

The demise of the internal combustion engine

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Credit: Unsplash/CC0 Public Domain

The Ford Model T did not end the horse, but it did replace it as America's primary means of transportation. Just as people still love and ride horses, so too will people love and ride their old jalopies. But starting in 2035, you won't be able to buy a new one in California. California's state government is phasing out their sale. As Coral

Davenport, Lisa Friedman, and Brad Plumer reported in the New York Times last week:

"The rule, issued by the California Air Resources Board, will require that all new cars sold in the state by 2035 be free of greenhouse gas emissions like carbon dioxide. The rule also sets interim targets, requiring that 35 percent of new passenger vehicles sold by 2026 produce zero emissions. That requirement climbs to 68 percent by 2030. Transportation is the nation's top source of planet-warming greenhouse-gas emissions."

The California rule is permitted under a Clean Air Act waiver, first established as part of the landmark federal air law enacted in 1970. California's ability for half a century to exceed federal requirements was eliminated by Donald Trump but recently restored by Joe Biden. About a dozen states typically follow California's lead, magnifying the impact of this exciting move by this path-breaking state.

As one might expect, there are those opposed to this infringement on liberty. Some have identified the obstacles to implementation: the [electric grid](#) will be overwhelmed, there aren't enough charging stations, EVs are too expensive, Californians will simply go to Nevada to buy their cars. The impediments are endless.

There will certainly be people who will not comply with this rule. But all of these obstacles are beside the point. There will be bumps along the way, but [electric vehicles](#) will displace today's vehicles because they are based on a superior technology. That is why the automobile replaced the horse. You couldn't just park a horse and walk away. They needed food, water, a clean stall, affection, and even medicine. Horses required more resources to maintain and were not as convenient or powerful as the internal combustion engine. Initially, there were more stables than gas stations, but that changed over time. We will see the same

transformation with charging stations replacing gas stations. Of course, every problem with EVs will be magnified by [social media](#) and the 24-hour news cycle, a fact of modern life that Henry Ford didn't have to deal with. (Breaking News: Model T runs out of gas! Driver wishes he hadn't sold his horse!)

Electric vehicles are more expensive now, but eventually, they will be price competitive. Over their lifetime they are already cheaper, but soon even the retail or capital cost of the electric vehicle will be as low as the internal combustion car. To the extent that the EV is powered by renewable energy, the cost of fuel will be low and predictable. EVs require less service and have fewer moving parts. Most importantly [auto manufacturers](#) see the huge business opportunity in replacing America's auto fleet and they have already bet the ranch on it. They are investing billions in electric vehicles. According to Davenport, Friedman, and Plumer:

"Several automakers said their strategies were aligned with California's goal of promoting emission-free vehicles. General Motors said it was still reviewing the rule but that the company also had a goal of selling only electric vehicles by 2035. "General Motors and California have a shared vision of an all-electric future," said Elizabeth Winter, a spokeswoman for G.M. Ford's chief sustainability officer, Bob Holycross, said the company planned to invest more than \$50 billion in electric vehicles and batteries by 2026 and said the rule would "set an example for the United States." A spokesman for Stellantis, which owns Chrysler, Fiat, Dodge and other brands, said the company intended to introduce 25 new electric models by 2030 to help support California's goals."

In fact, the [auto companies](#) are delighted that the risk they took in investing in electric vehicles now looks like a much safer bet than it did before California acted. The EVs they are marketing will include lower-

priced models, but their initial offerings include trucks like the Ford Lightning 150, sports cars, SUVs, and other popular high-end models. They are not asking their customers to sacrifice features but are actively designing-in fancy new options that take advantage of the new technology.

I see this as the template for the transition to a renewable resource-based economy: use technology to mitigate the worst impact of consumer technology on the planet but continue to develop and market features that people want. The materials used in the vehicle need to eventually be recycled when the vehicle's useful life is over. We already see that with the rare earth minerals used in batteries and with tires and aluminum. Most important is to change the image of sustainability from dreary sacrifice to exciting new products, features, and services. The auto companies seem to be doing just that.

The other noteworthy feature of California's move is the positive, technology-forcing impact of regulation. These new rules are not "job-killing" but job-creating stimulus. We have been seeing this for decades with motor vehicles. Auto regulation first focused on safety, requiring seat belts and then airbags. Then regulation focused on pollution control with catalytic converters and improved gas mileage. What happened? Once engineers figured out how to comply with rules, they had time on their hands and started to improve cars. They used lighter materials, they replaced mechanical parts with electronics, they turned our cars into mobile computers with an incredible array of features from sensors that kept you from crashing into other cars to alarms that reminded you there is a baby on board. The batteries and charging time required of the first generation of electric vehicles will eventually be replaced by batteries that have more range and recharge faster. We have already seen these improvements begin.

Federal policies like the ones that created the interstate highway system,

insured home mortgages, and made mortgage interest and property taxes deductible stimulated America's largely suburban land use development patterns. The [private sector](#) built the suburbs in response to public policy in the form of federal incentives. While there is some move to build walkable towns and repopulate cities, our overall pattern of land development requires the use of personal transportation. This is not going away, and many Americans prefer this type of living. As a resident of Manhattan, I prefer something different, but for many Americans, the way folks in my neighborhood live seems like a mystery. I remember once interviewing a prospective faculty member for a job who was genuinely curious about how I got my groceries and dry-cleaning home from the store without a car and driveway. In those days before Amazon Prime, I pointed to a fellow riding a bike with a delivery bin in front and said: "there goes someone's groceries."

We need to build environmental sustainability on the base we have and acknowledge the attractiveness of the way of life preferred by many people. California has been built on automobiles, suburbs, and freeways. I may find a 12-lane highway terrifying, but Californians take it in stride. But over the past half-century, this is the state that has led the way in cleaning our air. They are doing it again with [climate change](#) and with EVs. Even before this new rule, last year, 12% of all new cars sold in California were electric, and this year, that percentage is over 16%. About one million households in California have solar panels. The electric vehicle is one element of a system of households and transportation that will someday be less destructive to the environment than today's system. California will get there first and will need to teach the world how to get the job done.

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