The Politics of Controlling Auto Air Pollution

For more than thirty years, the United States has sought to improve regional air quality by regulating transportation-related emissions. Initiated under the Motor Vehicle Air Pollution Control Act of 1965 and expanded by three major revisions of the Clean Air Act (1970, 1977, and 1990), this regulatory program has employed three different approaches: (1) national technology mandates intended to make cars run cleaner by requiring auto manufacturers to develop effective vehicle emission control systems and oil companies to market less-polluting fuels; (2) mandates on state governments to curb motorists' auto use and keep their vehicle emission control systems in working order; and (3) requirements that transportation infrastructure investments be consistent with state commitments to meet national air quality standards.

These policies have achieved important successes. Although total vehicle mileage more than doubled between 1970 and 1995, emissions of all auto-related pollutants declined; on a vehicle-mile basis, they declined even more.

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more dramatically. Partly as a result of these reductions, ambient air quality in metropolitan areas has improved overall. Nonetheless, air pollution remains a heated issue in American politics. In a substantial fraction of the nation's large metropolitan areas, attainment of the national air quality standards first adopted in the early 1970s is still a major challenge. Meanwhile, the U.S. Environmental Protection Agency (EPA) has recently promulgated still more ambitious standards for ozone and particulate matter. And the United States has provisionally made international commitments to reduce greenhouse gases, produced to a great degree by automobiles. So the issue of reconciling transportation with clean air objectives seems certain to remain on the political and policy agendas for quite some time.

Given this prospect, an analysis of the politics of transportation pollution control efforts since 1970 seems appropriate. Not all elements of the federal regulatory strategy for transportation have contributed equally to the positive results so far achieved. This paper focuses primarily on one major source of the differences—variations in political and implementation feasibility—because those factors have been critically important in shaping the uneven results of the three approaches. Some federal policies have proved controversial and ultimately unacceptable to state and local governments, while others have proved difficult to implement because of strong resistance from affected interests. The paper also considers whether the regulatory policies make sense in economic terms. Although full treatment of that topic is beyond the scope of the current paper, cost-effectiveness data suggest that, at least to date, political logic has been roughly consonant with cost-effectiveness considerations. The politically feasible auto technology mandates have proved quite cost-effective relative to the more controversial efforts to regulate personal behavior, with some exceptions.

1. Although the United States initiated the Kyoto treaty in December 1997, the Senate must still ratify this agreement. The treaty does not become internationally binding until ratified by at least fifty-five countries accounting for at least 55 percent of the 1990 carbon dioxide emissions of the developed countries.

2. Auto emission control regulations have been strongly criticized from a cost-benefit perspective. See, for example, Council and coauthors (1986: 189-190). The Environmental Protection Agency has recently issued a major memorandum on EPA Office of Air and Radiation (1997). And economists have more generally debated the wisdom of the new standards. See Lane (1997) and Council (1997).

3. In reporting cost-effectiveness, we must consider the relative cost of reducing a ton of pollutants, not whether reduction is "worth" the cost in terms of ultimate social value. That question, while significant, goes well beyond what can be meant in this paper, indeed, beyond the economics of the issue.

POLITICS OF CONTROLLING AUTO AIR POLLUTION

What explains the differences in political and implementation feasibility? The first set of policies—national mandates requiring large corporations to improve product technology—has proved easier to sustain politically and far more cost-effective in reducing transportation-related emissions than other policies. Although the auto industry has frequently argued that federal "technology-forcing" policies are too aggressively paced, too costly, or technically infeasible, and has often secured deferrals of compliance deadlines, automobiles of the 1990s emit only a small fraction of the pollutants that the predecessors of the 1960s and early 1970s did and at reasonable cost. Meanwhile, with little fanfare, oil and automotive emissions declined sharply from gasoline. And new fuel mixes, marketed in specifically targeted metropolitan areas, are reducing emissions of carbon monoxide and volatile organic compounds. These mandates account for the vast majority of reductions in transportation-related emissions.

By contrast, efforts to regulate personal behavior through restrictions or economic disincentives have typically provoked intense controversy and in the end been given up as politically infeasible. This is not to say that motorists have been untouched by air pollution regulations. They have paid for improved pollution control technology when purchasing vehicles and fuel (although these product characteristics are not separately priced), and they have accommodated to requirements for the periodic inspection and maintenance of their onboard, factory-installed, pollution control systems. They have been almost entirely successful, however, in preserving their freedom to use available roads as and when they please—freedom not only from regulatory prohibitions but also from market disincentives.

As to the third policy approach—regulation of infrastructure investments—successive iterations of federal regulations have made transportation planners pay far more attention to air quality as an objective. The 1970 and 1977 Clean Air Act Amendments were ineffective in ensuring consistency between state transportation investments and state commitments to improve air quality. With rare exceptions, transportation agencies were able to keep environmental officials from playing a significant role in determining project and spending priorities. But these circumstances have changed somewhat in the 1990s. The Clean Air Act Amendments of 1990 embody a more realistic appreciation of how state transportation decisions are made, and the requirement that they "conform" with clean air plans is backed by a serious threat of federal fiscal penalties for failure to comply. The invigorated "conformity" requirement has greatly enhanced the attention paid to air quality objectives in metropolitan transportation planning.
Impacts and Extent of Transportation-Related Air Pollution

The key transportation-related air pollutants regulated under the Clean Air Act are ground-level oxides, formed by the sunlight-induced chemical reaction in the atmosphere of volatile organic compounds (VOCs), primarily hydrocarbons, and nitrogen oxides (NOx), both from engine emissions and fuel evaporation; carbon monoxide (CO) from engine exhaust; small particulate matter (PM) from engine exhaust, tire and brake wear, and dust kicked up by auto operations; lead from fuels; and sulfurous dioxide (SO2), overwhelmingly produced by industrial processes unrelated to transportation but also by burning high-sulfur transportation fuels.

The Clean Air Act regulates these pollutants primarily because of their effects on human health.

—Ozone harms lung tissues, reduces lung function, and sensitizes lungs to other irritants, creating problems (generally reversible), not only for individuals with respiratory problems such as asthma but also for otherwise healthy people engaged in moderate exercise.

—PM also causes respiratory problems, especially to children and the elderly, and can seriously aggravate the condition of people with existing pulmonary and cardiovascular diseases or asthma.

—CO reduces the delivery of oxygen through the bloodstream, affecting those with cardiovascular disease and posing hazards even to healthy individuals at higher levels of exposure.

