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California's Pioneering Transportation Strategy

The state that has become identified with freeways and smog now aspires to become the leader in reducing motor vehicles' carbon footprint and changing the way people travel.

No place in the world is more closely associated with the romance of the automobile and the tragedy of its side effects than California. Having faced the problem of traffic-damaged air quality, the state became a leader in policies to reduce auto emissions. Now that transportation is the source of 40% of the state's contribution to climate change, California has become a pioneer in the quest to shrink its transportation footprint and a possible trailblazer for national policy.

Two political circumstances favor California's climate policy leadership. First, it has unique authority and political flexibility. Because California suffered unusually severe air quality problems as early as the 1940s and adopted requirements for vehicles and fuels before Congress was moved to act, the U.S. Congress in 1970 preserved the state's authority over vehicle emissions, as long as its rules were at least as strong as the federal ones. California has continued in a

leadership role for over 40 years, launching many of the world's first emission controls on internal combustion engine vehicles, reformulated gasoline, and zero-emission vehicles. Since the 1977 amendments to the U.S. Clean Air Act, other states have enjoyed the option of following the more stringent California standards instead of the federal standards. The California legislature took advantage of this authority in 2002 when it directed the California Air Resources Board (CARB) to adopt limits on vehicular emissions of greenhouse gases (GHGs), designating these emissions as a form of air pollution.

Second, California has been able to act in advance of the national government because it has more political space to maneuver. The Detroit car companies have relatively small investments in California, and coal companies are absent. California is home to leading research universities, innovators, and entrepreneurs, as well as a diverse resource base of solar, wind, ocean, and geothermal energy resources. The state is also home to the world's largest venture capital indus-

try, which favors clean energy policy. California politicians feel freer to pursue aggressive energy and climate policies than do their counterparts in many other states.

In 2005, Governor Schwarzenegger issued an executive order requiring the state to reduce GHGs emitted by 80% from 1990 levels by 2050. This goal has also been adopted by the European Union and many other governments. By acting early, California has launched a policy experiment that could produce valuable lessons for the United States and other countries.

The 80% goal cannot be met without dramatic change in driver behavior and transportation technology. Researchers and companies have made rapid technological progress in recent years in improving conventional and advanced technologies. Performance-based regulations for gasoline-powered cars are expected to double fuel economy between 2010 and 2025, and rapid advances are being made with advanced lithium batteries and vehicular fuel cells. With greater emphasis on energy efficiency and low-carbon technologies, dramatic reductions in oil use and GHG emissions will occur. A key ingredient in reaching this goal will be government policy to stimulate innovation, encourage consumer behavior changes, and direct society toward large reductions in oil use and GHG emissions.

Emphasize regulation

The California strategy departs from the common approach to climate change in two notable ways: It does not depend on international agreements, and although it incorporates market instruments, it relies primarily on performance-based regulatory actions. Both elements are critical to its success.

Although climate change is a global problem that will require global action, transportation is essentially a local concern. International cooperation will be necessary to resolve problems in maritime and air transport, but action on cars and trucks can be taken at a national or state level.

In addition, although many experts say that the solution to our energy and climate problems is sending the correct price signals to industry and consumers, the transport sector's behavior is highly inelastic in that it does not change significantly in response to changes in fuel prices, at least in the range that is politically acceptable. Europe has gasoline taxes over \$4 per gallon and still finds the need to adopt aggressive performance standards for cars to reduce GHGs and oil use. These high fuel taxes certainly have an effect in reducing the average size and power of vehicles and leading people to drive less, but the resulting reductions in fuel use and GHGs still fall far short of the climate goals.

Large carbon (and fuel) taxes are efficient in an economic

sense, but their effect on vehicles, fuels, and driving is modest. The European experience suggests that huge taxes would be needed to motivate significant changes in investments and consumer behavior, but U.S. public opinion is hostile to even small energy tax increases. Moreover, the energy market is distorted by a number of factors, including the failure to internalize the total cost of pollution and climate change, the market power of the OPEC cartel, technology lock-in, and the fact that many energy users such as apartment renters and drivers of company cars are insulated from the price of energy because they do not pay the bills.

