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Clean Fuels For All

In June, President Bush released his Clean Air Plan for improving air quality in the U.S., particularly in urban areas. One aspect of this plan, the clean fuels program, is described by the White House as "perhaps the most innovative and far-reaching component" of the proposal. The clean fuels program would phase in alternative fuels, most notably ethanol, methanol and possibly natural gas, in at least nine major U.S. cities, including Houston, New York, Chicago, and Los Angeles. The program would also require car companies to produce alternative fuel vehicles, with a goal of one million new clean-fueled vehicles on the market every year by 1997. According to Bush, the plan "taps the power of the marketplace and local initiative."

Mobile Source Air Pollution in the U.S.

The clean fuels program primarily addresses the urban concentrations of carbon monoxide (CO) and ozone that result from gasoline vehicle emissions. Emissions of particulate matter are also addressed, but with the advent of unleaded gasoline these are no longer much of a problem except in diesel engines. Carbon monoxide is toxic in high concentrations, and can cause respiratory problems. Ozone can cause respiratory problems for children and the elderly, as well as aggravate already existing ailments such as angina.

CO is a primary emission of gasoline vehicles, while ozone is formed from the photochemical reactions of other emissions, namely nitrogen oxides (NOx) and a class of pollutants known as volatile organic compounds (VOCs). A decrease in either NOx or VOCs alone does not necessarily mean an overall decrease in ozone, and sometimes can cause a slight increase. Furthermore, high levels of CO can increase ozone concentrations as well. Because of the complicated nature of ozone, scientists are unsure how using a fuel that emits less of one ozone precursor will affect overall air quality.

Whatever the questions on how emissions react to form urban smog, there is no question that gasoline vehicles contribute significantly to air pollution in the U.S. Over 70% of the CO and over 30% of the VOCs in the U.S. from 1976 to 1985 came from vehicles.[1] From 1985 to 1987, 81 urban areas containing over 100 million people were recorded as exceeding federal ozone standards. Fifty-nine urban areas exceed federal health standards for carbon monoxide, although the trend for this pollutant has been downward for 10 years, and is projected to continue as older cars are replaced by new cars with more effective emissions control equipment.[2]

The Federal Strategy

President Bush's plan aims at bringing two-thirds of the cities currently in non-attainment of ozone standards into attainment by 1995, and to lower the ozone generated by motor vehicles from the current 40% level to 10%. The plan will try to bring every city into attainment for ozone and CO standards by the year 2000.

To achieve this, the plan would lower pollution from gasoline vehicles while replacing a portion of their numbers with vehicles that run on alternative fuels. Alternative fuel use would be mandated in non-attainment areas, as would the production of millions of alternative fuel vehicles. The plan would also impose tighter emissions standards on vehicles, greater volatility controls on gasoline to reduce evaporative emissions during fueling, and possibly the installation of emission control diagnostic and monitoring systems in all new vehicles.

Clean Fuels?

Fuels that produced less of the pollutants common to gasoline without generating other forms of pollution would merit the label "clean fuels." Furthermore, if such fuels provided benefits in terms of overall pollution reduction greater than their costs, they would be considered viable alternatives to gasoline. Unfortunately, the "clean fuels" advocated in the Bush plan do not meet these criteria. These alternative fuels can be cost-effective at reducing pollution in some regions, but in many cases they fail to provide substantial pollution reduction, or do so at excessive costs.

The Favored Fuels

I. Methanol

Methanol is produced mostly from coal and natural gas, the latter source being cleaner and less expensive. Most methanol fuel is an 85% methanol/15% gasoline blend due to the poor cold starting and high corrosivity of methanol, which gasoline helps ameliorate. There are approximately 1300 operational methanol vehicles in the world today.[3]

Engines running on methanol produce aldehydes, among them formaldehyde, a probable carcinogen.[4] Emissions of formaldehyde from methanol vehicles range from 0.01 to 0.09 grams per mile, levels 10 times greater than gasoline emissions.[5] Although methanol may produce a 34% to 83% reduction in reactive hydrocarbons (a class of VOCs)[6] and thereby reduce smog formation, formaldehyde is photoreactive and contributes to the formation of smog, which can offset any reduction in these hydrocarbons.[7]

