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THE AIR IS ALREADY CLEANER

Progress in Meeting Clean Air Goals for Oil in the U.S.

A Presentation by John H. Lichtblau

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U.S. environmental policy will inevitably reduce oil demand below what it would have been otherwise. The big question for the oil industry is whether the aim of this policy is to make oil and oil-consuming equipment environmentally cleaner and more efficient or whether the policy represents a transition toward a permanent move away from oil to other, supposedly cleaner, energy sources. In the short to medium term, say the next 8 - 10 years, there may be little difference quantitatively between the two approaches. In the long run, starting sometime in the first decade of the next century, the market loss from a move to alternate energy sources would be serious for the U.S. oil industry. Since the U.S. is the world's largest oil import market the impact would of course also be felt abroad. And it would be largely irreversible once the infrastructure for alternate energy sources has been developed.

The principal target for the eventual switch away from oil is the automotive transportation sector which in the U.S. accounts for over 50% of total oil consumption. The remaining consumption either does not cause significant atmospheric ground level pollution, such as aviation and maritime fuels, or the required changes are limited to sulfur reductions, as in stationary heating and industrial uses. In these latter markets oil is also facing strong and growing competition from cleaner burning natural gas.

The Transportation Sector: Consumption per Car Keeps Falling

Most proposals and prescriptions of how to reduce ground level pollution from oil consumption in the U.S. transportation sector contain exhortations or recommendations that go beyond the mandated improvements in the quality of the fuel and design of the engines burning it. Their aim is to replace oil progressively with other fuels. The first steps in this direction are already specifically mandated in the environmental legislation of several states. The most prominent is California. Some states in the Northeast have recently announced their intention to adopt the California vehicle standards although their pollution levels are all well below California's which has the worst record of attaining set environmental standards and the highest numbers of days on which these standards are exceeded. Alternate fuels will of course require different motors and since the U.S. is the world's largest maker and importer of automobiles, a move towards alternate fuel vehicles in the U.S. will contribute to similar moves in other countries.

As I said before, in the next 10 years the move towards alternate motor fuels will have very little impact on U.S. oil consumption and even less abroad. By the year 2000 only 1-2 million vehicles, consuming 35-70 MB/D of oil-equivalent, are likely to be in this category. This is not a significant share of the 200 million vehicles on the road by then. But by 2010 the DOE's National Energy Strategy Scenario projects that non-petroleum vehicles will consume about 500 MB/D of oil-equivalent, rising rapidly over the next 2 decades. Perhaps such a reduction in the growth of oil demand in the industrial countries, led by the U.S., will be desirable by then, considering the continued rapid growth in oil demand in the developing countries, which in the last 5 years has been 3 times as fast as that of the OECD nations, and the expected sharp growth in oil demand in the former Soviet Bloc states from the mid-to-late 1990's on.

However, the advocates of alternate fuels are not basing their case on potential future supply constraints but on the contribution of fossil fuel burning to two separate problems--ground level air pollution and atmospheric warming. Their case assumes implicitly and sometimes explicitly that the ground level and atmospheric pollution from oil burning is getting progressively worse. Hence, they argue, while transitory measures to improve the quality of oil-based transportation fuels and the efficiency of the engines which burn them are urgently required, the ultimate social goal of clean air requires progressive and irreversible inroads into the oil-based transportation market. Of course, these inroads would all have to be mandated by government edict or stimulated by government incentives since there is no public demand to move away from gasoline and diesel vehicles. In other words, market forces are continuing to opt for oil-based transportation fuels even under the requirements set forth in the Clean Air Act.

Does this mean there is an insoluble conflict between what the market wants and what may be termed a "politically correct" environmental policy? Not necessarily, because since the early 1970's dramatic progress has been made in reducing all forms of air pollution per car, per mile and per gallon. Current laws and regulations will continue and even accelerate this trend for the foreseeable future. Thus, the evidence is clear: further pollution abatement in the U.S. transportation sector is achievable without moving to alternate fuels. The advocates for alternate motor fuels tend to ignore or downplay this evidence. Let us look at some facts.