—Inhaled lead (as well as that ingested in food, dirt, or water) accumulates in blood, bone, and soft body tissues. Not easily excreted, it can affect the kidneys, liver, nervous system, and other organs and can cause seizures and mental retardation. Fetus and children are especially vulnerable to damage from lead.

—Nitrogen dioxide, one type of NOx, can irritate lungs and lower resistance to respiratory infections.

6. Ground-level oxides are not directly emitted by transportation sources, but in processes, VOC and NOx are. This form of oxides is not to be confused with the atmospheric (or "good") ozone that partially shields the earth from solar radiation.

5. Material in this section is taken from EPA Office of Air Quality Planning and Standards (1970) 7-43

—SOx affects breathing and can aggravate existing respiratory illness and cardiovascular disease.

In addition to health impacts, ozone causes damage to crops and trees. Particulate matter carries air toxics and contributes to reduced visibility in several locales, while airborne NOx and SO2 deposited as acid rain in bodies of water contribute to algae growth and unhealthy conditions for fish.

Regulatory Standards

Under the Clean Air Act Amendments of 1970 and subsequent versions of the law, the EPA administrator is empowered to set allowable pollution levels for specific pollutants as necessary to protect public health. These are the primary national ambient air quality standards (NAAQS).

The act requires that the standards be set exclusively on the basis of their effects on human health, permitting cost-benefit considerations, among others, to come into play only in the choice of policies to achieve the health-based standards. By statute, the EPA periodically reviews (and sometimes changes) the standards according to procedures that provide for both expert advice and extensive comment by interest groups and the public. The ozone and PM standards were revised most recently in 1997.

On the basis of empirical data from air quality monitoring stations, the EPA identifies geographic areas that do not meet ("nonattainment") the NAAQS. "Nonattainment" areas are required to develop plans for reducing pollu-

6. The result is a complex decisionmaking process involving science, policy analysis, and politics. See Landy, Dobson, and Thomas (1994: 49-80) for a careful case history of how the ozone standard was examined and changed in the late 1970s.

7. In 1977 the ozone standard was originally set at 0.08 parts per million (ppm), not to be exceeded more than once a year. In 1979 the hourly standard was reduced to 0.12 ppm. In 1977 the annual standard was tightened from 0.05 ppm, which, however, was to be measured at as eight-hour average not to be exceeded more often than three times a year. For particulate matter, as a result of new public health data, the standard was changed in 1977 from once originally regulating total suspended particulate matter to one focused on particulate matter smaller than 10 microns in diameter (PM10). As a result of new epidemiological studies, this standard was augmented in 1997 with a new standard regulating particulate matter smaller than 2.5 microns in diameter (PM2.5). For the new ozone and particulate matter standards, see "National Ambient Air Quality Standards for Ozone Final Rule." Federal Register 62 (138, July 18, 1997) 36855-3696 and "National Ambient Air Quality Standards for Particulate Matter, Final Rule." Federal Register 438 (July 14, 1977) 36851-3696.

8. Current nonattainment area boundaries were set on the basis of the NAAQS in effect at the time the 1990 act was enacted. The EPA will be designating nonattainment areas under the new particulate and ozone NAAQS over the next several years.
Table 7-1.  Total Vehicle Miles Traveled and Highway Vehicle Emissions, 1970–95

(Millions of short tons, unless noted)

<table>
<thead>
<tr>
<th>Category</th>
<th>1970</th>
<th>1995</th>
<th>Total percent reduction 1970–95 in U.S. emissions per VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>U.S. emissions</td>
<td>Highway vehicle emissions</td>
</tr>
<tr>
<td>Vehicle miles traveled, VMT (millions)</td>
<td>1,109,724</td>
<td>2,442,775</td>
<td>...</td>
</tr>
<tr>
<td>Emissions of pollutants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>88.05</td>
<td>68.6</td>
<td>54.1</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>7.59</td>
<td>34.2</td>
<td>7.2</td>
</tr>
<tr>
<td>Volatile organic compounds</td>
<td>12.97</td>
<td>42.1</td>
<td>5.7</td>
</tr>
<tr>
<td>Particulate matter</td>
<td></td>
<td></td>
<td>13.1</td>
</tr>
<tr>
<td>Fuel-related</td>
<td>0.44</td>
<td>3.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Fugitive dust</td>
<td></td>
<td></td>
<td>12.8</td>
</tr>
<tr>
<td>Lead (thousands of short tons)</td>
<td>171.96</td>
<td>77.9</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

the positive results. Table 7-2 shows changes in transportation-related emissions for selected major metropolitan areas in the period 1985–94.

Technology and Product Mandates: New Cars and Fuels

The first and most important approach to reducing automotive pollution has been national technology mandates on auto manufacturers and oil companies intended to make cars run cleaner. Table 7-3 summarizes the progression of federal automobile emission standards, as actually implemented, by year and pollutant. Gasoline automobiles meeting the 1994 standards were designed to emit about 97 percent fewer hydrocarbons, 96 percent less CO, 88 percent less NOx, and 73 percent less PM than uncontrolled vehicles of the 1960s.  

Table 7-2. Percentage Change in Transportation Emissions for Selected Major Metropolitan Areas, 1985–94