We are not saying that getting the prices right and adopting international climate agreements and carbon taxes are irrelevant and unimportant. But we are saying that much progress can, and probably will, be made in the transport sector in the next decade without international agreements and without getting the prices right. California is leading the way with policies that address three critical elements of the transportation system: vehicles, fuels, and mobility.

Vehicles

Americans like their cars big and powerful. U.S. fuel economy standards remained stagnant for 30 years, until 2010, while Japan, Europe, and even China adopted increasingly aggressive standards to reduce oil use and GHGs. California played a leadership role in breaking the paralysis in U.S. efficiency standards. In 2002, California passed the so-called Pavley law, which required a roughly 40% reduction in vehicle GHG emissions by 2016. The car companies filed lawsuits against California and states that followed California's lead. When those lawsuits failed, the Bush administration refused to grant a waiver to California to proceed, even though waivers were granted routinely for previous vehicle emissions regulations by California. In 2009, President Obama not only agreed to grant a waiver, but committed the entire country to the aggressive California standards.

And then in August 2011, at the request of President Obama, the Department of Transportation, Environmental Protection Agency, and CARB announced an agreement with the major automakers to sharply reduce fuel consumption and GHG emissions by another 4 to 5% per year from 2017 to 2025. California was recognized as playing an instrumental role by threatening to adopt its own more stringent rules if the federal government and automakers did not agree to strong rules. CARB expects to adopt these rules in January, with the federal government following suit in summer 2012.

These regulations requiring automakers to reduce oil consumption and GHG emissions are central to California's

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GHG reduction efforts and are expected to elicit larger reductions than any other policy or rule, including carbon cap and trade. The reductions are also expected to be the most cost-effective, with consumers actually earning back at least twice as much from fuel savings over the life of their vehicle than they would be paying for the added cost of the efficiency improvements, even after discounting future fuel cost savings.

The federal government has recently asserted leadership in supporting the commercialization of electric vehicles (EVs), with the Obama administration offering tax credits of \$7,500 per car and billions of dollars in loan guarantees and grants to EV and battery manufacturers. In addition, in 2009 the federal government adopted vehicle GHG standards that provide strong incentives to automakers to sell EVs.

But California has a much more ambitious long-term policy commitment to EVs. In 1990, California adopted a zero-emission vehicle (ZEV) requirement, mandating that the seven largest automotive companies in California “make available for sale” an increasing number of vehicles with zero tailpipe emissions. The initial sales requirement was 2% of car sales in 1998 (representing about 20,000 vehicles at the time), increasing to 5% in 2001 and 10% in 2003.

The intent was to accelerate the commercialization of electric (and other advanced) technology, but batteries and fuel cells did not advance as fast as regulators hoped. The ZEV rule, after surviving industry litigation and multiple adjustments to reflect the uneven progress of hybrid, fuel cell, and battery technologies, now bears little resemblance to the original. Although some consider the ZEV mandate a policy failure, others credit it with launching a revolution in clean automotive technology.

The actual numbers of vehicles sold to consumers as a result of the ZEV program are certainly not what CARB originally expected. Only a few thousand EVs were sold in the United States in the first decade of this century, most of them by start-ups such as Tesla. But 2011 could mark a breakthrough, because for the first time major automakers have made firm commercial commitments to the technol-

ogy. Nissan began selling its all-electric Leaf, and General Motors its plug-in hybrid EV, the very first commitment of major car companies to mass-produce plug-in vehicles in over a century. Sales of the two vehicle models amounted to fewer than 20,000 worldwide in 2011 (about half of which were in California), but both companies are expanding factory capacity in anticipation of each selling 50,000 or more in 2012, and virtually all major car companies have plans to sell plug-in vehicles in the next couple of years.

