others, who argued that even in the worst-case scenario, in which automakers were required to pay huge fines, new car prices would rise by only \$10 to \$70, and that the state could offset even this burden with funds from the collected fines.

10. Lewinsohn-Zamir (1998) presents this argument as an example of what public choice scholars call a "mutual assurance game." The mutual assurance game is like the classic Prisoner's Dilemma game, insofar as people are assumed to have the same preference orderings in public and private settings. Unlike the Prisoner's Dilemma game, however, in a mutual assurance game, people are said to often give highest priority to their other-regarding preferences.

11. Of course, any definition of *political association* is contestable. Although my focus here is on a state agency, it is important to note that there have long been political associations and forms of political activity neither affiliated with, nor directed toward, the state. Many of these, as noted in the introduction, have contributed to the civic shaping of technologies.

12. Women tended to be more concerned than men about reliability, comfort, safety, and cleanliness, and their driving needs were well met by EVs. But given a patriarchal culture, the EV's attractiveness to women became a factor in its demise. Other factors included the oil industry's aggressive establishment of an infrastructure of gasoline filling stations and a lack of similar involvement by the electric utilities. Also, despite lower operating costs, the high initial price of EVs forced makers to concentrate on the stable but very small luxury market. Finally, the introduction of the electric starter in 1912 allowed gasoline cars to co-opt some of the advantages of electrics (cf. Kirsch 2000; Schiffer 1994; Volti 1990).

13. According to a recent study by the Surface Transportation Policy Project (1999), between 1982 and 1997, average traffic delays in the United States grew by 235 percent. The average amount of driving per day increased by 70 percent. Sixty-nine percent of this increase in driving was caused by factors related to sprawl, including longer car trips, less carpooling, and people switching from walking or transit to cars. Population growth accounted for only 13 percent of the increase in driving.

14. The analysis included emissions of criteria pollutants from tailpipes and from power plants serving EVs, as well as some of the evaporative emissions associated with gasoline transport and use. Oil refinery emissions were not included.

15. When asked whether CARB had shifted its criteria between 1990 and 1996, one CARB staff member said,

I think that's probably correct but also just a little bit understandable. When you're looking at whether the agency . . . should make a whole-hearted effort to get behind a certain technology, you're looking at what is the potential of its succeeding. If it's got this [wide]

range of benefits, that speaks well for the possibilities of its succeeding. When you're . . . two years away, three years away from this being in peoples' hands . . . you've kind of got to look a little bit at a worst case scenario. . . . When the range was so far below expectations at a cost that wasn't commensurate with that, you've kind of got to go, "You know, all these things are great, but these things are this big and the range and cost issues are *this* big." (Kitowski 1999)

16. In a recent interview, a CARB staff member responsible for public outreach said that cost, not range, is the biggest issue. "The public is concerned about the cost of these vehicles, but they're supportive of the technology" (Bevan 1999).

17. When asked about the agency's use of consumer surveys, a CARB staff member said, it really is a political judgment, because . . . there's no way to be certain whether those [surveys] are accurate or not. . . . For every [survey] that has had very favorable response to lead acid you can find, obviously, somebody in the industry and some others [who] felt it was less favorable. (Evashenk 1999)

Another staff member said the consumer surveys were seen as a "much softer" issue than the battery technology:

That's an area where the board members can look at themselves and the people they know and go, "O.K., would a car with a fifty-mile range . . . be sufficient for me or the people I know?" . . . And yes, it's not scientific, but it's a pretty good kind of understanding. (Kitowski 1999)

18. "The Panel did not study the market for electric vehicles or the dependence of market potential on EV range and performance; indeed, we question the validity of existing, very divergent EV market potential estimates. EVs with advanced lead-acid batteries may well be able to gain applications in limited niche markets, but it seems clear that only batteries with substantially higher specific energy will give EVs the real-world driving range . . . required and/or perceived to be required by the majority of vehicle buyers and users" (Kalhammer et al. 1995, III.7-8).

19. Actually, a full 10 percent of study participants said they would choose an EV with a range of only 60 to 80 miles, but when translating this figure into an assessment of annual sales, other factors, such as the staging of vehicle purchases, were taken into account, thus reducing the low-end estimate to 7 percent. An expanded account of the study appears in Kurani, Turrentine, and Sperling (1996).

20. When using their linear Market Dynamics Model, in contrast, General Motors predicted an EV market of only 3,500 units. This model conceptualizes consumer demand as a fixed, pre-existing value, unresponsive to public learning (Purcell 1995).

21. Aside from the public hearings, CARB made very little effort to publicize the benefits of EVs. As a staff member said,

We have a public information office . . . and we've done our part in terms of going to conventions and public events. . . . But the gap that is missing is actually commercials, or radio, or TV, or newspapers or things like that that would really get some wholesale publicity on EVs and how much better they are. . . . Our agency has not traditionally done that, so it's difficult for us to try to come up with a budget . . . [but we] would certainly encourage manufacturers to do that. We certainly haven't stood in the way, but we haven't done any of that ourselves. (Kitowski 1999)

22. Ironically, just a few weeks after CARB formally adopted the ZEV program revisions, General Motors announced that it would begin leasing its EV1 in selected California markets in the fall of 1996. Between December 1996 and December 1997, General Motors leased only 224 of its EV1 electric sports cars to consumers in California, and a smaller number in other states. Other automakers placed a total of 176 EVs with California consumers or fleets (CARB 1998b, 7-10).

23. CARB had considered giving ZEV credits for hybrids from the inception of the program but had repeatedly concluded that hybrids suffer significant evaporative emissions and in-use deterioration, thus not offering the same environmental benefits as EVs. Regulations approved by CARB in November 1998, however, give partial ZEV credits for vehicles that achieve near-zero emissions, such as electric-gasoline hybrids, vehicles using fuel cells, and those meeting a new standard for "super-ultra-low-emission-vehicles" (CARB 1998a).

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