<table>
<thead>
<tr>
<th>Metro area</th>
<th>VOC</th>
<th>NOx</th>
<th>CO</th>
<th>PM10</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>–32.7</td>
<td>–7.3</td>
<td>–26.2</td>
<td>–17.9</td>
</tr>
<tr>
<td>New York, northern New Jersey</td>
<td>–39.9</td>
<td>–9.5</td>
<td>–31.2</td>
<td>–18.9</td>
</tr>
<tr>
<td>Pittsburgh, Beaver Valley</td>
<td>–46.0</td>
<td>–26.1</td>
<td>–36.9</td>
<td>–31.0</td>
</tr>
<tr>
<td>Indianapolis</td>
<td>–20.1</td>
<td>3.0</td>
<td>–1.7</td>
<td>–4.9</td>
</tr>
<tr>
<td>South</td>
<td>–46.4</td>
<td>–17.4</td>
<td>–34.9</td>
<td>–24.7</td>
</tr>
<tr>
<td>Dallas, Ft. Worth</td>
<td>–41.9</td>
<td>–15.3</td>
<td>–27.5</td>
<td>–34.1</td>
</tr>
<tr>
<td>Houston, Galveston</td>
<td>–34.9</td>
<td>6.5</td>
<td>–14.1</td>
<td>–7.1</td>
</tr>
<tr>
<td>Orlando, Fla., Pensacola</td>
<td>–41.7</td>
<td>–1.6</td>
<td>–23.5</td>
<td>–12.6</td>
</tr>
<tr>
<td>West</td>
<td>–31.7</td>
<td>–8.8</td>
<td>–25.9</td>
<td>–18.3</td>
</tr>
<tr>
<td>Los Angeles, Orange County</td>
<td>–30.1</td>
<td>–15.8</td>
<td>–22.3</td>
<td>–24.6</td>
</tr>
<tr>
<td>San Francisco, Oakland, San Jose</td>
<td>–38.3</td>
<td>–8.9</td>
<td>–12.3</td>
<td>–16.8</td>
</tr>
<tr>
<td>Seattle, Tacoma</td>
<td>–34.8</td>
<td>–15.2</td>
<td>–30.4</td>
<td>–22.1</td>
</tr>
<tr>
<td>Portland</td>
<td>–28.4</td>
<td>–5.2</td>
<td>–22.7</td>
<td>–12.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydrocarbons (HC)</th>
<th>Carbon monoxide (CO)</th>
<th>Nitrogen oxides (gasoline)</th>
<th>Nitrogen oxides (diesel)</th>
<th>Particulates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>8.20</td>
<td>90.0</td>
<td>3.4, 4.6</td>
<td>0.3, 0.5, 1.0</td>
<td></td>
</tr>
<tr>
<td>1970–71</td>
<td>3.00</td>
<td>33.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>3.00</td>
<td>28.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973–74</td>
<td>3.00</td>
<td>28.0</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975–76</td>
<td>1.50</td>
<td>15.0</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977–79</td>
<td>1.50</td>
<td>15.0</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>0.41</td>
<td>7.0</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>0.41</td>
<td>3.4</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1982–84</td>
<td>0.41</td>
<td>3.4</td>
<td>1.0</td>
<td>1.0</td>
<td>0.60</td>
</tr>
<tr>
<td>1990</td>
<td>0.41</td>
<td>3.4</td>
<td>1.0</td>
<td>1.0</td>
<td>0.20</td>
</tr>
<tr>
<td>1991</td>
<td>0.41</td>
<td>3.4</td>
<td>1.0</td>
<td>1.0</td>
<td>0.20</td>
</tr>
<tr>
<td>1994</td>
<td>0.25</td>
<td>3.4</td>
<td>0.4</td>
<td>1.0</td>
<td>0.08</td>
</tr>
<tr>
<td>2004–2006</td>
<td>0.13</td>
<td>1.7</td>
<td>0.2</td>
<td>0.2</td>
<td>0.19</td>
</tr>
</tbody>
</table>


New Car Emission Standards

The Clean Air Act Amendments of 1970 marked a critical turning point in U.S. efforts to deal with transportation-related air pollution. Congress required auto manufacturers to reduce auto emissions significantly by the 1975 model year. The statutory targets were to reduce CO and hydrocarbon emissions by 90 percent from earlier federal requirements, and NOx.
emissions, previously uncontrolled, by 90 percent between 1971 and 1975.\footnote{12} This technology-forcing strategy effectively required the auto manufacturers to get catalytic converters ready for mass production and 50,000 mile useful lives within four years and to install them as standard equipment on all new passenger cars.

The auto industry staunchly resisted this aggressive pace. Ultimately, despite three one-year extensions, the industry announced it would shut down production at the beginning of the 1978 model year if the law were not revised. Galvanized by this threat, Congress overcame a multiplicity legislative gridlock less than three weeks before the start of the 1978 model year.

The resulting Clean Air Act Amendments of 1977 left the hydrocarbon and CO emission standards for new cars unchanged, but extended the deadlines until 1980 and 1983, respectively. It raised the NO\textsubscript{2} standard, from 10 percent to 25 percent of the 1971 level, and extended the deadline to 1982. The EPA administrator was further authorized to relax the NO\textsubscript{2} requirement selectively until 1984 for innovative technologies that promised better fuel economy.\footnote{13}

Despite interim setbacks and continuing industry pressure for extensions, the emission characteristics of new vehicles constantly—and dramatically—improved under the 1977 amendments. As vehicles manufactured in the 1960s and early 1970s were retired, emission controls became ubiquitous in the U.S. automotive fleet.

\textbf{New Rules}

Notwithstanding these advances, it became clear that many metropolitan areas could not meet the NAAQS under the regulatory policies of the 1977 amendments. Because Congress and the Reagan administration could not agree on how to change the legislation, however, a new law was not enacted until the Bush administration took office. Regarding auto technology, the Clean Air Act Amendments of 1990 mandated a new round of vehicle emission reductions (so-called Tier I controls) by the 1994 model year. In addition, it authorized even more stringent Tier II controls on a contingency basis, to be imposed in 2004 by the EPA administrator if further studies show they are needed, technically feasible, and cost-effective.\footnote{14} Moreover, the 1990 act for the first time established standards to control evaporative emissions, namely, emissions that occur after engines are shut off.

The 1990 law, like its predecessors, had authorized California, which has the nation’s worst air pollution problems, to impose even stricter vehicle emission standards. California decided to require manufacturers to achieve, in stages, fleet-weighted average emissions even lower than those mandated by the federal Tier I regulations, beginning with the 1994 model year. The state further mandated that manufacturers market a small number of zero-emission vehicles (ZEVs, effectively electric-powered cars) by 1998 and achieve a 10 percent market share for these vehicles in California by 2003.\footnote{15}

The Clean Air Act Amendments of 1990 also authorized other states voluntarily to opt for the California standards; and several northeastern states, notably Massachusetts and New York, chose to do so. Subsequently, under another provision of the 1990 act, the Ozone Transport Commission, a statutory organization representing the twelve states from Maine to Virginia and the District of Columbia, was persuaded by several of its members to petition the EPA to impose these auto technology measures on the full region, including the states that had not done so individually. Combined with California, this action would have extended the California standards to about 40 percent of the total U.S. auto market.

The industry argued vehemently that the technology was not commercially ready because current battery technology gave the vehicles too little range and because recharging infrastructure was inadequate. It proposed an alternative to market a national low-emitting vehicle (NLEV) in forty-nine states that would meet the first two levels of the California standards (tougher than what the automakers were otherwise required to do by law), if all states other than California would abandon the remaining California requirements, especially for zero-emission vehicles. For several years, the EPA unsuccessfully sought to broker an agreement between the thirteen

\footnote{12} Congress had authorized new car emission standards which California had been setting earlier in the decade, in the Motor Vehicle Air Pollution Control Act of 1968; the secretary of health, education, and welfare subsequently ordered automakers to meet the California standards for carbon monoxide and hydrocarbons by 1968. See Jacoby and others (1979) and Althaus and Womack and Paster (1979).

