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A Brief History of Technology-Forcing Motor Vehicle Regulations

Faced with the worst air quality in the United States, California began in the 1960s to pursue a “technology-forcing” approach in establishing motor vehicle tailpipe emission standards. This approach sought to advance vehicle pollution control technology by establishing future tailpipe emission limits even if no technologies existed to meet them at the time regulators set the standards. The U.S. government later incorporated technology-forcing into the 1970 U.S. Clean Air Act (CAA), and it has remained the main regulatory focus for bringing cleaner cars to market in the United States for almost 40 years.



“We’d like to tell you we just up and did it, but it’s the regs.”

General Motors’ Camaro design team member, commenting in 1995 on how federal motor vehicle pollution limits led to a trio of benefits: lower pollution, more power, and better fuel economy.¹

Technology-forcing standards typically create much disagreement between regulators and automakers over what is technologically achievable at a reasonable cost by the regulatory deadline. A running example is the debate surrounding California’s low-emission vehicle (CA LEV) program, launched in 1990. Major issues since the inception of this program have been ultra-low-emission vehicle (ULEV) standards, a requirement for automakers to sell zero-emission vehicles (ZEVs), and a more recent attempt to limit greenhouse gas (GHG) emissions from light-duty vehicles. The debate has gone beyond California and now includes a number of other states that have adopted California’s LEV program in lieu of federal standards.

In light of the continuing vigorous debate over technology-forcing standards, the question arises: how did California, and subsequently the U.S. federal government, come to pursue a technology-forcing path? This article briefly describes California’s experience during the 1960s that eventually led the state to shift to technology-forcing approaches, the adoption of this approach at the federal level, and some of the results.

Technology-Following in California

Policies to require advanced pollution control technologies did not originally start out as technology-forcing. California initially began by implementing technology-following policies. Under this approach, California did not require automobile pollution controls until a minimum number of developers demonstrated that they had technologies capable of meeting a predetermined emissions level at a reasonable cost. California regulators established criteria to be met by proposed control devices, taking into account purchase and installation cost, durability, ease of ensuring continuing reliability once installed, and any other factors thought to bear on the suitability of the devices. The “other factors” included the financial stability of the manufacturer, and the manufacturer’s ability to

produce, distribute, and maintain adequate stocks to fit most cars.²

California’s technology-following approach required two devices to be certified by regulators before they were mandated for installation in new vehicles. California required two demonstrated technologies rather than one because it did not want to give the first innovator a monopoly in the pollution control market. For automakers, this provided an incentive not to acknowledge their own efforts until at least two control devices were certified.

California’s attempt at technology-following played out in the following sequence of events. In March 1964, the major automakers stated that they would not be able to meet California’s new emissions averaging standard until 1967. Just three months later, however, state regulators certified four exhaust devices that could meet the averaging standard. All four devices were developed by independent manufacturers, not the major automakers. Because the two-device certification threshold had been reached, the automakers were required to meet the emissions averaging standard in 1966, a full year before they previously said they could.

In August 1964, only two months after California certified the first four exhaust devices, the automakers announced they had developed engine modifications that were superior to the independent manufacturers’ add-on devices and could be installed by the 1966 model year. None of the four independently developed devices was actually used by the automakers. As a result of their experience, many independent technology developers left the field of automotive emission controls, saying that the California process was too unreliable to justify the investments needed to develop cleaner technologies.²

The speed with which the auto companies commercialized their emission control technologies,



California initially began by implementing technology-following policies.

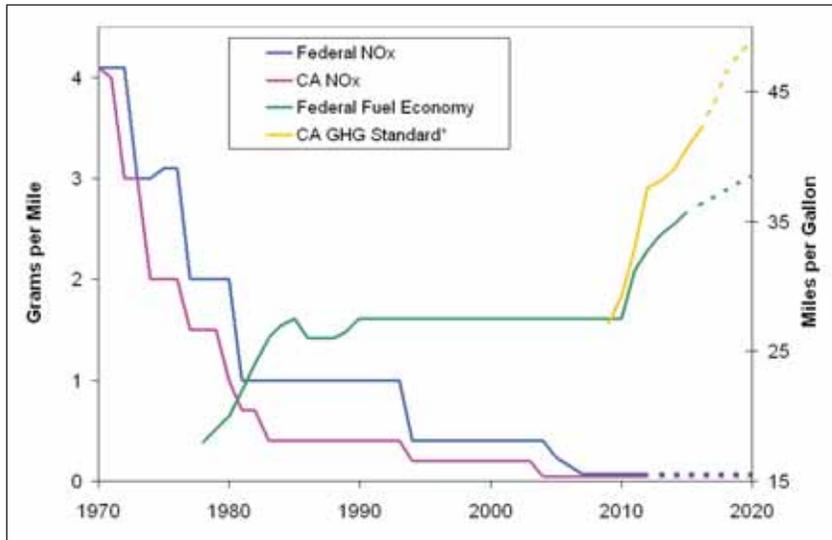


Figure 1. Comparative trends in California and U.S. NO_x technology-forcing tailpipe emission standards for passenger cars since 1970, and projected future trends for GHG limits.