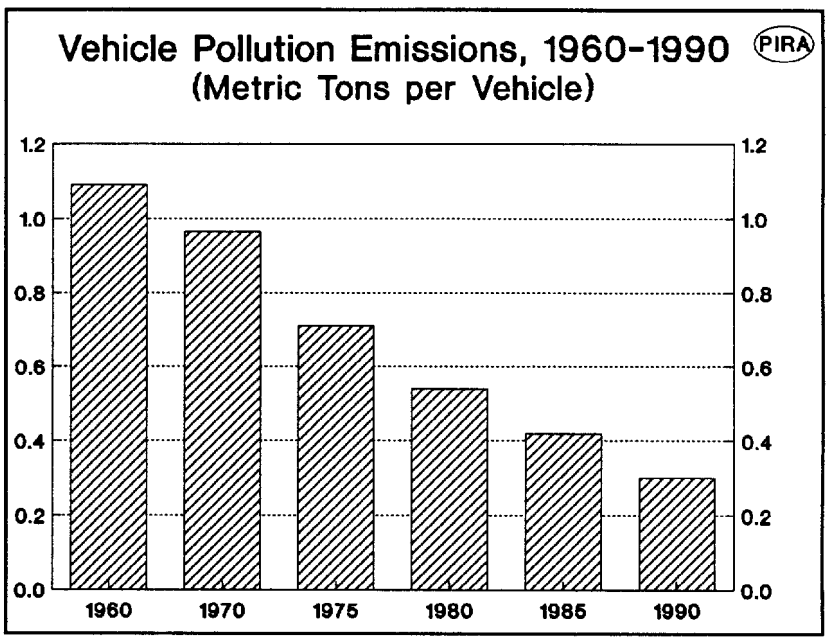
To begin with, there is the remarkably low growth trend for total U.S. oil consumption in recent decades. In 1990 U.S. petroleum demand was just 4% higher than in 1975 while the U.S. GNP had risen by 52%. For the more recent period of the 5 years since the big oil price break at the beginning of 1986, oil demand grew by 2.2% while the economy grew by about 10%. If we look at just motor fuels we find that in the last 10 years, (1981-91) total vehicle miles for cars and trucks increased by 40% while gasoline and highway diesel fuel consumption rose by just 14%. For gasoline alone the improvement in fuel efficiency was even stronger.

There is every indication that this trend will continue into the next century. The average fuel efficiency for all passenger cars has improved every year since 1973 and is now near 22 miles per gallon. It will continue to move up gradually to the level of new cars which is now mandated at 27.5 miles per gallon but is expected to reach at least 32 miles per gallon by the end of the decade. These developments, none of which require any technical break-through, should keep U.S. gasoline consumption flat or declining from the mid-1990's on, despite continuing increase in the number of passenger cars and total miles driven.

Vehicle Pollution Drops by Every Measure

Ground pollution from gasoline vehicles has an even better record than gasoline consumption: it has been declining--not only per gallon, per mile or per car but in absolute quantity--since 1970. The major cause for the reduction in exhaust emissions during this period was the required catalytic converter introduced in the mid-1970's. (Figure 1). It caused a sharp reduction in carbon monoxide emissions as well as significant reductions in hydrocarbon and nitrogen oxide. The exhaust emission reductions were accelerated in the early 1980's with various improvements in the catalytic converter system. At the same time evaporative emissions from gasoline were also substantially reduced both in the car through the introduction of canisters, different types of tank caps and in the gasoline delivery system through a variety of mandated measures, such as different pump nozzles, and controls at gasoline terminals. For gasoline itself the mandated pollution control started around 1975 with the phasing out of lead which is now virtually completed. Since 1989 gasoline vapor pressure reduction has been required during the summer months to reduce evaporative emission. There were still other changes, relatively small but cumulatively significant. As Figure 2 shows, the result of all of these factors was that while vehicle miles travelled (VMT) doubled between 1970 and 1990, emissions from automotive transportation were cut almost in half.

