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ENVIRONMENTAL POLICIES AND THE ENERGY MARKET

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Environmental Policies and the Energy Market

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Environmental Policies and the Energy Market

Energy production and use are associated with a wide range of environmental problems. Thus, it is also presumed that environmental policy must have major effects on energy markets. The processes of extracting, transforming and using energy all have great potential for damaging the environment. The kinds of air pollution given the most attention over the last few decades, in particular, come in large part from burning of fossil fuels. Nuclear power brings with it perceived risks of accidents and unanswered questions about the safekeeping of radioactive wastes. Production of oil and coal has created risks of oil spills and water contamination. And more recently all forms of fossil energy have been identified as contributing to the potential threat of global climate change.

The fact of interaction between energy and environment has some interesting implications. The first is that some common ideas about ways in which energy policy could contribute to environmental improvement turn out to be plain wrong, and some ways in which existing energy policies are palmed for doing environmental damage are also quite wrong. The second is that if we changed some of the policy choices that lead to interaction, we would see greater effects on energy markets but lower overall economic costs of achieving environmental objectives than under current policies.

Interaction also has implications for business strategy. Market opportunities without doubt have been created and destroyed by environmental policy. Energy companies should pay great attention to environmental policy in making strategic decisions on how to allocate their resources among oil, gas, coal, renewable energy or diversification outside of energy. Building scrubbers for coal generation planets will be a boom industry if a new clean air regulation occurs; and building a brand-new, large energy facility, whether it be a greenfield oil refinery or a super tanker terminal.

Concern about global warming, or more broadly global climate change, focuses attention directly on fossil energy use as the culprit. Carbon dioxide emissions, which come not in traces or accidentally, but as one of two compounds which fossil fuels become when burned, will have to be reduced to limit global warming. And the scale of the problem and the technological difficulty of removing carbon dioxide from waste streams after it is produced, may overwhelm the competitive advantages among fuels and frustrate government ability to diffuse impacts on specific energy sector. Coal use must fall, relative to what it would otherwise be, and all fossil energy use must eventually be reduced, if emissions are to be stabilized. But even in this case coal may prove, because of its cot advantages over natural gas, remarkably resilient in holding on to its share of existing electricity generation markets.

Pollution and energy

We can review some of the major environmental issues in which energy plays a strong role. In air pollution, the major issues throughout the 1980s were acid rain, and control air toxics. All coal contains some sulfur, emissions from coal-fired

electric power planets are the primary cause of acid precipitation. Burning of residual fuel oil in power planets may also contribute. Urban air pollution, comes from the release of hydrocarbons, nitrogen oxides, and carbon monoxide into the atmosphere. Motor vehicles, and gasoline they burn, have been seen as the culprits. Tailpipe emissions of carbon dioxide, unburned hydrocarbons, and nitrogen oxides come from combustion of gasoline, and other hydrocarbon emissions come from evaporation of gasoline from vehicles and storage tanks, and from filling up gas tanks.

Air toxics believed to pose acute dangers to human health. Such toxic are not so uniquely an energy phenomenon as acid rain and urban pollution. However, they are associated increasingly with another set of issues that relate to energy and environment, namely municipal solid waste combustion.

Two primary ways in which energy activities are implicated in water pollution are through oil spills and acid runoff from coal mining. Oil spill incidents around the world focused public attention and outrage on the risks of oil production and transportation.

Coal mining is now a far less visible issue but in the 1960s and 1970s pictures of the devastation wreaked by the acid runoff from coal mines created equal outrage. Worker safety and environmental health, including prevention of black lung disease, was also a major issue. Policies improved the situation, imposed strict new requirements on the coal industry, including prevention of runoff, restoration of mining sites to near-original condition, and dramatic changes in working conditions.

Finally, the nuclear industry. Nuclear safety has always been a matter of environmental concern. Still unresolved is the issues of how to dispose of the radioactive waste which remains when uranium is depleted in generating electricity and when reactors must be disassembled.

