The Drive Toward a Brighter Future: Electric Transportation

by Natasha Hyman

A Proposed Solution

Petroleum-powered vehicles dominate ground transportation in the United States. These vehicles provide an inexpensive and reliable means of movement. Over the past century, however, the United States has become increasingly dependent on petroleum products for transportation needs. This dependency has adversely affected air quality, energy security, and economic vitality.[1]

Several areas of concern surround the use of petroleum products. First, the extensive use of petroleum-based fuels contributes substantially to air quality problems. For example, gasoline-powered motor vehicles produce ground-level ozone (smog) and carbon monoxide, two major air pollutants.[2] Because the transportation sector has been unable to readily substitute fuel bases, any shortage in petroleum-based fuels can cause fluctuations in pricing, which in turn, can lead to serious country-wide economic impacts. To avoid shortages, our nation is forced to rely on foreign suppliers for nearly half of it's oil.[3] The transportation sector is largely the cause of the high demand on petroleum. It uses nearly two thirds of all oil consumed in the United States—more than the industrial, commercial, and residential sectors combined.[4] Within the transportation sector itself, nearly three-quarters of all energy is used by cars, trucks, and buses—vehicles that rely entirely on oil-derived fuels.[5]

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The problems that petroleum products create can be mitigated by replacement or augmentation with cleaner transportation fuels. While many alternatives to petroleum are being employed in small numbers today, electricity is a particularly enticing choice. It is the cleanest fuel source for air quality purposes, and it can be produced easily and economically in the U.S.[6] This article focuses on the unique benefits electricity offers as an alternative transportation fuel and will examine some legislative and regulatory mandates and incentives enacted in California and at the federal level to expand the use of electric vehicles. In addition, this discussion explores ideal electric vehicle market applications and current technology. By analyzing the benefits, legislative market drive, and technology, the following article presents a general overview of the current electric-vehicle industry.

Electric Vehicle Benefits

Replacing conventional petroleum-powered vehicles with wide-spread electric vehicle (EV) employment would offer major air quality benefits. In 1990, petroleum-powered vehicles alone were responsible for 27% of reactive organic gas (ROG) emissions and 28% of nitrogen oxide (NOx) emissions in the U.S.[7] ROG and NOx react together in sunlight to form ground-level ozone, or smog.[8] In addition, conventional cars and trucks produced 50% of carbon monoxide (CO) emissions.[9] CO is created when engines are unable to fully burn their fuel; this is magnified in winter or at high altitudes.[10] Finally, conventional vehicles generate approximately 24% of carbon dioxide (CO_2), a gas that is believed to cause global warming.[11]

In direct contrast to conventional vehicles, electric vehicle's do not themselves produce operating emissions.[12] Even after accounting for emissions created while generating electricity to power their batteries, electric vehicles are much cleaner than their counterparts.[13] A particular benefit associated with electric vehicles is that pollutants are typically redistributed away from crowded urban areas, where air quality is of greatest concern. One study estimates that in urban areas, replacing conventional vehicles with electric vehicles would all but eliminate CO, reduce ROG by 98%, and cut NOx by 92%.[14] Thus, the study states, replacing diesel-powered vehicles with electric cars, trains, and buses, would help remove cancer-causing particulates and soot from urban areas.[15] Electric vehicles produce neither the "evaporative emissions" that emanate from gasoline vehicles on hot days nor the "refueling vapors" that require special control equipment at gasoline stations.[16]

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Relatively little petroleum is needed to produce electricity.[17] In fact, only 4% of electricity produced nationwide requires the use of petroleum.[18] Consequently, the wide-spread implementation of electric vehicle use in the United States would reduce dependency on petroleum, thereby alleviating some energy security issues. Furthermore, with enough government backing and market drive, this sophisticated technology will likely create new economic and employment opportunities. As industry jobs in military defense and other areas decline, this advanced technology supplies a new source of employment in high-tech research and development fields such as advance electric vehicle battery and component technology.

Many state and federal legislators and agencies have taken an active role in the movement toward electric transportation. Examples of such legislation are the California Low- and Zero-Emissions Vehicle Program and the National Energy Conservation Policy Act.

California Low- and Zero-Emissions Vehicle Program

The federal Clean Air Act Amendments require that states with severely polluted areas implement clean air programs. Thus, the U.S. Environmental Protection Agency has promulgated comprehensive federal vehicle emissions regulations to be implemented in states requiring programs.[19] However, in 1990, the California Air Resources Board (ARB) adopted its own, unique emissions program, the California Low- and Zero-Emission Vehicle (ZEV) Program, to comply with the Clean Air Act Amendments. Because of California's severe air quality problem, both § 209 of the Federal Clean Air Act and California state law allow California to adopt its own standards.[20]

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The California ZEV program is the world's strictest vehicle emissions plan.[21] It requires the seven largest automakers—Chrysler, Ford, General Motors, Honda, Toyota, Mazda, and Nissan—to sell low- and zero-emission passenger vehicles and light-duty trucks (0-3750 lbs.) in the state. Initially, the ZEV program called for 2% of all vehicles offered for sale in California to be zero emission by 1998. This was to increase to 5% in 2001 and to 10% in 2003. However, because of technological insufficiencies, ARB postponed the initial deadline. Under the present standard, by 2003, 10% of new vehicles that are offered for sale in California must be ZEV's. Currently, electric vehicles are the only vehicles capable of meeting the zero-emission standard.