\footnote{13} On these initial regulatory efforts, see especially Carroll and others (1980). See also Jacoby and others (1978); Harris (1978); Quatman (1976); Mills and White (1979); Althaus, with Womack and Paster (1979); and White (1982).

\footnote{14} The EPA has reported to Congress that additional elements are required. See EPA (1998).

\footnote{15} Spots (1995).
northeastern jurisdictions and the industry. California ultimately delayed the timing of its ZEV mandate until model year 2003. But the four northeastern states that had individually adopted the California requirements—Maine, Massachusetts, New York, and Vermont—refused to accept NLEV as a substitute, and the industry refused to produce it unless they did.14

In early 1998, however, competition among the “Big Three” U.S. auto manufacturers and three major Japanese companies pushed them to pledge voluntarily to market NLEV vehicles in the forty-five states that had not mandated California cars.15 Although still opposed to tighter regulatory mandates, the auto manufacturers recognize the direction that U.S. air pollution law and international treaties on global warming are pushing. They have recently begun marketing prototype electric vehicles and hybrid gasoline-electric cars and have stepped up research on other technological alternatives to gasoline engines such as fuel cells.16

Fuel Standards

Federal mandates on the composition of automotive fuels have been less contentious than vehicle standards. Under the 1970 act, the EPA required oil refiners to market unleaded fuel by 1975 (necessary to avoid damage to the catalytic converters appearing on new vehicles) and to reduce gradually the lead content in all gasoline. Although the EPA temporarily suspended these rules when refiners challenged them in court, the agency’s litigators prevailed in 1976. The standards were then implemented without further controversy.17

The 1990 act totally banned lead in gasoline effective as of 1995; by 1993 the market penetration of unleaded gasoline was 99 percent. The 1990 act also required additional measures—“oxygenated” fuel in the winter months to reduce CO emissions in certain nonattainment areas, and “reformulated” gasoline in summertime to reduce hydrocarbons—in severe and extreme ozone nonattainment areas. Even though not required to do so, some areas have also chosen to require these fuels as elements of their clean air strategies. Oxygenated and reformulated gasoline met minor consumer resistance in a few metropolitan areas. By and large, however, they have won acceptance.

Experience with Technology and Product Mandates

Despite some differences, the politics of vehicle emission control and clean fuel regulations are extremely similar. Experience with both suggest that environmental regulation can succeed when it targets a small number of large corporations and focuses on inducing significant (but not radical or technologically infeasible) changes in product technology. When the government is seeking the universal deployment of new technology, however, the process may be marked by considerable sound and fury, together with hard-nosed bargaining and litigation. Delays are often unavoidable, particularly if industry can credibly claim that the product technology has not been sufficiently perfected to satisfy consumer expectations. Elected officials, however, perceived that most voters support corporate regulation to achieve clean air targets, even if by-products include small price increases and, on occasion, slight vehicle performance degradation.

Industry leaders often argue, of course, that regulations threaten jobs, collateral objectives such as energy conservation, or inflationary price increases. But when regulators are trying to hasten the arrival of technologies that already exist in prototype, firms cannot simply claim that the desired improvements are unachievable at a reasonable price because competitors may in short order prove them wrong. Even with more far-reaching technology mandates, as soon as one or two major competitors agree that the technology is ready for the marketplace, resistance tends to crumble. Actual costs have then often proved less than anticipated as production experience is acquired and scale economies are secured. After all, the regulators are guaranteeing a mass market. Since the missed deadlines under the 1970 act, moreover, Congress has generally given the EPA administrator considerable room for bargaining over the scope, details, and timing of regulatory requirements. In this framework, government officials can generally make accommodations between legislative purposes and industry interests.

The political logic of the policies implemented to date has proved roughly consistent with cost-effectiveness considerations.18 As Table 7-4

Table 7-4. Cost-Effectiveness of Technology Measures in Reducing Hydrocarbon Emissions

<table>
<thead>
<tr>
<th>Technology measures</th>
<th>Cost per ton of HC reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>New auto emission standards</td>
<td>50%</td>
</tr>
<tr>
<td>1980 vs. uncontrolled</td>
<td>3,500</td>
</tr>
<tr>
<td>1994 vs. 1981</td>
<td>6,400</td>
</tr>
<tr>
<td>Onboard refueling controls</td>
<td>1,100</td>
</tr>
<tr>
<td>California gasoline vehicles</td>
<td>3,700–21,000</td>
</tr>
<tr>
<td>TLEV</td>
<td>2,200–27,000</td>
</tr>
<tr>
<td>LLEV</td>
<td>4,200–41,000</td>
</tr>
<tr>
<td>Methane</td>
<td>30,000–60,000</td>
</tr>
<tr>
<td>Compressed natural gas</td>
<td>12,000–22,000</td>
</tr>
<tr>
<td>Electric (ZEV)</td>
<td>25,000–108,000</td>
</tr>
<tr>
<td>Gasoline reformulations</td>
<td>500</td>
</tr>
<tr>
<td>11 to 9 Reid vapor pressure</td>
<td></td>
</tr>
<tr>
<td>Federal standard</td>
<td>1,500–3,000</td>
</tr>
<tr>
<td>California standard</td>
<td>4,100–5,100</td>
</tr>
<tr>
<td>Inspection and maintenance</td>
<td>4,500–6,000</td>
</tr>
<tr>
<td>EPA enhanced</td>
<td></td>
</tr>
<tr>
<td>Remote sensing</td>
<td>2,600–6,000</td>
</tr>
</tbody>
</table>

\[a.\] Krupnick (1993); costs are stated in constant 1988 dollars
\[b.\] Harrington, Wada, and McConnell (1994); costs are not standardized.

