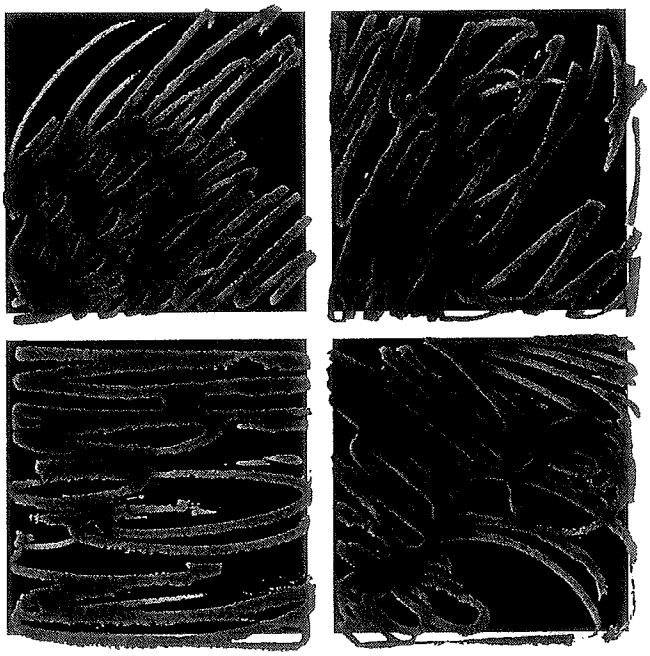

FORUM

FOR APPLIED RESEARCH AND PUBLIC POLICY

GLOBAL WARMING CALLS FOR CHANGES IN PUBLIC CLIMATE

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During the past two decades, atmospheric pollution has risen to the top of the environmental agenda. Concerns about photochemical smog, acid precipitation and, most recently, greenhouse gases have generated public and professional debates about the quality of the air we breathe.

The major sources of atmospheric pollutants are related to energy use and fuel combustion. The problems and solutions, however, largely have been viewed as pollution-related—not energy-related. Consequently, strategies have focused upon technological remedies using end-of-pipe controls.

The cumulative costs of air-pollution control have reached into the tens of billions of dollars, even though extensive programs addressing acid precipitation and greenhouse gases have not yet been initiated.

Public perception of the emerging greenhouse issue is different, although its major cause, energy consumption, is much the same. Because there is no practical way to remove greenhouse gases from smokestacks, solutions have centered on limiting carbon dioxide emissions through improved energy efficiency, renewable energy sources, and reforestation to promote the absorption of ambient carbon dioxide.

Measures to reduce greenhouse-gas emissions thus will require much different environmental management approaches than exist now. End-of-pipe approaches will be replaced by efforts to mitigate the problem at its source, either through greater efficiency or safer substitutes.

TIME TO ACT

Jessica Tuchman Mathews of the World Resources Institute has urged governments to act now despite incomplete knowledge of the potential magnitude of the greenhouse effect.[2] Mathews contends that (1) the potential impacts are too significant to wait, (2) the complexities of international cooperation will necessitate a long lead time to implement new programs, and (3) both humans and ecological systems will have to adapt eventually so we

should begin now to limit the effects. A recent Environmental Protection Agency (EPA) study concluded that delay by a few decades could increase the global warming commitment by 30 to 40 percent.[3]

Experience shows it is not wise to postpone policy initiatives under the assumption that more detailed scientific understanding and more sophisticated technological tools will offset the greater societal dislocations caused by the delay. For example, after approximately 20 years of research, the chemical mechanisms causing photochemical smog are not completely understood and the ability to model ambient concentrations remains modest. Therefore, the question is not whether to act, but how to begin—how to initiate an agenda to limit the greenhouse effect and to adapt to some degree to global warming.