Notes: Dashed lines indicate future limits not formally adopted. California's GHG standard is set in grams per mile, which is not a fuel economy standard given by miles per gallon as with CAFE. For purposes of comparison with CAFE projections, however, the impact of the standard has been projected on a miles per gallon basis.¹¹

after claiming that it would take them longer, raised questions of whether the companies had colluded to keep cleaner vehicle technologies from the market. In January 1969, the U.S. Justice Department filed an action under the Sherman Antitrust Act against the auto industry's trade association, then known as the Motor Vehicles Manufacturers Association (MVMA) and its individual member companies (General Motors, Ford, Chrysler, and American Motors). The action charged that the auto industry had, from as early as 1953, "engaged in a combination whose dual objects were the elimination of all competition in the research, development, manufacture, and installation of air pollution control equipment and the elimination of competition in the purchase of patents and patent rights from other parties covering air pollution control equipment."³

The Justice Department's suit was settled through a consent judgment in October 1969. One provision of the consent judgment prohibited the automakers from exchanging unpublished policy or technical information on pollution control devices. A second provision also prohibited the automakers from filing any jointly-authored statements with any government regulatory agency having authority to issue automobile emission standards. The consent

judgment expired in 1982 and is no longer in effect.

As a result of this experience with technology-following, California shifted to technology-forcing, of which the California LEV program is a current manifestation.

Technology-Forcing at the National Level

Up until the 1970 CAA, the federal government, like California, had pursued a technology-following policy for automobiles. It too failed to adequately advance technology development, as reflected in testimony by the U.S. Health, Education, and Welfare Secretary John Gardner at a 1967 congressional hearing:

[T]he state of the art has tended to meander along until some sort of regulation took it by the hand and gave it a good pull. ... There has been a long period of waiting for it, and it hasn't worked very well. ... If we can stimulate more rapid development of the state of the art through setting the standards at a point which we really have to reach for them, so much the better.⁴

Senator Edmund Muskie of Maine spoke out strongly during the legislative debates in support of the change in policy to technology-forcing:

The first responsibility of Congress is not the making of technological or economic judgments—or even to be limited by what is or appears to be technologically feasible. Our responsibility is to establish what the public interest requires to protect the health of persons. This may mean that people and industries will be asked to do what seems to be impossible at the present time. But if health is to be protected, these challenges must be met.²

These arguments, coupled with historical experience, led to the 1970 CAA Amendments largely abandoning technology-following in favor of technology-forcing in setting vehicle emission standards at the national level.

Results of Technology-Forcing

Figure 1 displays the downward trend in vehicle emission limits for nitrogen oxides (NO_x) since 1970 with the shift to technology-forcing approaches

in California and at the national level. Similar downward trends occurred with volatile organic compounds (VOCs) and carbon monoxide tailpipe limits (not shown in figure). Note that the federal NO_x limits, while trending downward, tend to lag in time behind California's.

Figure 1 also shows past and projected future trends in the U.S. Corporate Average Fuel Economy (CAFE) standard for passenger vehicles. The CAFE trend shows little sustained historical change, and it took congressional action in 2007 to alter its expected future trend. California is seeking to adopt GHG limits for light-duty vehicles to address climate change, and while not for the same purpose as CAFE (a fuel economy standard), Figure 1 suggests that California has taken a more aggressive approach for GHG reductions,⁵ which would be consistent with the historical trends seen with NO_x (i.e., California standards tend to lead federal limits).

Technology-forcing at perhaps its most extreme is California's requirement to produce and sell zero-emission vehicles. This has at times been called a

failure and over-reaching. The ZEV rule has now been modified several times, and its vision of significant fleet penetration (the original rule called for ZEVs to represent 10% of light-duty vehicle sales by 2000) has been scaled back. Even so, "failure" depends on perspective, as California's ZEV mandate has produced rapid advancements in electric vehicle technology. The requirement has helped accelerate the commercialization of hybrid electric vehicles that took advantage of advances in batteries and other components for electric vehicles, and the technology push continues with plug-in hybrid electric vehicles that even more closely approach the goal of ZEVs.⁶

Historical Vestiges

While technology-forcing approaches grew out of the failures of technology-following policies, efforts akin to technology-following have not entirely disappeared. In 1995, for example, the U.S. Environmental Protection Agency (EPA) proposed an alternative program, called National LEV, for states outside of California to adopt in lieu of the CA LEV program.