Nitrogen oxide is not significantly reduced with methanol use, and neither is CO, judging from tests of conventional vehicles modified for methanol. Although there are estimates that improved methanol engine designs could achieve 30% to 90% reductions over current gasoline vehicles,[8] a similar argument for potential technological improvement can be made for gasoline emission reductions. CO emissions have been declining as new cars with tighter emissions standards are phased into the U.S. fleet, and this trend is expected to continue. Given these figures, Sierra Research, a private research firm in California, reports that "methanol offers no clear advantage over gasoline in reducing vehicle emission levels."[9]

Health Threats

Aside from the pollutants it generates, methanol raises other serious health concerns. It is toxic and absorbed into the skin more easily than gasoline. Its vapors weigh as much as air, increasing the possibility of methanol poisoning in the case of accidental leakage, because the vapors would remain close to the ground.

Methanol is as much as 25 times as toxic as gasoline, which means large increases in poisoning fatalities, along with increases in methanol-induced blindness, if methanol is used widely. According to Dr. Toby Litovitz of the National Capital Poison Center, this could result in increases in annual health care expenditures of $50 million to $100 million. Her conclusion is that, "From a public health vantage, the acute hazard posed by conversion to methanol-based fuels is unacceptable due to the predicted increases in fatalities, blindness, and permanent neurologic disability . . ."[10]

Since methanol blends are more volatile than gasoline, they can cause explosions in the engine, or in the fuel tank if it is damaged in an accident. Methanol's colorless, almost invisible flame makes the fires from such explosions a double threat. It is much more water-soluble than gasoline, creating possibilities of deadly groundwater contamination. Dr. James Cannon notes that a "cleanup of methanol spills into water would be very difficult or impossible."[11]

Costs

Aside from the effects of methanol on humans, it is damaging to conventional gasoline vehicle fuel delivery systems as well. It is corrosive, eventually destroying both conventional automobile engine metals and rubber hoses. The result is a more expensive vehicle, since equipment resistant to methanol's corrosivity must be used. Estimates of methanol conversion costs range from $600 to $1900 per automobile.[12]

Methanol is more expensive to produce than gasoline. A probable pump price for methanol is estimated at 72 cents to $1.15 a gallon. Since methanol has a lower energy content, getting 50-60% of the mileage of gasoline, this pump price is equivalent to $1.30 to $2.07 for a gallon of gasoline.[13] Given these prices, methanol would not be competitive with gasoline unless oil prices rose above $35 a barrel.[14]

The infrastructure necessary to supply methanol to the nation's automobiles would take a great deal of time and capital to put into place. The costs of building the methanol facilities necessary to supply just 15% of the U.S. transportation needs has been estimated at over $30 billion.[15]

The U.S. Office of Technology Assessment, after studying 11 pollution control methods, including enhanced inspection and maintenance programs, gasoline volatility limitations, onboard vehicle fuel controls, and methanol fuels, determined that, of the group, the most expensive method of reducing VOCs would be to replace gasoline with methanol. Methanol fuel has an estimated mean cost of $30,000 per ton of VOC reductions, compared to an average cost of about $2135 per ton for the other methods

studied by the OTA.[16] Furthermore, the OTA calculates that methanol use in cities would only reduce VOCs by 1% by 1994, from 1985 base levels.[17]

Energy Security

In addition to costing more than gasoline, posing an increased health threat, and offering little in the way of pollution reduction, methanol also fails to increase energy security. Methanol is produced most cleanly and cheaply from natural gas, and domestic natural gas supplies are estimated to be capable of providing only 15% of the total U.S. transportation needs. To use a greater amount would require importing either the finished methanol, or natural gas, 70% of which lies in the U.S.S.R. and the Middle East. Otherwise, the methanol would have to be produced from coal, which causes even more total pollution than gasoline production.