GUIDING PRINCIPLES

Policies undertaken now should serve "multiple objectives" and be worth doing for reasons other than alleviating the greenhouse effect. Such policies would require a holistic view of related environmental problems and solutions. These policies would include:

- A creative combination of regulation, incentives, and penalties to guide consumers, industry, and the marketplace.
- Decisions that are environmentally sound and consider lifecycle energy costs.
- Research and development initiatives that emphasize the utilization, not just the development, of technology.

...full use of efficiency improvements would cut U.S. energy consumption in half and save $220 billion annually.

A Broader Vision. As the greenhouse debate over strategies, benefits, and costs sharpens, public agencies must adopt a new environmental accounting. In the past, whenever an environmental issue arose, a singular analysis of costs and benefits was developed. In the case of the greenhouse issue, it will be important to measure the multiple environmental quality benefits from any given strategy.

At the same time, a better integration of energy and environmental policy can produce substantial economic benefits. Energy conservation and efficiency are cheaper to achieve than augmenting energy supply. According to one estimate, full use of efficiency improvements would cut U.S. energy consumption in half and save $220 billion annually.[4] The 1987 Energy Efficiency Act, which upgrades energy efficiency standards for appliances, is expected to save approximately 22,000 megawatts, or the equivalent of 22 large power plants, which would cost $30 to $40 billion to build by the turn of the century.[5] Conservation measures also create new jobs, directly in energy-related fields and indirectly through increasing disposable income.[6] Moreover, there may be a dual benefit for the nation's balance of payments and trade deficits: improved energy efficiency would reduce oil imports and, perhaps, the import of foreign vehicles.

The dollars saved through energy conservation, in part, could be reinvested to fund the installation of renewable energy sources and to help develop a market and reduce the manufacturing costs of these products.

Furthermore, the development of alternate energy sources, such as solar photovoltaics, solar thermal, wind energy, biomass conversion, and cogeneration, can increase the nation's export of energy goods and services because the United States is the acknowledged leader in several of these technologies. For example, Chronar Corporation, a leading U.S. solar photovoltaic firm in Princeton, New Jersey, has launched a venture with the People's Republic of China to build a solar plastic pipe manufacturing plant. Thus, it is important to document the long-term environmental and economic benefits—not just the immediate costs—of pursuing energy-efficiency strategies.

A Holistic View. The United States must recognize that seemingly unrelated environmental issues and strategies, in fact, are related—all part of a larger environmental system. Ironically, the founding of EPA in 1970 was intended to coordinate disparate programs under one agency. However, within EPA and other government agencies, research institutions, and think-tanks, there arose a greater degree of specialization—"microspecialization"—in response to specific and complex environmental problems and research and regulatory needs. This trend makes it all the more important to devote personnel and resources towards the holistic view—that is, to how parts are interrelated—and to develop objectives and policies that complement rather than contradict each other.

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In the late 1960s, for example, a major air-quality strategy was to shut down old, polluting incinerators and bury garbage in landfills. Now, landfills have been shut down and incineration proposed as a solution. Although environmental officials recognize that a "multimedia" approach is necessary, often they promulgate regulations that prescribe narrow "technological fixes" that result in the emission of carbon dioxide and other greenhouse gases.

The greenhouse effect does not exist in isolation from other environmental issues. Different waste-management strategies can enhance or reduce the greenhouse effect. As deep-well injection and the burying of some hazardous wastes have been prohibited, incineration has emerged as an environmental remedy. Although carbon dioxide emissions are produced, there is no corresponding waste-heat recovery. The requirement of a carbon dioxide emissions offset could help spotlight other environmental costs associated with hazardous-waste generation.

Solid-waste incineration of biomass and cellulose materials yields a low Btu output and high carbon dioxide emissions in relation to the energy output (unless cogeneration is used); carbon dioxide emissions per Btu are approximately 55 percent higher than for natural gas and only 10 percent lower than bituminous coal.[7] Waste-to-energy facilities that utilize a "mixed waste" without separating metals and glass yield an even lower Btu content. On the other hand, recycling materials can reduce industrial energy demand and carbon dioxide emissions. Cellulose insulation, for example, can be manufactured from newspaper. And to the extent that packaging waste and "convenience" throwaway items can be reduced, both energy conservation and waste management purposes are served.