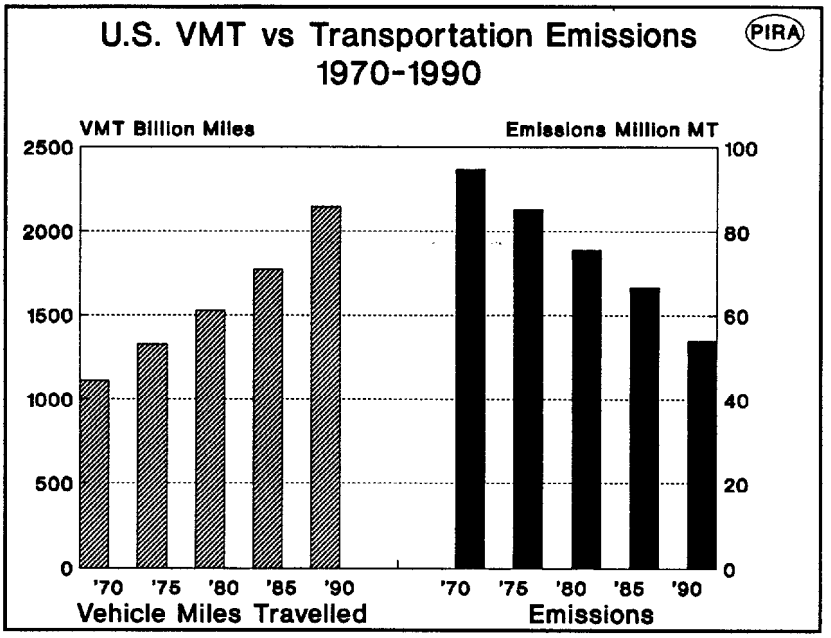
Figure 1



These opposing trends are a clear indication of the ongoing changes in the quality of gasoline and the engines which burn it. And the process is continuing. By November of this

year at least 1/3 of U.S. gasoline will require oxygenates during the winter months to further reduce the CO emission level; and by 1995 at least 1/4 of all U.S. gasoline year-round will have to be of the reformulated quality prescribed in the Clean Air Act of 1990. By 2000 as much as 75% of all U.S. gasoline may be of that quality, if enough of the states which are not *required* to adopt these standards under federal law will "opt-in" under state law. We are talking about a sea change, on top of the changes already made, whose sole purpose is to further reduce the emissions of hydrocarbons and toxics from gasoline. If you combine this with the widely accepted projection that gasoline consumption will level off or decline from the mid-1990's on, it is clear that ground level ozone formation from gasoline burning is being curtailed in the U.S. to the point where further measures to reduce it, beyond those already on the books, may well fall into the category of minimal incremental achievements at maximum incremental costs, the familiar law of diminishing returns.

Figure 2



Alternative Fuels--Are They Needed?

The worst approach, however, would be to consider all the changes described above only a temporary relief until mandated non-gasoline vehicles can be provided, first on a small scale and eventually in large enough numbers to seriously reduce reformulated gasoline consumption. Yet, California is planning to do this by requiring 2% of all new cars to be electric by 1998, rising in steps to 10% by 2003. Several other states are contemplating similar measures, perhaps more for political image than environmental necessity, and the official National Energy Strategy calls for the introduction of alternative fuel vehicles by 1998, including CNG, ethanol and methanol-fuelled vehicles, although not as a mandated target.

For the U.S. refining industry, which will have to spend at least $25 billion in capital, and potentially much more, to meet the already legislated fuel emission and related requirements this is a rather disconcerting prospect. If one considers the enormous gasoline and diesel fuels infrastructure in the U.S. to serve its 180 million cars and trucks, efficiently satisfying consumer needs, it may be time to pause before considering the next steps towards

dismantling a system which is working well and has demonstrated its ability to adapt to changing environmental standards and criteria.

I recognize that in some government-designated environmental "non-attainment" areas there may be a special need to accelerate the decline in ozone formation. But the government has a very effective instrument to accomplish this locally and is apparently about to make use of it: the accelerated removal of old high-polluting cars through incentives. According to the EPA, "the dirtiest six percent of the cars on the road emit 50% of total (automotive) hydrocarbons." This would make the removal of old cars perhaps the most benign, quick and effective measure to reduce air pollution in these areas.

Diesel oil, the other motor fuel, is also undergoing a major change under the U.S. Clean Air Act. By October 1993 the sulfur content (by weight) in all highway diesel fuel must be reduced from its current level of about 0.25% to 0.05%--a decline of 80%. This will radically reduce exhaust emissions from diesel engines. Unlike gasoline, automotive diesel oil demand, which accounts for 9% of total U.S. oil demand, is expected to grow for the foreseeable future. But the emissions from October 1993 on will be substantially below current levels for the next several decades.

