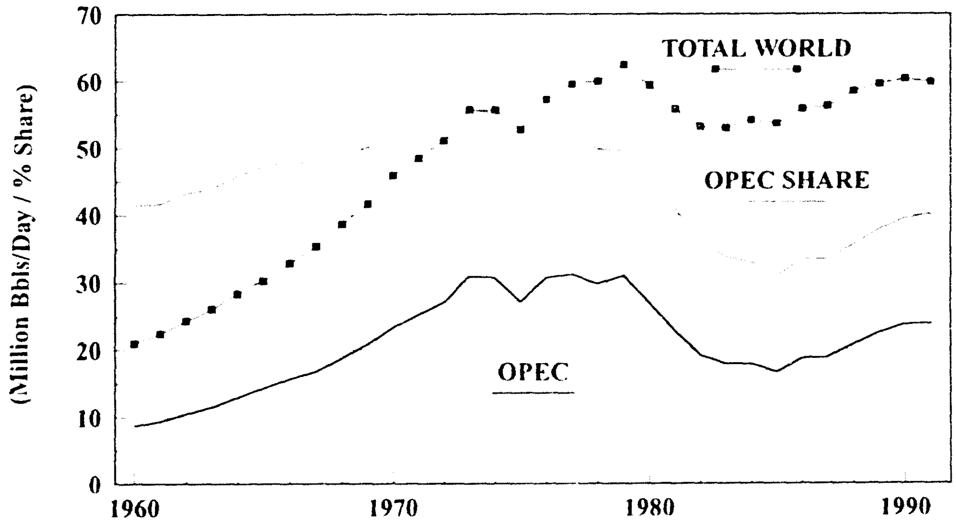
Figure 4

OPEC's WORLD OIL MARKET SHARE, 1960-1990



Source: Annual Energy Review 1991, Table 118.

Figure 5

TRANSPORTATION IS A MAJOR SOURCE OF AIR POLLUTION

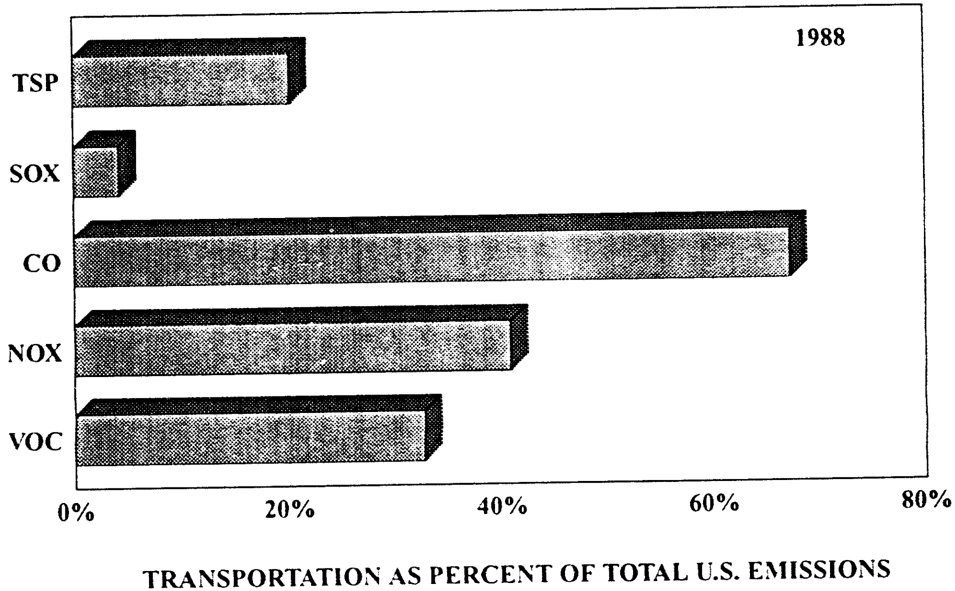


Figure 6

AVERAGE FUEL ECONOMIES OF DOMESTIC MANUFACTURERS, CAFE STANDARDS, & PRICE OF GASOLINE, 1978-1989

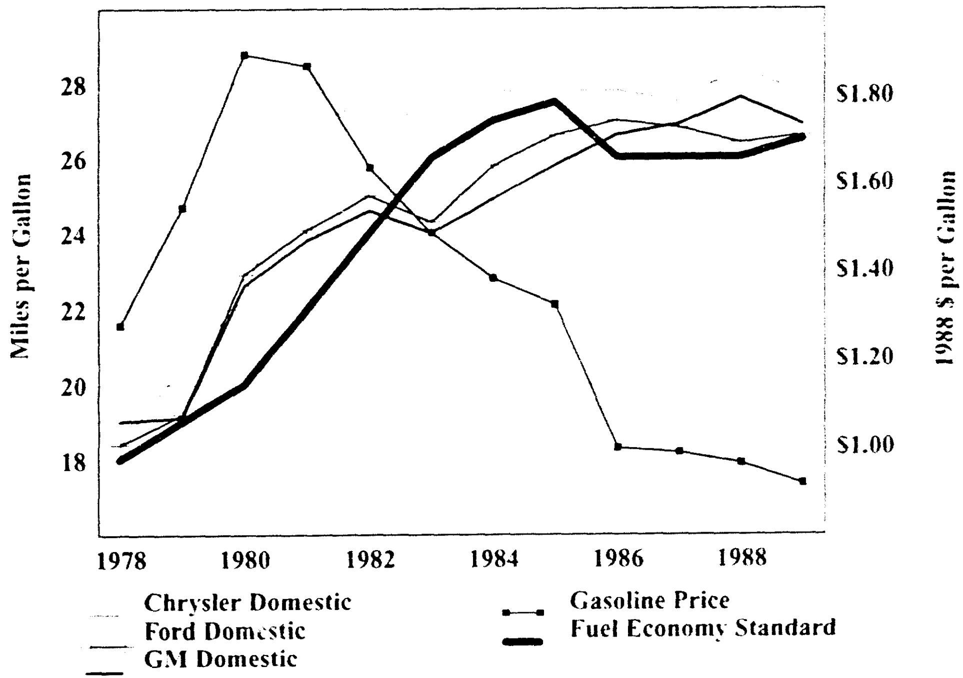
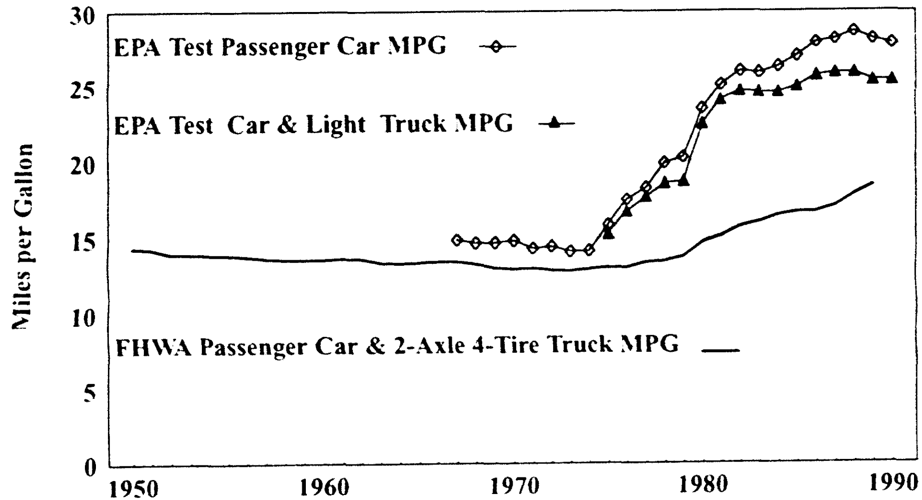


Figure 7

LIGHT DUTY VEHICLE FUEL ECONOMY TRENDS

New Vehicles on EPA Test Versus In-Use Fleet



Heavenrich, Murrell, and Hellman, 1990; Davis and Morris, 1992.

Figure 8

U.S. LIGHT DUTY VEHICLE TRAVEL & FUEL USE

1949 - 1990

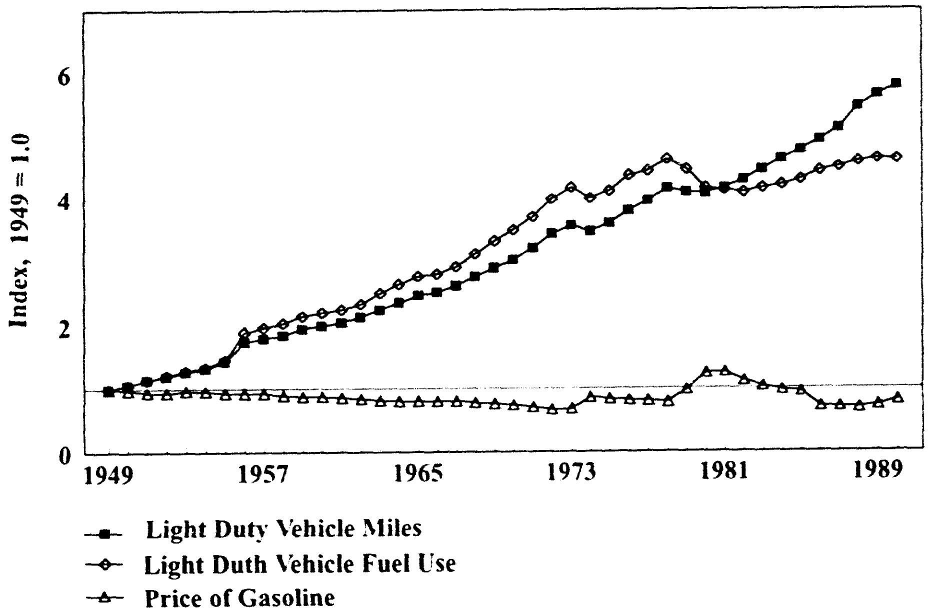


Figure 9

U.S. HIGHWAY TRAFFIC FATALITY RATES, 1950-1989

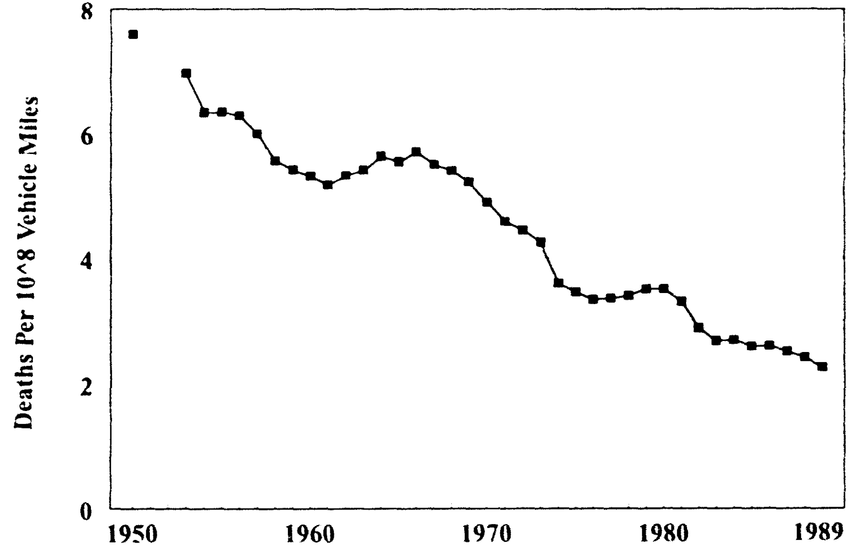


Figure 10

PASSENGER CAR WEIGHT DISTRIBUTIONS & RELATIVE RISK

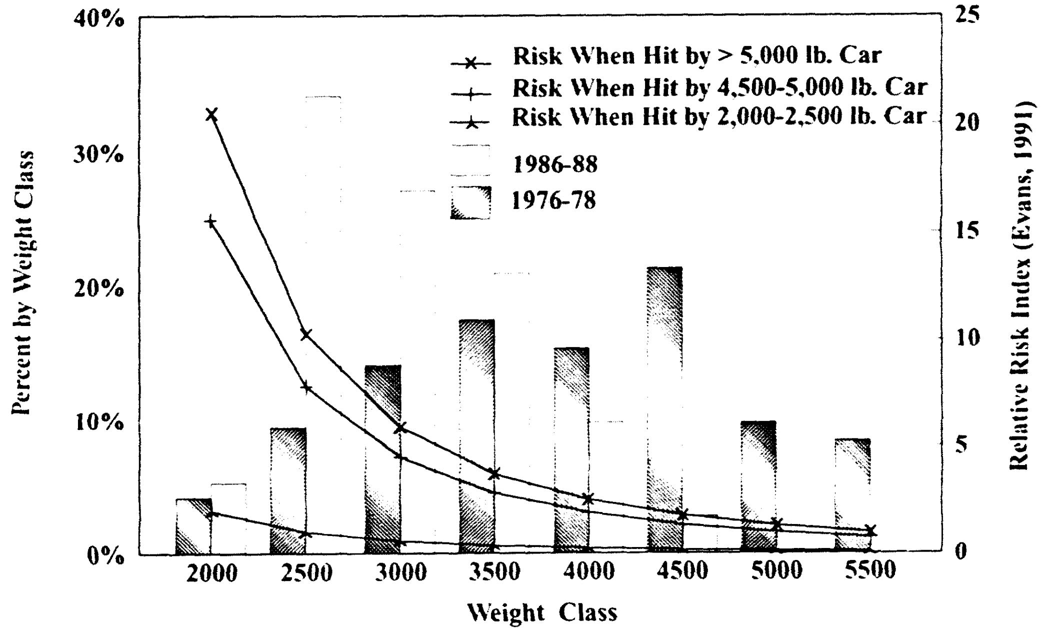
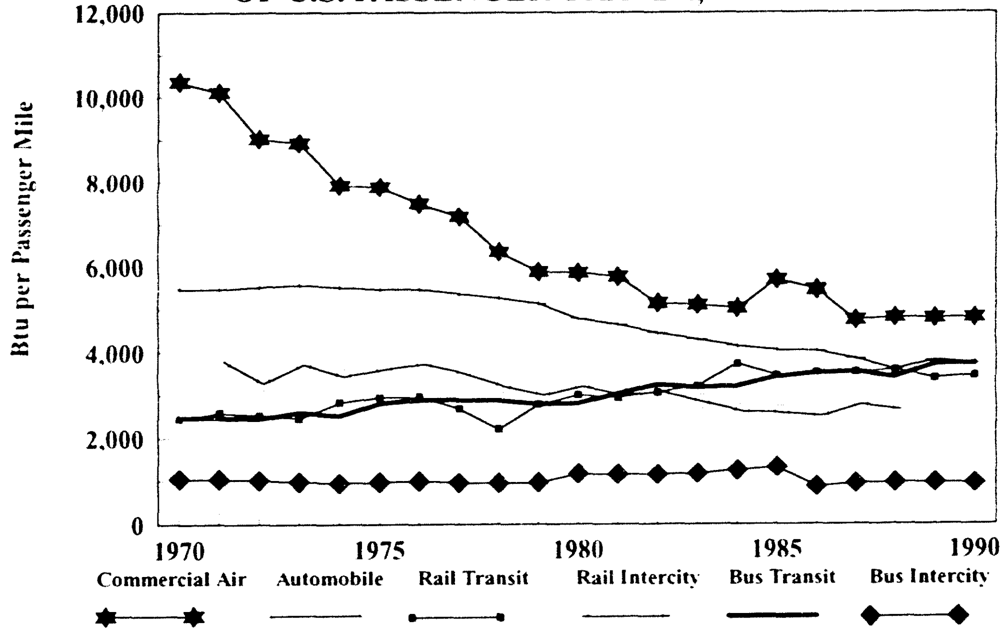


Figure 11

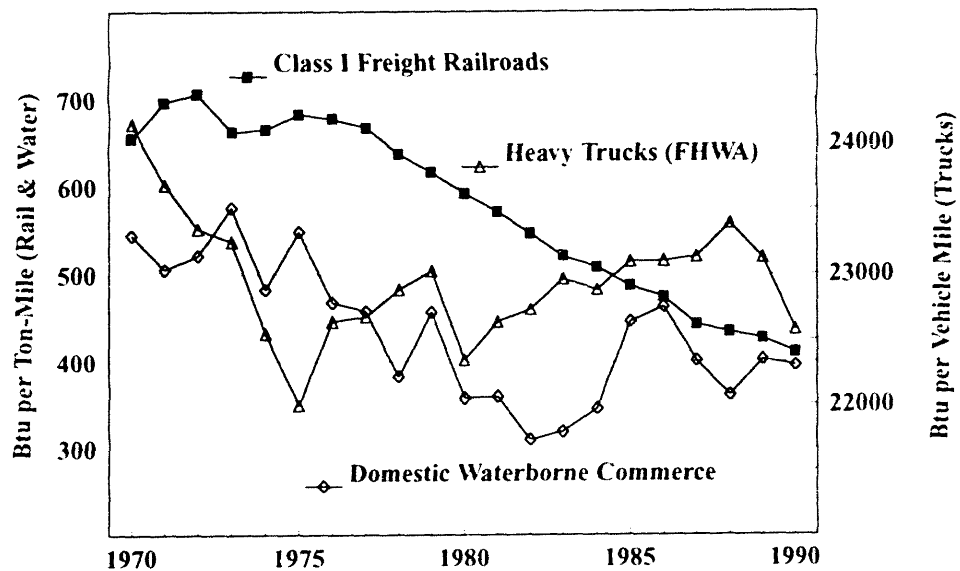
TRENDS IN ENERGY INTENSIVENESS OF U.S. PASSENGER TRAVEL, 1970-1990



Source: Davis and Morris, 1992, Table 2.13.

