
Substantial costs, limited results

Are electric vehicles really “green”?

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AUTOMOBILE manufacturers are once again under enormous political pressure to roll out electric cars.¹ The Obama administration and Congress have conditioned bailout funds for the beleaguered industry on the production of “greener” vehicles, while several US states are preparing more stringent emissions standards that will punish the internal combustion engine. Considering the substantial costs that such actions will impose on consumers and taxpayers, recognition of the policy limitations is warranted.

Government mandates and subsidies for electric vehicles date back decades,² while the rationale for the regulatory forcing of automotive technology has shifted over time. Air quality was the paramount concern in the 1960s, but America’s supposed “dependence on foreign oil” became the driving force for electrics following the Arab Oil Embargo in 1973. Most recently, electric vehicles have been promoted as essential to curbing the tailpipe emissions that supposedly cause global warming.

Automakers and the US government have poured billions of dollars into electric vehicle research and development. Progress has been made, but there remain significant obstacles to be overcome before an affordable all-electric auto is ready for mass production. Meanwhile, since the mid-1960s, passenger car tailpipe emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen have significantly decreased in the United States by 99%, 96%, and

95%, respectively (General Motors, 2009).³

Going electric

COMPARED to the internal combustion engine, an electric vehicle can produce less air pollution, consume less petroleum, and emit less greenhouse gases (GHGs). However, the degree of difference depends on a variety of factors, the more important of which include the source of the electrical power to run them, the type of battery that powers the vehicle, and the manner in which they are driven.

The actual consequences, if any, of reducing both petroleum consumption and carbon emissions are speculative. The notion that greenhouse gases cause global warming is theoretical, at best, and predictions about the environmental and public health effects of climate change are hypothetical. Thus, there is no scientific basis for believing that either increases or reductions in emissions will affect climate trends.

Nonetheless, an army of engineers is scrambling to ready electrics under the guise of averting environmental catastrophe. General Motors Corp. has scheduled the launch of its plug-in hybrid, the Chevy Volt, for 2010. The \$40,000 compact is supposed to run about 40 miles on a charge of six hours. Meanwhile, Tesla Motors of California is producing an electric-powered roadster with a sticker price of \$109,000 (Squatriglia, 2009).

To compare the emissions associated with conventional and electric vehicles, researchers conduct “life cycle” assessments of carbon “intensity.” Such assess-

ments attempt to account for the amount of CO₂ emissions produced during various phases of fuel production, vehicle manufacture, and use. These calculations are inherently imprecise due to the array of assumptions that must be made for a myriad of factors, such as vehicle weight and shape, battery and fuel type, and driving conditions, to name a few.

Researchers at Carnegie Mellon University in Pittsburgh, Pennsylvania, recently assessed the life cycle emissions of electric and conventional vehicles (Samaras and Meisterling, 2008). Assuming present-day average greenhouse gas “intensity” of electricity,⁴ they calculated that a plug-in hybrid electric vehicle (PHEV) reduces greenhouse gas emissions by 32% when compared to a conventional vehicle. But if the carbon intensity of the electricity is high, there may be virtually no difference between the two vehicles.

As the researchers noted, “When charging PHEVs with electricity that has a GHG intensity equal to or greater than our current system, our results indicate that PHEVs would considerably reduce gasoline consumption but only marginally reduce life cycle GHGs when compared to gasoline-electric hybrids or other fuel-efficient engine technologies.”

Other analyses have calculated a difference of about 30% in GHG emissions between burning coal to generate electricity and burning gasoline to power a conventional auto (Lave et al., 2000). But if the carbon intensity of the fuel source is high, there’s little if any difference in the volume of carbon dioxide emissions. Taking into account the greater emissions produced during the

manufacturing of electric cars and the higher losses of power during electricity transmission, there are conditions under which an electric vehicle would actually yield more CO₂ than a low-emission conventional model.

As noted by the American Council for an Energy Efficient Economy, “in regions with coal-heavy electricity generation, the plug-in [auto] would not reduce CO₂ emissions at all ... In most locations, achieving a major CO₂ advantage from plug-ins will require greatly reducing power sector carbon emissions” (Kliesch and Langer, 2006: iii). This conclusion was recently reinforced by a new report from the Congressional Research Service, which states that “widespread adoption of plug-in hybrid vehicles through 2030 may have only a small effect on, and might actually increase, net CO₂ emissions” (Parfomak, 2008).

To some extent, then, electric cars simply represent a shift in the source of emissions from oil to coal, and from direct sources (tailpipe) to indirect sources (smokestack).

Greater emissions reductions would require an overhaul of the nation’s electricity-generating capacity. That is a costly proposition, especially for countries in the throes of recession. Fossil fuels comprise a significant portion of the electricity-generating capacity in the United States. The US economy could not manage a major shift away from carbon fuels at this point in time without devastating economic impacts.

Other energy sources?

To a great extent, there is currently no sensible substitute for fossil fuels. But that is not stopping governments from instituting quotas for renewable energy use to create artificial demand.