Figure 3

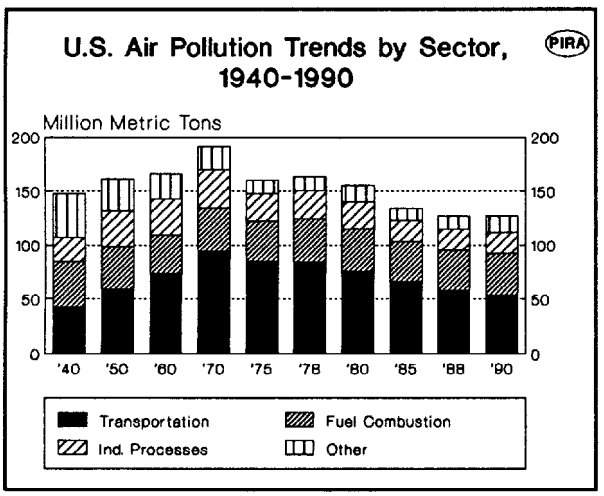
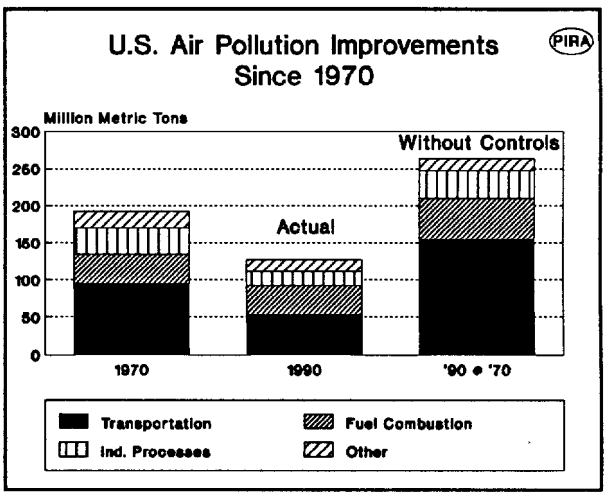


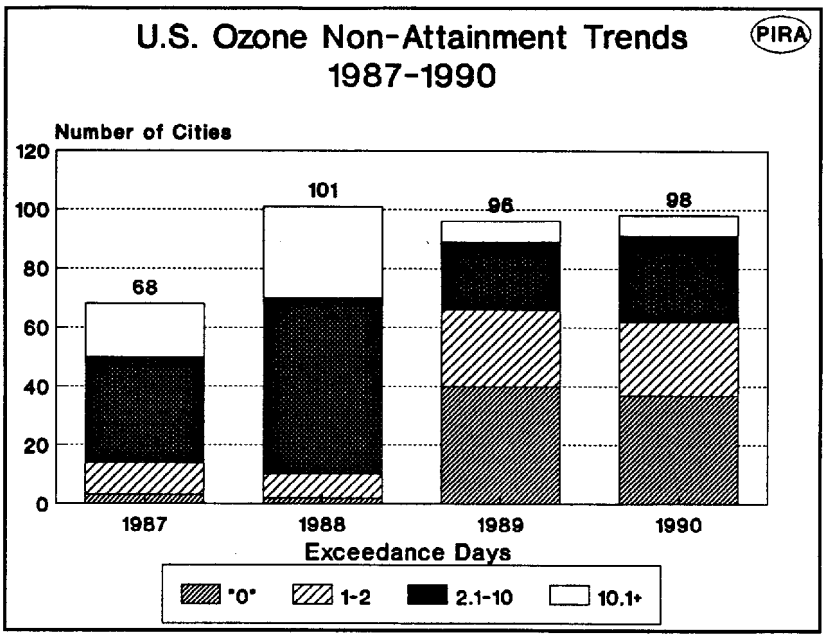
Figure 4



Thus, there is clear evidence that the reduction of urban smog is underway in the U.S., at least that part which comes from transportation fuels, and that this will continue for the foreseeable future. As Figure 3 shows, the total decline in pollutant emission since 1970, as measured by the Environmental Protection Agency, was due largely to progressive reductions in emissions from the transportation sector. Figure 4 shows that without emission control pollution from the transportation sector in 1990 would have been 50% higher than in 1970 rather than 50% lower.

There had been a widely publicized sharp rise in exceedances of daily urban smog "non-attainment" standards in 1988. This was viewed by some scientists and the media as a harbinger of what was to come. Yet, as shown in Figure 5, in 1989, and again in 1990, the number of cities with "0" exceedance days that year--*no* violations of ozone standards--*rose* by a quantum jump while the number of cities with high exceedance days dropped sharply. However, much less public attention was paid to these later data than to the scare figures of 1988 which continue to form the basis for counting non-attainment cities.

Figure 5



The Greenhouse Effect

Now I would like to address the other, very different, environmental problem caused by fossil fuel emissions: its impact on global climate changes--the Greenhouse Effect. In recent years the stratospheric Greenhouse Effect has increasingly dominated environmental debates. Yet, as a matter of human urgency and also because of the uncontestable cause-and-effect relationship between measurable ground level pollution and fossil fuel emissions, one could argue that ground level smog should have priority over the Greenhouse problem whose cause, effect and time of impact is still widely debated even among scientists who agree that its potential threat to the earth's climate is real.