Figure 12

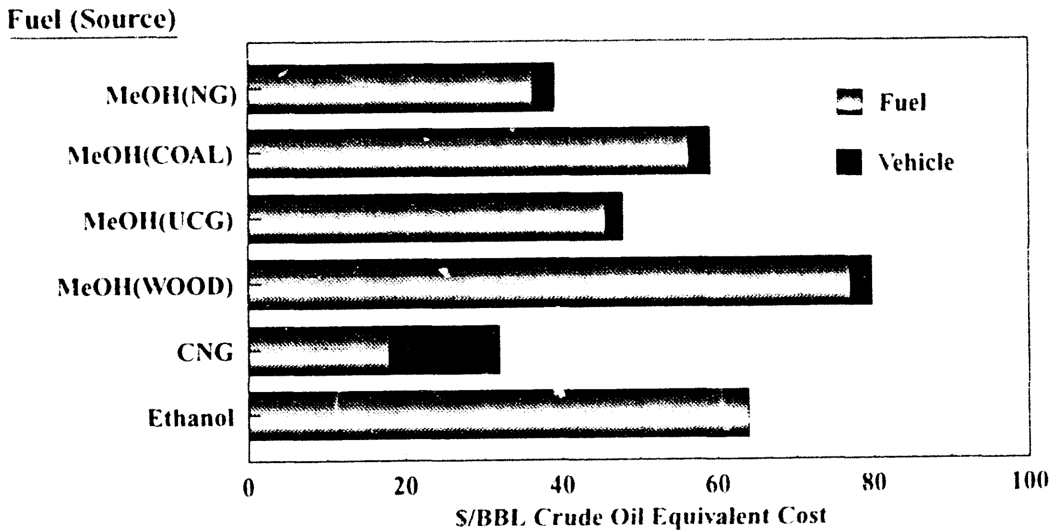
TRENDS IN THE ENERGY EFFICIENCIES OF FREIGHT MODES, 1970-1990



Source: Davis and Morris, 1992, Table 2.15

Figure 13

NRC STUDY ESTIMATES OF ALTERNATIVE FUEL COSTS IN TERMS OF DOLLARS PER BARREL OF OIL EQUIVALENT



NRC, 1990, "Fuels to Drive Our Future."

Figure 14

MANUFACTURERS' CORPORATE AVERAGE MPG INCREASES, 1978-1989

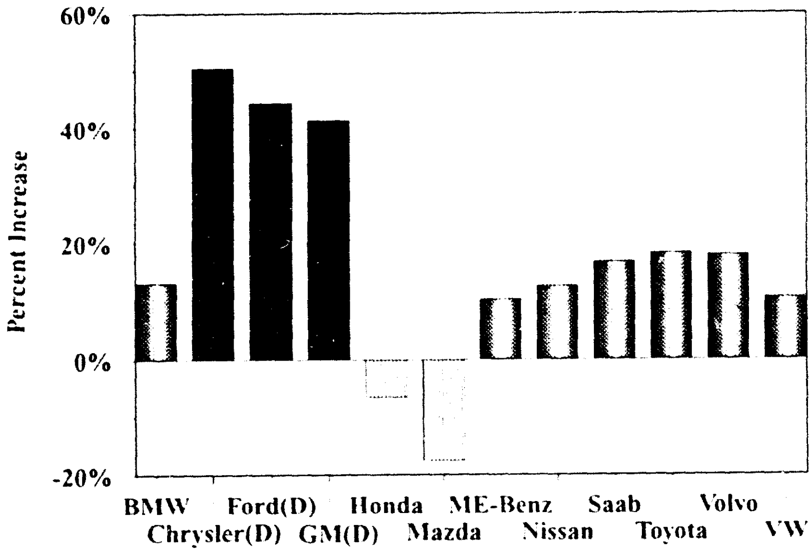
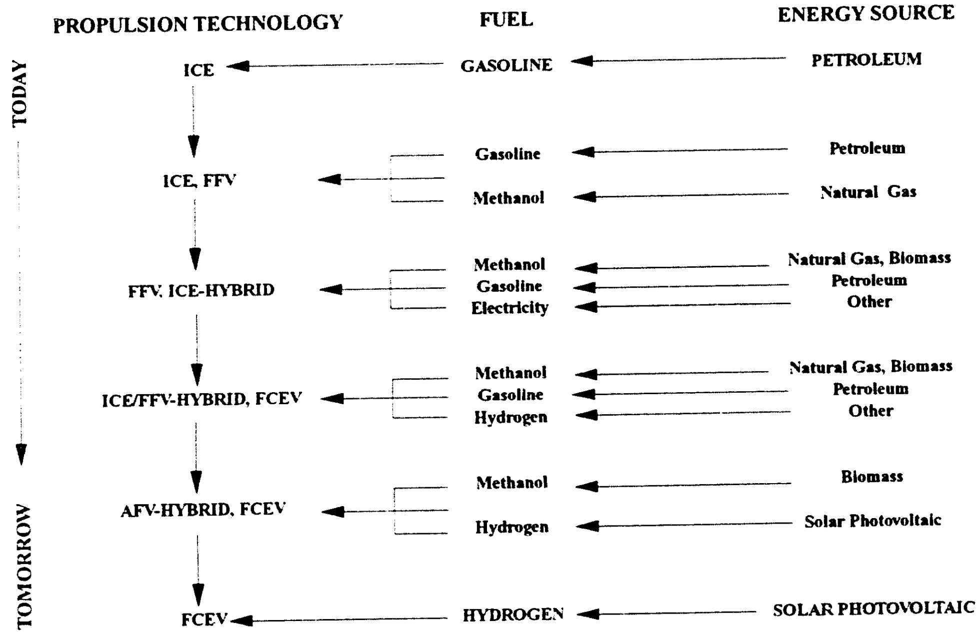


Figure 15

ONE PATH OF CHANGE FOR MOTOR VEHICLES AND FUELS



SOCIAL AND BEHAVIORAL CHARACTERISTICS OF ENERGY USE

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Because this paper's subject matter is so broad, the best one can hope to do in the time allotted is to say a few things about what we know about human behavior and energy use, and to point to some persistent problems. Because the vast majority of work on human factors in energy use has been undertaken in the residential sector — although many of the principals that apply there probably also hold true in other sectors — my discussion will focus on household energy use.[1] While there has been recurrent interest in this subject over the past 20 years, it has most recently been fueled by concern for the impacts of the energy system on the global environment. However, even concerns of this magnitude may not provide a sufficient basis for the expansion of research in the directions that I believe to be necessary.

I will first provide an overview of changing patterns of residential energy use over the past 20 years. Second, I will summarize some of the ways that human behavior shapes, influences, and even determines rates of energy use and energy conservation. Third, I will discuss some alternative approaches that energy analysts use to understand energy and behavior — identifying problems and gaps in these perspectives and indicating areas where additional research needs to be done. Finally, I will say a bit about the institutional barriers that limit an expansion of our knowledge of energy and behavior.

U.S. ENERGY CONSUMPTION PATTERNS: 1972-1992

Total energy use in the U.S. increased by about two-and-one-half times in the 40 years from 1950 to 1990. In the past two decades, however, the rate of increase was only about 22 percent — around 11 percent for end-use energy (with power plant and transmission losses factored out) — while population grew by 22 percent and GNP (in constant dollars) grew by 70 percent. Total residential energy consumption actually *declined* from 1978 to 1987 (the period for which we have the most accurate data) by about 15 percent, from 10.6 to 9 quads (quadrillion Btus). In the same period, per capita consumption decreased 27 percent (from 138 mBtu to 101 mBtu), although there was considerable variation across the U.S., e.g., from -32 percent in the Midwest, to -15 percent in the South.[2]

When we consider the growth in consumption that *might have occurred* if historical trends had held true, the effects of increased energy efficiency in the residential sector are even more striking. The U.S. Department of Energy (DOE) planners estimate, for example, that about four quads per year had actually been saved by 1987.[3] They attribute the efficiency improvement to changes in space conditioning behavior (one quad), appliance use and efficiency (one quad), building weatherization (0.8 quad), new home shell efficiency (0.4 quad), and increased wood use, decreasing household size, and migration to the Sun Belt (0.3 quad each).

A surprising finding (from the point of view of "hardware-oriented" engineers and energy analysts) is that *heating behavior* and *appliance use and efficiency* accounted for fully *half* of that change — in each case more than building retrofits or building code changes. We also find that, when estimates of energy use attributable to specific residential end-uses are considered, declines in space heat energy use from 1978 to 1987 were accompanied by *increases* in measured energy demand for air conditioning (+40 percent), appliance use (+19 percent) and water heating (+7 percent).

Clearly, impressive aggregate changes in residential energy consumption have occurred over the past 20 years, and the role of human action and choice has been central in affecting these changes. But exactly what happened is not well-understood. It is undoubtedly accurate to point in the direction of energy crises, price increases and conservation initiatives, but while these are all important factors, alone they provide little more than a gloss on the social and behavioral processes involved.

While we know a good deal more now about energy and behavior than we did in the early 1970s, our knowledge is still fragmentary. This can be remedied by further research and energy efficiency program experience. But a more significant problem lies in the fact that our knowledge can also be *misleading* and even damaging when used inappropriately to inform policy. Roughly paraphrasing Will Rogers: "Often it isn't what we don't know that gets us into trouble, so much as what we know that ain't so."

BEHAVIOR AND ENERGY USE

To orient the following discussion, I would like to briefly review some of the ways in which human factors influence residential energy use. While the characteristics of buildings and the efficiency of equipment are certainly key determinants of energy consumption, it is the human producers and consumers who invent, build and use buildings and equipment. Past human choices and actions, through a number of generations, have shaped the housing and appliance inventories of American society. Once this hardware has been put in place, the ongoing behavior of human energy users continues to play an important part in determining the intensities of energy flow through buildings and equipment — e.g., as a product of persons' thermostat settings (for heating, cooling and hot water), their manipulation of the building envelope, their use of hot water, appliances, lighting levels, and so on.

Changes in the resulting patterns of energy consumption are also driven by human action — through decisions to remodel or to buy new housing, to add new end uses (computers, spas, air conditioners, home theater), to replace old appliances with new models, and to adopt efficiency measures (e.g., added insulation, more efficient furnaces or refrigerators, and so on). And, as we've seen, changes in behavior (e.g., changes in thermostat settings, and appliance and building use) directly alter consumption patterns — sometimes dramatically — as do longer-term demographic changes, such as shifts in the size and composition of households.

On a more macro level, changing social patterns of the relationship between the household and the workplace have resulted in more family members spending more time at work — sometimes with more services such as child care provided at work. As a result, persons may eat out more often, spend increasing amounts of time in public (e.g., using the shopping mall as a peculiar combination of local community and theme park). Increases in travel and use of vacation homes can also reduce household consumption. As Lee Schipper points out, however, these reductions in residential energy use may be accompanied by increased consumption elsewhere in the society.[4]

Corporate actors also strongly influence consumer energy use, particularly through decisions about hardware efficiency — decisions that are complexly determined within the organizational networks through which technologies must pass. Take heating systems, for example, where efficiency decisions are made by the combined choices of manufacturers, distributors, and installers who determine consumers' (often quite limited) local menus of heating technology choices. Or take the housing market, where decisions made by developers, realtors, builders, lenders, subcontractors, unions, code officials and so on determine the energy efficiency of buildings' mechanical systems — often justified by the unsupported claim that consumers are being offered "only what they want and are willing to pay for." Of course, manufacturers and suppliers of all sorts of commodities in modern industrial societies use advertising and other inducements to persuade consumers regarding their needs, wants and willingness to pay.

The actions of governments also shape demand — e.g., in the design and adoption or non-adoption of building codes and appliance efficiency standards, as well as in their regulation of utilities. And utilities, depending upon their commitments to particular fuels and supply technologies, and their load growth prospects, are free — even in this golden age of "demand side management" (DSM) — to promote either conservation or consumption, and sometimes do both at the same time. In short, both corporate actors and consumers, macro and micro processes, are involved in shaping the housing stock, the characteristics of appliances, and the consumer behavior patterns that produce aggregate demand for energy, and changes in that demand.

MODELS OF CONSUMER BEHAVIOR AND ENERGY CONSUMPTION

Energy analysts and social scientists have, over the last 20 years, focused their attention almost exclusively on the demand side of this system. As a result of that research, we know considerably more about energy use than we did 20 years ago. There are also large gaps in our knowledge, and as I have noted, some perspectives frame the problem in ways that probably obscure as much as they illuminate.

Although legend has it that early in the first energy crisis federal planners were instructed to leave the lifestyle issue alone — i.e., to propose nothing that would require persons to change their behavior — non-governmental attempts to understand the connections between lifestyle and energy use actually began quite early in the 1970s. The Ford Foundation-sponsored Energy Policy Project (directed by David Freeman), for example, issued the Newman and Day study, *The American Energy Consumer*, in 1975. That analysis examined: varieties of lifestyles, differences in energy use between the rich and the poor, the relationship of energy to pollution, how black households use energy, and the likely effects of various energy policy alternatives on consumers.

Since that time, numerous "demand side" studies have been undertaken by interested DOE national lab and academic researchers (primarily psychologists, sociologists, anthropologists, economists, and marketing researchers). Some of the large utilities (e.g., Pacific Gas and Electric Company and the Bonneville Power Administration) have sponsored behavior-relevant research, as have utility associations (e.g., the Electric Power Research Institute and the Gas Research Institute) and university-based institutes (e.g, the University of California's Energy Research Group, Michigan State University's Family Studies Center, and Princeton University's Center for Energy and Environmental Studies). Much of this work has been summarized in periodic review articles, which have appeared in the social science press.

In the 1980s the National Academy of Sciences, working through the National Research Council, completed two research needs assessments that considered human aspects of energy use and conservation. The first produced the report, *Energy Use: The Human Dimension*, in the mid-1980s.[5] The results of the second — concerning the "human dimensions of global environmental change" particularly the relationships between consumer society, the energy system and global change processes — was released last year.[6] The most current critical and comprehensive review of the energy and behavior literature can be found in my forthcoming chapter in the *Annual Review of Energy and the Environment* concerning "Social and Behavioral Aspects of Energy Use."[7]

Energy Policy Models

Surprisingly, despite 20 years history of work in the area and the clear importance of social and behavioral influences upon energy demand, the two classes of policy models that dominate energy analysis — (1) the building and appliance performance models (e.g., DOE2), and (2) aggregate demand forecasting models (e.g., PC-AEO) — focus nearly exclusively on *buildings and appliances*. These "hardware models" fall on one side of an invisible divide between two distinct approaches to energy use: one that focuses on behavioral *differences* in consumer *sub-groups*, and the other that assumes that the behavioral side of energy use involves only the *average* or *normal* action by *individuals* (who can safely be treated as homogenous in the aggregate). Formal policy models and other hardware-based analysis systems take the latter approach, while the social sciences and utility marketing research pursue the former.

In hardware models, consumers are treated as normal/average, self-conscious, comfort-seeking actors who make instrumental choices about how to behave in the world, and who are aware of the energy consequences of those choices. Because these utilitarian actors simply act to satisfy basic human needs through energy use, their behavior is relatively inelastic (and resistent to change). Therefore, the key to changing their consumption patterns lies in altering the characteristics of their hardware.

This view is challenged, however, by a variety of empirical findings. One involves the observed large short-term changes in consumption during the energy crises that are clearly attributable only to behavioral, rather than hardware, changes. But beyond the exigencies of crisis behavior, we can see from the studies of the Princeton and UC-Davis energy research groups that identical buildings (built to the same plans, by the same builders, with the same materials), when occupied by humans, can vary in their energy consumption as much as 300 percent — challenging the assumption of consumption as normal/average. The Davis group has also shown that modelled predictions of consumption from DOE2 runs using the characteristics of real buildings, can vary considerably from the measured consumption at those sites. Frustrated in their efforts to validate the building performance model, the Davis group (which included both physical and behavioral scientists) could only attribute the variations to "occupant behavior," a category that is now frequently invoked to explain failures of energy efficiency programs to produce predictable results.

Human action also plays tricks on the larger-scale models used to predict aggregate demand. For example, backcasting tests — which use forecasting models to predict actual consumption from past years — frequently miss the mark by as much as 20 percent, suggesting that factors other than the proxy relations captured by measures of housing and appliance stocks, average appliance consumption and weather patterns are involved. In fact, regression analyses of household energy use that include social information not normally considered by forecasters, perform significantly better than hardware-only models. Unfortunately, these problems are not widely recognized in the energy policy community (although modelers, themselves, generally recognize that the predictive power of their models is weakened by a limited ability to capture the effects of human choice and behavior).

Along with estimates of "average energy use" associated with appliances, forecasters also frequently incorporate an economic model of human behavior to predict likely changes in building and appliance efficiencies. This approach assumes that consumers are "economically rational," i.e., that they are fundamentally economic creatures who are calculative, strongly influenced by price, and are consciously *aware* of their actions and the *costs* of their choices. It also assumes that they are informed about their own energy use, the range of technology choices available to them, likely future energy prices, and future technical possibilities. These consumers are construed as "sovereign" or "autonomous," meaning that their demands for goods and energy are structured only by individual tastes and preferences, the costs of alternative goods, and their "budget constraints." On the basis of these assumptions, econometric energy modelers are able to estimate the aggregate changes in building and appliance efficiencies that would occur at various future energy price levels.

Empirical data contradict many of these assumptions as well. Consumers (as well as firms) have been shown to frequently demand very short energy savings pay-back periods — in other words, to have non-rationally high discount rates. On the other hand, consumers have also been found to make economically irrational investments — e.g., investments in energy technologies that will not be repaid in energy savings for uneconomically long time periods. History has shown that *modest* energy price increases can produce fairly *dramatic declines* in consumption.* One can hardly deny that economic factors (e.g., costs, information, benefits) are involved in energy consumption (demand). But the functioning of these factors in the real world of consumer behavior seems to be quite different from their assumed operations in the theory of aggregate market outcomes.

Alternatives to the Economic Factor

The behavioral scientists who most vigorously contend that persons are frequently motivated by *non-economic* factors are the psychologists. Paul Stern (National Research Council), for example, has been quite influential in identifying the limits of the economic model in energy analysis. He is not bent on discarding economics, but rather, asking how choices that we commonly think of as "economic" are actually made in the real world. Also, the work of psychologists Darley, Aronson, Pettigrew and Ester are clearly important in this regard, as are Willett Kempton's studies in cognitive anthropology. All have added considerably to our knowledge of consumers' knowledge, calculations, and behavior — and how these influence energy use and technology choice.