Solar power, for example, is inherently inefficient and unreliable. Even the most advanced experimental solar cells convert no more than 45% of the cap-

tured sunlight into energy; the typical efficiency is 25% (Hodgin, 2008, Dec. 1). Much of the energy is lost through heat. The other limitation, of course, is that sunlight is variable, dependent on location and cloud cover.

Wind power is likewise intermittent, and the turbines require a wind speed of about 15 mph to generate electricity and 25 mph to reach maximum output (United States, Department of Energy, 2008). Nor is it necessarily environmentally benign. The best locations for wind turbines often are remote and thus require miles of new roads and transmission lines—as much as 19,000 miles of new transmission lines, according to a recent report by the Congressional Research Service (Parfomak, 2008).

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Ethanol and other bio-fuels suffer a host of unintended consequences. For example, a recent study published in *Science* reports that the cultivation of corn for ethanol and other bio-fuel feed stocks substantially increases emissions of greenhouse gases (Searchinger et al., 2008).

The study calculated that corn-based ethanol nearly doubles greenhouse gas emissions over 30 years, while the production of fuel from switch grass increases emissions by 50%. The excess emissions result from land conversions that are driven by demand for corn and other crops used to produce “renewable” fuels. According to the researchers, soil and plants together store 2.7 times more carbon than is present in the atmosphere. Thus, burning and plowing grasslands, rain forests, savannas, and peat land for crop cultivation releases huge amounts of CO₂ into the atmosphere. Moreover, the loss of plants and soil reduces the

absorption of carbon dioxide from the atmosphere that would otherwise occur.

Reductions in greenhouse gas emissions may be achieved by using bio-fuels derived from “waste biomass,” such as wood byproducts and agricultural debris, or from biomass grown on abandoned agricultural lands, researchers say.

Battery challenges

AMONG the most challenging obstacles to achieving an electric fleet is battery technology. The battery in a conventional car principally starts the vehicle and powers accessories. But the battery in an electric vehicle must run it all and, therefore, must be significantly more powerful and easily rechargeable. A

large portion of the premium cost of an electric vehicle is the cost of the battery, which can retail for as much as \$9,000 (Delucchi et al., 2000).

Considerable attention is now being focused on lithium-ion (Li-ion) batteries. Compared to other types, the Li-ions offer greater energy density, which means that they are more compact. Currently, however, lithium is obtained from open-pit mines or extracted from salt-water ponds lined with polyvinyl chloride (PVC). Some researchers also warn that there is an insufficient supply of lithium to sustain a fleet of electrics (based on known reserves worldwide).

According to William Tahil (2006) of Meridian International Research, “Depletion rates would exceed current oil depletion rates and switch dependency from one diminishing resource to another. Concentration of supply would create new geopolitical tensions, not reduce them.”

Nor is there currently sufficient battery production capacity in either the United States or Canada. The *Wall Street Journal* (Smith, 2008, Dec. 18) recently reported that 14 American companies are seeking \$1 billion in federal aid to build a battery plant. Meanwhile, federal and state governments are doling out cash to construct the charging stations and other infrastructure needed to support an electric fleet.

Whatever the battery type, the benefits of electric vehicles, if any, depend on a critical mass of drivers behind the wheel. But there is a hefty price premium on electrics due to the cost of batteries and the lightweight materials used to reduce curb weight. A \$40,000 compact is doable for some, but certainly not average, families.

Automakers are banking on subsidies and tax credits to spur sales. But there has been relatively little consumer interest in purchasing the hybrid vehicles that have been available for years. Hybrid sales accounted for only 2.4% of the new vehicle market last year (Green Car Congress, 2009). The reason for this trend is hardly difficult to understand: the internal combustion engine is affordable and highly functional; tailpipe emissions have been greatly reduced; and at this point in time, the environmental benefits of electrics simply do not appear to be commensurate with the cost for consumers.

Notes

¹ “Electric car” here and throughout the paper refers to both plug-in hybrid electric vehicles (PHEVs) and all-electric models. A PHEV is propelled solely by an electric battery and is recharged via a household power outlet. The gasoline engine serves only to generate power to recharge the battery. A hybrid gas-electric vehicle (HEV) is also powered by a battery. However, once the battery is depleted, the car is propelled by the gasoline engine.

² The first federal legislation advocating use of electric vehicles to reduce air pollution

was introduced in Congress in 1966. The US Clean Air Act of 1970 authorized \$25 million annually for government purchase of low-emission vehicles. In 1975, the US Postal Service purchased 350 electric jeeps, and in 1976, Congress authorized a five-year, \$160 million project to develop an electric vehicle. The Clinton administration launched the \$1 billion Partnership for a New Generation of Vehicles involving seven federal agencies, 15 federal labs, and dozens of universities, while the George W. Bush administration funneled hundreds of millions of dollars annually into the FreedomCar initiative.

3 If more diesel-powered passenger cars were allowed in the states, remaining emissions of greenhouse gases could be reduced an additional 25%.

4 At present, about 30% of electricity generating capacity is fueled by coal, 40% by natural gas, and 6% by petroleum. These percentages are derived from the “Generator Nameplate Capacity,” which is the maximum output of generators in the nationwide network. In actuality, more than half of the electricity used in the United States is generated by coal (EIA, 2008).

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