Methane gas emissions from biomass decomposition and other sources contributes to the greenhouse effect, whereas the recovery and combustion of

methane gases from landfills (and a conversion to "less noxious" carbon dioxide emissions) can reduce the greenhouse effect.

Acid precipitation is another environmental issue linked to the greenhouse effect. The only significant treatment presently in use is to "lime" affected lakes. The production of lime, in turn, releases carbon dioxide. The latter strategy thus fails to alleviate the problem of stunted forest growth or reduce carbon dioxide emissions. On the other hand, if scrubber technology is used to control acid precipitation, carbon dioxide emissions may increase due to the electrical requirements to operate scrubbers. Acid rain legislation could exacerbate the production of greenhouse gases by retaining many older plants with high carbon dioxide emissions per Btu if these facilities are (1) excluded from scrubber requirements and thus encouraged to operate indefinitely, (2) required to retrofit expensive sulfur scrubbing and thereby encouraged to operate indefinitely due to the capital investment, or (3) engaged in either (1) or (2) without retrofitting of carbon dioxide reduction technologies and methods.

Acid rain legislation could exacerbate the production of greenhouse gases by retaining many older plants with high carbon dioxide emissions....

Therefore, acid precipitation legislation should encourage other strategies in addition to scrubbers—energy conservation, cogeneration, and fuel-switching. To the extent that older coal-fired facilities are shut down and replaced by energy conservation and efficiency measures and other generating technologies, sulfur dioxide, carbon dioxide, and nitrogen oxide emissions all would be reduced. The latter, an important precursor for acid precipitation and ozone, would not be removed by sulfur-removal technologies alone.

Forest management policies also are important in controlling carbon-dioxide emissions. The United States could set an example by making forest management a national priority. It is time to establish "forest banks" that make land and biomass-energy developers responsible for funding an equivalent amount of reforestation "offsets" as part of the environmental permitting process.[8] If several states within a region embraced this policy (perhaps through the National Governors' Association), they would create a "level playing field" that would prevent environmentally attentive states from suffering economic penalties. In fact, at the recent "Global Climate Change" conference sponsored by the National Governors' Association, several working groups issued policy recommendations calling for economic incentives to promote reforestation and decrease deforestation.

Incentives, Penalties, and Regulations. Despite their successes, past environmental and energy policies have had serious shortcomings. Too often, arbitrary environmental regulations that specified technological fixes, such as "best available technology," led to solutions that were either expensive, hampered innovation, or created other pollutants. Other programs that provided residential or industrial tax credits for alternative fuels, energy conservation, or pollution control often have not been cost-effective.

Therefore, if efforts to improve energy efficiency and reduce carbon dioxide emissions are to be met, a careful, multi-faceted approach incorporating a mix of economic incentives, penalties, and regulation will have to be developed and tailored towards specific situations. Because low energy prices, market distortions, and barriers will make it difficult to rely primarily upon market

solutions, the challenge is to develop an integrated approach tailored towards specific situations.

ENERGY SECTORS

If the United States is to significantly reduce carbon dioxide emissions by the next decade (by the often-mentioned 20 percent target), it is important to examine the relative size and importance of different energy sectors to the problem and to set priorities. Of the total U.S. carbon-dioxide emissions, approximately 32 percent are from the transportation sector; 33 percent from electric utilities; 28 percent from the industrial and commercial sectors; and 7 percent from the residential sector.[9]

If the only policy goal were to rapidly reduce emissions, it might be wise to neglect the residential sector, except for strengthening national appliance standards. In practice, however, energy consumption by the residential sector is proportionately greater than its carbon emissions. Therefore, other energy and economic policy considerations instill an important role for residential energy conservation.