The environmental heroes on the energy side are natural gas and certain forms of renewable energy –solar, wind and certain forms of biomass energy utilization- in which byproducts are converted to useful forms of energy rather than being wasted or disposed of in environmentally damaging ways.

Environmental policies

Environmental policies are believed to have had major effects on energy markets, the interaction of environmental policy and energy choices is due in part to market forces. Existing cost relationships among fuels and differentiation of their markets make it very hard to tip the balance away from one fuel and toward another. The design of environmental policy also plays a role, especially, when the fundamental choice for the government environmental policy, to achieve emissions reductions through technology-based standards rather than economic incentives or behavior changes, has led to the interaction.

In many ways, improving energy policy and reducing energy-related pollution are complementary goals. A policy that increases energy efficiency, for example, can have both energy security and environmental benefits. On the other hand, sometimes

the two goals conflict. Limiting oil imports, for example, might decrease oil consumption and consumption-related pollution, but it would also increase domestic oil production and production-related pollution. Moreover, it might increase consumption of other fuels, such as coal, which are even dirtier. Likewise, policies to limit the use of coal might increase consumption of imported oil and reduce energy security. Even measures such as gasoline tax which is often touted as simultaneously reducing dependence on foreign oil and providing environmental improvements, may not be able achieve both of these goals.

Failure of the market and external costs

One of the failures of the market is negative externalities. This problem causes the government to intervene to correct the situation. Consumption and production of energy of all types, especially fossil fuels causes different kinds of air and water pollution; mining of coal causes water pollution, soil erosion, and other disamenities; burning of fossil fuels in factories, electric utility generating plants, and cars and trucks creates air pollution. These wide range of pollution are negative environmental externalities. This means a wedge exists between marginal social cost and marginal private costs. No one individual producer or consumer has an incentive to take his/her contribution to pollution into account, even though the overall contribution has a clear negative impact on social welfare. This "free-rider" problem creates a role for government.

Environmentalists often say that 'economics' does not take into account the real costs, including waste disposal, of producing or consuming a product. They confuse sound economic theory with what actually happens in free market economics, commonly failing to take 'external' costs into account. In the free market economic system there are some basic ways to 'correct' the failures of the private market and thus reduce pollution to a level which the planet and society can comfortably live with, but they require some level of government intervention.

Focusing on air pollution, the philosophy of air pollution control has always been to set standards for emissions from various sources based on the availability of control technologies that would remove pollutants from the waste streams, implementing regulations specify the type of equipment that must be installed and kept operating or the maximum permissible emission rate allowed a particular source.

Policy Options

1. pollution standards:

The traditional approach is to regulate pollution via pollution standards and mandatory controls. The polluter must bear the costs of meeting the standards. The polluter should pay for the damages to the environment, but economists have different schemes from this 'command and control' system.

An example of this option is the clean vehicle and clean fuel instruments. According to this policy, vehicles must meet emissions standards. Manufacturers

producing those vehicles will be allowed use any combination of emission controls and clean fuels to meet the standards. Thus, in the clean vehicle Program, the major candidates as clean vehicles include methanol vehicle using a form of alcohol produced from natural gas, ethanol vehicles using alcohol from corn, compressed natural gas vehicles, and electric vehicles. A very low emission gasoline vehicle can be used, either of these, methanol and compressed natural gas vehicles are the most economic.

The clean fuel vehicle requirement is likely to result in some increase in natural gas demand, at the expense of gasoline, because of the apparent cost effectiveness of methanol. However, since manufacturers are allowed to chose any combination of emissions controls and clean fuels to achieve the clean vehicle standard, the possibility remains that reformulated gasoline will offer sufficient emissions reductions to be used. Clean fuels requirements implemented separately from the clean vehicle requirements. They apply to all fuels sold in the designated regions, during the times of year when pollution is worst. The requirements are designed to reduce both ozone and carbon monoxide in non-attainment areas. The impact of the requirements on the cost of gasoline and on the refining industry hinges critically on how many do opt in. Refineries are required to meet these requirements for fuels sold in each non-attainment area, but again an allowance trading system is set up, for each area, so that fuel suppliers who fail short of the requirements can purchase allowances from suppliers whose products exceed requirements. The way these fuels will be produced is by changing the composition of gasoline and including additives to increase the oxygen content. Costs of gasoline may increase significantly. The clean vehicle and fuel instruments has been experimented in many countries.