Cognitivist insights include observations that, because energy is invisible, its consumption is ordinarily not noticed; that billing information generally comes in very highly aggregated terms, once a month; and that frequently consumers don't understand information supplied on the bill — or they understand it differently from utilities. Consumers think about and quantify energy in ways quite different from engineers or economists — being much more likely, for example, to think in terms of average bills, rather than marginal costs or kilowatt hours. What's more, the amount of information that persons possess concerning technologies, energy prices and their own energy use seems to be generally quite limited. And, it is also probably the case that, to the extent that consumers optimize anything, they may conservatively optimize their respectability and status in the community, especially in terms of the opinions of friends, family, neighbors, and co-workers. As a result, persons are often risk averse when experts say that they should not be, and they perceive constraints that experts do not. They also accord social norms, beliefs, and values; they participate in social networks and are, therefore, influenced by other individuals, as well as by corporate actors. Finally, psychological studies have uncovered a good deal of variability in energy attitudes and conservation behaviors among consumers. Unfortunately, they have also shown that it is impossible to accurately predict consumption levels, or the likelihood that persons will conserve energy, using only information about social attitudes. In the case of residential energy use, the attitude-behavior link seems to be weak.

The Consumption of Social Groups

But the observation that energy consumers act as members of groups — that they learn to behave and make choices in groups — has led some researchers to see *social groups* as the primary consuming units — and the appropriate object of analysis. These researchers (primarily sociologists, anthropologists and marketing researchers) are interested in patterned *differences* between households in terms of housing, appliance ownership, behavioral routines, and energy consumption.

Their studies have focused on both the micro level of everyday life in households, and the macro level of consumption patterns in populations of households, discovering fairly striking differences in consumption and conservation between groups differentiated on the basis of: social status (social class or income), life cycle stage, age and gender of the household head, rural/urban residence, and ethnicity.[9]

Marketing researchers have combined attitude and demographic studies to try to build typologies of consumer groups or "market segments" who differ significantly from one another in their approaches to energy use and conservation. The Electric Power Research Institute, for example, has proposed six consumer types, assigning households to the categories of: "pleasure seeker," "appearance conscious," "resource conserver," "hassle avoider," "value seeker," or "lifestyle simplifier."

The primary problem with this approach lies in the fact that it is largely descriptive. Typologies that only offer descriptive categories beg important questions about consumer behavior and the social processes that underlie market segmentation, such as: "Where do lifestyles come from?" "How freely can they be chosen, or are they constrained by wealth, education, ethnicity and other social factors?" "Why these lifestyles and not some others?" In other words, fundamental questions about group formation and social change simply aren't addressed. As a result, we don't know how well defined the boundaries between groups may be, or how behavior in those groups may change as their members age and social and economic conditions evolve. This means that, while they represent an advance in conservation marketing efforts — i.e., they may be of some use in designing residential DSM appeals that are sensitive to differences among utility customers — market segmentation schemes are of limited value in scientific and policy applications.

Lifestyle and Consumer Subcultures

A more theoretically grounded and rigorous line of research, pursued primarily by anthropologists and sociologists interested in modern consumer cultures, has attempted to more closely examine the differences between lifestyle groups. This approach sees consumers as cultural actors whose knowledge and action make sense in terms of the values, standards and expectations of the social groups to which they belong. These groups include nuclear or extended families, neighborhoods, communities, voluntary associations, groups of co-workers, and persons bound together by the standards of occupations, professions, and social status. In this view, housing, appliances, routines, and practices -- hardware and action -- "hang together" in subcultural patterns that differentiate persons from others who live in different ways.

Most behavior is energy relevant, but because it generally occurs in familiar settings and is so habitual and unconscious, its energetic character is overshadowed by other concerns. The continuous scrutiny and criticism of behavior by others means that energetic activity -- whether it be cooking dinner, visiting with friends, bathing, or washing, or keeping up appearances is governed by social norms. These shared meanings and expectations differ substantially between groups and, because they are likely not to take energy explicitly into account, the differences in energy use between subcultures may also be extreme.[10]

We can infer from the ethnographic literature that subcultural worlds may possess very different understanding of what energy-using appliances are for and how they work. They may have different standards for heating and cooling, different ways of controlling technologies, different social norms regarding who pays the bills, different notions of the rights, prerogatives and responsibilities of different family members (as well as how and when these rules can be suspended), and different notions of how and when animals and plants can become family members requiring heating, cooling and bathing. It is certainly the case that energy flows though these worlds, that energy bills are delivered to them once a month, and that their occupants are faced with opportunities to alter their energy use patterns (either through behavioral changes or building-technology investments). But the key here is to recognize that, rather than all behavior being conscious, rational and uniform in the energy analyst's and economist's terms, consumer behavior (particularly in prosperous societies) follows multiple cultural logics governed by concerns other than cost and benefit. It is also the case that little is known about *when* and *how* consumers calculate energy-environment-technology-behavior costs and benefits. It seems to me that understanding energy consumption and efficiency in cultural or lifestyle terms is the challenge of the 1990s.

RESEARCH NEEDS

The overall perspective that social life is, well, social, also means that, rather than fixing attention on individuals or individual households, it is also important to ask questions about how the household is connected to the larger society. In the energy literature, the actions of corporate actors, the dynamics of communities, and the energy implications of changes in social institutions have scarcely begun to be addressed. Because the origins of many needs and desires in modern consumer societies may be traced to the machinations of producers, and because, at least since Keynes, consumption and production are seen to be two sides of a coin, future studies of energy use behavior should at least glance at the relevant goings on of actors in the industrial and commercial sectors.

But before such ambitious work is undertaken, a large number of questions remain in the sphere of consumption itself. Some areas in which we need a better understanding of energy use include:

- *differences in consumption and conservation* among social groups (e.g., lifestyle differences in behavior, varieties of meanings of technologies, consumer understandings and beliefs about energy and the environment)

- the *empirical nature of economic behavior* (including questions about consumer information processing, risk aversion, and cost/benefit calculation)

- the *role of incentives* in residential programs (How do they work? When do they work? How much is enough? Can/should consumers be treated like firms? i.e., weeding out free riders, etc.)

- problems of *differential access to knowledge and technology* (particularly among non-white, non-male, non-professional, and non-affluent groups)

- *inertias* in built environments, technologies and cultures that shape energy use patterns

- the forces working to *expand consumption* (e.g., population growth, new energy end-uses, growth in the size of new housing)

- the strength of *non-energy trends toward increased energy efficiency* (growing environmental concerns, and the possibility of making the connection between persons' energy use and resulting global impacts).

In terms of the connections and interactions between consumers, communities and corporate actors, we should know more about:

- *producer-consumer relations* in the promotion of energy-using equipment

- technology *R&D processes* and *diffusion network* dynamics

- *utility-customer relations* (possibilities and limitations)

- *differences between public and private utilities* in perspectives on consumers, DSM, and efficiency program design and management

- *alternative social-technological simulation models*, of both building performance and societal-level consumption, that combine social, technological and environmental factors.

CONSTRAINTS ON RESEARCH AND LIMITS TO KNOWLEDGE

Adequately funded and carefully designed research along these lines would yield significant results for energy planning, policy development and strategic interventions aimed at increasing the energy efficiency of the entire society. DOE's "very high conservation" policy model estimates that cost-effective hardware efficiency improvements could reduce American residential energy use 28 percent by the year 2010.[11] An adequate understanding of the human factor in design, production and consumption might well yield even more dramatic results. The problem, of course, involves putting conservation in place. But, if successful, the effort would contribute directly to improved American global competitiveness, as well to reductions in the rate of global-scale environmental change.

Institutional Barriers to the Expansion of Research

I am fairly pessimistic about the prospects for such a research program, however, even on a modest scale. The past 20 years has seen only a handful of funded social science energy research projects. The small core of academic scientists and policy analysts interested in the human side of the energy system has aged, dwindled in size, and generally failed to intellectually reproduce itself. As a result, institutional support for this sort of research has declined in academia.

What's more, energy-related studies run up against a strong bias in the social sciences against applied research — a bias that is based in more than academic elitism. Applied studies are often tightly controlled in terms of problem definition and methodology by the institutional interests of their sponsors. As a result, they generally contribute little to theoretical advance. The disconnect between marketing research sponsored by utilities, and work in anthropology and sociology is a case in point.

There are academic homes for this kind of research in small sub-disciplines such as environmental sociology, as well as in the corners of anthropology and social psychology. But the literatures there are small, and the opportunities to publish energy-related research in the mainstream disciplinary journals are limited. Unfortunately, studies that do make it into the mainstream social science publications are likely to be considered (by practitioners) to be too abstract for application in policy and program design. This "Catch-22" means that social scientists who attempt to pursue some kind of middle ground are likely to find their tenure and promotion problematic. The marginal status of energy-related social science research translates, in turn, into few positions in academic departments and few graduate students who -- since they would like to actually find jobs -- are unwilling to take up the subject.

On the policy and program side, despite the recent flurry of interest in DSM, it is fair to observe that consumer research isn't always welcomed. Lifestyle is still a sensitive issue for utilities and energy policy agencies. These organizations generally lack social science expertise and are dominated by technical perspectives more at home with physical systems and determinate models than human beings. A new generation of DSM managers who are unaware of the experience of earlier efforts, and of the limitations of hardware-only programs, are likely to reproduce the mixed successes of the past two decades.

The limitations of policy models camouflaged in the determinate language of the technical sciences are also hidden from utility managers and policy makers, both by organizational barriers as well as by the authority of the professions that promote them. Both energy efficiency programs and modelling operations tend to be isolated in labyrinthine organizations, and are thus not readily open to scrutiny or criticism. This means that energy modelers are free to perpetuate a view that energy flows are a purely physical matter, while DSM managers can promote the notion that the strategic application of monetary incentives is an all-purpose energy efficiency tool -- a kind of "magic bullet." In both cases, rather than recognizing social and behavioral phenomena as causal factors and conservation opportunities, the vagaries of human action are seen as perverse influences in an otherwise orderly physical and economic energy system.[12]

What about influences from outside the energy system? One might expect environmentalists, for example, to be advocates for consumer research -- particularly when changes in consumer behavior might have significant effects on pollution and other environmental impacts. Unfortunately, this is not the case. While environmental advocates frequently point to "consumerism" as a root cause of environmental damage, and argue for pro-environmental shifts in consumer buying patterns, a stereotypic "average American over-consumer" is as prevalent in environmental criticism as the "normal consumer" is in building performance modelling. The notion that some consumers are better able to alter their behavior than others caught up in physical and cultural inertias, is an infrequent visitor to environmental discourse. To acknowledge, for example, that the domestic poor might be further disadvantaged by environmental policy interventions (e.g., carbon taxes) probably seems to flirt dangerously with the "people before nature" rhetorics of the anti-environmentalists.

Breadth of Vision

A final barrier lies in fundamental differences between the kinds of research that academic social scientists, utility companies and state energy agencies are able to undertake. In the latter two cases, research tends to be problem-driven and closely allied to the interests of organizational sponsors. It is, in a word, narrow — being interest-shaped, and therefore, blind by design to the roles and influences of its sponsors. The broader social science perspective attempts to place the actions of consumers in the contexts of the subcultures, communities, producers, utilities, and governments within which they are embedded -- and to take an historical perspective on those relationships. It considers consumption as an aspect of a world shaped by contending political and economic interests, and, therefore, as the historical co-production of individuals, groups and corporate actors.

There is a place for both sorts of studies of the social and behavioral aspects of energy use, and both have a future. But a realistic assessment of our research capacities and interests suggests that neither the social science community nor the energy system is likely to take the first step toward a major expansion of energy and behavior research. Too many institutional inertias work against it. In the near-term, at least, the needed stimulus can only come from *political actors*, whose responsibilities for economies and societies in a declining planetary environment require that their views be broader, longer-term and less paradigmatically constrained than those fostered in and around the energy system.

ENDNOTES

1. This paper summarizes and expands upon a chapter tentatively titled "Social and Behavioral Aspects of Energy Use in Built Environments," which will appear in the 1993 edition of the *Annual Review of Energy and the Environment*. Because the present paper provides limited citations, interested readers may obtain a copy of the more fully-referenced chapter from the author at: Departments of Sociology and Rural Sociology, Washington State University, Pullman, WA 99164-4020. This research was supported by the Agricultural Research Center, Washington State University, and the Universitywide Energy Research Group, University of California-Berkeley.

2. Aggregate consumption estimates from: *Annual Review of Energy 1990*. U.S. Department of Energy, Energy Information Administration, DOE/EIA-0384(90).

3. Energy conservation estimates from: *Energy Conservation Trends: Understanding the Factors that Affect Conservation Gains in the U.S. Economy*. U.S. Department of Energy, Energy Information Administration, DOE/PE-0092.

4. Lee Schipper, Sarita Bartlett, Dianne Hawk, and Edward Vine, "Linking Lifestyles to Energy Use: A Matter of Time?" *Annual Review of Energy*. 14:273-318 (1989).

5. Paul Stern and Elliot Aronson (eds.), *Energy Use: The Human Dimension*. Washington, DC: National Academy Press (1984).

6. Paul Stern, Oran Young and Daniel Druckman (eds.), *Global Environmental Change: Understanding the Human Dimensions*. Washington, DC: National Academy Press (1991).

7. Loren Lutzenhiser, "Social and Behavioral Aspects of Energy Use," *Annual Review of Energy and Environment*. Vol. 18, (1993, forthcoming).

8. This might lead one to conclude that there is a good deal of slack in the system — and a good deal of room for conservation. But this is also the stuff of utility nightmares, e.g., fear of the death spiral — a hypothetical case in which increased prices produce declines in demand that have to be offset by further price increases, that further dampen demand, and so on. Stable levels of consumption are important to utilities. The long-term inertias of buildings and equipment and the well established behaviors of consumers seem to provide that stability. But the persistence of those patterns, and their periodic change, are not best explained by simple models of economic rationality.

9. These findings should hardly be surprising, since cross-national studies have shown quite different consumption patterns between societies, even at similar levels of development — e.g., the U.S. consuming about twice as much energy per capita as Europe and Japan. Some of these differences are due to societal differences in transportation systems and dwelling size, but they can also be traced to other, more behaviorally based, cultural or lifestyle differences. A growing body of social research suggests similar consumption differences within American society.

10. Clearly there are influences in consumer society that work to homogenize lifestyles influences that have been loosely captured under the heading of "consumer culture." On the other hand, many social theorists believe that status differences between social groups (produced by the constant efforts of some groups to stylistically distance themselves from others, while producers continuously offer new opportunities to emulate the style leaders) may be the

primary engine of industrial-consumer society. We simply haven't conducted enough research to know as much as we should about lifestyle and consumption, or whether contemporary societies can be sustained without continuous expansion of status-based consumption.

11. *Energy Consumption and Conservation Potential: Supporting Analysis for the National Energy Strategy.* U.S. Department of Energy, Energy Information Administration, SR/NES/90-02 (pp. 58, 64).

12. I do not claim that less-than-perfect planning and intervention represent system failures. To the contrary, they can be functional for the energy system. Stable demand and load factor are of central concern to energy suppliers, and rapid energy efficiency gains are not in the best interests of most utilities. Even where regulators are experimenting with reimbursements to utilities for revenues lost to energy efficiency, there is a certain amount of cynicism in the system (one utility executive remarking that the "best kilowatt hour" is one that "everyone thinks you saved, but that you were able to sell to a customer, and to be reimbursed by the regulators for, at the same time.")

III. NEW ENERGY AND ENVIRONMENTAL TECHNOLOGIES

INFORMATION SYSTEMS AS ENERGY SYSTEM SUBSTITUTES

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INTRODUCTION

The technical and business communities have long realized that there is a tradeoff between information processing and energy usage. In this talk, we will survey available telecommunication systems and indicate how they can be used to help with energy conservation and usage efficiency.

Most human activities require the use and transmutation of energy. However, the industrialized world understands that energy usage carries with it certain penalties in addition to the benefits associated with the ability to do work. It is now clear that many sources of energy in use today are finite in quantity, and we can envision the day when depletion of some sources will occur. Political or natural barriers often cause the flow of energy resources to vary or be interrupted. Furthermore, thermodynamics tells us that energy transmutation cannot be 100 percent efficient, leading inevitably to waste and pollution byproducts. Nevertheless, energy systems have helped the world to shrink into a global community which requires even larger energy expenditures to maintain activities at critical levels. Efficiency and productivity must increase for us to maintain or increase our activity level in the face of the above energy supply issues.

Over the last 20 years, telecommunications and electronic computing have become powerful tools for helping civilization cope with energy intensive processes. In particular we will see how telecommunications can be used as direct substitutes for certain energy systems, and in addition, how telecommunications can help energy systems become more efficient in their operation.

OVERVIEW OF TELECOMMUNICATION DEVELOPMENT

We now discuss three areas in which telecommunications has developed and where we believe evolution will continue. These areas are technologies (used by both the customer and network), architectures of network equipment, and information carrying capacity (bandwidth).

Technologies

The technological changes in the telecommunication industry have been enormous. Figure 1 shows how people and machines communicate today and in the future. (Figures and tables may be found at the end of this paper). Customer equipment has progressed from the simple analog telephone used for voice communications to image transport using facsimile machines, video using video-telephones, and data communications using Gigabit/second channels. Furthermore, access to telecommunications networks has and will evolve from analog cables to optical fiber to the home or business, digital cable for voice and data communications, and wireless access systems between remote terminals, base stations, and potentially even satellite relay terminals. As we get into the interior of the network, past the serving office, new technologies will dominate the long haul channels. In almost all cases, communications will proceed through digital techniques such as digital satellites, which are especially useful for international traffic, digital radio, which reduces the need for large quantities of copper, digital optical fiber, with its enormous information carrying capacity, and digital cable for short-run, lower demand applications. All of these technologies are continually undergoing improvement in performance and capability.