Another doubling in auto-fuel efficiency is technologically feasible and would contribute...towards the...reduction in carbon-dioxide emissions.

Policy initiatives should be targeted towards the transportation and electric-utility sectors. Within the transportation sector, the primary question is how to substantially improve automobile-mileage standards in order to reduce gasoline consumption. Some analysts have suggested a "one-time" large increase in the gasoline tax or a "tax/rebate" to promote a market for fuel-efficient vehicles. For example, the Natural Resources Defense Council (NRDC) has suggested a "push-pull" energy program for autos, buildings, and appliances: if an optimal energy-efficiency standard is not met, a sliding scale of fees would be charged; if the standard is exceeded, then a scale of rebates would be offered.[10]

Such a system could be designed to be "revenue-neutral." However, the concept would be difficult to design and administer. If the president and Congress do not consider tax or economic incentives to stimulate the market to deliver highly improved efficiency, then regulation will, once again, be the only option. The 1975 Energy Policy and Conservation Act, which achieved a doubling in auto-fleet fuel economy to 26 mpg, is widely regarded as one of the nation's most effective legislative energy initiatives.

Another doubling in auto-fuel efficiency is technologically feasible and would contribute substantially towards the 20-percent target reduction in carbon-dioxide emissions. The transportation sector also exemplifies the interdependence of environmental problems and solutions. Because of the unmanageable urban ozone problem in many U.S. cities, there will likely be an attempt to introduce cleaner fuels, including natural gas-fueled vehicles.

Electric-Utility Sector. The electric-utility sector, with several hundred regulated companies, provides a significant and complicated policy challenge. In contrast to the industrial sector, which consists of tens of thousands of energy-using facilities operating in diverse industries, the electric-utility sector is more concentrated. In principle, the high degree of state and federal regulation also makes it a good candidate to reduce carbon-dioxide emissions. In fact, the National Association of Regulatory Commissioners appears willing

to provide leadership to deal with this issue. At the same time, the electric-utility industry is undergoing a slow transition towards deregulation and perhaps offers the best opportunity for using market signals within a regulatory framework to promote carbon-dioxide emission reduction.

There are two distinct goals with respect to reducing carbon-dioxide emissions from electric utilities. The first is to "rollback," or reduce existing emissions. The second is to reduce future emissions generated as a by-product of meeting future electricity demand. The difference between the two goals is not trivial; "least-cost planning," for example, will not reduce existing emissions but will help limit growth of future emissions.

The first goal focuses on how to "displace" existing electrical generation, primarily from coal-fired facilities, with conservation or alternative, non-fossil fuels. Many of the same vexing economic and energy issues that have hampered acid-rain legislation are present here. Coal will continue to play an important role as an energy source. State economies that depend on coal will have to adjust to a careful "phasing out" of older coal-fired generating facilities. Although "plant life extension" has become popular among utilities, there is an opportunity to phase out older plants and "replace" them with low-cost, energy-efficiency conservation methods and cogeneration. Amory Lovins, for example, recently painted a potentially rosy energy-efficient picture. Based upon available technology and favorable economics, he contends that U.S. electrical consumption could be reduced by 70 percent through an array of energy-efficient retrofit options for lighting, appliances, and motors.[11]

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Demand for electricity is expected to grow. Therefore, the second goal must be to reduce future emissions from electrical power plants. Many national organizations, such as Natural Resources Defence Council (NRDC) and Public Citizen, have been studying and urging strong energy conservation and end-use efficiency measures to reduce power demand, including improved national and state energy-efficiency standards for new appliances, lighting, and buildings. Traditionally, electric utilities have shown little enthusiasm for conservation and have preferred to emphasize generation. Recently, 42 electric-utility holding companies formed nonregulated subsidiaries to develop and market electricity—a sure sign of their ambivalence toward "marketing" conservation.[12] In part, the behavior can be attributed to an engineering focus and peer pressure. Mostly, however, this has been a rational response to the existing regulatory climate and profit incentive structure.