Could another policy have accomplished the same at less cost with less conflict? Who knows? What's certain is that the ZEV program accelerated worldwide investment in electric-drive vehicle technology. The benefits of those accelerated investments continue to sprout throughout the automotive world, and California policy was the catalyst. In addition to the ZEV mandate, California has enacted various other incentives in recent years to support the introduction of fuel-efficient and low-GHG vehicles, including allowing access to carpool lanes and providing rebates to buyers of EVs.

Fuels

California has also taken steps to encourage the development and use of low-carbon alternative fuels, and the federal government has followed with its own aggressive actions. The federal Renewable Fuel Standard (RFS) requires the production of 36 billion gallons of biofuels by 2022, and Congress and President Obama have enacted a series of provisions that promote EVs. But these efforts have serious shortcomings.

The RFS biofuels mandate has led to the annual production of more than 12 billion gallons of corn-based ethanol, but almost no low-carbon, non-food-based biofuels. Corn ethanol is roughly similar to gasoline in terms of life-cycle carbon missions. The EPA has repeatedly given waivers to oil companies that allow them to defer investments in lower-carbon advanced biofuels.

California has gone further in pioneering a regulation that provides a durable framework for the transition to low-carbon fuel alternatives. Its low-carbon fuel standard (LCFS),



MICHAEL LIGHT, *Tailings of Barney's Canyon Gold Mine Looking Southwest, Near Bingham Canyon, UT*, archival pigment print mounted on aluminum, 40 x 50 inches, 2006.

adopted in 2009 and taking effect in 2011, applies to all fuel alternatives, unlike the biofuels-only RFS, and it allows oil companies to trade credits among themselves and with other suppliers such as electric utilities. Also, unlike the federal RFS, it provides incentives to make each step in the energy pathway, from the growing of biomass to the processing of oil sands in Canada, more efficient and less carbon-intensive. The LCFS provides a framework for all alternatives to compete. Versions of California's LCFS are being enacted in other

places, including British Columbia and the European Union, and many states are in the advanced stages of review and design of an LCFS.

Because the LCFS is novel, casts such a wide net, and requires major investments in low-carbon alternative fuels, it has been controversial. Economists argue that a carbon tax would be more economically efficient. Energy security advocates and producers of high-carbon petroleum, such as that from the Canadian oil sands, are concerned that it will



MICHAEL LIGHT, *Barney's Canyon Gold Mine Looking South, Near Bingham Canyon, UT*, archival pigment print mounted on aluminum, 40 x 50 inches, 2006.

discourage investments in unconventional energy sources and technologies that could extend the world's supply of oil. Oil companies correctly argue that the imposition of the LCFS in one state will encourage the shuffling of high-carbon ethanol and petroleum to regions that don't discourage those fuels. And corn ethanol producers complain about the details of how emissions are calculated. Moreover, administering this seemingly simple rule requires vast amounts of technical information and great transparency in the calcu-

lation of life-cycle emissions.

The LCFS is a powerful policy instrument that is already stimulating innovation. Oil company executives in Europe and North America acknowledge privately that the LCFS has motivated their companies to reduce the carbon footprint of their investments and to reassess their long-term commitment to high-carbon fuels such as fuel from oil sands. But to realize the full benefits of an LCFS policy, more governments must adopt similar policies to minimize fuel shuf-

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fling. Also, as with low-carbon vehicles, additional complementary policies are needed to target the many market failures and market conditions that inhibit the transition to low-carbon fuels. For example, investments in hydrogen stations are needed to reassure car companies and early buyers of hydrogen fuel cell cars that fuel will be available. It is a classic chicken-and-egg dilemma. California is considering a requirement that oil companies build a certain number of hydrogen stations in accordance with the number of hydrogen cars sold.

