STRATEGY FOR SAVING GASOLINE BY SUBSTITUTING LOW PERFORMANCE ELECTRIC VEHICLES

Sumner Meyers, Institute of Public Administration

This paper discusses the use of electric vehicles to save energy. Information is given regarding the current technological limitations to producing and marketing these vehicles and how these can be overcome. Financing the vehicles is a major factor, and the argument is made that they should be financed over a 6-year period with lower insurance rates and the battery provided through a rental system.

The best way to save urban transportation energy is to improve the energy efficiency of the internal combustion engine (ICE). A study sponsored by the Federal Energy Administration estimates that a 40 percent increase in new-automobile fuel economy would save almost 37 Mm^3 (233 million bbl) of oil per year (1). That is clearly the way to go, and 1975 marks the beginning of a rather substantial movement in that direction. Other policies might help in a marginal way, at least in the beginning.

How else (besides improving ICE efficiency) might urban transportation energy be saved? The study cited above also estimates that doubling ridership of public transit would save 2.9 Mm^3 (18 million bbl) of oil per year, just over the consumption of one average day. Doubling the size of transit operations to accommodate this new ridership would cost $61 billion (2). That is a capital expenditure of $3400 to save 0.16 m^3 (1 bbl) of oil per year. The trouble is that simply doubling the size of transit systems will not necessarily double ridership, which means that the policy might be ineffective as well as costly.

A feasible and more cost-effective transportation policy might encourage the development and use of vehicles that would operate on electric power rather than on liquid hydrocarbon fuels. Such a policy would make us less vulnerable to manipulation by the oil cartel, at least to the extent that the policy resulted in gasoline savings. How much gasoline might be saved if electric vehicles were available to substitute for conventional vehicles?

A study funded by the U.S. Environmental Protection Agency estimated that 17 percent, or 1 000 000, of the automobiles in the Los Angeles region could be electrically powered without requiring their owners to change their driving patterns much (3). Assuming that the average conventional vehicle replaced would have traveled 50 km/day (30 miles/day) at 6 km/liter (15 mpg), approximately 3 Mm^3 (18 million bbl) of gasoline per year would be saved, approximately the same as the hoped-for transit savings. One million electric vehicles would cost about $3.1 billion, which translates into $1006/$m^3$ ($160/bbl) saved per year. Thus, developing one million electric vehicles is a more cost-effective policy than encouraging a shift from automobiles to transit. What is more, it probably can be achieved through proper financial incentives.

Getting motorists to substitute electric for gasoline vehicles will not be easy, given the present state of electric-vehicle (EV) technology. An EV can be designed and manufactured to serve adequately the patterns of metropolitan driving, most of which are made of short trips with one other passenger. But such a vehicle will cost at least as much to run per kilometer as a conventional vehicle and will give much poorer performance. Why, then, would anybody want to own one?

After reading a recent article in Consumer Reports (4), few people will want to own either the Citicar or the Elcar, whose performance and safety standards proved much too low for urban use. The shortcomings of both automobiles stem partially from the fact that they are not mass produced. So that the purchase price could be kept down and the range up, they were designed with performance that was too poor and bodies that were too light. To produce a higher quality, higher performance automobile at reasonable cost, manufacturers would have to produce electric automobiles in runs of one million. And that means that a mass market must be developed for them.

The mass market for EVs will be limited for some time by their relatively primitive technology. Even so, the technology is adequate to the requirements. For example, present technology (i.e., lead acid batteries) would permit the design of a 2-person subcompact with performance characteristics that almost matched those of a 1954 Beetle. That is, the electric vehicle could accelerate at 5 km/h/s (3 mph/s) up to 50 km/h (30 mph), its top speed. Its urban driving range would be about 55 km (35 miles), although in hilly terrain, cold weather, or near the end of battery life that range would be considerably less. Such a vehicle might look like a Honda

Civic, weigh about the same, and cost approximately $3000, less batteries.

The batteries are estimated to cost an additional $440. But that is not the whole story. The battery must be replaced every 32 000 km (20 000 miles) or so. That drives up the life-cycle cost per kilometer to somewhere near 7.1¢/km (11.5¢/mile), including maintenance but not including taxes, insurance, or parking. Much of the cost per kilometer is in the battery replacement, 2.2¢/km (3.5¢/mile).

A conventional subcompact that seats four people and has higher performance and unlimited range costs about 6.3¢/km (10.2¢/mile), a difference of 0.8¢/km (1.3¢/mile). Electric automobiles might close both the cost and performance gap after 1985 or so, when either the zinc chlorine or lithium sulfur battery is available. Given the long lead time necessary, we should immediately encourage the mass manufacture and use of EVs at their current state of technology, designing them so that they can accept better batteries later on. The existence of a large number of EVs will create a strong market pull for improved battery technology and higher performance vehicles. And that will expedite the substitution of electric vehicles for conventional automobiles faster than government sponsored research and development programs will.

By 1978, a low performance state-of-the-art electric vehicle could be developed to handle most urban driving needs except those involving freeways. This is a severe limitation, but not a crippling one. The average conventional automobile now runs as much as 50 km/day (30 miles/day), mostly short business and family-business trips no longer than 15 km (10 miles) or so. Most trips are entirely on urban streets that have speed limits of about 40 to 50 km/h (25 to 30 mph). And most urban trips involve 1.6 passengers per car. These business trip patterns can be met by a two-seater electric vehicle with a 55-km (35-mile) range and maximum speed of 50 km/h (30 mph). Such a vehicle, however, could not handle social and recreational trips that cover greater distances at higher speeds with more passengers. Thus, the electric vehicle must be used as part of a two-car strategy, one for business and one for pleasure.