The overriding question is how to make conservation more profitable than generation. If conservation pays, electrical utilities will be pressured by shareholders to develop conservation strategies. Regulators could encourage conservation by (1) allowing utilities to keep a higher percentage of their savings from conservation versus other sources of supply or (2) permitting higher rates of return on conservation than on generation. In principle, this strategy seems simple, but it calls for something of a regulatory revolution. Traditionally, ratemaking bodies and public service commissions have been concerned with assuring an adequate supply of electrical energy at a reasonable price.

Now, however, in addition to traditional responsibilities, ratemaking agencies must seek to solve environmental problems—a responsibility previously under the sole province of environmental regulatory agencies. The role is unfamiliar and perhaps uncomfortable, and it could conflict potentially with other regulatory roles such as ensuring a reasonable price. However, the environmental role is compatible with the conventional role of regulatory commissions to consider different schemes to increase competition among energy sources and suppliers in order to reduce the cost of power.

To meet demand, utilities and public service commissions are turning to systems of competitive bidding from independent power producers. In principle, this is a worthwhile idea, but precautions must be taken. Using only economic considerations, there is a tendency to favor short-term over long-term gains and to hamper innovative technologies. To ensure that more clean-burning fuels and efficiency improvements will be utilized, the bid system must adequately account for environmental factors, especially air quality and climate change. One means of doing this would be to include the cost of carbon-dioxide offsets along with other economic costs in both competitive bidding and rate-setting.[13]

California is...the only state that has... developed economic incentives to make conservation...more profitable than electrical generation.

At the same time, it is important to encourage energy service companies to bid to "supply" large energy users through conservation programs. In practice, however, there are barriers that inhibit the regulatory process. Energy service companies do not have access to utility customer energy-usage data. And because there is also competition with cogeneration and independent power producers, there must be a provision to ensure that conservation precedes electrical generation.

Therefore, to stimulate energy conservation in the commercial/residential sector, utilities must develop programs to spread new technological improvements (*e.g.*, lighting, appliances, and motors) and subcontract these programs among energy service contractors. Such a program would include "public education" about conservation alternatives and rebates to reduce the cost of energy-efficient appliances. Again, it is a matter of providing the right signals and incentives for utilities in order to break the linkage between sales and profit.

Several states are now evaluating or implementing least-cost pricing, which would require utilities to rank and obtain new electricity supplies from the lowest-priced sources. Environmental and consumer groups are lobbying for this approach, which is expected to promote conservation. However, least-cost pricing will require detailed cost analysis of conservation opportunities, independent power production, and traditional generation. There will be many critical assumptions with respect to fuel prices, electrical demand, financing, interest rates, transmission costs and access, and standby costs. The analysis is destined to be controversial. It could be manipulated by vested interests and may take years to implement.

Least-cost pricing is potentially an important innovation and should increase the emphasis upon lower-cost conservation alternatives. However, direct economic incentives for utilities would likely be a more rapid path to conservation. In practice, both approaches could be combined. California is

presently the only state that has extensively developed economic incentives to make conservation and energy efficiency more profitable than electrical generation.

Commercial Sector. More than the residential sector, the commercial sector offers substantial opportunities for energy conservation. Although there are many diverse users and buildings, the number is smaller and energy consumption per building is much greater than with residential users. Unfortunately, there are frequently "disincentives" for investment in state-of-the-art energy efficiency and life-cycle costing. In most cases, the building owner passes along the energy costs to the tenant. In other cases, when energy usage is individually metered and paid by tenants, there is an incentive for the tenant to practice "housekeeping" conservation measures but no incentive for the building owner to improve building and appliance energy efficiency. Frequent change in building ownership also dissuades such improvements.

