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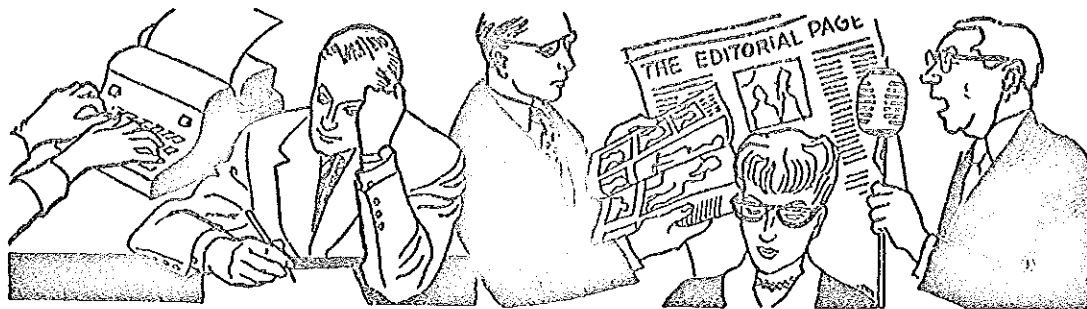
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New Tasks for the Energy Industries

I WANT to reassure you, if you had any doubts, that in the universities we are not sitting with perfect answers and refusing to tell anyone about them.

Scientists have been as surprised as anyone by the rapidity with which environmental problems have risen toward the top of the list of problems deserving national attention. But scientists should have known better, because they are on more intimate terms with nature and respect nature for her cussedness, her indifference, and her beauty. Although men have been seeking to tame nature for several centuries, we scientists should have been able to anticipate that the outcome of the struggle would find nature taming us.

Few men thought about how nature would constrain man's activities on the planet until man got active enough for the constraints to matter. Now we must all think about our interaction with nature: Since man is not likely to get less active, the constraints are here to stay.

It is sometimes argued that the constraints we are facing are a reflection of our lack of knowledge, and that as we get wiser we will be able to circumvent them. But this is misleading. Some of the constraints we are facing are very much *part* of our knowledge. We understand the global ecosystem to a considerable extent, and out of that understanding comes the realization that there are things we are not going to be able to accomplish, ever. There are physical laws that say you cannot do something as well as you might like; physical laws do not always say that there must be some way to overcome a problem.

I think we owe the vividness of our vision that we are on a finite planet to what may have been history's most impressive technological enterprise—the American space program. This let us look at our planet from outer space, seeing how unusual and special it was. I think the heightened awareness of our condition as a species totally dependent on a limited environment is probably the most significant of the long-term consequences of that space program.

The heightened awareness has been accompanied by a flood of new literature critical of technology, and spokesmen defending technology have been tempted to treat the whole literature as if it were presenting a

single argument. But actually the arguments critical of technology can be divided into several broad categories. The most important distinction is the distinction between arguments from necessity and arguments from preference. The arguments from necessity take the form: "We have to do this or else we are all in trouble"; the arguments from preference take the form, "I want us to do this because this is how I like it, even if we would not be in trouble doing it another way."

Arguments from necessity sometimes use the word "survival." Occasionally environmentalists can be caught saying that if a certain technological development is allowed to proceed, our whole life will be at stake on the planet. And occasionally an executive from an electric utility calls the task of producing more electricity a matter of "survival." Both uses of the word are, needless to say, overstatements.

There are two subcategories of the arguments from necessity, reflecting two properties of nature, its "cussedness" and its "indifference," mentioned before. Arguments reflecting the cussedness of nature stress the fact that nature could turn around and do something very out of the ordinary—produce an avalanche or a tidal wave or cross some kind of a threshold that we did not expect. We know such things can happen in nature. The frustrating thing about these "cussedness" arguments is that we rarely know enough science to deal with them quantitatively. Arguments that we could trigger an ice age or destroy our stratospheric ozone can rarely be proved wrong in advance. Even when an aberration of nature *has* occurred—the failure of a rice crop, the ravages of pests, the chaos attendant on a flood—it is hard to decide what part of the responsibility to assign to man.