Sources provide additional information about emission reductions, cost per unit, and sources of data.

shows, the earliest automobile emission control devices were highly cost-effective. Securing additional reductions has become progressively more expensive, in large measure because the early controls had already eliminated a high proportion of the emissions that the earlier vehicles had produced. But subsequently implemented vehicle emission control improvements, including the Tier I requirements under the 1990 amendments, have remained relatively cost-effective. Similarly, improvements in vehicle refueling systems (in the design of auto gas tanks and the pumps at service stations) and reformulations of gasoline have produced relatively cost-effective emissions reductions. By contrast, the estimates in Table 7-4 for California cars and, particularly, alternative fuel vehicles, including the electric vehicles staunchly resisted by the automakers, show far higher costs per ton of hydrocarbon emissions reduced. The magnitude and wide range of cost estimates reflect the experimental nature of these vehicle types. The technologies are not mature, nor are they ripe in either cost-effectiveness or political terms.\(^{21}\)

Changing Behavior: Transportation Controls and Vehicle Maintenance Requirements

A second policy approach focuses on reducing emissions by inducing motorists to reduce their vehicle use, by ensuring that they maintain onboard vehicle emission control systems in good working order, or both. Efforts to curtail motor vehicle travel have almost invariably failed in the face of political resistance. Efforts to require vehicle maintenance have been more successful, although the EPA’s latest effort to ratchet up the rigor of inspection and maintenance regulation has encountered opposition.

Restrictive Transportation Controls

Beginning in 1973 the EPA required the states to develop transportation control plans for their air pollution control areas (no matter how metropolitan). These plans were to be incorporated into the overall State Implementation Plans for attaining and maintaining compliance with national air quality standards. Because the 1970 act required attainment of the standards by 1975, it appeared that draconian transportation controls would be required in many areas—including measures such as parking supply restrictions, high taxes or surcharges on parking, downtown access restrictions, mandatory inspection and maintenance of auto emission control devices, and retrofit of vehicles without control equipment. But these policies proved highly controversial. State officials quickly perceived that

\(^{21}\) As noted earlier, these considerations do not engage the question of whether the reductions in emissions produce sufficient social benefits to warrant these regulatory measures. Many economists would argue that although the cost per ton of pollution abatement has been rising, the benefits of an additional unit of reduction—in human health effects, for example—have been declining so much that further reductions are not worth the cost. See Crandall (1993).
however much the public supported clean air legislation, it was ambivalent about or hostile to virtually all measures that would directly affect its own behavior. Consequently, despite the federal mandate, most states refused to submit transportation control plans.\textsuperscript{22}

As required by the act, the EPA therefore developed and promulgated federal transportation control plans for nineteen major metropolitan areas in the summer of 1973. These included, however, exactly the types of policies that the states had already refused to impose on their own authority.\textsuperscript{23}

Still unwilling to commit themselves to intensely unpopular policies, the vast majority of state and local officials simply refused to implement the federal requirements.\textsuperscript{24} Even though it had sufficient legal authority, the EPA soon realized that it had little or no organizational capacity to implement them by direct federal action. Nor did it have any reason to believe that Congress would appropriate funds for a massive expansion of federal field bureaucracies to do so.

For its part, Congress, faced simultaneously by widespread public outrage at stringent transportation controls and continued strong support for the goals of the clean air act, approved both sentiments. It enacted amendments restricting the EPA's authority to require price disincentives (such as road-use tolls and parking surcharges) or to restrict parking at all. Key legislators also made clear (in a conference report on a bill that failed for extraneous reasons) that they intended to block the EPA if it ever sought to require gasoline rationing as part of a state plan. At the same time, Congress rebuffed calls to relax the standards or deadlines mandated in the act. Recognizing the evident discontinuity between congressional attitudes toward the policy and toward some methods required to carry it out, the EPA for the most part abandoned efforts to enforce the federal control plans.\textsuperscript{25}

\textsuperscript{22} The statutory language of the 1970 Clean Air Act Amendments was permissive but very broad; it did not specifically require or authorize the types of measures that the EPA ultimately sought to impose under its aegis. See Howze (1986). Alkire with Winsack and Pucher (1979), and Mayer and Grossman (1982).

\textsuperscript{23} See Alkire with Winsack and Pucher (1979), and Sabin and Dicks (1982) for discussions of these control measures.

\textsuperscript{24} Concerning in October 1973, moreover, these policies became increasingly feared in the public mind with long lines at service stations, sharp increases in gas prices, and the economic recession reawakened by the first (and more severe) Arab oil embargo. See Howze (1986).

\textsuperscript{25} Alkire with Winsack and Pucher (1979); Howze (1986).

\textit{New Legislation}

The 1977 act, which extended the federal deadline for achieving national air quality standards from 1975 to 1987, was generally crafted to avoid the political problems encountered under the 1970 act. It did not place restrictions on personal travel even in the most severely polluted areas, although it permitted states to adopt restrictions if they wished. To encourage state and local cooperation, the new act required bringing elected officials more directly into the air quality planning process, provided greater opportunity for public participation, and authorized more money for planning. It also empowered the federal government to withhold most federal highway grants from any state failing to submit an acceptable air quality plan to the EPA. The political incentives facing state and local officials remained essentially unchanged, however. They believed that the public was unwilling to accept significant restrictions on auto use or economic disincentives to discourage such use. As a result, while the states did routinely submit required plans this time around, very few proposed even the mildest controls on personal travel—and fewer still implemented any.\textsuperscript{26}

For its part, the EPA sought to avoid conflict with the states on the issue of travel demand reduction. The agency concluded, however, that annual inspection and maintenance was essential to ensure that the tailpipe controls it was requiring manufacturers to install on all new cars did not malfunction in use: The EPA's determination intensified as evidence accumulated that large numbers of motorists, concerned about degradation of auto performance, were intentionally disabling emission controls or damming them by using leaded gasoline. The EPA applied persistent pressure on individual states to adopt inspection and maintenance programs. Such programs differed politically from other transportation controls because they did not affect everyday travel behavior and, in many cases, could be combined with regular vehicle safety inspection requirements.\textsuperscript{27} Even so, a number of resistant states adopted inspection programs only when the federal government, invoking the sanction authorized by the 1977 act, temporarily suspended much of their highway funding.


\textsuperscript{27} In several instances, however, the auto repair shops initially opposed inspection and maintenance programs because they did not want to incur the expense of acquiring testing equipment and feared that the fees would not adequately compensate them for the expected diminution of their repair business.
The 1990 act and ISTEA

The 1990 act, which once again extended the time frame for achieving national air quality standards, adopted a new regulatory strategy: different attainment deadlines and interim measures for different regions, depending on the current severity of their air pollution problems.26 The law left the question of whether to adopt transportation demand measures to the discretion of state and local officials, with one major exception—mandated employer trip reduction programs in the ten most severely polluted nonattainment areas. It also required more than thirty areas with serious pollution problems to adopt an "enhanced" form of inspection and maintenance.27 Politically, the 1990 act gave state and local decision makers some latitude to draw up regionally acceptable pollution-reduction plans, while holding over their heads the threat of much stronger penalties than before.28

The new law made two types of federal sanctions available: denial of federal highway aid; and the imposition of stricter new-source / source / source / source requirements. (These are requirements that any emissions generated by new pollution-generating facilities be offset by reductions elsewhere in the same nonattainment area.) It also gave the EPA much more latitude in deciding when sanctions could be imposed. In addition, the new "conformity" provision posed a threat to the flow of federal funds to metropolitan transportation plans were not shown to be consistent with state air quality commitments. (This provision is discussed in more detail below.)