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With the advent of efforts to regulate GHG emissions from motor vehicles, the back-and-forth tension between technology-following and technology-forcing is likely to continue.

National LEV included an Advanced Technology Vehicle (ATV) component that made sales of ZEVs voluntary. EPA outlined a series of tasks to perform to facilitate the emergence of an ATV market, and called for establishing criteria “needed to sustain retail sales.” EPA recognized this was a different approach than technology-forcing, but felt it was appropriate to try a different model toward achieving environmental benefits.⁷ The use of prospective criteria, however, is the approach that California and federal regulators tried in the 1960s that was subsequently discarded as a failure.

In 1992, the U.S. automakers established the U.S. Council for Automotive Research (USCAR) to coordinate a variety of joint industry research efforts, such as the U.S. Advanced Battery Consortium and the Partnership for a New Generation of Vehicles. Automakers developed performance and cost criteria to be met before a technology was deemed no longer at the pre-commercial stage. This is a technology-following approach, as well as a form of industry collaboration that might have been prohibited under the expired 1969 antitrust consent judgment.

Responses to advances in vehicle technology also find recent parallels with past history. While ZEVs were considered the most onerous of the California LEV program requirements, U.S. automakers also strongly criticized the ULEV standard when originally adopted as unrealistically expensive to achieve. Honda announced in 1995, however, that it could build a gasoline-powered engine that would achieve ULEV emissions a reasonable cost.⁸ Other automakers quickly downplayed the announcement and

suggested that they too would soon bring comparable technologies to the market. A Ford spokesperson said, “Probably all manufacturers have some vehicles that meet the ULEV levels... We just choose not to make announcements until we’ve gone through all the hurdles.”⁹ Another Ford spokesperson stated, “They’re the first to announce it, but it’s our hunch that you’re going to see other people announcing the same thing, and bringing out other products in the same time frame.”¹⁰ Honda responded with, “There’s been a tone of, ‘This can’t be done.’ Now it’s, ‘Aw, anybody can do that.’ It’s kind of funny.”⁹ The “it can’t be done” followed by “we’ve already done it” harkens back to 1964 and the auto industry’s rapid rollout of engine modifications following the certification of independently developed emission control products.

Summary

Looking at the historical record, it’s clear that technology-forcing mandates to promote advanced technology vehicles were not the result of spontaneous generation. Rather, they branched off of technology-following policies that had reached evolutionary dead ends. Throwbacks to technology-following continue to arise from time to time, however, despite the positive progress made in developing cleaner cars with technology-forcing standards. With the advent of efforts to regulate GHG emissions from motor vehicles, the back-and-forth tension between technology-following and technology-forcing is likely to continue. **em**

References

1. Anti-Smog Push Sparks Revved-Up Engines; *USA Today*, August 17, 1995, p. 1B.
2. Krier, J.E.; Ursin, E. *Pollution and Policy: A Case Essay on California and Federal Experience with Motor Vehicle Air Pollution 1940–1975*; University of California Press: Berkeley, CA, 1977.
3. *United States vs. Motor Vehicles Mfrs. Ass’n*, 643 F.2d 644, 645 (1981).
4. Hearings on Air Pollution—1967, Hearings before the Subcommittee on Air and Water Pollution, Senate Committee on Public Works, 90th Cong., 1st Sess., pt. 2, p. 766-767 (1967) (testimony of Secretary John Gardner, U.S. Department of Health, Education, and Welfare).
5. The ability for California to adopt GHG emission standards for light-duty vehicles is dependent upon the U.S. Environmental Protection Agency approving a request from the state.
6. Burke, A.; Kurani, K.; Kenney, E. J. *Study of the Secondary Benefits of the ZEV Mandate*; Institute of Transportation Studies, University of California, Davis, CA; Paper UCD-ITS-RR-00-07, 2000; available at <http://repositories.cdlib.org/itsdavis/UCD-ITS-RR-00-07> (accessed March 2009).
7. *Fed. Regist.* **1995**, 60, 52,761 (October 10, 1995).
8. Honda Announces Gas Engine Meets Anti-Pollution Goals; *The Washington Post*, January 7, 1995, p. A1.
9. Flap over ‘Clean’ Engine: Competitors Cry Foul over Much-Publicized Announcement; *USA Today*, January 13, 1995, p. 2B.
10. New Honda Engine a Threat to Natural Gas; *The New York Times*, January 9, 1995, p. D1.
11. *Comparison of Greenhouse Gas Reductions for the United States and Canada Under U.S. CAFE Standards and California Air Resources Board Greenhouse Gas Regulations—An Enhanced Technical Assessment*; California Air Resources Board, Sacramento, CA, 2008; available at www.arb.ca.gov/cc/ccms/reports/pavleycafe_reportfeb25_08.pdf (accessed March 2009).