The other class of arguments from necessity stress nature's indifference to man, and in particular her indifference to our desires to continue current trends. Many of these arguments point out that a measure of activity currently growing rapidly cannot continue to grow indefinitely. I have my own rule of thumb about the projections I see. The rule is to extend every projection twice as far as what is shown on the graph,

and only if *this* still makes sense, to take what is shown on the graph seriously. If it does not really make sense then we are not thinking something through.

If a projection of electricity consumption shows doublings each ten years for three decades, I ask myself if I believe two-to-the-sixth power, or 64 times, as much electricity being produced in this country by the time my little children are getting ready to retire. I do not believe it.

If six doublings is wrong, then some place between now and sixty years from now we will have to start thinking about the problems that are going to cause departures from that trend. So why not start thinking about them now just to get started, just to limber up?

The other broad category of arguments critical of technology, the "arguments from preference," are the ones that generate most of the political heat. A pond may still be fine for industrial cooling water, and may not be a menace to public health, but if there are no fish in it, these facts will not matter to the guy who used to fish there as a kid.

The transformation of natural areas bothers some people more than others. Those who were bothered *most* used to have the environmental movement to themselves. But now there is a coalescence of arguments from preference and arguments from necessity; and the environmental movement is much stronger and more self-confident now that many arguments can be couched in universal (nonpreference) terms.

There are many constructive ways in which the energy industries can respond to the environmental challenge. The first would be to recognize that an economy can grow without increasing its total energy output. It has been true for many decades that economic output has been roughly proportional to kilowatt-hours, but this does not have to be true indefinitely. There is no such physical law.

The energy industries will probably be transformed as much as any industries in our country by the adaptations that lie ahead. The new areas of production and distribution that the energy industries can be expected to open up in the next two decades include breeder reactors, coal gasification, solar energy, and nuclear fusion. The last two will outlast the others; what kind of mix of the two will ultimately prevail is something none of us will live to find out, but we will get some hints as research gets more vigorous in the two areas.

The energy industries have much to gain by supporting research centers that can share the burden of establishing credibility for these new technologies, both centers in new research institutions and centers in the traditional universities. It is in everyone's interest to get studies of environmental impact done well. Until recently, much of the technology assessment was done by committees of prestigious scientists spending two days a month in Washington. Now there are a large number of small consulting firms as

well. But what are still needed are environmental research centers committed to a long-term view, busy with enough different problems that no particular source of funding will dominate, and determined to be independent.*

May I add a remark from the perspective of a faculty member at an engineering school. The lack of enthusiasm for science and engineering among talented students in recent years, especially among those students who felt large stirrings of social conscience within them, has been a concern for all of us. I suspect that there is a direct link between the growth of public interest research—in energy technologies, in transportation, in pollution abatement—on my campus and the return of motivation to many of these students. In a country that from any long-term view will have a great need for technical talent, especially coupled with social conscience, the reversal of these recent trends is welcome. It also suggests another link between the self-interest of the private sector and the support of independent research groups.

In addition to developing new energy sources and funding the independent research that assists the passage from development to deployment of the new technologies, I would encourage the energy industries to get more deeply involved in the fate of the energy they produce, as it is finally consumed by a car or household furnace or piece of machinery. The energy industries can no more convincingly disclaim responsibility for such matters than the automotive industry can disclaim responsibility for abandoned auto hulks and the packaging industry can disclaim responsibility for the growth of indestructible solid waste. The energy industries ought to assume that "efficient energy utilization" will become ever more prominent as a national goal, and that their responsibility for addressing that goal will be ever more widely recognized.

As the energy industries take up the challenge of efficient energy utilization, there will be many opportunities for innovation. Some, such as redirecting promotional activities and revising rate structures, are already under way in some parts of the country. Others, such as managing the operation of total energy systems where these appear to be advantageous from an energy conservation standpoint, are currently resisted, to a degree that appears to me to be unwarranted.

A time when brownouts and blackouts are regarded as corporate embarrassments may not be the best time to advocate that these, too, could be reinterpreted to accommodate a new era. If voltage reductions can get us past the few unusually hot days of summer, then we should find ways to assure that they

*For further discussion, see "Institutions for the Effective Management of the Environment," Part I, of the report of the Environmental Study Group to the Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering, Washington, D. C. (1970).

are maximally available as a tool to add to our flexibility in getting through these periods. Today utilities are constrained to keep voltage reductions to no more than 5 per cent, but the necessary safeguards (voltage regulators and safety switches) on critical machinery and appliances could be provided to allow much greater flexibility. A similar approach aimed at damage limitation would apply to local blackouts—they do not have to be as disastrous as they now are. A system of backup and selective channeling that provides electricity for the limited uses that have *genuine* priority (refrigeration, elevators) in every vulnerable region would seem to me to be an attractive new objective for the energy industries.