II. Ethanol

Ethanol is an alcohol fuel usually made from corn, although other biomass such as sugar cane or beets can also be used. Ethanol is blended with gasoline, usually in a 10% ethanol/90% gasoline mixture, which increases the amount of oxygen in the fuel and reduces lead and CO emissions, while reducing mileage by only about 2%.[18] This blend is estimated to be capable of reducing CO emissions by about 22% if used nationwide.[19]

There is an emissions trade-off, however, because ethanol fuel can increase total VOC emissions by over 25%.[20] A Colorado study estimated that ozone formation in Denver would increase by over 13% if ethanol fuel were used year-round.[21] The Congressional Research Service concluded that "the net effect on the combination of emissions and evaporation over time is more likely to be a net increase in VOCs than a net reduction."[22]

Since CO emissions will decline with continued use of gasoline engines due to fleet turnover anyway, we are left with the possibility that widespread ethanol use could result in more air pollution over time than would result from continued use of gasoline, even though in the short run ethanol would reduce CO.

Furthermore, a study in Brazil, where ethanol blends are used widely in concentrations of up to 100%, shows that aldehyde emissions from ethanol vehicles are four times higher than from gasoline vehicles.[23] In addition to ozone, these aldehydes create peroxyacetyl nitrate (PAN), which damages plants.[24] Certainly the fact that the fuel used in Brazil's vehicles has a much greater amount of ethanol than the 10% blend in the U.S. affects these emission levels, but ethanol vehicles in the U.S. would still require emissions equipment similar to gasoline vehicles in order to control these emissions.

Costs

The estimated cost of a gallon of ethanol, taking into account production, shipping costs, and capital expenditures, is $1.10 to $1.80 more than a gallon of gasoline.[25] Since each gallon of the fuel bought at the pump will probably contain at most a 10% mixture of ethanol, the blend will cost an estimated 11.1 to 17.3 cents per gallon more than straight gasoline.[26]

Subsidies to Survive

Ethanol production in the U.S. currently receives federal and state government subsidies in excess of $500 million a year. These subsidies include an exemption for 10% blends of 6 cents per gallon from the federal gasoline tax, which amounts to a 60 cents per gallon subsidy of pure ethanol, various direct and indirect state subsidies, and federal guarantees of loans for the construction of ethanol plants. Without these subsidies, ethanol would not be competitive with gasoline. In fact, in Colorado, where there is an oxygenation requirement for gasoline in the winter, ethanol is not competitive despite the subsidies. Gasoline producers have overwhelmingly chosen to blend their gasoline with MTBE, a derivative of methanol, over the more expensive ethanol.

Special Interest Legislation

One of the reasons ethanol is being considered for a national mandate is because of special interest pressure that could cost taxpayers millions more than the current subsidies. Midwestern corn growing states, including Illinois, Indiana, Iowa, and South Dakota, have a great deal to gain from a federal mandate of ethanol production. Each additional billion gallons of ethanol production is estimated to provide a net gain of $200 million for the farm sector.[27] H.R. 2052, introduced by Representative Richard Durbin (D.,Ill.), would mandate production of 5.5 billion gallons of ethanol per year, making the net benefit to corn farmers by this estimate $1.1 billion dollars a year.[28]

Ethanol producers also have a tremendous stake in its mandate. In 1986, they received $53.8 million in subsidies from the U.S. Department of Agriculture, and had ethanol sales at "record levels."[29] Archer Daniels Midland, which has 60% to 70% of the ethanol market, received $29.23 million in subsidies from the federal government in 1986, the largest single direct subsidy in USDA history.[30]

Food Versus Fuel

Because ethanol is produced primarily from corn, widescale ethanol production is expected to raise food prices in the U.S. an estimated $6 billion to $8.6 billion.[31] Furthermore, the U.S. Department of Agriculture has estimated that a $1 per bushel fluctuation in corn prices would mean roughly a 40 cents per gallon change in ethanol prices.[32] In a 3 year period between 1983 and 1986, corn prices ranged from $3.21 per bushel to $1.50 per bushel.[33] Using the USDA estimate, this would have meant a 68 cents per gallon fluctuation in ethanol prices during this period. Crop fluctuations have the potential to make OPEC oil prices seem static.

Ethanol does offer benefits such as higher octane ratings, and, since it can be produced entirely from domestic foodstocks, improved energy security. In addition, vehicles don't have to be committed solely to ethanol use. Thus, in the event of a corn shortage, it would be relatively simple to revert back to oil, barring political constraints.