The potential impact of the 1990 act on the transportation sector was substantially increased by congressional enactment one year later of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. This bill authorized federal transportation appropriations for a six-year period and laid out requirements for state and regional transportation planning procedures. The two laws were far more closely synchronized than any previous pairing of air quality and transportation statutes. Thus, as the 1990 clean air amendments commanded new priority for environmental

26. The new deadline for ultimate compliance with the same standard raised from three to twenty years. (The only region given twenty years to achieve full compliance was Los Angeles.) That for carbon monoxide varied from five to ten years.

27. Key transportation elements of the clean air act are clearly summarized in Hawthorn and Meyer (1992).

28. To induce greater state and local compliance, the new clean air act mandated the development of the state implementation plan with participation by local elected officials, representatives of the state and local air quality agency, the metropolitan planning organization, the state department of transportation, and members of the general public.


52. The EPA's enhanced inspection and maintenance regulations recognized that the "basic" test was not able to determine adequately whether the increasingly high-tech emission control systems on new vehicles were functioning properly. The "tune-up" function of inspection and maintenance, which, typically joined in existing basic systems, created opportunities for fraud and made it difficult to detect incompetence or repair-shop performance. Under enhanced inspection and maintenance, the EPA believed, more sophisticated testing equipment and a broader range of tests would more accurately determine whether vehicle pollution controls were working effectively. Independent testers, moreover, would have no stake in whether or where repairs were done and could determine when they had been done correctly. The EPA's program design proved very unpopular in states whose inspection and maintenance was historically carried out by the private repair industry. Service stations and auto dealers did not want to lose what they saw as a lucrative side business with resulting repair jobs. If they could not administer and charge fees for the tests themselves, they did not want to purchase the expensive new equipment needed to diagnosis vehicles that had failed as testing stations. In addition to sympathizing with these interests, many elected officials were concerned about potential citizen complaints. They feared that because the new test-only stations would be fewer and less convenient for motorists than the existing network of service stations and repair shops, some owners would face long waiting lines. Moreover, the new system seemed likely to send massive "ping-ponging" back and forth between test stations and repair shops until their cars could pass the emissions test. And in greater grip, would result in more expensive repair bills than the existing system.
tion to restrict transportation voluntarily. For example, a congestion pricing demonstration program authorized by ISTEA, which would have subsidized experiments with economic disincentives, found only a few jurisdictions willing to examine the idea seriously—and none willing to implement even a demonstration project. 35

Two conflicts in 1994 seriously undermined the credibility of the federal government’s commitment to enforce specific statutory mandates. The first conflict involved the employee commuting program, which encountered growing, often bitter, resistance from business groups. 24 Because the program promised in-harrier emission benefits at best, it was difficult for the EPA to defend. As the most recalcitrant areas suffered no consequences, other areas began to rethink their willingness to comply and lobbied Congress to repeal the requirement. Congress ultimately made the program voluntary in December 1995, effectively killing it.

The second controversy involved challenges to the enhanced inspection and maintenance requirement, most notably by California. The EPA at first resisted making any policy concessions (although it did not impose sanctions on the increasing number of recalcitrant states). 35 After the 1994 elections shifted party control of Congress, however, the EPA, fearing ma-


36. The EPA changed the name of its program from Employer Trip Reduction (ETR) to Employee Commute Options (ECO). The change reflected the EPA's nervousness about its potential to arouse conflict. Although several of the mandated areas (such as New York and Houston) developed ECO plans without provoking much controversy, business groups in some other regions—particularly Baltimore, Chicago, and Philadelphia—protested vociferously. They were concerned about high administration costs, the inflexibility of federal requirements, the burden of imposing an unproven federal mandate, and the possibility of increasing federal penalties if they failed to achieve program goals.

37. Through 1996 the EPA had filed no strong legal or direct-expression to use "discretionary" inactions against states failing to adopt enhanced inspection programs. In contrast to the clear air "mandatory" sanctions, which took effect only after eighteen or twenty-four months service, discretionary sanctions could be imposed immediately. In January 1994, however, as the agency was preparing to impose sanctions on California, a major earthquake struck the Los Angeles area. With the White House apparently reluctant to risk cutting off infrastructure funding needed for earthquake recovery in an election-year state, the EPA allowed California to adopt an inspection and maintenance program differing in major respects from what it was insisting that other states accept. The agency even faced a rash of demands from other states, which it sought to resist, for modifications in or alternatives to the inspection program. These demands increased and crystallized here in 1996, following Clinton’s ill-prepared launch of enhanced inspection and maintenance. Maine officials, finding themselves on the receiving end of a rash of citizen complaints and negative media coverage, quickly shut down the program. Several other states then put their plans on hold.

POLITICS OF CONTROLLING AUTO AIR POLLUTION

Experience with Behavioral Change Policies

With few exceptions, regulatory efforts under successive versions of the Clean Air Act to limit motorists' use of their cars or to impose direct charges with the intent of reducing use have proved politically infeasible. 37 Elected officials fear voter backlash if they try to prevent or discourage motorists from using their vehicles in ways to which they have been long accustomed. A visceral political resistance to pricing policies that was clearly evident in the reaction to EPA policies under the 1970 act has, if anything, become more intense since the 1980s as a consequence of state and local "tax revolt." At the national level, therefore, Congress has rarely mandated specific policies of this type, the principal exception being the Employee Commute Option Program in the 1990 act. At the state and local levels, many politicians have been willing to defy EPA mandates for such policies, except when confronted with a seemingly clear federal determination to invoke sanctions. But the federal government has proved unable to sustain a credible threat to impose penalties for noncompliance. Faced with strong protest against the EPA's aggressive policies under the very general statutory language of the 1970 act, Congress responded in the mid-1970s by forbidding specific forms of regulations—and clearly signaling its intent to bar others—if the EPA did not change its policies. The commuting program suffered a similar fate in 1995.