This situation highlights the need for mandatory energy audits and energy-efficiency codes for existing and new buildings. California and New York have adopted noteworthy energy-efficiency standards for new buildings. For existing buildings, frequent ownership changes could serve as a "pressure point" for change; before the real estate is transferred, the building could be required to meet energy-efficiency standards. (There is precedent for this approach in the regulation of toxic wastes and radon that often require certification of approval.) "Model" energy-efficient building codes for existing structures are in place in San Francisco. To gain support for such measures, standards could be developed to amortize costs and save the building owners money over time. Federal and state governments must provide leadership in this approach. Because of similarities, approaches towards energy conservation in the commercial sector could be adopted in the residential apartment sector as well.

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Industrial Sector. An analysis of the industrial sector in relation to greenhouse policy is exceedingly complicated. Although accounting for 24 percent of national carbon dioxide emissions, the industrial sector encompasses tens of thousands of sources spread across hundreds of diverse industries with differing products, processes, competitive characteristics, and costs. Among policy analysts, there has been increasing discussion of using "market forces" to encourage industrial-energy users to make their own decisions to reduce carbon-dioxide emissions. The same traditional barriers that have affected other energy and environmental decisions are present here. Turnover in capital stock tends to be slow so that more efficient industrial processes, with lower emissions, are slowly diffused through industries. Companies are reluctant to invest in energy-conservation features that do not produce a payback within three years; corporations, in fact, require a higher rate of return for such measures than for industrial expansion.

Taxes on carbon-dioxide emissions could provide an economic incentive for industries to reduce emissions. Proposals have included a tax on fossil-fuel production and a tax on fossil-fuel consumption, both in proportion to carbon content. There is, however, a "Catch-22." If the taxes are phased in over time to be noninflationary and politically acceptable, they will not have much of a

policy impact; but if they are designed to have a substantial policy impact, they will not be politically acceptable.

Therefore, there are two other approaches to consider in promoting industrial-energy conservation. The first is a voluntary program to reduce carbon-dioxide emissions by improving energy efficiency and by fuel-switching (primarily oil to natural gas). Of course, it is easy to be skeptical of a voluntary program. The expanding industrial world, together with a large measure of corporate neglect, has been largely responsible for past environmental and toxic-waste problems. On the other hand, conditions are much different today than they were 20 years ago. Many corporations are striving to improve their public image, and many corporate leaders are willing to lead and generate peer pressure to act upon important social issues.

If a...tax on industrial oil consumption were enacted...a...reduction of about 12 percent in carbon-dioxide emissions...could be realized... .

If there is strong political leadership—both here and abroad—stressing the importance of this global issue, it may be possible to develop corporate leadership to get corporations to respond positively. Ken Murphy, executive director of the Energy and Environmental Study Institute, refers to it as a "broader vision" and "new investment calculus" that factors in longer-term energy costs, energy availability, and productivity. When a corporation does not succumb to quarterly pressures for the bottom line, it is in its interest to take such measures. Even without presidential leadership, there is a beginning of corporate leadership. At the Global Climate Change conference in New York City in February, 1990, Jerome Feldman, chairman of the National Patent Development Corporation, spoke in his capacity as chairman for the Corporate Initiatives Committee and pledged that industry would be willing to respond to this vital issue. At the same conference, Ted Turner, chairman of Turner Broadcasting Corporation, pledged to use the media to develop public awareness of this and other environmental issues.

There are also effective public watchdogs and socially responsible investment institutions willing to monitor corporate progress or footdragging. Indeed, the 1980s brought a socially responsible investment movement. Organizations such as the Interfaith Center for Corporate Responsibility, Council on Economic Priorities, and the Investor Responsibility Research Center monitor research and corporate performance on environmental and social issues and publicize their findings through the media and investment community.