Architecture

We could easily take up the bulk of our discussion with changes in the way various telecommunications components are arranged by customers and network providers. Suffice it to say that architectural evolution has increased the availability and reliability of important telecommunication services. The network has evolved from a hierarchical arrangement of elements available to large user communities, to non-hierarchical arrangements which take advantage of differing activity levels in different communities (e.g., time-zone differences), to ring structures that enhance network survivability during emergency situations.

Bandwidth

Throughout the world there is an effort to convert existing analog facilities and equipment into digital networks, as we have done in North America and connecting inter-continental links. With this change comes a change in nomenclature from the analog bandwidth concept of a voice-band of frequencies (300-3300 Hz) to the idea of digital bandwidth expressed in bits/second (b/s). Table 1 shows the commonly used definitions for various bandwidth telecommunications services and indicates a large increase in information carrying capacity over the former analog network.

Of course, as we shall see, there will be needs by users for analog techniques for many years to come in order to accommodate voice and lower speed applications in an economical manner. However, the digital regime shows that our ability to carry large quantities of data is expanding.

TELECOMMUNICATION APPLICATION CATEGORIES AND EXAMPLES

Our first step in understanding how to use telecommunication systems to supplement or replace energy systems is to classify telecommunication application categories and give examples. Refer now to Table 2.

Alarms and status indicators typically call for the sporadic transmission of a few hundred to a thousand bits. Remote monitoring and control require about the same number of bits per transaction, but the transactions may be more regularly spaced in time. The example of household environmental control clearly has implications for energy conservation. Terminal dialogue sessions usually require relatively long holding times during which information up to wide-band rates are used. When multimedia applications are employed here and in other categories, broad-band rates may be needed. We will later show how audio/video teleconferencing and video-telephones can replace energy systems requiring human transportation. Terminal inquiry systems may have short or long holding times. Typically a few data bits which represent an inquiry then generate a larger number of bits in response from the far end. Electronic news is a good example of an information system that saves the energy associated with the manufacture and disposal of newsprint. Message delivery systems are used to replace letter delivery. These systems tend to have shorter holding times and transaction bit-lengths. Image communication is a rapidly growing area. Images can have a wide variance in total bits, and holding times are from about a minute on upward. As an example, Computer Aided Design (CAD) can save energy by using electronic images to replace actual prototype fabrication and modification. Furthermore, the product design can be refined as many times as needed, so energy and time-consuming assembly line modifications and recalls are reduced. Finally, we include bulk data transmission. This application can have long holding times and large numbers of bits transmitted in bursts, usually over wide or broad-band facilities.

MAJOR ENERGY USERS AND USES

We now come to the point where we summarize the sectors that use energy and the uses to which it is put. Table 3 shows a matrix which correlates agriculture, households, industry, military, and other energy users to predominant uses. These include land processing (such as fertilizing, irrigation, and mining), manufacturing of products, transportation of humans, distribution of goods and services, service provisioning processes, environmental control (such as lighting, heating, and clean-up), the processes associated with the sales of goods and services, and recreational activities.

ENERGY/TELECOMMUNICATIONS TRADEOFF MATRIX

The next step in the analysis requires that we correlate the energy users (or uses) to the telecommunication application categories in Table 2. Figure 2 shows how this matrix might look. Let us focus on a particular cell in the matrix. How can terminal dialog systems be used in industry as an alternative to an energy system? The example which comes to mind is the use of audio/visual teleconferencing as a substitute for transport. Each cell in the matrix would enable similar substitutions and enhancements by telecommunication systems for energy systems.

We can return to our example in detail by studying Table 4, which shows the energy costs for long distance jet travel and audio/video teleconferencing. The left side of the chart displays energy requirements in kilowatt-hours for a person traveling (round-trip) from New York to Los Angeles by jumbo-jet. No matter how long this person stays in Los Angeles, the travel energy requirement is the same. On the other hand, a wide-band video meeting service uses energy at a rate proportional to the contact time, as does a voice-band video-telephone. However, the telecommunication alternatives use less and in some cases far less energy. Ratios of energy use are shown on the right part of the chart. Comparing travel to audio/video teleconferencing shows that lower contact times give the best energy advantage to teleconferencing. In fact for an eight hour meeting, the video-telephone uses about a thousandth as much energy as travel. The comparison between teleconferencing methods shows a constant ratio independent of contact time. This discussion does not take into account the cost of infrastructure, but purely estimates the incremental energy costs of operating the systems. Furthermore, energy costs in dollars depend on the energy form (in this case jet fuel versus electricity). Finally, it is easy to generalize this chart if more than one person is involved in the travel or teleconferencing.

OTHER TRADEOFFS

As we have suggested, there are other tradeoffs that are possible. A number of them involve transport, others do so indirectly or not at all. Below is a list of other activities where energy systems may be replaced or substituted by information systems.

- Local business travel (telecommuting)
- Traffic control
- Healthcare delivery
- Education
- Delivery of government services
- Consumer and small business services
- Privacy/security
- Games
- Cultural events

CONCLUSION AND ISSUES

As a result of these discussions, we believe that it is possible to conclude that information systems are feasible and economical substitutes for and enchancers of many energy systems.

With plans based on this conclusion comes a set of issues that both favor and impair implementation. On the positive side, reduced use of common energy systems will decrease our dependence on foreign oil and its vagaries. Also pollution should be reduced or at least will not increase so rapidly. The cost of building and maintaining our highways and related systems could be reduced due to decentralization of work areas and reduced traffic in our inner cities. With less time on the road due to telecommuting, changes in family structure and local communities would become apparent. Furthermore, government would institute changes in policy, regulations, and requirements on vendors. There may, however, be a resistance in the community, from various sectors, in implementing many of these innovations. The picture of the Orwellian "Big Brother" is not hard to imagine in a society with such strong information exchange capability. There are issues associated with the automobile and transport industries and how these effects will be managed. Also, what will be the impact on labor, jobs, and working conditions? Clearly as we proceed to more information based activities, the form of energy that we use will be different. Today, about 25 percent of our energy expenditure is in transport and almost all of this comes from fossil fuels, especially gasoline. Information systems, on the other hand, use predominantly electrical power. Planning must be carefully done, since it takes an average eight years to bring up a new conventional electrical plant with its facilities and equipment. A nuclear plant may take over 12 years due to additional government regulation. Finally, this transition will also be one of iron and copper to silicon, aluminum, and rare-earth elements. While iron and copper are relatively abundant, and silicon and aluminum are very abundant, rare-earth elements needed for semi-conductor material are, as the name indicates, more difficult to find.

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Table 1

DEFINITION OF BANDWIDTH SERVICES

Analog	Voice-band	voice - 28.8 kb/s
Digital	Narrow-band	< 1.5 Mb/s
	Wide-band	1.5 Mb/s - 45 Mb/s
	Broad-band	> 45 Mb/s

Table 2

TELECOMMUNICATION APPLICATION CATEGORIES & EXAMPLES

Category	**Examples**
Alarms & Status Indicators	Burglar Alarms Paging
Remote Monitoring & Control	Household Environment
Terminal Dialogue	Telephones Video-Telephones Audio Teleconferencing Audio/Video Teleconferencing
Terminal Inquiry	Credit Card Validation Library Databases Access Electronic News Electronic Banking
Message Delivery	Voice Mail Electronic Mail Public Survey & Polling Criminal Intelligence
Image	Facsimile Medical Imaging CAD
Bulk Data Transmission	Inter-Computer Communications Broadcast Video

Table 3
MAJOR ENERGY USERS & USES

User/Use	Land Processing	Manu-facture	Transpor-tation	Distri-bution	Service Provision	Environ-ment	Sales	Recrea-tion
Agriculture	■			■		■		
Households	■		■			■		■
Industry	■	■	■	■	■	■	■	
Military			■	■	■	■		
Other*	■	■	■	■	■	■		

* Includes Government, Health, Education, Police, Science

■ = Major Correlation

Table 4

ENERGY COSTS FOR LONG DISTANCE JET TRAVEL AND A/V TELECONFERENCING

Energy Requirements (Kilowatt-Hours)				Ratios		
Contact Time (Hours)	Jumbo-Jet (JJ)	Picture-Phone (PP)	Video-Phone (VP)	JJ/PP	JJ/VP	PP/VP
8	9500	1200	9.6	8.0	990	125
16	9500	2400	19	4.0	500	125
24	9500	3600	29	2.7	330	125

Notes:

- Based on round-trip air travel from New York to Los Angeles
- Picturephone is for AT&T PicturePhone Meeting service (1.5 Mb/s)
- Videophone is for AT&T VideoPhone 2500 terminal (19.2 kb/s)

Figure 1

TELECOMMUNICATIONS TECHNOLOGY

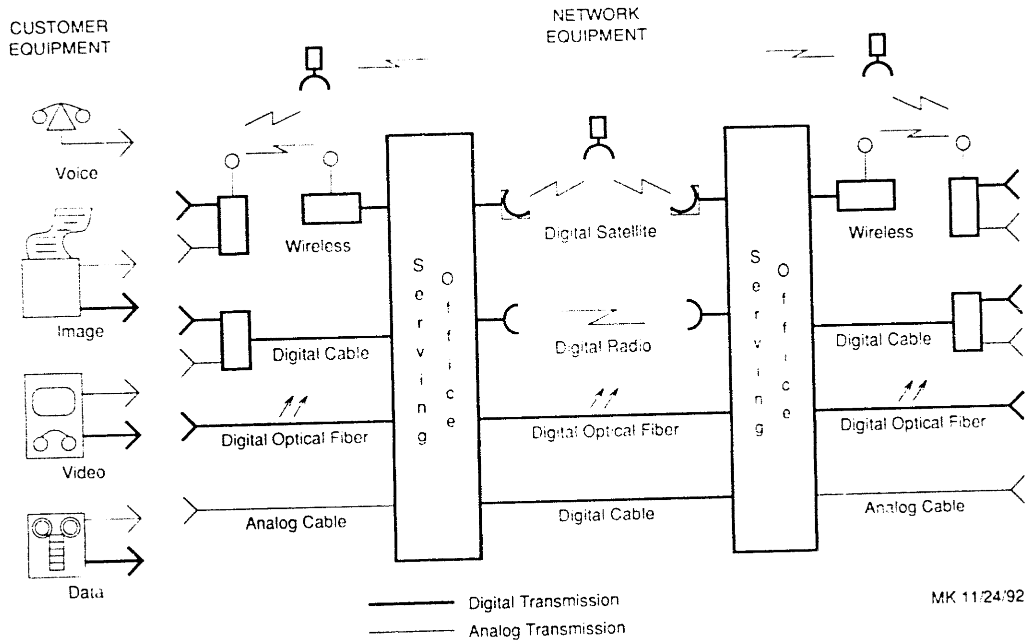
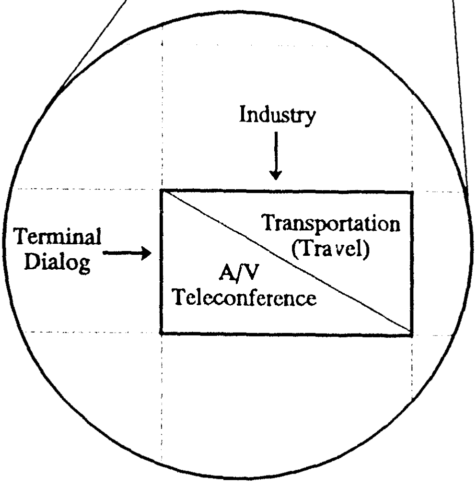


Figure 2

ENERGY/TELECOMMUNICATIONS TRADEOFF MATRIX

User / Category	Agriculture	Households	Industry	Military	Other
Alarms & Status Indicators					
Remote Machine Control					
Terminal Dialog					
Terminal Inquiry					
Message Delivery					
Image					
Bulk Data Transmission					



U.S. COAL AND CLEAN-COAL TECHNOLOGY: IMPROVING CRITICAL ENVIRONMENTS

Richard L. Lawson
President
National Coal Association

We have just had a Presidential election that turned largely on the state of the economy, present and future. The 1990s may be the time in which Americans resolve the sum of their aspirations — that blend of economic hope and environmental concern. Energy, especially electric power, is the life's blood of a modern economy; it raises productivity, competitiveness and standards of living.

Our subject is energy and environmental technologies, and so I would like to make an early point about technology and electric power. In the United States in 1992, we produce from one pound of coal the same amount of electric power that required eight pounds in 1892. Technology in this century increased the efficiencies of power generation by a factor of eight.

There has been an eight-fold increase of output with no increase of input. This is the substance of economic growth, of a rising standard of living.

At the same time, there has been an 80 percent reduction in all emissions per unit of output, including those of current environmental concern. This is the essence of conserving the natural environment.

Think of how cramped and miserable life might be without technology, and perhaps, how short; and of what devastation would be wrought by humankind in search of its daily bread, let alone butter. Increased efficiency through technology is the most effective tool we have. It improves both the natural environment and the economic environment. The clean-coal technologies we will discuss extend and expand the trend.

This year was pivotal in energy as well as politics. Congress passed, and the President signed, an energy policy — the National Energy Security Act of 1992.

Since our overall theme is 20 years of energy policy, I would like to begin with an overview of policy and coal in the economy during these years. Then I will discuss coal and coal-combustion technology in meeting America's energy requirements under the new policy, our third within the same 20 years. I plan to look about 20 years ahead.

About 20 years ago, I had to make a long drive through Arizona on U.S. 89. That highway turns toward its ultimate destination at a little town called Congress. It runs through others named Surprise and El Mirage. Once past El Mirage, the road goes home to Phoenix, named for the mythical bird that periodically burns and then rises from its own ashes. For me, that trip on Highway 89 later came to symbolize America's first attempts at energy policy — Congress to Surprise to El Mirage.

In 1973 we had the oil embargo — the Surprise. We thought imported oil was just another industrial commodity traded on a more or less free market — the Mirage. Prices spiked. The U.S. and the world's economies shook and inflated. At home, we had anger and gasoline lines. Something called Project Independence took on new political urgency.

The gas lines waned; the anger waned, and political interest waned. America returned to business as usual — to El Mirage. However, there was a result.

From 1970 through 1979 the electric utility coal-burn increased by 65 percent — from 320 million tons to 527 million tons. In 1970, the coal industry delivered 18 percent of America's total energy requirement. By 1979, it was delivering 19 percent.

Coal-fired power's share of generation rose from 46 percent to 48 percent. Coal itself supplied 24 percent of domestic fossil energy production in 1970 and almost 28 percent in 1979. The U.S. coal industry quickened and began to modernize.

In 1979, we had the fall of the Shah and the associated price spike — another Surprise. Once again, economies shook, trembled and inflated. The gas lines and the anger came back.

Twice surprised, we went back to Congress. In near panic, we embarked on crash programs and heavy subsidies for quick answers. Then the gas lines went away; the anger went away, and the political interest went away. The crash programs lived up to their names — they crashed. And policy went back to El Mirage.

Nevertheless, there were results.

From 1979 through 1990, the electric utility coal-burn increased by 47 percent — from 527 million tons to 774 million tons. In 1979, the American coal industry delivered 19 percent of America's total energy requirement. By 1990, it was delivering 24 percent. Coal-fired power's share of generation rose from 48 percent in 1979 to 56 percent in 1990.

Coal itself came to be 33 percent of all domestic fossil energy production, the leading source of domestic energy. The energy intense and ever electricifying American economy turned to coal for sustenance and to uphold growth. The electric utility coal-burn multiplied by a factor of 2.4 during the 20 years under discussion — grew by a little more than 140 percent, an average annual rate of 4.5 percent.

America returned to business as usual during the 1980s — but not entirely. Leaders in Congress salvaged something from the crash of the crash programs. An early effort involving the Synthetic Fuels Corporation had won a lot of favorable attention — a coal gasification power plant demonstration in the California desert.

The Cool Water plant markedly increased the efficiencies of power generation, and it bettered the requirements of the toughest environmental permit in the world, one much more stringent than federal standards. And so, when SynFuels fell, the salvagers hauled an idea from the wreckage of its $88 billion subsidy. They pulled out the beginnings of the Clean-Coal Technology Program. The program was started to keep promising new technologies alive.

Today the Department of Energy's Clean-Coal Program demonstrates an array of high-efficiency technologies that raise both economic and environmental performance. They are for capacity, for re-powering present capacity and for retrofit of present capacity.

Clean-coal is a $5 billion plus venture. Costs are shared among the federal government, industry, and other interested parties. The State of Illinois is one such party through the Office of Coal Development and Marketing.

Industry and interested parties have carried about 60 percent of the costs. Illinois has participated in 20 clean-coal projects valued at $1.1 billion across the range of technology. Nevertheless, policy during most of the 1980s was based on the Mirage.

We went back to Surprise — and also to the Persian Gulf — with the 1987 deployment to keep open the tanker routes, as much to uphold the world economy as our own. And we began to think again about energy policy. By 1990, we had begun to talk about policy, and Saddam Hussein had begun to think of controlling the world's dominant energy — two-thirds of the imported oil reserves.

And so we had a fourth trip to Surprise — Operation Desert Storm. Desert Storm had uncountable costs and countable costs; the lives in combat of 148 young Americans, and a dollar price of $61 billion.

This year Congress passed, and the President signed, our third energy policy in less than 20 years. The new energy policy is different.

First, it is based on what can happen according to the needs facing the nation and the resources at our disposal. It does not bet the economy on long-shot breakthroughs. It does not try to allocate resources, to direct the economy, to force technology or to subsidize. But most important, it recognizes — as the coal industry all along has said it should — that there is no bad form of domestic energy.

The new policy stresses the development and deployment of every domestic energy at America's disposal — oil, natural gas, nuclear power, coal and anything that can serve economically, including renewable energy and especially conservation. This policy has multiple purposes.

The highest is to reduce dependence on imported oil. It seeks to lessen the likelihood that young Americans will have to go again into harm's way to uphold the world's economic and political stability.