Mobility

The third major factor in transportation is the vehicle user. GHG emissions will be reduced if people drive less, and people can be nudged to drive less by cities that reduce urban sprawl, enhance public transportation, and raise the price of travel to incorporate externalities of carbon emissions, pollution, and energy security. Still other user-related strategies to reduce GHG emissions include better driving habits, keeping tires properly inflated, and removing unneeded roof racks that increase wind resistance. Better road maintenance and traffic management can also reduce energy waste and excess emissions.

Efforts to alter vehicle use have enjoyed little success. Indeed, vehicle use has increased substantially, despite decades of federal initiatives such as “Transportation System Management,” “Transportation Control Measures,” and “Transportation Demand Management,” as well as the construction of networks of carpool lanes and increased subsidies for public transportation. After all these efforts, the number of vehicles per licensed driver has increased to 1.15, public transport has shrunk to less than 3% of passenger miles, carpooling has also shrunk, and vehicle miles per capita have steadily increased. Cars have vanquished competitors and become ever more central to daily life. Reversing this trend, while providing a high level of access to work, school, health care, and other services, is a daunting challenge. It requires a vast swath of changes related to the imposition and disbursement of sales and property taxes, land-use zoning, trans-

portation funding formulas, parking supply, innovative mobility services (such as demand-responsive transit and smart car sharing), pricing of vehicle use, and much more.

As noted, California pioneered car-dependent cities and living and took it to an extreme, creating a highly expensive and resource-intensive transportation system. It has overindulged. Most of the world has followed California’s car-dependent path, but none have gone as far as California. Other countries have been far more innovative and determined at restraining vehicle use. But perhaps because it has gone so far to the extreme, California is now showing policy leadership in reversing the pattern.

In 2008, California passed the Sustainable Communities law, known as SB375, to reduce sprawl and vehicle use. It led to the creation of a new policy framework for cities to guide the transition to a less resource-intensive and car-intensive future. It provides a more robust and performance-based approach than did previous efforts to reduce vehicle use. It is just the beginning, but it does provide a good policy model for others.

In implementing the law, CARB established distinct targets for each metropolitan area in the state. Those targets range from 6 to 8% reduction in GHGs per capita for major regions by 2020 and 13 to 16% by 2035. The targets are applied to regional associations of governments that then work with individual cities and counties within their region to attain those targets. One strength of SB375 is that local governments are free to choose what strategies and mechanisms will work best in their situation.

The downside of SB375 is that it imposes no penalties for noncompliance and only weak incentives and rewards. The rationale for the absence of penalties is that the responsible parties are cities, most of which are in desperate financial straits. The challenge is to provide incentives that are compelling enough for the cities to assert themselves. Two options under consideration are diverting cap-and-trade revenues to cities that comply with reduction targets and restructuring transport funding formulas to reward complying cities. Current formulas are tied primarily to popu-

lation and vehicle use, with the result that having more vehicles earns cities more money. The incentives should be just the opposite.

One lesson learned during the early implementation of the program and the development of the GHG targets was that local politicians and transportation managers came to support the targets when they realized that strategies to achieve the GHG targets are the same strategies they were already pursuing for other reasons, such as infrastructure cost reduction, livability, and public health. In fact, having a formal policy framework aids their efforts in governing their cities. But whatever the motivation, behavioral change is difficult.

Carbon cap and trade

Perhaps surprisingly, California's adoption of a carbon cap-and-trade rule as the capstone of its plan for meeting the goals of AB32, the state's overarching climate law, will not have much impact on transportation. A cap-and-trade program imposes shrinking carbon caps on factories, oil refineries, cement producers, electricity-generating facilities, and other large GHG sources. If companies cannot or choose not to shrink their emissions, they can purchase "allowances" from companies that are overperforming. With carbon trading, a market is created for carbon reductions, with carbon gaining a market value. The carbon price will be low if everyone is successful in reducing their emissions and no one needs to buy allowances from others, but it will be high if they are not successful. When carbon has a market value, polluters know exactly how much it costs them to pollute and can make economically rational decisions about how to reduce GHG emissions.