Should it become necessary, however, a tax penalty or disincentive could be effective and easier to implement than a broad tax on carbon-dioxide emissions or fuel consumption. About one-half of industrial carbon dioxide energy consumption is from oil. The emissions of carbon dioxide per Btu for natural gas is about 70 percent that for oil. If a sufficiently large tax on industrial oil consumption were enacted to prompt switching from oil to natural gas, while prohibiting a conversion to coal, a maximum reduction of about 12 percent in carbon-dioxide emissions from the industrial sector could be realized (while serving other energy-policy objectives such as a reduction in foreign oil consumption and conservation of domestic petroleum reserves). At the same time, by developing additional regulations to foster industrial cogeneration in

conjunction with the fuel-switching to natural gas, it also would be possible to displace a portion of older, coal-fired electrical generation.

NEW DIMENSIONS OF R&D AND UTILIZATION

A dramatic shift in research priorities is needed to accelerate the development of alternate-energy sources and to reduce fossil-fuel dependency. Proponents often make the case for aggressively funding photovoltaic research, developing biomass conversion techniques, and improving the efficiency of coal combustion, primarily at the expense of nuclear-power research. Arguments over research priorities miss a key point, however.

Good alternative technology, ranging from the simple to the complex in energy conservation and solar, already exists. Indeed, in the last two years there have been important strides in solar photovoltaics and solar-collector systems. What is needed is research to help overcome behavioral and economic barriers and to develop new institutional mechanisms. Part of the problem is that energy-research institutions have established narrow missions, and too often the engineering focus does not fully appreciate the social aspects. Even when R&D is expanded to include demonstration, the emphasis has been on demonstrating technical or economic feasibility.

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As a result, worthwhile passive-solar technology exists but is underutilized. A reliable active solar hot-water heating system can be installed for less than $2,500, but most builders are not interested. We now have much-improved, energy efficient low-emissivity glass, which most homeowners do not retrofit, and a state-of-the-art earth-coupled heat-pump technology usable in northern climates, which the larger manufacturers do not want to license because it competes with their own products. In Japan and Western Europe, highly energy-efficient manufacturing processes are used but not so much in the United States.

Two possibilities to develop financing and institutional arrangements for energy conservation and alternate energy come to mind. First is a state gasoline-tax levy to establish a fund to pay the upfront costs for energy improvements. The costs could be repaid and the fund replenished from monthly paybacks from energy savings until the improvements are paid, to be collected by the utility along with monthly bills. Second is state-created special tax-free bond issues that energy service companies could tap to finance larger energy improvements for industrial and commercial users who would also repay the cost from energy savings. Although this would be an initial drain on the federal treasury, the program is an investment that would generate additional economic growth and savings from oil imports.

We must research and develop incentives and institutional arrangements to (1) bring new technologies to market, (2) finance and incorporate lifecycle costing, (3) improve building codes, and (4) expand the faltering "shared savings concept," which allows energy improvements to be repaid over time from energy savings. Then perhaps the debate over future directions in energy research and development will be more meaningful.

CONCLUSIONS

As an environmental management problem, the greenhouse issue will require fundamentally different approaches if the United States is to do its part to limit global warming. Preventive measures must be used to reduce emissions of carbon dioxide and other greenhouse gases, and reforestation and vegetative processes must help capture future carbon-dioxide emissions.

In turn, these approaches will require changes in environmental and institutional management. There must be a close integration of energy and environmental policy with coordinated efforts among environmental agencies, energy agencies, and public service commissions to promote and evaluate energy conservation and energy efficiency. A creative policy mix of regulation, economic incentives, and penalties will be required, with specific policies targeted towards specific segments of the economy. There must be a holistic review of existing environmental management programs and an evaluation of the linkages among different environmental issues and policies. Finally, energy R&D priorities must be broadened to promote utilization of existing and new energy-conservation and alternate-energy technologies that have not reached their market potential due to economic, institutional, and behavioral barriers. It is time to use the greenhouse problem as an opportunity to alter the management and use of our productive resources.

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NOTES

1. The author wishes to thank Mr. Gunnar Walmet, program manager, New York State Energy Research and Development Authority, and Mr. William Davis, executive deputy commissioner, New York State Energy Office, for helpful review comments and encouragement.
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