In the US, the Clean Air Act Amendments (CAAA) of 1990, implemented by Environmental Protection Agency (EPA), required a mix of technological fixes to automobiles, alternative fuel requirements, requirements for changing the composition of gasoline, and a tightening of exhaust emission standards. "By the 1996 model year, all high-duty vehicles must meet a .25 g/mi non-methane hydrocarbon standard, a 3.4 g/mi CO standard, and a .4 g/mi Nox standard. The amendments also require manufacturers to install on-board diagnostic system on all new light-duty vehicles within 18 months, these systems identify emissions-related systems deterioration or malfunction; they include catalytic converter sensors and oxygen sensors. Stage II vapor recovery systems are required on all gasoline pumps in certain ozone non-attainment areas. Gasoline sold in certain ozone non-attainment areas must be reformulated to meet the following specifications: a benzene content not more than 1.0 percent by volume; a total aromatic hydrocarbon content not more than 25 percent by volume; no lead; additives to prevent deposit accumulation in engines; and an oxygen content of at least 2.0 percent by weight".

The CAAA include alternative fuel requirements. All fleet vehicles in selected ozone non-attainment areas must run on a "clean" fuel and meet stricter standards than those for conventional gasoline vehicles. A clean fuel can be methanol, ethanol, reformulated gasoline, diesel, natural gas liquefied petroleum gas (propane), hydrogen, or electricity. On the other hand, emissions standards for all vehicles have been tightened and on board diagnostic systems are to be required on all new vehicles.

Much of the cost of meeting the mobile source requirements of the CAAA -in particular, the costs of cars meeting the lower standards and on board diagnostics requirements- will be borne by areas of the country that receive very little benefit. In this case areas pay costs of a Program without reaping corresponding benefits, redistribution should take place to remedy that problem.

In Europe, environmental policy-making in was based mainly on isolated actions of a command and control-type that were justified by technical arguments. In 1994, however, the Council of Ministers (which is the legislative body of the European Union) approach and requested cost-effectiveness be a guiding principle for the European Auto/Oil Program. That Program will set stricter standards both for fuels and vehicles for the year 2000. Another research Program, the European Program on Emissions, Fuels and Engine technologies (EPEFE), determined the correlation between fuel qualities and engine design and the resulting emissions. The research for this study was carried out jointly by the automobile manufacturers and the oil industry. The focus of EPEFE, while similar to that of the US Auto/Oil Air Quality Improvement Research Program (AQIRP), takes into account many differences between the situation in the US and Europe. For example, the US study contained no research on diesel fuel, while in Europe, diesel is used almost as much as gasoline.

Vehicle technology, as defined in the Auto/Oil Program, always has a greater influence on exhaust emissions than do fuel changes. This result of EPEFE, therefore, favors technical progress in cars more than improvements in fuel quality. Preliminary conclusion from the Auto/Oil Program suggests a reasonable reduction can be achieved by implementing ECU-wide measures, while the remainder is left for local so-called non-technical measures, such as accelerated car scrapping, traffic management, road pricing,...etc.

The impact of clean fuel clean vehicle on oil market

The above measures will have immediate cost consequences on the refining and marketing sector and changing demand for oil products, which may come about by changing the price curve or by non-price factors. The price curve for oil products may be pushed upward by environmental compliance costs in the downstream sector or by increasing excise taxes on oil products or motor traffic-related activities. The immediate cost consequences for the down-stream sector could be modest or severe, depending on the degree to which the political negotiation process will stick to the rational approach.