Some voluntary behavioral change policies (such as ride-sharing programs, enhancement of existing transit service, compressed work weeks, and telecommuting), which provide alternative means of transportation or permit individuals to forgo trips, have won political acceptance, but they generally have quite limited capacity to affect overall auto use, each yielding at best 1-3 percent reductions in vehicle miles traveled. 38 Inspection and maintenance programs require behavioral response by individual citizens, but they do not restrict everyday behavior. Although they have evoked political resistance at times, opposition has been stronger from elements of the auto repair industry than from aggrieved citizens themselves. In turn, because of lower citizen impacts, the federal government has been willing to keep a greater degree of pressure on state and local officials in support of inspection programs than restrictive transportation controls. In the early 1980s Congress stayed out of the fray as the EPA invoked sanctions against states unwilling to adopt basic inspection and maintenance programs. It did intervene in 1995, forcing the EPA to soften its enhanced inspection policies, but it did not revoke the mandate.

Again the political logic is roughly consistent with cost-effectiveness considerations, with the important exception of economic incentive policies. As the data presented in table 7-4 indicate, the one mandatory behavioral change policy that has proved politically feasible—inspection and maintenance—is somewhat less cost-effective than technology controls, but not substantially so. Table 7-5 provides data about other behavioral measures. 39

37. Traffic rules, highway tolls for use, and gas taxes to finance roads are less problematic because their aim is to facilitate, rather than restrict, automobile use.
38. See Apugre Research, Inc. (1994).
39. This data is drawn from an extended analysis of this issue in Apugre Research, Inc. (1994: 30-41).
Voluntary transportation controls (such as ride-sharing, telecommuting, and compressed work-week schedules) also seem cost-effective. Conversely, the most controversial mandatory type of behavioral restriction—employer trip reductions, such as the Employee Commute Option program—appears dramatically less cost-effective. As the data in table 7-3 reflect, moreover, policies that reduce vehicle miles traveled become less cost-effective over time if federally mandated vehicle emission control regulations are implemented. As cars become cleaner, it takes a greater reduction in vehicle miles traveled to produce equivalent emission reductions.

Measures such as congestion pricing or taxes on emissions per vehicle mile traveled are the major examples of deviation between political and cost-effectiveness considerations. Economic incentive policies have not been adopted to improve air quality, even though their cost-effectiveness for this purpose and congestion reduction has been strongly advocated by many economists. Compared to alternatives, these policies also have the possibility of yielding somewhat greater reductions in travel and associated emissions. As discussed, however, elected officials and other policymakers strongly regard the imposition of direct auto-use charges on individuals as politically infeasible. Fundamentally, this is a collective benefits problem. From the perspective of any particular citizen or firm, these policies promise few perceptible positive effects, at best a hypothetical (and marginal) improvement in air quality or travel time; but they do impose significant individual costs in inconvenience or dollars. As a result, these policies have few strong political advocates other than some economists, planners, and environmental activists, and they tend to provoke intensely motivated opponents exercised by the associated costs. Knowing they will get little public credit for support from the beneficiaries, politicians shy away from the heat generated by such opposition.

Transportation Planning and Infrastructure Investments

Environmentalists have long sought a regulatory lever to discourage the financing of increased highway capacity and boost mass transit. Most environmentalists believe that highway capacity expansion, by improving access and reducing travel times to outlying regions of the metropolitan area, is a major cause of urban sprawl. In turn, they believe, low-density development increases the number and length of auto trips, decreases auto occupancy rates, and diminishes the practicality of pedestrian and transit trip making. Similarly, they argue that the main effect of road building to alleviate congestion in densely developed corridors is to induce additional travel, because there is invariably a great deal of latent travel demand in such areas, suppressed mainly by the existing congestion. All things equal, they believe, additional auto travel generally means more pollution. But air pollution concerns are only part of the story. Environmentalists also object to highway expansion as a threat to other key values, such as preserving open space and agricultural lands, maintaining pedestrian- and transit-friendly patterns of settlement, and conserving energy.

The National Environmental Policy Act (NEPA) of 1969, which required that federally funded projects be broadly analyzed for their impact on the environment, gave advocacy groups a regulatory tool to challenge road-building proposals. In tandem with other environmental laws, NEPA provided leverage throughout the 1970s and 1980s to delay, and sometimes kill, specific highway projects or to secure commitments to mitigation measures such as new transit service. But NEPA requires only that environmental impacts be considered in evaluating projects; it does not provide substantive guidelines for determining which projects should proceed. Therefore, environmentalists found that it does not prevent decisionmakers from moving ahead with projects that have adverse environmental effects, as long as those effects were considered. In addition, NEPA project-by-project focus ignores the cumulative environmental effects of multiple projects on the transportation system as a whole.

Since the early 1970s environmental advocates have thought air quality regulation had potential for a more systemic perspective. Early efforts to create strong links between air quality regulation and transportation planning, however, encountered significant institutional problems and resistance. Until the 1990 clean air amendments, neither federal law nor the practices of metropolitan transportation planning provided clear air advocates and regulators with much leverage to influence urban transportation investment policy.

41. Others argue that the causal factors shaping metropolitan growth and development are more complex than this viewpoint allows. See Transportation Research Board (1995:374-209).

42. As cars become cleaner, however, emissions per vehicle mile decline and congestion relief can also reduce emissions per vehicle mile.
Section 109(j) of the Federal-Aid Highway Act of 1970 did require the secretary of transportation, in consultation with the EPA administrator, to issue regulations to ensure that federally assisted highway projects would be "consistent" with the air quality plan for each pollution control area. But the regulations were extremely vague on the crucial question of how consistency should be determined, and they entrusted state transportation officials rather than environmental regulators with making consistency determinations. In most areas, EPA regional offices—politically beset, understaffed, and preoccupied with other responsibilities (including the need to develop transportation control plans)—made little effort to activate Section 109(j). Where they did, the effect was minimal.45 The 1977 clean air amendments contained stronger language, but it was only marginally more effective.46

**Strengthened Connections**

The 1990 act, reinforced by ISTEA a year later, required much tighter integration of clean air and transportation planning at the regional level. To implement a stronger conformity clause in the 1990 act, the EPA mandated a complex analytic procedure intended to ensure that transportation-related emissions in nonattainment areas would stay within the act's limits. Backed by the potential penalty of a transportation funding cutoff, these conformity procedures provide far more powerful incentives than ever before for state-local compliance with the clean air act.