The European Union preceded California by a few years in implementing a cap-and-trade system, and the northeastern and mid-Atlantic states followed Europe in instituting a carbon cap-and-trade program for their electric utilities. But California's policy is broader than the eastern utilities program by including all large industrial and electricity-generation facilities, and broader than the European program by capping transport fuels.

The cap-and-trade program is valuable in creating a price for carbon, but it is not central to reducing transportation emissions. The California cap-and-trade program covers oil refineries, and beginning in 2015 the carbon content of the fuels themselves. The program is designed with floor and ceiling prices of \$10 and \$70 per ton of carbon through 2020. Although \$70 is likely to motivate large changes in electricity generation, the effect will be far less for transportation, where \$70 per ton translates into \$0.70 per gallon of gasoline. That is not enough to motivate oil companies to switch to alternative fuels or to induce consumers to significantly reduce their oil consumption, but it is still important to establish the principle of placing a price on carbon.

Replicable?

California has put in place a unique, comprehensive, and largely coherent set of policies to reduce GHGs and oil use in transportation. Although it includes a carbon cap-and-trade policy that injects a price of carbon into the economy, more important is the mix of policy instruments that target specific vehicle, fuel, and mobility activities. Most of these policies are regulatory, though they are largely performance-based and many, such as the LCFS and its credit-trading component, have a pricing component to them.

This California model has the benefit of minimal cost to taxpayers, extensive use of performance-based standards, and some harnessing of market forces. Most important of all, it has survived political challenge. Even in the midst of a severe recession and 12% unemployment, California voters defeated an initiative measure to suspend implementation of the program.

The plan does suffer from some theoretical and practical defects. One concern is that many of the policies shield consumers from price increases and will thus slow the behavioral response. One future option might be to impose a system of feebates for vehicles, whereby car buyers pay an additional fee for those that consume more oil and produce more GHGs, and less for those that consume and emit less. A fee-

bate reconciles regulations with market signals. Another way to create more transparency and boost the effectiveness of the price signal might be to convert the carbon cap imposed on fuels into a fee or carbon tax.

Another major weakness is the absence of policies addressing most air, maritime, and freight activities, leaving significant chunks of the economy untouched by carbon policy. These activities can be much more effectively addressed at the federal level. Emissions leakage and fuel shuffling—whereby fuel suppliers send their “good” fuel to California and their high-carbon fuel elsewhere—is a particular challenge for California and for any small jurisdiction, whether the policies are based on market or regulatory instruments.

In a broad sense, perhaps the biggest challenge is the complex interplay of the many regulations and incentives, and the involvement by various government bodies. For example, large-scale adoption of EVs depends on whether the design of the cap-and-trade program by CARB and the Public Utilities Commission encourages electricity generation that replaces high-carbon petroleum in the transportation sector. The Public Utilities Commission also enacts rules regarding who can or cannot sell electricity to vehicles. Meanwhile, the federal government and CARB determine how much credit EVs receive as part of vehicle performance standards. Are full upstream emissions from utilities considered, even though they are not for petroleum-fueled vehicles? And should automakers be given more or less credit for EVs relative to fuel cell vehicles in the ZEV mandate? It is important to make sure that the many rules are aligned and send consistent signals. This will be a challenging task, exacerbated by the involvement of numerous government agencies and legislative bodies.

One might argue that California has no business in pioneering climate policy, that it contributes a small part of the world’s total GHG emissions, and that it is a global problem that should be left to global agreements. Although it is true that California contributes only about 2% of the world’s

total GHG emissions, there are few entities with larger shares. More important, although it is clear that top-down approaches contained in international treaties and even national rules will be required to achieve substantial climate change mitigation, a bottom-up approach that more directly engages individuals and businesses is also needed. California is providing the bottom-up model for others to follow.

Recommended reading

National Research Council, *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO₂ Emissions* (Washington, DC: Transportation Research Board of the National Academies, Special Report 298, 2009).

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