Considering the high costs of widescale ethanol use, and the fact that any advantages it offers over improved emissions control equipment in reducing CO are short-lived and outweighed by increased VOC pollution, a federal mandate of its use is unwarranted.

III. Natural Gas

Compressed natural gas (CNG) is distinguished from liquid natural gas such as propane by the fact that it is gaseous. Liquid natural gas is used in small quantities in some areas for transportation, but the only major proposal for natural gas as an alternative fuel concerns CNG, to which this discussion is limited. About 700,000 vehicles, mostly in Australia, Italy, and New Zealand, currently run on CNG.[34]

The EPA has found that CO emissions from CNG vehicles were 50% to 80% lower than from gasoline vehicles, with total VOCs reduced a similar amount. Nitrogen oxide emissions, however, ranged widely from no change to increases of up to 80% .[35] Natural gas also produces much more carbon dioxide than gasoline.[36] Carbon dioxide emissions are significant, because carbon dioxide is one of the primary "greenhouse gases," believed by some scientists to cause global overheating.

Costs: Cleaning Up the Air By Making Driving Too Expensive

On an energy-equivalent basis, CNG vehicles get 20-30% of the mileage of gasoline vehicles.[37] In addition, steel storage tanks weighing seven and a half times as much as a conventional gasoline tank are necessary to hold the natural gas equivalent of 5 gallons of gasoline. Dr. James Cannon writes that:

> Most natural gas vehicles have room for only two or three cylinders. This limits their driving range to less than 300 miles between refills while adding up to 500 pounds to the car and consuming more than half of the usable trunk space in cars using steel tanks.[38]

Furthermore, the additional weight from these cumbersome tanks cuts down on the mileage of CNG vehicles even more, adversely affecting handling, braking, and acceleration as well. Dr. Cannon reports that CNG vehicles have 10-15% less power than gasoline vehicles, with acceleration rates 20-65% lower than typical gasoline vehicles.[39]

The pump price of natural gas is estimated at 63 to 88 cents for the equivalent of a gallon of gasoline.[40] This estimate still makes CNG only marginally cost effective, and uneconomical if other costs of its mandated use are considered. For example, the refueling stations necessary to meet just 14% of the U.S. transportation needs is estimated to cost $12 billion.[41] In addition, one study places the cost to convert a vehicle

to run on natural gas at $1500 to $2300.[42] Still, Dr. James Cannon estimates that if the CNG vehicle is driven over 25,000 miles per year, and the wholesale price of natural gas remains less than half the price of an equivalent amount of oil, it will be economical. While this may hold promise for taxis, buses, and other heavily used vehicles, the average passenger car in the U.S. traveled an estimated 9883 miles in 1987, substantially below the 25,000 mile level.[43]

Experience Abroad: No Subsidy, No CNGs

Like ethanol, natural gas depends on government subsidies and gasoline taxes to survive in the vehicle fuel market. When petroleum prices fall, the CNG vehicles become even more uneconomical. The governments of Canada and New Zealand, for example, spent large amounts to nurture the CNG vehicle industry, but conversions of gasoline vehicles to natural gas fell dramatically when government subsidies were withdrawn, or when the price of natural gas rose above two-thirds of the price of gasoline.[44] New Zealand, with ample domestic natural gas supplies, subsidized natural gas vehicles from 1978 to 1986, but with the fall in oil prices in 1986, coupled with the rise of a pro-free market government which ended the subsidies, vehicle conversions plummeted.[45]

Potential Benefits

Natural gas does have qualities that might justify its costs if used in heavily polluted areas. High mileage CNG vehicles have the promise of being cost-effective as well, which raises the possibility of CNG-powered buses and taxis in smog-covered cities like Los Angeles. Indeed, since domestic natural gas supplies can only meet about 15% of the nation's transportation needs anyway, the solution may be simply to target the use of CNG vehicles where they will be cost-effective. Unfortunately, directing the right fuels to the right areas is easier said than done.

Additional Problems with Alternative Fuels

Just as oil production creates pollution, we can expect the same problems with alternative fuels. Most studies of these fuels concern themselves only with pollution generated from use, yet this is not an isolated process, and any consideration of the pollution of these fuels compared to gasoline must take into account the whole spectrum of alternative fuel use, including production, distribution, and storage.