ARB's Battery Panel found that electric vehicles with "commercial-production, advanced technology batteries could become available in the 2000-2001 time frame...[but] significant uncertainties [still exist]."[22] To insure that emissions reductions are not delayed any further, ARB reached an agreement with each of the seven auto manufacturers that are subject to the program. By this agreement, the manufacturers commit to continued investment in the development of advanced batteries.[23] The American Automobile Manufacturers Association (AAMA), for example, has agreed to help fund advanced battery research.[24] Auto manufacturers have also pledged to use good faith to facilitate market awareness of and demand for electric vehicles.[25] Additionally, the agreement obligates the manufacturers to submit reports to ARB detailing

product plans for model years through 2003 and to participate in significant advanced-technology battery demonstration projects. Each demonstration vehicle will be used for at least three years.[26] The projects will entail the distribution of approximately 3,750 electric vehicles by the seven manufacturers.[27] In return, ARB is pursuing funding for co-sponsored electric vehicle programs and working on electric vehicle infrastructure issues. These issues include placing electric vehicles in state fleets, working on battery recycling programs, creating incentive programs, and working with the California Department of Insurance to establish reasonable rates for insuring new electric vehicles.[28]

National Energy Conservation Policy Act

The National Energy Conservation Policy Act of 1992 constructed a comprehensive policy on energy issues. First, the legislation created tax incentives for clean-fuel vehicle purchases.[29] It introduced a tax credit equal to 10% of the purchase price of an electric vehicle up to $4,000.[30] Further, a $100,000 tax deduction is available to corporations for each clean-fuel refueling facility established.[31] The legislation also establishes three research and development programs. The first program is a five-year, $485-million research and development project to generally promote electric vehicles. The second allocates $50 million over ten years to fund ten electric vehicle demonstration projects, each containing at least 50 vehicles. The third program authorizes $40 million over a five-year period to determine the infrastructure needed to support electric vehicles.

In addition, the Act requires different types of fleets to begin using clean-fuel vehicles, including electric vehicles. These fleets are:

1) Fleets owned by alternative-fuel providers;
2) Federal fleets of 20 or more vehicles used in metropolitan areas with populations of at least 250,000;
3) State fleets of 20 or more vehicles used in metropolitan areas with populations of at least 250,000—provided the state owns or operates at least 50 vehicles, and;
4) Private and municipal fleets of 20 or more vehicles used in metropolitan areas with populations of at least 250,000—provided the operator owns or operates at least 50 vehicles.

Today's Electric Vehicle Market

Modern electric vehicles are being used in commercial and government fleets. Offering the ability to relieve road congestion and reduce traffic-related emissions and energy use, electric public transportation is an increasingly popular choice for travel

within and between cities. Today, electric vehicle's have sufficient range to perform many fleet operations.[32] Their range and performance is sufficient for urban delivery routes, meter reading, local and on-site errands, and use as shuttle buses. Electric shuttle buses are used at airports, universities, and shopping malls, among other places. In 1990, 10.6 million vehicles were in fleets of four or more, 8.4 million were in fleets of 10 or more, and 16% of all new vehicle sales were to fleets.[33] Thus, commercial and government fleets prove to be a good initial market for electric vehicles, as the vehicles' range, performance, and battery recharging are compatible with fleet practices, garaging, and refueling needs.

An electric vehicle niche market is both realistic and in progress.

Electric vehicles are also being developed for personal use. Because many personal trips are short, the comparatively short vehicle range is not always a prevalent performance concern. As personal vehicles, electric vehicles offer advantages over conventional vehicles. They are nearly silent during operation, and require less maintenance than gasoline-powered vehicles. Furthermore, "refueling" in a home garage will be cleaner, more convenient, and safer than at a gas station.

All seven of the automakers included in ARB's program continue to improve electric vehicles. The vehicles they have manufactured include conversions from conventional vehicles, cars designed solely as electric vehicles, and hybrid-electric vehicles, which have the capability of running on either gasoline or electric power. Many of these prototype vehicles are vans, but the vehicles range down to a small General Motors electric sports car.

Developing the Batteries

The battery is the most critical aspect of the electric vehicle. Battery technology affects performance, cost, and ultimate market acceptance. Government, automakers, battery manufacturers, and utilities are continuously working to improve electric vehicle battery technology. Today's challenge is to provide enough power to allow for rapid and frequent acceleration and higher energy for increased range between recharges.

In 1990, to accelerate the development of high-performance electric vehicle batteries, the major U.S. automakers joined with the electric utility industry and the U.S. Department of Energy to form the United States Advanced Battery Consortium. This consortium continues to research and develop advanced, long-range batteries for mass production.

Currently, most electric vehicle owners must charge their vehicles overnight, in residential or fleet garages. Such refueling typically takes up to ten hours. Efforts are under way to further develop standardized connectors, decrease the amount of time needed for recharging, and provide a reliable network of stations for charging away from home.

Conclusion

While progress toward advanced electric vehicle technology has been made, technical and financial barriers still exist. In order to assure the success of electric vehicles, battery quality must continue to improve. Despite implementation set backs, ARB continues to advance its research and development efforts. An electric vehicle niche market is both realistic and in progress. By working to reduce the overall cost of electric vehicle technology, these specialized markets will help bring electric vehicles to the general consumer market.

Over the next ten years, industry and government will continue to work together to develop advanced vehicles and batteries, easy access to recharging, and consumer support. Through this cooperative effort, the broad national goal of developing a transportation system that protects natural resources while ensuring the mobility necessary for national economic health will be achieved. As more and more electric transportation options reach the market, their benefits will continue to enhance the quality of life for millions across the country.

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Article Editor: Vince Caruso

Notes

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