Advocates of stricter environmental policies tend to argue that one measure or another would only cost one or few cents per liter or per gallon of gasoline. Even some of the most expensive packages under the ECU program would cost not more than 5 cents per gallon of gasoline and under the US regulation would cost from 5 to 10 cents per gallon of gasoline. The argument is that the consumer might not even notice and pay the higher price anyway. However, a capital-intensive industry, which is under heavy competitive pressure, does not work this way. The industry is a group of independently acting enterprises with quite different starting positions and interests. And refiners outside the ECU, like those in Eastern Europe, the former

Soviet Union, or the Middle Eastern countries, might find it easier to adjust only part of their output to ECU product norms and in this way realize a competitive advantage for their product exports. Consumers have proved to be remarkably reluctant to pay higher prices for cleaner fuels. The United States experienced this phenomenon when reformulated gasoline was introduced. Many urban areas have backed out of the program and motorists have refused to pay an extra 4 to 5 cents per gallon.

One can conclude that it will be very difficult to recover the full cost for the most stringent reformation of fuel. If it were as easy as environmental policy suggests, oil companies already would have made the investment as part of their routine business plans. The experience of the last 5 to 10 years tells a different story. The margin situation in the European refining industry has been for many years, except for the 1990/1991 Gulf crises, under extreme pressure. Margins of less than $2 per barrel were not sufficient to justify new investment in upgrading or in refinery modifications prompted by environmental regulations. Low margins and poor returns on investment have prompted a wave of refinery rationalization in Europe and US. Recent examples are the closure of Mobil Oil Corporation plant in Germany, the decision of British Petroleum (BP) to close or sell off two more refineries in Europe, and the merger of downstream activities in Europe and the US by many oil companies.

Environmental compliance costs alone cannot be made responsible for all difficulties in the downstream sector in Europe and US during the last decade, but they have made a contribution of mounting importance.

2. The carbon tax

An idea which has been around for a long time is to impose a *per unit* pollution tax on the amount of pollution that firms emit into the environment. This will internalize the external costs inflicted on the recipients of the pollution and is in line with the polluter pays principle. Also, it minimizes total emissions control costs and provides an economic incentive to adopt ever cleaner technology and energy conservation. It is easily adjusted to new circumstances in order to be continuously effective. Much of the revenue earned has been set aside for environmental improvement of distribution effects. Emissions taxes are common in Europe, several countries such as Sweden, Finland, and the Netherlands have already adopted emissions taxes.

Economic studies have shown that, to be effective in reducing CO_2 emissions, a carbon tax would have to be believed at very high levels, in excess of $100/ton of carbon. For example, a recent study conducted for the Electric Power Research Institute (EPRI) in US by Charles River and Graw Hill concluded that a tax of $100 to $200/ton of carbon would be necessary to stabilize US CO_2 emissions at 1990 levels. This means imposing such a high tax will have significant negative effects on the economy.

Opponents to this tax argue that, there will be energy consumers who are able and willing to pay higher energy prices and this inelasticity in demand will not secure a significant reduction of energy-related emissions. Also, under existing tax

structures the relatively less environmentally damaging energy, e.g., natural gas, are often subject to higher taxation, while coal, the most carbon intensive fuel, is frequently not taxed or even in part subsidized. The most contentious aspect of energy taxes is their impact on the competitiveness of export-oriented industries with energy-intensive production. The imposition of a national energy tax could harm their competitiveness and may even lead to a relocation, or leakage of industry to low-energy tax countries, thus, jeopardizing the environmental benefits of such an energy tax.

Carbon tax advocates argue that these negative effects can be minimized by making the tax revenue neutral, i.e., by reducing other taxes by an equivalent amount. Assuming that the tax revenues can be recycled in an effective way, the tax will still create a massive redistribution of wealth in the country implementing it, the consequences of which cannot be fully assessed.

A recent empirical study on gasoline demand of Hong Kong by W. Walls lead to the conclusion that a carbon tax would be the most effective policy instrument due to the immediate short-term impact on gasoline demand in addition to the long-term impact resulting from adjustment in the stock of vehicles. Changes in the price of gasoline can affect demand both directly and indirectly: the direct change occurs as a move is made along a given demand curve; the indirect change occurs as the size of the vehicle fleet adjusts to the new gasoline prices. As the size of the fleet adjusts, the demand curve for gasoline shifts.