Next, it seeks to guarantee adequate energy at reasonable costs to strengthen the economic environment; and, at the same time, to responsibly resolve reasonable concerns about the natural environment.

In sum, the policy recognizes that there are three environments critical to survival — the political, the economic and the natural. The policy seeks to balance and improve all three environments, none at the expense of the others. Each influences the others as they act and react in ways as complicated as anything found in nature alone. In this mix, America's 268 billion ton reserve of recoverable coal constitutes 90 percent of our fossil fuel reserves. It is the energy equivalent of all the world's known oil reserves.

U.S. coal production is the world's most efficient, the industry now its most modern and productive. The industry also meets the world's highest standards in protecting miners and in reclaiming the natural environment. Mining is only a temporary land use. Coal, then, is a resource to be counted on in terms of centuries. We know where it is. We know how to get it — get it economically, get it efficiently, get it safely, and get it with minimum disruption.

To see the future of coal and coal technology, it is necessary to think about electric power's role in the economy. America is headed towards greater use of electric power. It is the essence of a modern economy, of competitiveness.

Electric power is expected to supply 41 percent of our end-use energy requirement by 2010. It supplied 32 percent in 1980 and supplies 36 percent today. The United States will require 150,000 to 200,000 Megawatts of additional generating capacity by 2010. It is a big increment, more than the standing capacity of most industrial nations. The need will come in addition to conservation, and the estimates assume we will keep in operation the 700,000 Megawatts we have today.

Greater reliance on electric power arises from the nature of both a modern economy and modern society. Increased reliance has to do with the need for economic efficiency and competitiveness and changes in the economy. It also has to do with concern for the natural environment and possible related developments, including the advent of the electric automobile.

Year in, year out, coal is the backbone of electric power. Coal became the utility fuel of choice during the 1980s for economic reasons — the choice on the competitive basis of cost, on the stability of cost, and on reliability of supply.

In terms of fuel costs, coal energy in 1990 came at only 75 percent of the next closest fossil fuel in price per million British thermal units. In terms of operating and maintenance costs, coal fired plants are the most economical of any kind except hydropower. The price of coal has fallen every year since 1978 in terms of constant 1982 dollars. This is because coal mining productivity rose by 126 percent between 1978 and 1990.

In consequence, coal fired plants are dispatched earlier and kept on-line longer. Coal power picks up the slack when other generation falters — when nuclear plants go off-line for long periods and when low water knocks out hydropower.

Through the 1980s coal delivered more than 55 percent of America's power. Coal power drove the economic growth of the 1980s. And the growth of tomorrow will require coal power. Technology is the link — the art and the science of producing more at lower cost, including the cost to the natural environment.

The retrofit technologies in the Clean-Coal Technology Program are to improve pollution control at lower costs in capital and output for existing plants. They include:

- Limestone injection multi-stage burners;
- Gas re-burning;
- Advanced slagging combusters;

- In-duct injection (introduction of calcium-based sorbents into the exhaust stream); and

- Advanced flue-gas desulfurization.

The program's new combustion technologies markedly raise thermal efficiency and dramatically lower all emissions, including carbon dioxide.

These advanced systems are for re-powering older plants and for greenfield, or new, capacity. In demonstration now, they should enter commercial deployment between 1995 and 1999. They are:

- Atmospheric fluidized bed combustion, 37 percent thermal efficiency;

- Pressurized fluidized bed combustion, an advanced combined cycle application, 40 percent first generation efficiency; and

- Integrated gasification combined cycle generation, a more advanced application, 42 percent first generation efficiency.

The Department of Energy's Coal Research Program focuses on a second generation of high efficiency power technology for the years beyond 2000. The program includes:

- Advanced conventional generation (low emissions boiler systems) with projected efficiency of up to 42 percent;

- Advanced pressurized fluidized bed combustion, 45 percent efficiency;

- Advanced gasification combined cycle generation, 50 percent efficiency;

- Indirectly fired cycles that approach 55 percent efficiency;

- Fuel cells and fuel cells linked to gasification, up to 59 percent efficiency; and

- Magnetohydrodynamic generation, 60 percent efficiency.

Measure all of these efficiencies against the present average of 33 percent. The higher efficiencies will reduce carbon dioxide emissions for each unit of power produced — by 10 percent to at least 23 percent in the first generation; and by 35 percent to at least 42 percent in the second.

Advanced research goals are to increase efficiencies, to lower costs, and, ultimately, to cut sulfur dioxide and nitrogen oxide emissions to one-tenth of current U.S. New

Source Performance Standards. Plans call for demonstration of systems with 42 percent efficiency by 2000; with 47 percent efficiency by 2005; and with 55 percent efficiency by 2010. Thus, the way is open for coal and electric power producers to extend and expand the relationship that now upholds the American economy.

The first generation technology is near deployment. The new law supports continued work on the second generation, and it authorizes a sixth round of the Clean-Coal Technology Program. Other provisions foster innovation from research through early deployment — work on advanced technologies for coal beneficiation, preparation and utilization, including the "coal refinery" concept. But the policy does not require coal use. It lets power producers decide what fuel is most economic and reliable for them.

Some ask, what is the future of coal in power generation given the Clean Air Act and the climate change controversy? Today, only coal need not pass through a wilderness of regulation and litigation that swallows up some new capacity; or needs no immediate expansion of infrastructure to guarantee availability and reliability. Only coal can be counted on to deliver power in the large increments required for competitiveness and growth. No other fuel offers the same advantages: suitability; dependability; stability; lowest cost; and a rapidly advancing, high efficiency base of combustion technology.

In perspective, the question is, what is the future of power without coal, and of America without adequate power? Forecasts say the electric utility coal burn will increase another 46 percent by 2010; that much existing coal fired capacity will be life extended; and that coal will win a significant share of the new increment, especially after the year 2000. In addition, coal export now contributes $4.5 billion to the plus side of our balance of payments. There will be increased opportunities for the export of coal and of coal technology.

This, then, is the outline of what America's most abundant fossil energy stands ready to contribute within the new policy.

The policy undertakes to mobilize America's strength in energy — oil, natural gas, nuclear power, coal, renewables and conservation, anything that can serve economically. And so the new law is the best of three tries at policy. It does not subsidize, allocate, command, control, or otherwise attempt to tilt economic choices.

This policy can work. It can improve all of the critical environments. But success requires two other things — good faith attention and time. Any policy can soon be undone by politics as usual. Some political activity associated with the postulation of global climate change would have the effect of tilting the choices.

One possible filter is a big carbon tax on all fossil fuel. Another is the concept of externalities — the idea of speculatively creating new costs, the so-called unaccounted for costs — and then adding them to the price of a fuel.

The climate change controversy involves so much that detailed discussion is almost a separate speech. At present, it centers on carbon dioxide emissions from the combustion of fossil fuels in economic activity and on their role in a postulated warming. Earlier this year a century's worth of near global temperature records were analyzed in a study published by the Carbon Dioxide Analysis Center of the Oak Ridge National Laboratory. The work analyzed temperatures for much of the northern hemisphere's land area, Russia, China and the United States. Two distinguished scientists, Thomas Karl of the National Climatic Data Center and Thomas Kukla of Columbia University, concluded as follows:

- That factors other than carbon dioxide must be involved in the slight warming seen this century;

- That the pattern across most of the hemisphere is of slightly cooler days and warmer nights;

- That the trends possibly have little to do with human activity; and

- That the trends may be beneficial to much human activity.

Science now cannot say if there is, or will be, human induced warming; and if there is, or will be, what the causes and effects might be, and what remedies might be effective and which futile but expensive. The postulation does not define the problem, and science is trying to define it.

We have concerns about the natural environment, domestic and global. Present concerns center on energy. At the same time, we have high efficiency technology that delivers progress while dramatically alleviating all the causes of current concern. We in the coal industry are as concerned as anyone. We and our children and our grandchildren must live in this world just as everyone else. And like everyone else, live in all of its critical environments. We in the coal industry say to the environmental community: let's define the problem; and then let's develop the technology to fix it without disrupting the other critical environments.

We have problems in the economic environment, domestic and global. They too relate to energy, and to imported oil. In history, economic conditions have brought on revolution and dictators in other countries, and war in the world. Here they only bring on a high voter turnout — for the time being. We know the economy will need energy to satisfy aspirations — including 200,000 Megawatts of new power generation capacity.

And we have problems in the geopolitical political environment. The most serious relate directly to rising dependence on imported oil. We also have 268 billion tons of recoverable coal — the equal of the world's known oil reserves.

We will never solve our problems in the political and economic environments by raising the natural environment above them. We can significantly improve all three with policies that emphasize efficiency and technology. Science and engineering have proved the case: efficiency and technology already have improved performance by a factor of eight in both the economic and natural environments. This is no postulation. As has been said, "technology made large populations possible; large populations now make technology indispensable."

This year Congress produced the best energy policy we have had in 20 years. Let us all — the representatives of industry, of government, of science — of the environmental community — resolve to do what we can to make it work this time. Let's define our problems, and then work on solving them with all critical environments in mind.

If we do not, we will soon be due a fifth trip to Surprise — and perhaps once more to the Persian Gulf. One Desert Storm is one too many in the political environment.

NUCLEAR POWER IN THE 21ST CENTURY

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Fifty years ago and perhaps five miles from downtown Chicago, Enrico Fermi and his colleagues at the University of Chicago performed their successful experiment on CP-1, demonstrating the feasibility of power from controlled nuclear fusion. Argonne National Laboratory, today still operated by the University of Chicago, is the direct lineal descendent of that group whose achievement 50 years ago began the nuclear age. On this basis, just perhaps, it may be appropriate that my assigned task here is to address the subject of nuclear power in the 21st century.

The subject of overall energy requirements for the 21st century has been covered admirably well by many, many people. All point to the need for huge increases in energy production over the first half of the 21st century and even greater increases in electrical energy. Even the numbers tend to be in the same range — factors of three or four by the middle of the next century.

The effect of growing environmental concerns, and the need for nuclear power in very large amounts as the 21st century progresses, is likely to be an imperative, and this is ground that I will touch upon.

Ground that generally is not touched on, and which I will therefore take as my jumping off point, is for me to look at what reactor technology will be, and what it will do, as the world goes on through the next century.

Will there be advanced reactor technologies? If yes, what will they be? Will they differ from today's? If so, how? What is possible to say about such things today?

Over the past few years, it has been my privilege to lead an effort at Argonne National Laboratory, the Integral Fact Reactor or IFR program, that re-examined the aims of advanced reactor development, to redefine the characteristics of a successful reactor system according to today's lights. And, taking advantage of the knowledge acquired over these 50 years of reactor development, to put in place a fresh program to develop an advanced reactor system — new reactor, new fuel, new fuel cycle, new waste processes — building on the old, but — note — the entire reactor system, reactor, closed fuel cycle — all.

I do not pretend that this experience gives me any special qualifications to speak about the future. But it did cause me, and the many brilliant colleagues I work with, to think very hard about what kind of reactors that the future will demand.

Starting anew in the early 1980s in the critical, even hostile environment for nuclear that surrounded us, required the main lines of thought to make sense to a lot of people inside and outside our enterprise, and outside our business. Having succeeded in establishing the IFR program, and having now pushed well along the developmental path, and having many of our predictions borne out by now established technical fact, gives me some basis at least for confidence in what I will say today.

Now what do I mean by advanced technology? Well, first I am talking specifically about energy, not medicine, not other related fields. Also, some people define advanced technology to include evolutionary improvements on the LWR — the world reference system — or current technological alternatives to the LWR that are currently available — the very fine Canadian reactor, CANDU, for example, or evolutionary forms of the HTGR, specifically with modularity, also as advanced technology. They are, in a sense, but not in the sense I mean today.

There is always incentive to do better. Evolutionary improvements will continue to be made, always. Among the evolutionary systems, the evolutionary LWR, CANDU, HTGR, each has a constituency. Each has its strong points; each has its case. It is not my purpose to contrast their merits today. Different systems may well be optimum in different parts of the world. Differing economics, histories, possible third-world considerations, may come in.

Where present systems are available to the market, the market will decide — their economics will play out and decide such things as modularity — now a matter for debate — in the natural course of things in this way.

I would only note the obvious fact that where present systems are in place — and where they are accorded the regard due their success — as for the LWR in most countries, and CANDU in Canada — the driving force for appreciable change would have to be large for an alternative evolutionary system to be brought to market successfully. I personally do not see a lot of incentive of this kind to change. These systems in their own contexts are very successful systems.

The driving force for change comes when the perception becomes clear that current systems, or evolutions of them, can no longer do the job for any length of time — the systems are no longer sustainable.

The driving forces for a sustainable nuclear future are just what we have been talking about — environment and resources. But these forces are so strong, so unavoidable, so inevitable, they make a nuclear future certain. Non-fossil, non-nuclear alternatives are mismatched to the magnitudes required.

Fusion is a fascinating technology, but there is growing consensus it's a long way off, if ever. Fission is known; it can handle the magnitudes and how to do it is known. A large nuclear future is certain. The driving force for change in nuclear systems is the issue of resources — uranium resources.

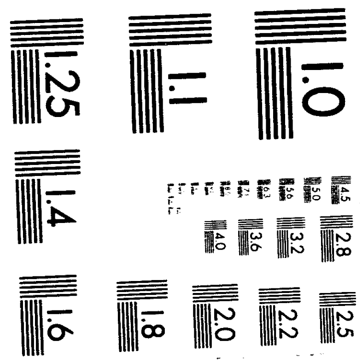
From an environmental standpoint, all nuclear plants are the same. Apart from its waste product, any nuclear plant of any technology is the same: No CO_2 emissions, no acid-causing emissions, no ash and so on.

The difference between reactor systems — and the difference is crucial — is in how many plants a given uranium resource base can support. Number of plants is a more reliable scale, probably, than years or time. Let me give you a simple scale for judgment.

Present uranium resource estimates, known and guessed at, are about six million tons. An LWR of 1,000 MWe in its 30 year lifetime uses about 6,000 tons. Six thousand into six million: 1,000 reactors of 1,000 Mwe each in perspective, perhaps half or slightly more, of the world's present energy usage.

Useful, very useful, of course, but what about the factors of three and four increases in the next 50 years in energy need. With these increases and over the time involved, these resources would support just a few percent. Resource estimate changes by factors of two would not materially change the picture.

It is a picture of relatively limited resources, feeding relatively unlimited demands that drive reactor systems inexorably in directions that allow vast improvements in the utilization of the uranium resource. This means breeding. Practically, this means the liquid metal cooled reactor. And, of course, this means some form of closed fuel cycle. The questions only relate to the kind and quality.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Now, more or less implicit in most discussions, is the premise that the reactor concepts we have today — deployed already as in the case of the LWR or CANDU, or not yet or only partly deployed, as in the case of the LMR or HTGR — make up the complete roster of candidate technologies from which future generations will make their choice. This seems to me to be an uncertain, even shaky, proposition. Assurance that all the most desirable reactor technologies were discovered in the 1950s, when certainly all of today's did originate, and that they now have reached that stage of perfection that suggests nothing really new need be done or looked for, seems to me not well founded, even a little presumptuous.

In fact, it seems unlikely. Other fields have been revolutionized by breakthroughs. It is possible, for example, that reactors stand at the point of air transport before World War II — awaiting the revolution wrought by the jet engine. These technologies originated in the 1950s. The needs our technologies must now meet are not the same as they were then.

Our field has developed enough that we can, I think, be sure that the concerns that have emerged are likely to be lasting. The concerns are now defined, not always with precision, but they are defined. More technical amelioration is possible. In fact, a lot can be done technically, I believe, if the will is there to change.

Predictions of the future are cheap. Anyone can make them. All of us make them all the time in our daily lives. Predictions are important, not so much because they are right or wrong, but because in such predictions of the future we provide rationale for present action or inaction. So, predictions of the future are by no means an empty exercise. They determine present action, and present action determines the options that will or will not be available in the future, and thus what the future can be.

Let me therefore make some predictions about the advanced reactor technologies in the future.

In the main, the line that reactor technology will take and the part it will play, are dominated by a few simple facts.

BREEDING

We have already touched upon breeding. It is the way of the future; a necessity.

SAFETY

Safety is passive. To the degree possible, inherent safety is the way of the future. But saying this does not make it so. Each characteristic, each accident, each scenario has to be evaluated.

It was the TMI-2 accident that initially gave impetus to thought about the desirability of reactor characteristics, that in and of themselves they could make reactors more invulnerable to events that would normally initiate serious accidents. The term "inherent safety" has come into use as an encapsulation of these general ideas. It is also a controversial term. It can be taken to imply both an unwarranted absoluteness and an unwarranted exclusiveness. Clearly, however, a given reactor can posses inherently safe characteristics that unarguably are very important, without implying an absoluteness that covers all possible situations and also without implying that these characteristics are necessarily limited to one reactor type. In my thinking, the term inherent safety has this specific meaning: the reactor has inherent characteristics that enable it to respond benignly to specific accident initiating events. Accident initiating events are the failure of major mechanical systems that under normal conditions cool the reactor and keep it within safe temperature limits.

For the public, the TMI-2 accident called into question the fundamental safety of nuclear power to an unprecedented degree. The consequences of failures of mechanical systems and less-than-optimal operator actions were dramatically played out on national television for many days, and continues to be news for months and years afterward. Chernobyl, even more, has intensified and solidified public concern. At bottom, the public knows instinctively that sooner or later mechanical systems fail, and operators make mistakes. Reactors must become demonstrably able to survive these events. Their nuclear safety will not hinge on proper operation of mechanical systems or even on reliable judgments of plant operators.

To a considerable extent, then, they will be foolproof. In the end, no such absolute is possible. But this is the direction that advanced reactor development will take, if nuclear power is to supply a large fraction of world energy needs.

Here the experience with IFR development is that in the liquid metal cooled system, much can be done. The demonstrations of passive shutdown in EBR-II were impressive.