Regional Differences

While problems exist for all of these fuels, and their costs outweigh their potential benefits in many regions, they are potentially cost-effective, depending on how they are used to address the specific pollution problems of a region. Denver, for example, has excessive carbon monoxide pollution in the winter, which it is attempting to address by requiring the use of oxygenated fuels in the winter months. By contrast, if these fuels were used in Los Angeles in the summer, when ozone is a problem, they would provide little real benefit, and possibly even cause the formation of more ozone,

all at great cost. Furthermore, if these fuels were required in Bozeman, Montana, they would offer virtually no benefit, because air pollution from mobile sources is not a significant problem there.

The task, then, appears to be determining where, when, and which methods, fuels or other pollution control technology to use. It may be possible to realize substantial reductions in air pollution at a reasonable cost if fuels could be directed to specific regions where they would be useful in reducing air pollution, and if their use can be implemented effectively. Likewise, if other pollution control methods, such as tighter emissions standards, gasoline volatility controls, and more efficient traffic patterns could provide greater benefits at lower costs than alternative fuels, then we would want to direct them to regions where they could be put to best use as well.

The Flaws of Federal Mandates

President Bush's plan lacks the flexibility to decide where pollution control technology can be used in a cost-effective manner. The plan allows cities some leverage in determining how they reduce pollution from mobile sources. All city plans that deviate from the federal plan, however, must still be approved by federal officials. This requirement promises to seriously hinder any local efforts. In addition, air quality standards and goals continue to be determined at the federal level by the EPA. The result of all this is a cumbersome, inflexible policy of mandated pollution-control strategies that, like many previous programs, is likely to enrich special interests at the taxpayers' expense.

The Bush plan mandates, for example, the production of millions of automobiles capable of running on alternative fuels without attempting to determine who will buy these vehicles. The Administration simply assumes that once the cars are produced, they will be bought in non-attainment cities. We have seen, however, that the needs of cities vary, and that alternative-fuel vehicles, if necessary at all, may be best suited only for certain areas. The Bush plan seeks to create a uniform supply of pollution control technology, despite what the actual needs and demands of the country may be.

A Real Use of the Market to Control Air Pollution

The problems with the Bush plan are characteristic of federal-level approaches to regionally diverse problems. A practical alternative is a system of pollution control that captures the benefits of technology like alternative fuels while avoiding the excessive costs incurred when the technology is broadly mandated, rather than selectively applied. This system relies on the price mechanism to make polluters pay when they pollute, creating a direct relationship between the benefits and costs of pollution abatement.

An ideal use of the market would be for individuals harmed by air pollution to own the air around them, giving them legal mechanisms, such as injunctions and contracts, to force polluters to reduce or eliminate their pollution. In such a scenario, we might see individuals in communities set levels for pollution above which they would not allow, forcing drivers to conform to certain emissions standards or be fined if caught.

Air ownership, like land ownership, would create legal obligations on the part of polluters to account for the costs of their pollution to others.

In the absence of air owners to contract with polluters for a mutually acceptable level of pollution (and hence an overall price level for various pollutants), we must rely on government to set a price for air pollution which presumably reflects, or at least resembles, individual preferences. Economic theory and the experience of command economies demonstrates that such a close match will only happen by chance. But, such a system of mobile emissions pricing is still far superior to federal mandates of pollution control.

Mobile Emissions Charges

Several methods of charging automobile owners for emissions are available. One method is to base charges on annual inspections, when emissions can be measured and a tax assessed according to the odometer reading. A problem with this strategy is that car owners might tamper with their emissions equipment during the year, and readjust it just before each inspection. It is also possible that car owners could mix a fuel additive with their gasoline just before their inspection to lower their emissions.