The conformity analysis is based on computer-generated forecasts of travel patterns and emissions under various scenarios of transportation system development.47 If aggregate transportation emissions, forecast for several milestone years during a twenty-year planning period, are within the aggregate mobile source budget established in the area's state implementation plan, the area can receive federal transportation funds and proceed with its projects.48 If emissions are projected to exceed the budget, then the area may not use its federal transportation money (except for limited types of exempt projects). Conformity generally applies to the net emission profiles of entire regional transportation plans or the shorter-term investment programs derived from that plan, given socioeconomic trends and specific transportation policies, such as transit fares or expressway speed limits in the area. It does not bar specific projects that individually raise pollution, so long as the aggregate levels of each pollutant fit within the mobile source budget.49

**Conformity Effects**

Conformity puts large amounts of federal grant money at stake—more than $100 million a year in some metropolitan areas.43 To date, however, the most widespread effects of conformity have been procedural and cultural.

43. See Green and Wachs (1996: footnote 52) and Houston (1986). The EPA particularly aggrieved New England regional office, for example, see rigorously enforced by state transportation officials when it tried to claim a win over Boston area transportation project. There, as elsewhere, EPA officials had very little training or experience in the field of transportation. Nor were they able to adopt the institutional and personnel networks of transportation officials, which severely limited the agency's capacity for information gathering, cohesive discussion, formulation of policy alternatives, persuasion, and societal feedback in setting its goals.

44. It prohibited metropolitan planning organizations (MPOs) from adopting a "project, program, or plan" that did not "conform" to the provisions of an approved state implementation plan (SIP) and authorized the U.S. secretary of transportation to withhold more federal highway aid upon a finding of nonconformity. The Federal Highway Administration (FHWA) and Federal Transit Administration were assigned responsibility to ensure compliance with the conformity requirement, in consultation with the EPA. After extensive negotiation, the FHWA and EPA operationalized the statutory requirements in ever more general terms. As a practical matter, they required only that states ensure the timely implementation of transportation control measures they decided—on their own initiative—to include in their SIPs. In no case did the secretary of transportation withhold transportation funds from a state for noncompliance with this requirement. Consequently, the "conformity" requirement of the 1977 Clean Air Acts Amendments was a negligible factor in transportation investments decisions, although environmental advocates occasionally used conformity as a litigation "hook."50

45. For carbon monoxide, a project-level "hot spot" not may also be applied. 46. In the transportation community fear that the flow of funds would be disrupted by modeling results well within the margins of error of the models, while many environmentalists fear that transportation officials are manipulating the results. In practice, however, modeling results are neither easily directed nor rigidly applied to the margins. See Houston and Wachs (1990), which will examine conformity experiences in fifteen major metropolitan areas.
nal. With greater interaction, transportation and environmental agencies have gained more knowledge about and a greater appreciation for each others' perspectives. Although transportation officials typically view environmental protection as a constraint rather than a primary mission, most today accept the legitimacy and high priority of environmental values in transportation decisionmaking. Air quality considerations are being far more carefully considered in investment decisionmaking.

Some rapidly growing metropolitan areas have experienced conformity difficulties that may ultimately force hard choices between pollution control and transportation objectives. Atlanta and Charlotte, for example, have had federal transportation funding interrupted because of conformity problems. In conjunction with the fiscal constraint provision of ISTEA, the conformity role has made it more difficult to justify major new highway capacity expansion. As further emission reductions are required in the years ahead, more rapidly growing nonattainment areas are likely to experience conformity as an extremely salient constraint. How the conflicts between transportation and air quality goals in such areas will be resolved—and whether the federal government will remain firm in enforcing the regulation—remains uncertain.

To date, however, the conformity rule has not generally forced metropolitan planning organizations to abandon or significantly modify major transportation projects in the planning pipeline. Nor has it led to widespread increases in financial support for rail transit projects, because conformity modeling has generally shown very small pollution reduction benefits from such extremely costly transit improvements. More generally, as the data in tables 7-4 and 7-5 indicate, infrastructure policies, including high-occupancy vehicle lanes, park and ride lots, and bicycle and pedestrian facilities, appear far less cost-effective than technology policies. But these types of projects have been more widely programmed since ISTEA was enacted because the Congestion Mitigation and Air Quality program provides a dedicated source of federal funding for them.

Future Implications

Achieving national air quality standards is likely to remain a major issue for transportation in the foreseeable future, but one should not an-

50. Taken from the EPA World Wide Web site (http://www.epa.gov/airs/npa/npgh.html). The ozone and carbon monoxide nonattainment areas are primarily major metropolitan regions, while the particulate nonattainment areas, with exceptions, are predominantly smaller cities and rural areas.
51. See, for example, Law (1995) and Goodall (1997).
52. Pursuant to particular regulations had applied to particles as small as 10 microns in diameter (PM10), the new standard applies to particles as small as 2.5 microns in diameter (PM2.5). Current ambient air monitoring equipment is not adequate to measure the prevalence of the smaller particles.
53. See, for example, Law (1995) and Goodall (1997).
54. See, for example, Law (1995) and Goodall (1997).
December 1997 the United States initiated the Kyoto treaty agreeing to reductions of greenhouse gas emissions, primarily carbon dioxide, although Senate ratification is uncertain. If the treaty goes into effect, the United States will be obligated to reduce net emissions by 7 percent from 1990 levels, whereas current trends would see increases of 13 percent by 2000 and of 30 percent by 2010. Compliance with the treaty would almost certainly require significant reductions by the transportation sector through reduced travel, increased fuel economy, or development and deployment of new vehicle propulsion technologies and energy sources.

It is not at all clear at this juncture how much practical potential exists for radical departures from existing vehicle technologies for reducing automotive emissions, let alone in what time frame and at what price. These measures, however, seem the most likely way to achieve substantial future reductions of both regional pollutants and greenhouse gases. Most of the available strategies for reducing transportation demand either have very limited capacity for substantially reducing vehicle miles traveled or have so far proven politically infeasible. (Transit investments, ride-sharing, and new community forms are examples of the former type of strategy; congestion pricing, gasoline tax increases, and strong land use controls are examples of the latter type.) It seems highly improbable that strong measures will be adopted when they were politically unacceptable in the past to deal with worse conditions. Moreover, because global warming is an abstract problem whose most severe effects are likely to lie in the (politically) distant future, it is difficult to conceive of Congress soon legislating strict controls on transportation to avert this threat, absent a series of dramatic natural disasters that can credibly be linked to global warming.

References


56. These are, however, some nonsense in the technology measures appropriate for dealing with regional pollutants as opposed to greenhouse gases. Current catalytic converter mechanisms NO, nitrogen oxides, a greenhouse gas 200 times more potent than CO2 in trapping heat. See Matthew L. Wald, "Auto's Converter Increase Warming as They Cut Smoke," New York Times, May 29, 1998, p. A-1.
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