PROLIFERATION

Proliferation is a touchy issue but it can be handled. It is more sensitive for recycle systems than once-through systems that continuously increase the amounts of plutonium by perhaps a fifth of a ton per GWe, with no cap on the amount possible.

The aim will be for technology — materials and processes in recycle — that advance the status of fissile material as little as possible toward the forms needed for weapons.

The lesson from the IFR development is that radically new and different processes for reprocessing breeder fuel are possible. These processes keep a mixture of uranium, fission products and higher activities along with the plutonium at all times, making the product thoroughly fresh for a fast-spectrum reactor fuel, with little or no practical advance toward weapons composition.

TRANSPORTATION

Commerce will be minimized. Movement of fissile material and waste will continue to be seen as objectionable. Transport is too vulnerable to symbolic attack. We have seen it with waste in the state in which I live. And the current news on sea-going plutonium shipments, I think, further makes the point.

Localized areas of limited movement with limited access will be the norm. Compact, complete recycle systems, with diversion-proof properties helps. Processes such as the IFR process have many of these properties.

WASTE

Waste should be another of the strong points of nuclear improvement. Compact and detectable, the waste product must be handled with consummate care. But it is not — currently it is nuclear power's weakest point. Waste content can be improved. In recycle systems, actinides can be recovered and burned; waste volumes can be reduced; waste forms improved.

In this area, the lesson from IFR development is that with new processes, many of these attributes can come along simply as a natural and unavoidable part of the process — free as it were. Properly handled, I believe nuclear power's limited waste will progressively be seen once again as a nuclear strong point.

These, then, will be some of the characteristics of the reactors of the 21st century.

CONCLUSION

In summary, nuclear is important. It may even be essential to a stable environment with a climate as we now know it. Advanced reactor development, further development, that is aimed at improving the outlook today for large-scale nuclear power in the future is extremely important.

In recent years in the IFR program at Argonne, we have made discoveries and have seen advances. Sometimes they were complete surprises that potentially revolutionize the outlook in various areas of the breeder reactor system. I expect we are not unique — we found these things because we looked. Looking again, in the context of modern knowledge and in the light of modern requirements, helps.

But whether we succeed or the U.S. succeeds on all fronts with the specifics of the IFR is secondary to the fact that real R&D, on real and new materials and on new processes, is being done here. The lesson from the IFR is that radically new discoveries still await those who look, and some of these, in my opinion, could turn out to be among the most important technological bases of the 21st century reactors.

The path then of the future will be evolutionary LWRs, including as much passive safety as economically feasible, and then breeders — but breeders, I predict, with the kind of characteristics in safety, proliferation, transportation and waste that I have touched upon based on research and development, much of which still remains to be done.

It has been our experience that development programs today are accepted, if aimed at these problems and concerns, and for the reasons that they are seen as necessary for the future. There is logical consistency here.

The breeder time will come. It is inevitable. But with the right characteristics, that time will be sooner rather than later. And more, it will be the right system, alternatives having been considered, at each stage of evolving knowledge and experience, as good as man can do.

IV. THE ENVIRONMENTAL FUTURE: PHYSICAL AND REGULATORY

THE NEW PARADIGM

Valdas V. Adamkus
Regional Administrator
U.S. Environmental Protection Agency
Region 5

My task is to talk about the future direction of federal environmental activities. That is a daunting task these days, what with a new administration posed to move into the White House and more fresh faces in the next Congress than we have seen in a generation. There was some discussion of environmental issues during the campaign. How the rhetoric gets translated into public policy remains to be seen. Will there be some new directions? Probably yes. New leadership invariably brings a different perspective.

Yet, the more I think about the Environmental Protection Agency's (EPA) future in 1993 and beyond, the more convinced I am that there will be significant continuity in the agency's direction, regardless of who may hold certain key positions. Our statutory mandates will still be in place. The array of environmental problems facing us will remain the same. And the resource crunch at all levels of government is not likely to change any time soon.

But the main reason why I think we are likely to see strong continuity in the years to come is because of the significant changes that have already begun during Bill Reilly's tenure at EPA, changes that I expect will continue to gain momentum in the coming years. These changes include setting priorities based on risk, integrating programs, and using innovative tools to achieve environmental results.

Just as this conference marks its 20th anniversary, EPA and Earth Day both had 20th anniversaries not too long ago, in 1990. It was a time for taking stock.

During that 20 year period, carbon monoxide and sulfur dioxide were reduced by more than one-third. Particulate levels in our cities dropped by two-thirds, and airborne lead emissions were cut by an astounding 97 percent. The average car of today spews 96 percent fewer emissions per mile than the average car in 1970. Unfortunately, that success has been largely offset by more Americans driving more cars more miles every year, underscoring the need to factor energy and environmental concerns into our land use decisions.

Here in the Great Lakes region, we have seen more dramatic improvements. Lake Erie, once the symbol of environmental ruin when it was declared "dead" in the 1960s, is now an outstanding commercial and sport fishery.

Even the much maligned Superfund Program, which was barely getting started ten years ago, is now completing cleanups at the rate of one a week.

Despite the considerable successes of the last 20 years or so, it has become abundantly apparent to EPA management and to many of our constituents that the way we have done business historically has significant limitations. Our old way of doing business can be summarized in phrases such as "command and control" and "end of the pipe."

The focus was on a relatively small number of large facilities, emitting pollutants that were usually visible and fairly easy to measure. The tools were permits and enforcement, and the result was often an add-on control technology at the end of the process. I do not want to discredit this methodology, because it has brought us substantial environmental improvements and will always be an important part of our overall approach.

Nonetheless, command and control has its limitations, especially when trying to address huge numbers of smaller, more diffuse sources of pollution. These diffuse sources are unlike those we have traditionally regulated.

They range from small businesses, such as dry cleaners and gas stations; to farms, with problems of agricultural run-off and pesticide management; to the average citizen, who produces a staggering 1,500 pounds of trash per year, tops in the world.

Moreover, end of pipe approaches generate sludge and other residues that are merely moved from one environmental medium, such as water, to another medium, such as land, in a shell game that never really eliminates the pollution.

A new approach is needed, one that builds on the successes of command and control, but goes beyond its limitations. This new approach, the so-called "new paradigm," is slowly but surely changing the corporate culture at EPA, and will, I think, be one of the lasting legacies of the Reilly Era.

The new paradigm can be defined as an approach to environmental protection that relies on pollution prevention as the option of first resort, and recognizes that preventing pollution is an indicator of economic efficiency. The new paradigm includes market incentives, technical assistance, and education, as well as command and control.

It is a holistic approach that promotes integration across traditional program lines within EPA, in partnership with other agencies and levels of government, and to all sectors of the economy. It is a risk-based approach that targets scarce resources based on human health and environmental risks, supported by good science. And it relies on the principles of total quality management to develop and implement programs, using principles such as continuous improvement, measurement and feedback, and better listening to our various constituencies.

The new paradigm calls for us to measure our success in terms of reducing risk, both risk to human health and risk to the natural environment. This represents a change in several respects. First, EPA has traditionally been focused almost exclusively on public health, with a few notable exceptions, such as our responsibilities to regulate wetlands development and assess environmental impacts of federal projects. By consciously looking at ecosystem health as a fundamental goal, we are trying to put the "e" back in "EPA."

Measuring our success in terms of reduced risk is also a departure from our traditional mindset of measuring administrative activities, rather than environmental results. The public, of course, couldn't care less about bureaucratic bean counts. Nor are they necessarily satisfied to know how many tons of a pollutant have been reduced or controlled. What the public is most interested in are environmental and health results: "Is the air safe to breathe?" "Is the water safe to drink?" "Are the fish safe to eat?"

These are essentially questions focused on risk. They also point out the challenges EPA faces in trying to develop environmental indicators that can be effectively measured and easily communicated to the public.

The shift toward risk-based decision-making actually predates the Reilly Administration. A 1987 report entitled, *Unfinished Business*, studied attitudes among EPA senior managers, and found that our priorities as an agency appeared to be much more closely aligned with public perceptions of risk than with actual estimated risk. The alar scare with apples was a classic case of risk perception, rather than risk reality, driving public policy.

In 1987 EPA risk study found that such "hot button" public concerns as solid and hazardous waste landfills ranked relatively low on the risk scale, while indoor air pollution, radon, and stratospheric ozone depletion, topics which generate less public attention, are among the most serious and widespread problems we face.

Region 5's own comparative risk project reached very similar conclusions. EPA is funding states to undertake similar efforts as a means of focusing their priorities on the relative risk of state-specific issues.

Risk measurement provides a common currency to examine problems scientifically, and to target efforts strategically so that we can achieve maximum risk reduction from finite public and private resources. Risk measurement becomes a priority-setting tool, allowing policy-makers to weigh the relative risks associated with certain pollutants, certain geographic areas, and certain activities. Risk management and risk communication can also be leadership tools to help shape the nation's environmental agenda.

To help institutionalize the new paradigm, Administrator Reilly put forth a number of themes to guide agency actions. Many of them I have already touched on in passing. Whether all of these themes survive intact into the Clinton Administration remains to be seen. My guess is that many of them will, especially efforts on strategic implementation, pollution prevention, market-based mechanisms, and geographic targeting.

Let me briefly explain a couple of these themes. First, strategic implementation of statutory mandates and state and local capacity. As you may know, EPA has responsibility to implement 12 major environmental laws, each having extensive and complex requirements for government and the regulated community.

It should come as no surprise, in this era of huge deficits, that the increasingly complex mandates imposed by Congress have greatly outpaced the resources provided to implement them. The states, which have been facing perpetual fiscal crisis in recent years, are seeing the federal share of their budgets continue to shrink, even as new mandates are required.

EPA cannot do it all, nor can the states. By necessity, we are having to target our resources on higher risk problems, on particular geographic areas, or on populations that are especially vulnerable or impacted. We are also having to rely on non-traditional means to achieve our objectives.

We are blending old and new approaches to pursue environmental improvement. For example, tighter standards and growing liability has caused the price of hazardous waste disposal to skyrocket. However, these escalating costs have proven to be a powerful incentive for companies to explore waste minimization and recycling techniques, as well as process changes and product reformulations. Government supplements the command and control of a hazardous waste regulatory program, with technical assistance on pollution prevention and research on innovative treatment technologies.

Another example of a regulatory program having a pollution prevention result is our program to identify and clean up leaking underground storage tanks. Some 40,000 leaking tanks have been discovered in Region 5 to date. Eight-thousand have been cleaned up already, another 20,000 are undergoing cleanup. Not only is this effort preventing significant pollution to water, soil, and air, but it is saving valuable energy resources. We estimate that, in Region 5 alone, we have prevented the release into the environment of a staggering 193,000 gallons of petroleum every day!

Market-based approaches are another non-traditional way of promoting a cleaner environment. The 1990 Clean Air Act Amendments created a market mechanism to trade sulfur dioxide emission credits. Those power plants that can more cost effectively control emissions below federal standards can generate an asset that can be purchased by another plant that is less able to control its emissions economically. The net result is that acid rain is reduced at lower cost than if every plant had to add on the same expensive controls, with greater flexibility for utilities.

Illinois EPA, under Director Mary Gade's leadership, has pursued a number of innovative approaches to harness the power of the marketplace to reduce pollution. One recent example that you will hear more about is Illinois EPA's pilot "Cash for Clunkers" program. In this program, certain grossly polluting cars are bought and scrapped for recycling. The program costs are borne by industrial sponsors, who find it cheaper to get a ton of pollutant out of the air by buying old cars than by installing expensive additional controls on their plants.

Even the mundane business of household trash can respond to market-based incentives. Over 40 communities in Illinois have some form of user fee system for garbage pick-up. These programs require people to "pay as you throw." Those who produce more waste have to pay proportionately more for disposal. Communities that have adopted this approach have seen the rate of waste generation go down, and the rate of recycling soar.

Education and outreach are other non-traditional means of achieving environmental objectives, particularly when dealing with small business or the general public. For example, radon is the second leading cause of lung cancer. However, regulation would be an unmanageable approach to attacking the risks of radon in the home. But public service announcements and other outreach mechanisms can convince millions of families to have their homes tested and, if need be, remediated.

Agricultural practices (such as runoff of nutrients, pesticides, and livestock waste) are a major cause of groundwater and surface water degradation in rural areas. Regulating and inspecting every farm would be cost prohibitive and politically unpalatable. So Region 5 and Purdue University developed computer software that allows farmers to assess the site-specific pollution impacts of their farms and evaluate the feasibility of alternative practices. By putting this information into the farmers' hands, they are empowered to make informed decisions that can improve the efficiency of their farms, reduce their pollution, and ultimately save money. This particular software package has proven to be so popular that EPA has had it translated into some 20 different languages for international use.

I would be remiss in talking about new environmental approaches at an energy conference without highlighting U.S. EPA's "Green Lights" Program, a key component of our response to the issue of climate change. Lighting accounts for over 20 percent of total U.S. electricity consumption. Off-the-shelf technology can improve the energy efficiency of typical commercial lighting by 50 to 70 percent, with payback periods of three to four years. By promoting these efficient lighting technologies to industry and government, EPA hopes to achieve significant reductions in carbon dioxide, acid rain, and electricity costs. Already, EPA has voluntary commitments from over 600 Green Lights partners to survey their lighting, using EPA software, and upgrade their facilities, where cost effective, within the next five years. These commitments represent 2.8 billion square feet of facility space, more office space than the seven largest cities in the country combined!

Other programs to encourage the development and use of energy efficient computers, electrical motors, and appliances are among the ways that EPA is achieving environmental protection, while at the same time promoting energy security and economic competitiveness.

Clearly, U.S. EPA is heading in some new strategic directions. Those new directions are shaping Region 5's priorities as well. We, too, are trying to adopt new practices, as well as build on the successes of traditional methods.

In Region 5, we have long prided ourselves on enforcement, a traditional method. It is part of our corporate culture in the Chicago office. Let me point out why we believe so strongly in prompt, vigorous, aggressive enforcement. Enforcement is the engine that drives everything we do. Without it, we would lack the deterrent to make the permits and regulatory system credible. Vigorous enforcement also provides equity and fairness to those members of the regulated community that comply, typically at considerable expense. Finally, enforcement is a great incentive for parties to pursue pollution prevention, waste minimization, technological innovation, and market-based approaches. Besides, we have an obligation to enforce the law, and the public expects us to do just that.

One way that we are enforcing the law in a creative way is through so-called multimedia enforcement. As many of you know, federal environmental laws are not well integrated. Each statute has its own mandates, standards, deadlines, and constituencies. Because of this segmentation, known tongue-in-cheek at EPA as the "hardening of the categories," we have not generally been very good at coordinating multiple laws at a given facility in order to achieve prompt compliance in a way that best benefits the environment.

Instead, an inspector trained in one program might overlook significant problems under another law. Or, different inspectors might show up on different schedules, like the old story of the blind men touching different parts of the elephant. Under that scenario, no one gets a coordinated understanding of the big picture. Multimedia enforcement, while resource-intensive, allows us to look holistically at a major polluter and develop a coordinated approach to bring the facility into compliance, and perhaps look for pollution prevention opportunities.

Region 5 has seen the greatest improvement in multimedia coordination through our geographic initiatives. Geographic targeting has proven a successful way to leverage base program activities (such as permitting, inspection, and enforcement) to have a major impact on a critical area. Our northwest Indiana initiative focuses on one of the most environmentally degraded areas in the nation. Thanks to multi-million dollar enforcement cases against several major steel companies, other industries, and municipal wastewater plants, a critical mass has been created that will lead to clean up and dredging of large stretches of the Grand Calumet River, one of Lake Michigan's most polluted tributaries. Significant enforcement cases for air and hazardous waste violations, along with cleanup of five Superfund sites, promise to reduce pollutants to other media. Similar geographic initiatives are planned for other critical areas of the region.

Integration among programs and disciplines is essential if we are to succeed. We must look at the whole picture.

One place where EPA is pioneering its efforts to integrate multiple programs to achieve a common goal is the Great Lakes. The Region's highest priority in the next several years is protection of the Great Lakes, our Region's most precious natural resource. Our five-year strategy for protection and restoration of the lakes is the most ambitious EPA geographic initiative in the country, and is the preeminent model within the agency to demonstrate the new paradigm.

Because the Great Lakes are essentially a closed ecosystem, or pollution sink, the strategy must be multimedia to address loadings from all sources. It is an integrated work product, representing the inputs and commitments of virtually all of the affected governmental parties on the American side: EPA; other federal agencies, such as the Army Corps of Engineers, and the Fish and Wildlife Service; the eight Great Lake States; even an Indian tribal organization. It envisions continued outreach to the Canadians to complete the loop. This multimedia strategy covers virtually all of the major activities that the participants will conduct in the Great Lakes Basin until 1997 — research, monitoring, planning, implementation, restoration, and remediation. Environmental indicators will be developed to set targets and track progress.

The Great Lakes five-year strategy is unified by three central goals:

1. Eliminate persistent toxics;

2. Protect and restore critical habitats; and

3. Restore and maintain bio-diversity.

The strategy relies on both traditional mechanisms — such as permits and enforcement, and non-traditional mechanisms, such as pollution prevention, voluntary reductions, and non-point source management practices — to achieve its goals. It relies on all levels of government, including municipalities, as well as the private sector. It relies on every major environmental statute to achieve part of its objectives:

- Superfund, to clean up toxic sediments and soils at sites such as Waukegan, Illinois, where a $20 million cleanup has removed one million pounds of PCBs from the harbor;

- The Clean Air Act, whose air toxics standards and early reduction provisions promise to substantially reduce air deposition to the Lakes;

- The Toxic Substances Control Act, which could be used to ban or restrict selected chemical products in the Basin;

- And, of course, the Clean Water Act, with traditional permitting and standard-setting for point sources and wetlands protection, and newer provisions to address stormwater, combined sewer overflows, and non-point source pollution.