These problems could be at least partially addressed by measuring emissions from vehicles as they are moving, with testing devices set up on exit ramps and turnpikes. The technology to do this has been developed and applied by Dr. Donald Stedman of the University of Colorado at Denver. Using infrared beams, Stedman has successfully performed 250,000 measurements of carbon monoxide emissions from vehicles in Denver and around the country, at a fraction of the expense of annual tailpipe emissions inspections. This technology can also be used to measure hydrocarbons, nitrogen oxides, and other pollutants.[46] Coupled with cameras to record license plate numbers, these measuring devices could be used to send bills to vehicle owners who pollute above a certain level.[47]

This technology could also be used in conjunction with inspection programs. Vehicles could be given different colored inspection stickers based on standards resulting from testing the car model in question, on individual tests of each car's emissions, or a combination of the two. If, via a measuring device such as Stedman's, cars were found emitting more of a pollutant than their sticker allowed, they could be assessed a stiff penalty, plus be required to pay higher emissions taxes. There are certainly a number of ways to reduce the incidence of emissions "cheating," just as there are ways to reduce excessive speeding.

Less Traffic, Local Control, Fairness,
and Profit-Driven Technological Advances

Charging drivers for the pollution from their automobiles has four beneficial effects. First, by increasing the costs of driving, it lessens traffic congestion. This effect has been noted in Singapore, where drivers with less than three passengers were required to purchase a daily sticker for their cars before entering the city during

morning rush hours.[48] Although this pricing system was not designed specifically to eliminate pollution, it reduced rush hour traffic by approximately 75%, as people began to carpool and seek alternate forms of transportation. Reducing traffic congestion could achieve substantial reductions in air pollution.

A second effect of emissions pricing is that decisions on how much pollution to reduce are necessarily delegated to local officials, who have a better idea than officials in Washington about what pollution their region needs to control. As discussed above, Denver instituted a program requiring oxygenated fuels in the winter in order to reduce carbon monoxide emissions, because officials there realized the necessity of reducing CO, and devised a way to do it. In a federal clean air program, such regional flexibility is not available.

Although an emissions pricing scheme is not perfect, if placed in the hands of city and local governments it would be more effective at balancing the costs and benefits of emissions- reducing methods than any federal plan. Local governments, aware of the pollution problems they have, could set prices for emissions commensurate to the problem each pollutant presents for the community's air quality.

A third effect is fairness, because only polluters pay. Under the Bush plan, rural dwellers, for whom automobile pollution is not a problem, have to pay for the clean air of city dwellers via higher taxes and vehicle costs. If pollution costs were borne by those who create the pollution problem, people in areas where air pollution is not a problem would not be required to pay the costs of cleaning up the air for others. Concentrating pollution control costs on polluters will require residents to seriously consider just how much they are willing to pay for marginal improvements in air quality, focusing the emissions controls debate on cost/benefit analysis rather than emotional posturing by environmentalists.

The fourth and most vital effect of emissions charges is that a market for pollution control technology is created. Automobile manufacturers, chemical companies and petroleum producers have incentives under the present system to develop only the technology that is favored by politicians. There is significant risk involved in investing in technology development if the government, rather than consumers, ultimately determines what technology is used. Because federal mandates of pollution control technology tend to stagnate technological development (since industries scramble to meet federal standards rather than improve technology), creating a market in this technology promises to eliminate more pollution at less cost in the long run.

If a market of consumers eager to purchase pollution control technology existed, these companies would have incentives to develop such a technology, whether it be ethanol additives or more effective catalytic converters. The profit-motive would be employed to clean up the air. Although pricing can be criticized because the decision on the exact price for emissions is more or less arbitrary (keep in mind the same criticism is even more pertinent when applied to federal mandates of politically popular technology such as "clean fuels"), the resulting market for technological development

holds the promise to eventually overcome this "bubble" of inefficiency, by making pollution control more affordable and available.

Make Polluters Pay

Most people agree that industry should be required to pay for its pollution, and the same argument can be applied with equal validity to individuals. By utilizing the polluter-pays principle, emissions pricing would concentrate the costs of pollution on those who create it. Emissions pricing offers the greatest hope of "harnessing the market" to reduce pollution cost-effectively. The current consensus in Washington on the need for air pollution control has the potential to produce a number of benefits, as long as a need for national action isn't confused with a need for national planning. The Bush Administration and Congress should concentrate less on mandating how to reduce air pollution, and more on creating an incentive structure that will lead to cost-effective improvements in air quality.

NOTE: Anthony Woodlief is a research associate at the Competitive Enterprise Institute.

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