The potential inherent in the two-automobile market is great enough; more than 30 percent of the households in the country own more than one automobile. (The potential seems to be growing, at least in the Washington, D.C., metropolitan area. A study by the Washington Center for Metropolitan Studies found that the number of families with two cars increased by 41 percent between 1970 and 1974.) The question is, How can a million or more people who own two automobiles be motivated to substitute one of them for an EV with higher costs per kilometer and lower performance and range characteristics? The answer may lie in how the EV purchase deal is financed. For better or worse, people buy automobiles not on a life-cycle cost basis but on a monthly-payment basis.

A number of EV advantages can be wrapped into a monthly payment plan that looks attractive.

1. Electric vehicles have a life of about 20 years, conventional vehicles last about 10 years. Therefore, EVs can be financed for 6 rather than 3 years.
2. Since EVs will probably travel no more than 1800 km/year (6000 miles/year), their insurance rates can be proportionally lowered.
3. Since there are external benefits to be gained through the wide use of EVs, they might be financed at 8 percent (the current government borrowing rate) instead of the current market rate.

Table 1. Costs and monthly payments for two types of automobiles.

Cost	Internal Combustion Subcompact, 3-Year Financing ($)	Electric Vehicle 6-Year Financing ($)	Electric Vehicle Subsidized 6-Year Financing ($)
Amortization	867	433	433
Interest	130	104	104
Insurance	140	84	84
Battery	–	210	Subsidized
Per year	1137	883	673
Per month	95	69	56
Per workday (224 days/year)	5	4	3

4. Battery technology is likely to improve dramatically after 1985, so an EV program can start by renting the lead acid batteries and including the rental charge in a flat monthly payment that need not change even when the new batteries become available.
5. Better still, since a substitution of electric power for gasoline by some people would ensure the supply of gasoline for other people, a cross subsidy is in order. Specifically, a percentage of the federal gas tax could be diverted to cover the high cost of using the interim lead acid batteries. For a million EVs, the total battery cost would be $440 million. That is 10 percent of the amount of fuel tax contributed to the Highway Trust Fund in 1974. (Present regulations do not preclude such a diversion. Probably several states with unspent highway money would have to get together for a mass production operation.)

The data given in Table 1 show how these various incentives would affect monthly payments required to own or rent EVs and how they would compare with a conventional Honda costing $3000.

The monthly payments for the EV look good compared with the monthly payments for a conventional $3000 automobile. Payments on such an automobile assuming a $400 down payment and 10 percent interest for 3 years are about $95 per month, including insurance. If the EV were financed for 6 years with smaller insurance payments and slightly less interest, the payments might be as low as $69 per month. (The mechanics of financing EVs for 6 years would be modeled after the way aircraft are financed for foreign buyers. The first 3 years of ownership might be financed through conventional channels. For the second 3 years of financing the government would set up a federal corporation, such as the Energy Corporation suggested by Rockefeller, to raise and dispense the necessary capital.) The difference of $26 per month may be attractive enough to induce some people to buy EVs.

A much more attractive package can be put together if the lead acid battery can be lent without charge to the EV purchaser through the cross-subsidy scheme suggested above. In that case, the total monthly payments might be about $56, a $39 per month difference. Will either low payment plan induce people to buy an electric vehicle slightly ahead of its "technological time?" Nobody can answer that question for sure. Recall, however, what happened to the housing market when 10 to 15-year mortgages were stretched to 20 and 30 years.

Given the uncertainty of future demand, tooling up for a million automobiles is risky. Even the prospect of an attractive financing package is unlikely to induce manufacturers to take such a risk unless other means can be devised to encourage them. Loan guarantees and subsidies from the general fund come to mind, of course. But the administration is cool to these. Besides they may not be needed. What is needed is a fail-safe strategy that will cost the government nothing but will generate a strong market pull.

A strong market pull can be generated by opening up a brand new market for electric automobiles only. If it should turn out that low performance EVs do not sell in sufficient numbers, 15 year olds could be licensed to drive them on streets and highways other than freeways where high performance is needed. That will tap an exclusive market of 3.5 million individuals. Presumably, safety is the only reason to exclude 15 year olds from driving now. Low-speed, short-range vehicles may be safe enough for 15 year olds to drive. Indeed, low performance would tend to protect 15 year olds and others from themselves. It should be pointed out that 15 year olds now operate motor boats, tractors, and so on. In any event, if it should turn out later that 15 year olds driving low performance EVs are too frequently involved in accidents, the program need not be extended beyond 1 year.

REFERENCES

1. M. S. Stuntz, Jr. Mass Transit and Energy Conservation. Federal Energy Administration, March 5, 1975.
2. A Study of Urban Mass Transportation and Financing. Report to the Secretary of Transportation to Congress pursuant to section 138(a), Public Law 93-87.
3. Impact of Future Use of Electric Cars in the Los Angeles Region: Volume 1—Executive Summary and Technical Report. U.S. Environmental Protection Agency, Ann Arbor, Mich., Oct. 1974.
4. Two Electric Cars: Ready for the Road? Consumer Reports, Oct. 1975.