Another empirical work for Public Power Corporation of Greece (PPCG) by S. Vassos and A. Valchu indicates that carbon taxes induce a technical restructuring of the industry toward less polluting technologies but at significant cost increases. Carbon taxes increase the cost of producing electricity substantially. These cost increases imply further adverse economic effects on the competitive position of Greece's industries and on the Greek economy in general.

In general, we can conclude that the level of a carbon tax should be designed with great care so that it could be efficient in reducing CO_2 emission but, at the same time, should not create significant adverse effects on the electric power industry and the economy as a whole.

3. The Permit Approach

Another alternative is for government to create and oversee a 'marker' where formerly there was none. For example, the government can establish a market in pollution rights *via a* "permit system". Although supported by economists, the permit system is unpopular with small firms and environmental groups. So let us consider what the permit system in fact is, and why it is opposed by these two factions.

On a regional basis, this is a method to reduce air pollution. Tradable emission permits are auctioned or presented by government to firms. These permits give the firm the right to pollute some specified amount over some specified period of time. This features of the "rights" makes many environmentalists object to the permit

system in principle. Polluting without permit would meet with the same punishments violating standards system of laws.

The permit system has been experimented in Europe and in the US. A more radical version might impose punishment without due process in a court of law, similar to the approach in some European countries. It can be shown that this system promotes economic efficiency to the extent that society will achieve a certain degree of reduction in air pollution for the least overall cost which will appeal to budget-sensitive members of most governments.

Firms which cannot afford permits will have to cut back on production, and hence, on the amount of pollution discharged, or else find some other technology which reduces discharge without reducing production. Small firms think they will be at a disadvantage because they are not likely to have access to the capital and technology of big firms.

An economic model has been developed by D. Bohi and D. Burtraw to show how the benefits from permit system can be affected by regulatory rules of public utility, and how that will help achieve the social objectives of minimizing the cost of pollution control, the study provides two possibilities may face a power producer, first case where net returns on capital investments are negative. In this case, biases in the cost recovery rules can result in an unnecessarily high price of permits and create a barrier to entry for new sources of generating capacity. A second possibility where utilities earn a positive net return on their investments. If a sufficiently large number of utilities operate under these conditions, the costs of compliance under this system could exceed that of command-and-control regulation. This condition will lower entry barriers to new generation capacity.

These two possible outcomes are unlikely to occur simultaneously. Within the extremes, how efficient the program will be depends, to a large degree, on the decisions of public utility regulations.

Conclusion

The interaction of environmental policies and energy markets has come in part from policy choices that have avoided causing changes in patterns of energy use. For the most part, these choices have increased the cost of achieving environmental goals over what it would have been if changes in energy use had been allowed or encouraged. The most pervasive of these choices is the preference for technology based standards over performance standards or the use of economic incentives to encourage changed behavior, as well as introduction of emissions control technology.

Emissions trading changes the impact of environmental regulations on energy markets. Trading provisions in the clean fuel and clean vehicle program are actually likely to avoid disruptions of the gasoline refining industry that would occur if no flexibility were allowed.

A gasoline tax might be a far less costly means of reducing emissions that contribute to urban air pollution than many of the measures standards. Yet, some

reductions in driving that would be brought about by a gasoline tax would reduce motor vehicle emissions at a far lower cost in lost consumer satisfaction.

The lesson of all this is that abandoning attempts to prevent specific energy sectors from being adversely affected by environmental policy might serve to minimize economic damage overall.

Energy efficiency policies, strongly motivated by environmental concerns, will limit oil demand. In the medium-term, this might not lead to an absolute reduction, but oil demand will be certainly lower than without these restrictions. In the long-term, motor fuel consumption is generally expected to decline under the rising impact of environmental restrictions.