One other Great Lakes effort deserves special mention, because the regulated community and government are anxiously awaiting its fate — the Great Lakes Water Quality Initiative. This initiative, begun originally as a collaborative effort between EPA, the states, and selected environmental and industrial representatives, is now part of the Great Lakes Critical Programs Act. Phase one of this project undertook the enormously complex task of developing uniform water quality standards for point sources throughout the Basin. The controversial draft rulemaking package went to the Office of Management and Budget in September 1992. We are hopeful that this package will go to the Federal Register for public comment before the end of 1992.

In the meantime, EPA and the other involved parties are beginning phase two. The goal of phase two is to draft uniform water quality standards for non-point sources, which could include agricultural runoff, sediments, even air deposition.

Our experiences in the Great Lakes are very telling. They are telling us why the old ways of doing business — with rigid categories, poor coordination, end-of-the-pipe solutions, and an exclusive reliance on command and control methods — will ultimately not take us to our goal of a healthy environment. Our Great Lakes experiences are also telling us that models such as the Great Lakes five-year strategy may hold greater promise for cost-effective achievement of environmental success.

With its emphasis on cross-program integration, risk-based priorities, and the use of prevention and education, as well as control and cleanup, the new paradigm not only accommodates change, it actually encourages innovation. I think it has a long, bright future at EPA.

MARKET MECHANISMS: A NEW APPROACH TO REGULATORY ISSUES

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FOUR YEAR STRATEGY FOR ENVIRONMENTAL PROGRESS

The world is rapidly becoming a very different place. With the threat of wide-scale nuclear war subsiding, the cold war is finally drawing to a close. New economic and political alliances are changing the global landscape with international economic competition capturing center stage. Change, and more change, is the watchword of the 90s.

Amidst all these revolutionary events, there is also an increasing awareness of the environment. The importance of caring for and respecting the Earth steadily gains credibility as a basic value for human society. Part of this "green revolution" is surely fueled by scientific advances in assessing environmental problems on a global scale (e.g., holes in the upper ozone layer). An equally important part is the growing grass roots commitment to the environment. Local citizens have made and will continue to make a difference in pushing for better environmental protection and resource management. Industry has also been responsive and cooperative with many respects to environmental protection. After all, the Earth belongs to everyone or, perhaps more appropriately, everyone belongs to the Earth.

In many ways, these changes will impact the roles of all levels of government. Old ways of perceiving and doing business may not work in this new age. Internationally, the United States is taking a leadership role in addressing new global environmental issues from deforestation to waste exports. Within this country, state governments are uniquely situated to be a strategic link in building new ways of operating. On one hand, state governments are closer to the people and, thus more accessible and, hopefully, more responsive. On the other hand, state governments have regional and national relationships which enable them to understand and participate in broader approaches. Initiatives can be tried out at a state level that might be too much to tackle nationally.

The Illinois Environmental Protection Agency has chosen to directly confront the dynamic setting within which we find ourselves. We view strategic planning as a means of fulfilling our obligation to the citizens of Illinois to provide a safe and healthy environment in the most creative, cost-effective and sensible way possible. This strategic plan represents an Agency-wide effort using a comprehensive approach to identifying our priorities. Consequently, we expect to find many opportunities for improvement as we continually review and update our strategy. Nevertheless, we have already found the process beneficial for clarifying our goals and mission. We hope that you also find some merit in this process and its implementation.

STRATEGIC PLANNING PROCESS

Strategic planning can be described as a structured process to produce decisions and actions which enable an organization to deal with significant changes. As part of the development process, the Agency has identified and considered certain significant changes and trends. These influences are presented in the next section. To structure this process, a framework consisting of the following components was utilized:

- Agency mission statement
- Agency program goals
- Strategic management directions
- Program vision and focus statements

The intent behind the design of this framework is further explained in the sections which follow. The four-year period for this strategy covers from 1992 through 1995.

The mission and goals for the Agency were updated in the fall of 1991 in concert with the strategic planning process being carried out by the Governor's Office.

The mission of the Illinois EPA is to safeguard environmental quality, consistent with the social and economic needs of the state, so as to protect health, welfare, property and the quality of life.

In support of this mission statement, the following program goals have been developed:

1. Provide leadership to chart a new course for clean air which is responsive to relevant needs in Illinois and complies with priority aspects of the Clean Air Act Amendments.

2. Address outstanding solid and hazardous waste management concerns and participate, as appropriate, in the national deliberations on reauthorization of the hazardous waste program.

3. Utilize creative means to address the priority needs for clean and safe water in Illinois and participate, as appropriate, in the national deliberations on reauthorization of the water programs.

4. Enhance capability to fund environmental cleanup, when necessary, and to provide better service for private party actions.

5. Promote pollution prevention and market-based approaches for continued environmental progress.

6. Develop an environmental planning capability which emphasizes risk-based analysis, good science and sound data, and open communication and informed participation.

A discussion document about this strategy was prepared and distributed in November 1991. Comments and suggestions were solicited from the following interested parties:

- Environmental groups
- Local government
- Agricultural groups
- Business groups
- State agencies
- Region V, USEPA

In particular, we were hoping for feedback about significant changes and trends, the strategic management directions and the vision statements. The comments that we received were helpful in pulling together the final strategy.

SIGNIFICANT CHANGES AND TRENDS

Change is the order of the day in many ways. Documentation and analysis of the impacts of such changes on the field of environmental protection could become a major task in its own right. In the interest of moving ahead, the Agency has selectively considered the qualitative aspects of certain key changes. These changes were identified through dialogue among the senior managers, some effort to scan the surrounding policy landscape and by solicitation of comments from interested parties. The following listing presents a summary of our findings regarding significant changes (SC) and trends (T).

1. (SC) Limitations on funding for environmental programs.

   (T) Expected to persist, if not intensify, for general revenue but additional fees and federal funds are likely to be available.

2. (SC) Demands on the state from national environmental programs.

   (T) Expected to increase for a number of programs (CAAA-1990, CWA Reauth., RCRA Reauth., SDWA, TSCA).

3. (SC) Mandates to address concerns which are not nationally based.

   (T) Likely to occur as events generate political/administrative responses (e.g., new medical waste program and unsatisfied site cleanup needs).

4. (SC) Diminishing returns from traditional regulatory approaches and continued emergence of new approaches such as pollution prevention.

   (T) Projected to be a complex mixture of approaches but with more recognition of the "limits" to command and control regulation and the value of communication and cooperation.

5. (SC) Interface of environmental and economic agendas.

   (T) Projected to expand with new insights on interrelationships, co-dependencies and opportunities.

6. (SC) Environmental liability.

   (T) Continues to grow unless legal reforms start to come along due to excessive impacts.

7. (SC) Environmental awareness and interest, and emerging new concerns such as biodiversity and habitat protection.

   (T) Expected to expand but the extent and consistency could be periodically influenced by other social concerns.

8. (SC) Technology advancement.

   (T) Expected to continue for analytical and monitoring equipment, pollution control equipment, information management and a wide spectrum of other relevant commercial concerns.

9. (SC) Nature of governmental processes.

   (T) Likely increase in public scrutiny, both formal (audits) and informal, desire for involvement and expectation of openness.

10. (SC) Development of human resources.

   (T) Expected to grow in importance for achievement of mission.

In general, the Agency has tried to take these matters into account during the development of the directions and visions. While the degree of influence varies, the strategy is responsive in some manner to just about the full gamut of these significant changes. This linkage should be reasonably apparent to most informed readers and, thus, no detailed accounting is provided. The principal value of this presentation of significant changes and trends is to advise interested parties about motivating influences on our strategic planning and to document our judgments about such matters.

BASE PROGRAMS

As one might also imagine, the Agency has gone through many changes since its inception in 1970. Dramatic growth has taken place in both the 70s and 80s. Many new and complex programs have been put into operation. The Agency currently has delegations of authority or approval to operate 14 programs for the USEPA. Our FY92 operations budget of $161 million is obtained from the following sources:

- 40 percent federal
- 12 percent general revenue
- 26 percent fees
- 22 percent other

The use of environmental fees has greatly increased over the past four or five years due to various initiatives pursued by the Agency and other interested parties.

For the purposes of this strategy, we have chosen to characterize our current operations as "base programs." This approach has certain advantages for streamlining the analytical effort and helping to identify needed strategic directions. On the other hand, it tends to over-simplify what in reality are very dynamic programmatic circumstances. In some instances, for example, the Agency already faces a resource shortfall relative to program performance expectations. In other words, the base is akin to a three legged table. The program is still standing, but is not as stable from all angles as one would prefer. In a forward looking spirit, the Agency has assumed that such matters will be worked out as the strategy unfolds.

STRATEGIC MARKET DIRECTIONS

Setting forth the mission statement and program goals does set the stage and define the scope of the play. It does not fully describe the expectations for how the scenes will be performed and what norms will guide the play as it unfolds. Such concerns are relevant for the managerial processes that are used to bring direction to the manner in which the play is performed. Thus, the programmatic nature of goals needs to be buttressed with specific strategic management directions. These directions can, of themselves, greatly influence the performance of programs by impacting the way the game is played.

Strategic management directions can be described as a managerial agenda of priority themes which serve as guides for how we will go about getting the job done; that is, the "common managerial consciousness" of the Agency. These directions serve as a cross-cutting managerial emphasis relative to the program goals which have been articulated. The Agency has developed the following strategic management directions.

1. **Pursue the state's environmental interests in concert with applicable national environmental programs.**

   Illinois has a progressive history of dealing with many environmental problems. While significant progress has been made, we still have our fair share of problems to resolve as well. These concerns result from a complex interplay of political, social, economic and natural resource factors. In some respects, the resultant collage is unique to Illinois and, in other respects, it fits larger patterns found at a national level. Largely because of the extensive commonality of these interests, Illinois has aggressively sought and obtained approval to operate national environmental programs that are applicable to the state. Such commonality of interest is not, however, a total match and important distinctions and differences merit recognition in the way our programs are handled.

First and foremost, then, the Agency will be guided by a sense of what best satisfies Illinois' needs for continued environmental progress. Given the complex interplay of forces, this direction will surely prove challenging for our management. At times, we are likely to be strong advocates for Illinois' interests in the national arena. At other times, we may serve as spokespersons for national programs that will serve the state well. In all instances, pursuit of these interests will have implications for various state/federal relationships. In our view, strong state programs are important for achievement of balanced and productive relationships with our federal counterparts and for achievement of continued environmental progress. In the years ahead, the dominant features of these relationships are seen as mutual respect, interdependence, and responsible tolerance.

2. **Produce sound environmental decisions that are conducive to environmental progress.**

The basic nature of environmental decision-making is evolving in concert with the maturation of the programs being operated. A new kind of sophistication is developing based on analysis of environmental risk. To some extent, this development holds a promise of enhanced flexibility in assessing and addressing environmental problems. More effective and efficient performance could also result from reduced bondage to the old patterns of regulation. At the same time, one must be sensitive to the inherent limitations of this new paradigm. The Agency is prepared to move forward into this risk-based decision-making mode but will do so with a healthy dose of common sense about what it all means.

On another related tract, good environmental data is vital for better decision-making. Both generation and use of data are ripe for refinement. We must move beyond simply having lots of data to careful consideration of the relevance of these data for solving environmental problems. The elusive nature of solutions to some problems (e.g., ozone control) raises questions about our understanding of the true underlying causation. At the same time, we should be wary of unintentional program paralysis due to recognized uncertainty. Prudence dictates that we maintain program momentum while we enhance our ability to get the most benefit from available data.

Finally, a new way of looking at environmental problems and programs is gaining in prominence. It goes by many "handles" such as multimedia, multiprogram, cross-program, and intermedia. Whatever name tag one chooses, there are certain key characteristics of this new outlook. First, it tends to emphasize a systems approach to solving environmental problems. With this approach, coordination and interrelationships are emphasized rather than mutually exclusive program operations. Secondly, this approach tends to stress synthesis over dissection. From this perspective, the "whole" becomes the driving force behind management of sources, sites and impacts. In response to this emerging phenomena, the Agency will be guided by a recognition of the value of such perspectives. In a practical sense, better teamwork among programs, use of cross-cutting projects and initiatives, integration of data with respect to facilities and geography, and environmental planning are seen as conducive to building this perspective. Activities which represent this perspective are flagged with the following symbol in the program sections: ✓

3. **Strengthen the governmental framework for environmental protection in Illinois.**

Illinois has developed its own unique institutional structure and processes for environmental protection. These elements can be functionally described as rulemaking, enforcement, permitting, monitoring, research, education, financial and technical assistance, and remedial response. Diverse sets of interagency relationships exist for these many functional elements. Perspectives regarding the relative strengths and weaknesses of these arrangements are also quite variable. Out of this institutional mosaic, the rulemaking and enforcement processes stand out as particularly worthy of strategic attention.

The Agency is convinced that a better job of managing the rulemaking process can be done. In this regard, the Agency adopted and has operated a new rulemaking management system in recent years. A key feature of this system includes more open outreach to, and interaction with, interested parties prior to the formal filing of any proposal. While this seems to have been a positive step, we still see a need for more basic changes to achieve more timely and less resource intensive results. Perhaps a fresh look at the process itself would prove beneficial for all concerned. Towards this end, the Agency will be guided by a commitment to achieve better performance from the rulemaking process in Illinois.

In like manner, the Agency finds that the enforcement process needs improvement. In particular, the absence of any real administrative enforcement provisions leaves Illinois at a significant disadvantage as compared to many states' environmental programs. Prompt administrative response to routine or less significant violations is a good deterrent against escalation of compliance problems and some assurance to the public that corrective action is likely to be taken. In a similar fashion, the state's credibility with the USEPA would be better served by a truly responsive enforcement process. In addressing this matter, the Agency will be guided by a sense of what represents good performance for a protective environmental enforcement system.

4. **Foster innovation, systems improvement and human resource development.**

In these changing times, there is an especially pressing need to be open to new ways of doing business. Such openness, however, is really only a beginning. The Agency believes that overt encouragement of innovation will be necessary to get us to where we want to be. Of course, some innovation has taken place within the Agency and from outside as well but not necessarily due to a concerted effort to foster this occurrence. The Agency foresees an organizational atmosphere which will be more conducive to this type of behavior.

Coupled with innovation, we should be receptive to the mood of the times with respect to systems improvement. One approach which seems to fit this need is total quality management or TQM. Under TQM, the focus is on continuous improvement of processes that are in use. The Agency has already taken the initial steps to implement TQM. The senior managers have participated in one round of training and other staff have received this training too. A team from the senior managers group is in the process of designing a full-scale implementation process that will take place over the next couple of years. The Agency is seeking to involve as many staff as possible in the TQM initiative.

Such wide-scale involvement in TQM is also a reflection of the Agency's interest in human resource development. The timing seems right for a more intensive commitment to training for all categories of staff and better recognition procedures for good performance.

5. **Stress responsiveness to relevant publics.**

The Agency is involved with many communication networks and a wide range of types of interaction with interested parties. Each situation has its unique characteristics, limitations and consequences. Such complexity is ripe with potential problems and opportunities for looking ahead. The range of interactions is challenging since it extends from the very formal, such as under the Freedom of Information Act (FOIA), to the very informal conversations that take place on a daily basis. To facilitate these interactions, the Agency has begun making greater use of forums and roundtables so that all interested parties can be engaged in the dialogue.

In past years, the Agency recognized the importance of citizen complaints and placed a priority on being responsive. More recently, the Agency has struggled to handle a growing burden of FOIA requests. Providing good service for responsible permit applicants is another concern that is worthy of mention. At the same time, we have a responsibility to keep interested third parties fully informed and to consider their concerns. In coping with these matters, the Agency will be guided by a commitment to responsiveness across all types of interactions. This commitment also includes an openness to receipt of constructive criticism about how we are doing.

These five strategic management directions become the basic guideposts for how the Agency will do the job of safeguarding environmental quality in Illinois. Taken as a group, these directions set the pattern within which specific programs will operate. Each major program, in turn, has its own vision of the future that is appropriate for that particular environmental concern.

VISION AND FOCUS STATEMENTS

A vision statement has been developed for each major program or activity in the Agency. These statements are intended to establish a mindset about what we want to be realized for a particular program, activity or situation by the end of the planning period. To emphasize the future commitment, these statements are written as if it were 1995. This approach is clearly less prescriptive than what is typically produced using management by objectives. In our approach, however, the added flexibility is provided to encourage creativeness and enterprise from the programs. A reasonable measure of accountability will be maintained through an annual planning and review cycle that will include assessments of program performance and progress.

Another means of ensuring that the vision statements are well founded is to develop a more near-term focus for each one. Such focus statements can be used to describe the centers of interest or activity which will help support the realization of the visions. In some cases, programs have gone beyond the focus stage to describe specific steps that will be taken for each focus. The combined effect of these descriptions should be a more clear portrayal of what we hope will come to pass for environmental protection in Illinois.

The remainder of this paper presents the statements that have been developed for the programs. A brief description of each program as it currently operates is also provided as a point of reference.

ENVIRONMENTAL PLANNING

Vision Statement - 1995

The Agency has in place a more systematic approach for anticipating strategic environmental issues and coping with the related potential impacts. A formal policy analysis and planning function is fully operational within the Agency. This operation is responsible for the following achievements:

- Key environmental trends are being regularly tracked and reported.
- Good environmental data is periodically presented to the public and interested parties.
- Environmental forecasting is tried on a developmental basis with the year 2000 being an initial focal point.
- Better integration of environmental and economic concerns is taking place.
- Cooperative means are afforded a greater opportunity to help resolve potential environmental problems.

This operation also enables the Agency to develop a more workable strategic and program planning interface with the USEPA. Illinois' issues, constraints, priorities and concerns are more systematically articulated to Region V and, in turn, generate more responsive action.

Base Program Description

The Agency has relied on a fairly informal system of policy development and internal planning in past years. In large part, the senior managers have served as the focal points for an ongoing planning process of sorts. Some aspects were structured, such as the annual planning session and budget previews, but most aspects were activated in response to emerging issues and addressed on a custom basis.