Nobody can deny or ignore the scientific basis of the Greenhouse issue. But nobody should ignore the political, emotional and ideological aspects of the Greenhouse debate. Those who call for early action often try to present themselves as "environmentalists." Does that make those who disagree on technical, scientific or economic grounds "anti-environmentalists?" Do we really know whether reforestation or protection of the rain forests would not be a better and faster way to prevent global warming than a reduction in fossil fuels burning? How reliable are the current data on global warming? To what extent do the positive effects of global warming on agriculture which are acknowledged by most scientists, offset the negative effects?

But let us assume that CO_2 released by the burning of fossil fuels does add to the Greenhouse effect and must be curbed over time to help prevent global warming. What is the U.S. energy sector's contribution to this warming and what can be done to reduce it?

Coal and CO_2 Emission

In 1990 the U.S. accounted for about 23% of total world CO_2 emission from commercial energy sources. 42% of the U.S. emission come from oil, 37% from coal and 19% from natural gas. As Table I shows, the shares of oil and gas were approximately in line with their contribution to total U.S. energy consumption while coal's CO_2 share was substantially higher because of its higher emission per unit of energy. The most recent Department of Energy projections show a Base Case increase in U.S coal consumption of 11% from 1990 to 2000 and 22% from 2000 to 2010. By comparison, the DOE's Base Case projection for oil demand growth is 8% and 9%, respectively, for these two periods. The reason for the growth in coal is electric power which is 55% coal-generated (and 4% oil) and is expected to grow at an annual rate of 1.5-1.6% from 1990 to 2000. Together with the levelling off in nuclear power production within the next 2 years, this is causing the growth in coal demand. The difference in growth between oil and coal was even more pronounced in the last decade. In 1990 U.S. coal demand was 24% higher than in 1980 while oil demand was 2% lower. My point in citing these figures is that the principal contributor to the growth in U.S. CO_2 emissions was and is coal and this will continue to be the case. In fact, even in the Energy Department's National Energy Strategy Actions Case in which the government proposes to intervene actively to reduce the growth in fossil fuel demand and lower Greenhouse pollution, carbon emissions from coal will rise by nearly 40% between 1995 and 2010, accounting for most of the total increase in U.S. carbon emission during this period.

Table I
Share of Fuels in U.S. Energy Consumption and Carbon Emission, 1990

	%	
	Consumption	Carbon Emission
Oil	40	42
Gas	22	19
Coal	22	37
Other*	16	2

*Nuclear, renewables, etc.

Source: U.S. Department of Energy, *Limiting Net Greenhouse Gas Emissions*, Vol. II, p. 5.31, 5.37

Hence, a move to electric vehicles may not bring any net environmental benefit. For while it reduces gasoline emissions, the recharging of the battery raises CO_2 and other emissions from power plants. The most effective way to reduce these emissions is to curb the growth in electricity demand through "demand side management" and to substitute natural gas for coal in electric power generation. Co-generation will also improve the efficiency of electric power generation and, indirectly, reduce CO_2 emissions since the principal co-generating fuels will be gas followed by oil.

I'm not suggesting that coal generation be cut back from its present level. This would be commercially very difficult and socially very painful. But the projected growth can be substantially curtailed, perhaps even arrested by the end of the century, primarily through the substitution of natural gas which emits about half as much CO_2 per unit of energy as does coal. The resumption of nuclear power construction would of course also contribute to reducing coal's dominance. But, realistically speaking, there is very little chance of this for the remainder of this decade at least, though the present Administration clearly favors it.

U.S. natural gas has been in surplus for the past 12 years now and its potential is apparently much larger than had been realized until recently. Furthermore, Canada, our overland import source, also has large spare capacity as well as the potential of its Arctic regions. Currently, natural gas accounts for about 10% of U.S. electric power generation. A significant increase of this share requires more gas drilling and an expansion of the existing pipeline network. This would likely raise the cost of gas for utilities. But this could be partly offset by the higher efficiency of co-generation plants.

Conclusion

To sum up, ground level ozone formation from oil consumption in the U.S. transportation sector will continue to decline for the foreseeable future because of a combination of factors, including cleaner fuels, more efficient cars, and the reduction of vapor emissions in the gasoline distribution system. CO_2 emissions into the atmosphere from total U.S. oil consumption are likely to increase slightly in line with the less-than-1% expected growth rate in U.S. oil demand. The principal contributor, by far, to the projected growth in U.S. CO_2 emissions will be coal.