The new technological responses now forthcoming to respond to the environmental challenge are going to keep the technological enterprise vigorous. But they cannot possibly represent the full dimensions of the response to that challenge. Along with a redirection of technological activity, I expect there to be increasingly widespread acceptance of the principle that we should place limits on our mastery over nature. We have agreed recently not to dress in the skins of tigers and leopards, and not to travel faster than 800 miles per hour (at least in American planes). These were acts of renunciation, constraints the most prosperous portions of our society placed on themselves. I would expect other acts of renunciation of the domination over nature—agreements not to cool theaters, stores, and office buildings below, say, 75 degrees Fahrenheit in summer, for example. It has become part of our culture to live the other way—to use our prowess in technology to make nature do whatever we like, managing every river, overriding every fluctuation in climate. (We are still embar-

assed, I think, if a major snowstorm makes us change our routine for a day or two.) But the alternative of *accommodating* to nature and her constraints is a compelling one—it reduces the burden on the natural environment by conserving some resources and it also answers to a widely perceived need—well articulated in what is often called the counterculture—to be aware continually that we are, after all, a part of nature.

There is also likely to be an increased emphasis on the *distribution* of residual growth in energy consumption between the rich and the poor, as it becomes more widely accepted that the total consumption of energy is subject to limits. The energy industries can take the lead in fighting for air conditioning in housing for the elderly, for example; arguments for rehabilitation of energy distribution systems in cities can be supported in terms of their impact on current social inequalities as well.

With technological challenges ranging from better heat pumps to safer nuclear reprocessing plants, and social challenges ranging from rate structures to issues of plant siting, a quiet time does not seem in the offing. This should reassure anyone in those industries who has had fears that a *stagnant* society is implied by the environmental realities we currently are recognizing.

—ROBERT H. SOCOLOW,

Associate professor, Center for Environmental Studies, School of Engineering and Applied Science, Princeton University.

EDITOR'S NOTE: Professor Socolow's analysis is based on a talk earlier delivered to a conference on "Energy and the New Jersey Environment," sponsored by the Rutgers University Graduate School of Business Administration.

Naphtha Import Fee Could Perpetuate Gas Shortage

ON April 18, 1973, President Nixon sent his Energy Message to Congress and issued a Presidential Proclamation making major changes in the oil import regulations. The quota system was abolished and replaced with a system of license fees on crude oil and various petroleum products. Persons holding historical quotas were given initial exemption from payment of the license fees, such exemption to be gradually phased out over the next seven years. New crude oil refineries and new petrochemical plants were given an initial exemption from payment of license fees to the extent of 75 per cent of the new capacity. Gas utility companies contemplating the construction of new synthetic gas plants were given no exemption whatsoever even during the first five years of operation from payment of the full license fee on imports of naphtha. This fee has been fixed at 63 cents a barrel or 1½ cents per gallon. Since it requires ten gallons of naphtha to make one Mcf of synthetic gas, the license fee on imported naphtha will increase the cost of synthetic gas by approximately 15 cents per Mcf.

In the Northeast, the estimated cost of synthetic gas made from naphtha as a feedstock is approximately three times the cost of gas supplied by the major pipelines to this area. The gas distribution companies would, of course, greatly prefer to buy additional volumes of gas from their historical pipeline suppliers.

However, the major pipelines have advised the gas distribution companies that no substantial additional volumes of pipeline gas can be made available, at least during the years immediately ahead. Gas from Alaska and the northern territories in Canada is many years away. Likewise, gas from new large-scale coal-gas plants is not expected to be available for anywhere from five to seven years. Accordingly, the only practical near-term alternative of augmenting gas supplies is through the construction of synthetic gas plants using naphtha as a feedstock. Such plants can be built in a relatively short period of time—fifteen to thirty months.

The new license fee imposed by the federal government on naphtha imports was claimed to have the