Several steps have been taken towards the development of a more formal system. In December 1988, the Agency adopted an Executive Planning System (EPS). The EPS was updated in March 1990 to include the internal audit program and other refinements. These efforts fell short, however, of a designed and staffed policy and planning program and a structured means of handling strategic concerns.

Strategic Changes

In 1991 a decision was made that policy development and planning needed to be addressed in a more rigorous manner. A number of factors were influential in this regard. The Edgar Administration began emphasizing strategic planning as a means to address oncoming changes. The national environmental programs were, and still are, changing in many respects. Relationships with our sister agencies in the state are evolving as well.

The Agency is committed to the realization of a more formal process for policy analysis and planning. We need to be more anticipatory in our actions to address environmental concerns. In a sense, this represents an emphasis upon prevention in the overall manner in which we conduct our business.

The following focus statements are provided as a means of realizing the vision:

1. A senior level policy analysis and planning function is created within the Director's Office.

2. An external scanning system is designed and placed into operation during 1992. Periodic briefings are prepared for Agency management, and key considerations are flagged for future strategic planning.

✓ 3. A special project is carried out during 1992/93 to develop market-based approaches for the clean air program. Consideration of similar approaches for other programs is undertaken as well.

✓ 4. A manageable system for tracking key environmental trends is developed and put into operation.

   a. Environmental progress (1970-1990), the transition document, is revisited during 1992 with a view towards creating an ongoing trends analysis and reporting system.

   b. The Agency's participation in the Critical Trends Assessment Project (CTAP) serves as a means of broadening the effort to address this matter.

   c. Outside sources of relevant trends information are sought and, where suitable, are made available to the Agency.

✓ 5. Developmental work is pursued during 1992-94 to lay the groundwork for how to approach and structure an environmental forecast. Consideration is given to a menu of "leading environmental indicators."

   a. The design and execution of an environmental forecast project for 2000 takes place during 1993 and 1994.

   b. The CTAP and USEPA's efforts are monitored to determine if methods, techniques and guidance are applicable to the Agency's project.

6. The Agency establishes working relationships with planning processes in other state agencies (DOT, DCCA, DPH, DOA, ICC, etc.) over the next several years. To the extent feasible, an operable network is one result of this effort.

7. An effort is made to put more operational meaning into use of the "sustainability" concept. In particular, refinement of key environmental considerations as inputs to sustainability analyses is emphasized.

SUMMARY OUTLINE

I. Times are changing in big ways

   A. Limits to command/control regulation and detailed prescription of compliance actions.

   B. Resource intensive, adversarial relationships between government and business.

   C. Global economic competition and environmental concerns. Sustainable development and longer term view.

   D. IEPA's Four Year Strategic Plan and strategic planning process for six states and Region V, USEPA.

II. What is market-based approach?

   A. Government sets performance expectations.

   B. More flexibility for regulated entities to choose cost-effective compliance actions.

C. Opportunities for some market-like activity or exchange between regulated entities. Competition as more of a factor.

D. Government tracking to ensure results are achieved.

III. Current Activities

A. Federal grant project — mostly Clean Air Act.

B. Cash for Clunkers Project.

C. Tradeable emission reduction credits for ozone nonattainment areas:

1. South Coast Air Quality Management District (SCAQMD) — Boldly going where no regulatory program has gone before!

2. Post trade review

3. Legal privilege

D. Tax incentives that might be pursued:

1. Tax credits

2. Sales tax

IV. Conclusion — Moving from command/control to communication, cooperation and commitment.

UTILITY REGULATION IN ILLINOIS: UNCERTAINTY AS A REGULATORY PRODUCT

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UNCERTAINTY AND UTILITY REGULATION IN ILLINOIS

If one were forced to choose one word which best described the utility regulatory situation in Illinois at the moment it would certainly be "uncertainty."

Uncertainty must, of course, always be a feature of human endeavor. However, because conventional utility regulation was inaugurated in this country in the 19th century and refined in the 20th as a means of managing a variety of risks and uncertainties, to use the single word, uncertainty, to characterize regulation is going some distance. The word, of course, describes the situation in several other states as well.

Nevertheless, the use of the word reflects the belief that something has gone wrong somewhere along the line in Illinois.

This paper does not attempt to assess blame but, rather, to analyze the situation and to suggest a few solutions. To the extent that blame were to be apportioned, I would be honored to accept 99 percent of it and to allocate the remainder to Sam Insull. He is gone and cannot defend himself — and I enjoy getting blamed.

Among the uncertainties of life, utility regulation was originally intended to bring a modicum of certainty along several dimensions.

First, utility services are capital intensive and require long-term fixed assets such as power plants and transmission and distribution facilities. To the extent that regulation limited competition and had "rules of the game" which provided a high degree of assurance that investment would receive a reasonable return, investors could confidently commit their funds to utility stocks and bonds. With the risk lower, the cost of the capital would be lower — meaning that the single largest cost component of utility service would be less expensive.

Second, customers could have the expectation that in a context in which competition was limited or prohibited, the prices paid and the conditions and quality of service would be kept roughly at competitive levels.

Third, in line with the reality that utility services involved private provision of public infrastructure, users of the services looked to regulation for some reasonable level of assurance that the infrastructure would be expanded as demand warranted and that there would not be shortages. This is really no different than the role played by public authorities in providing for adequate transportation, water and sewer infrastructures.

There should be genuine concern that the regulatory situation in Illinois is not likely to deliver the degrees of certainty along any one of the three dimensions that conventional regulation would be expected to deliver. Moreover, there are some features of the current Illinois regulatory situation which are, in fact, likely to induce uncertainty.

There are four key sources of uncertainty in Illinois energy utility regulation:

1) Competition and the Unraveling of the Monopoly

2) Judicialization of Economic Regulation

3) Retrospective rather than Anticipatory Regulation

4) Incongruence between Planning and Accountability

All four are linked to one another, and the future effects of all four are susceptible to being avoided by an aggressive program of inoculation. So there is hope.

COMPETITION AND THE UNRAVELING OF THE MONOPOLY

Public Policy and Competition

The question of competition and the competitive threat for the local energy utility was barely on the horizon when the first of these conferences was held 20 years ago. But in these past 20 years competition has become not merely an issue but increasingly represents the cutting edge of public policy development.

In the late 1970s, Congress passed the Public Utilities Regulatory Policy Act (PURPA) and the Natural Gas Policy Act (NGPA). These laws provided legislative stimuli leading to the deregulation of natural gas wellhead prices, the opening up of the interstate natural gas pipeline network for transport services as an alternative to merchant services, and the rise of the independent electric power generation business.

More recently, the Energy Policy Act of 1992 disestablished the notion of the vertically integrated local electric utility as the sole legitimate model for the organization of the industry. The Energy Policy Act's reform of the Public Utility Holding Company Act of 1935 (PUHCA) has thoroughly legitimized the independent power business. In addition, access to the bulk electric transmission system for wholesale power transactions is now a reasonable expectation on the part of electric wholesale power generators.

A vigorous debate over retail wheeling cannot be far off.

The key point is that utilities are increasingly being confronted with the fact that captive utility customers have the potential for choices and alternatives. Technology, market changes, important regulatory and policy developments at the federal level have all dramatically altered the context in which utilities and their customers must make decisions and operate.

Competition — Unraveling the Regulatory Compact

The movement toward competition has been accelerated over the past two decades by events largely external to the utility industry. These events undermined the basic conditions which had allowed a regulatory bargain or social contract for the operation and regulation of utilities.

The regulatory compact was successful for many reasons, including the presence of some real giants in utility management, in the regulatory ranks and in legislative and other policy roles. In addition, there was a well understood commitment to adhering to what was understood to be a regulatory compact. Important as well was the reality that electric and gas services were not taken as much for granted in the past. With virtually 100 percent availability of full service today, there is less emphasis on promoting the expansion of utility industries to meet unmet needs.

Underlying the success of the regulatory compact, certainly in the post-war era, were economic and other conditions which were essentially stable and, we believed, reasonably predictable. The short of it is that external conditions increased risk and uncertainty in the utility planning and operating environment with which classic utility regulation simply was not well suited to coping.

In the post-war period up to the 1973 OPEC oil embargo following the Yom Kippur War, conventional utility regulation was a success story. However, it and the industry it regulated came under increasing criticism over the past 20 years. While things have settled down in most parts of the country, some areas, such as Illinois, continue to fight out the lingering battles of the 1970s and 1980s. Some of the reasons for Illinois continuing to be trapped in the past are merely unfortunate matters of timing while others involve a situation of our own making.

In any event, the success of conventional regulation in Illinois and around the country during the 1945 to early 1970s period may have been due at least as much to favorable conditions as to the sagacity of the players or the aesthetics of the regulatory design.

Conforming Regulation to Reality

Conventional utility regulation was well designed to address the conditions and the objectives of its day. The past 20 years have witnessed a far from complete struggle around the country to arrive at a new regulatory format which conforms to new technological and market realities.

Illinois has been as much a scene of that struggle as has anywhere else. Unfortunately, rather than moving in the direction of attuning itself to a new set of conditions, there has been a tendency to retrench. In other words, certain features of the conventional system of regulation which were thought by some to have been deficient, have been emphasized, such as retrospective regulation. In other respects, ideas have been imported from other contexts which have little relevance to the new conditions except that they are completely unsuitable. These include an approach to regulation which looks to highly judicialized procedures to elicit a desirable result.

The first major source of uncertainty for utilities and regulation, the introduction of competition and disruption of the old conditions, ought to be considered susceptible to a new regulatory format. But in Illinois, three features of regulation actually serve to exacerbate the uncertainty arising out of the new competitive and economic environment.

JUDICIALIZATION OF ECONOMIC REGULATION

In Illinois, the regulatory process has come to place a premium on due process considerations rather than on overall reasonableness of outcome. This represents a radical departure from conventional regulatory standards which have prevailed throughout the prior history of utility regulation in the United States.

Utility regulation was originally designed as a quasi-legislative activity but has evolved in many places, and in Illinois with a vengeance, into a quasi-judicial activity instead. The legislative approach reflects the give and take, the balancing of interests which is at least metaphor for the marketplace. It was well recognized as well that the many pieces and considerations in a utility regulatory decision were interactive and interdependent.

Importantly, an entirely new standard for the judicial review of utility decisions in Illinois seems to have grown up, one which places due process considerations ahead of reasonableness of outcome. That is taking the conventional standard of review and standing it on its head. The classic measure of economic regulation has been reasonableness of outcome, not whether a variety of procedural steps were taken and certain rules adhered to.

The importation of the notion of procedural justice from the world of criminal law, while perhaps perfectly applicable to assuring the dispensing of justice with respect to criminal defendants, is a thoroughly debilitating idea in economic regulation. We are prepared as a society to have the occasional absurd result of the clearly criminal individual go free in order to assure that the innocent are not punished. We rely on procedure to provide that level of assurance. Economic regulation does not involve sorting out the guilty from the innocent but in achieving workable results.

It should not be surprising that utility regulation has become more judicialized. We are in a litigious era and some would say that the lawyers have hijacked much of the economy and our system of social relationships. It is difficult to think of some problem or issue which we have not somehow seen subjected to the court room.

Unfortunately, the exaltation of process over substance implies the willingness to accept absurd outcomes for the sake of procedure. The rules of the game in utility regulation need to be focused on the eliciting of information and must be flexible. Judicialization tends toward rigidity and byzantine reasoning.

There are five features, in particular, which characterize the judicialization of utility regulation, all of which make it more difficult for regulators, utilities and customers to meet the challenges posed by an increasingly competitive marketplace outside the confines of the hearing or court room.

The Partial Remand

Most characteristic of the departure from the standard review which looks to the reasonableness of the outcome, is the opportunity since the passage of the 1985 utility law for partial reversals and remands of Illinois Commerce Commission decisions. In the past, the courts had to judge an order as a whole, up or down. That forced an assessment of the overall reasonableness of the order and forced a reliance on the expertise of the Commission.

However, with the advent of the partial reversal and remand, reviewing courts are able to pick and choose which issues to send back to the Commission for reconsideration. This eventually will make for an impossible situation for the simple reason that there is interdependency among the parts of an order and the Commission engages in a balancing act among different issues.

The partial remand situation, a rarity among the states, suggests that we can expect regulatory cases to go on much longer than in the past, with the Commission regularly called upon to reconsider some small or large issue, long after other closely related matters have been treated as finally resolved. This incongruity creates a situation in which there will be a tendency to revisit questions beyond those which have actually been returned by the court under the partial remand.

A final and extremely important point about the partial remand is that they are subject not merely to misinterpretation but to active distortion as to their meaning. Partial remands are customarily characterized in the media as representing a wholesale reversal of an order when, in fact, the reversal is partial and usually highly technical, given the focus on procedure.

The combination of the elevation of due process over substance and the partial remand as a likely outcome means that most partial remands — which can easily evolve into a full blown rehearing of a case — will be based on technical procedural deficiencies. Thus, in a perverse way, partial, procedural remands are transformed into total reversals on substance.

Partial remands have made utility regulation and therefore utility investment, planning and operation take place in an atmosphere of greater uncertainty.

Lengthy Delays

In a rapidly changing marketplace, utility cases are taking longer and longer to reach conclusion. To the extent that partial remands are likely to drag out resolution of a matter the greater is the uncertainty for the simple reasons that delay is uncertainty and both time and uncertainty mean money.

Throughout our economy we see not merely change but rapid change which requires successful players to be able to make prompt decisions to respond to changing conditions. While utilities must be able to shorten the planning cycle to better deal with a dynamic marketplace, they are caught in a regulatory environment which seems to be largely uninterested in the requirement for promptness.

The culture of delay developing in utility regulation appears in places other than in the problem of cases on appeal in the courts. Despite much public and media attention to utility rate cases, it can be argued that the more important decisions, certainly those for the future, will involve other matters such as corporate structure (holding company formation), incentive regulation, demand-side management, competitive marketing affiliates, and so on. Yet many of these issues are best dealt with in proceedings of their own, apart from rate cases. Yet, such proceedings have no time limit on them. The absence of a time limit and the growing overall judicialization of the process are likely to discourage utilities from presenting innovative ideas to the Commission both out of concern over delay and worry over the way in which the idea might be reformulated.

Delay, much of it born of judicialization, is fundamentally incompatible with the dynamic nature of the modern energy markets.

Too Much Sunshine

The full application of the state Open Meetings Act to the Commerce Commission has the effect of permitting only two Commissioners to discuss a case or the public business without an audience. Nothing could be better designed to stifle understanding, collegiality, creativity, and solidly written orders than this situation. Perhaps the simplest illustration of the absurdity of subjecting Commission discussion and sorting out of the issues to public theater is that the multi-member courts which review the Commission's decisions are conducted totally in private, without even a recapitulation of the private discussions in public.

The Open Meetings Act, while generally well intended, has a basically anti-intellectual result, depriving Commissioners of an opportunity to candidly share their views and to become educated on complicated topics by Commission staff. The Open Meetings Act was not originally applied to the Commission in recognition of the complexity of the body's task as well as the possible impact of interim discussion on the financial markets.

The Open Meetings Act probably contributes little to the understanding by parties to cases of the reasoning used in development of an order and certainly has no impact on general public understanding or that of the media.

The full application of the Open Meetings Act is a major contributor to uncertainty in Illinois utility regulation largely because it degrades the quality of decision, making more likely debilitating partial remands.

Bifurcation — Alienation of Staff and Commissioners

Closely associated with the judicialization of the process has been the ongoing separation of the ICC staff from the Commissioners themselves. The bifurcation of the regulatory agency into a staff and "tribunal" comes in many forms. The essence, however, is that staff who are participating in cases as witnesses, presenting evidence and opinions, become merely another party to the case and therefore subject to the same *ex parte* rules as other parties. They are cut off from Commissioners with respect to the issues in the case in which they testify or are otherwise involved. Again, the problem here is that *de jure* or *de facto* bifurcation of the regulatory body is a step toward judicialization and away from economic regulation. It is so in two respects.

First, bifurcation begins to undermine the role of staff as the Commissioners' own experts. It is not enough that Commissioners have personal assistants or that other professional staff can serve as advisors. ICC staff resources are limited. Most major cases will result in a severe limitation on the staff expertise actually available to Commissioners in deciding the case. This can only serve to degrade the quality and consistency of decisions, again increasing uncertainty. Continuity of advice and the ability to maintain constant contact between Commissioners and the staff is crucial, but is being lost the more that staff are dragooned into cases and therefore become inaccessible to the tribunal.

Second, bifurcation undermines the ability of the Commission to act as a positive force, shaping the future rather than being reactive. The more that the Commissioners are not a team but rather two separate forces in the process, the more the Commissioners are involved largely at the 11th hour, and therefore less able to articulate meaningful policy.

RETROSPECTIVE RATHER THAN ANTICIPATORY REGULATION

The substance of a decision to be made in the future is naturally more uncertain than the substance of a decision made today. To the extent that conditions and decisional rules can be expected to remain constant then the uncertainty about a future decision can be mitigated. But that is not the case with utility regulation in Illinois today.

Fully seven years since the passage of the new Public Utilities Act there is little consensus on what the rules of the game really are. But it can at least be agreed that there is no reason to expect that market conditions will remain largely the same. Future regulatory decision in Illinois must currently be considered highly problematic — uncertain.

The reality of utility planning and operation today in Illinois is that what in the past may have been normal business decisions and investment are undertaken with a greater sense of risk. This is due in part because it is expected that not only will the efficacy of management choices be addressed only far down the road but that standards for evaluation will themselves be established only in the future.

The problem of retrospection as the official vantage point of Illinois utility regulation has been reinforced in recent years, in great part by the growing judicialization of the system.

Fuel Reconciliation Cases

The advent of the electric fuel adjustment clauses in the late 1960s and early 1970s was meant to remove much of the uncertainty which had developed due to an incongruity between the operation of regulation and the market. Fuel prices — especially in the context of the 1973 oil embargo — became volatile and were seen to be surging inexorably upward. The problem was that regulation tended to treat fuel prices as if they were stable. In addition to becoming volatile, however, it was also clear that fuel prices had gotten well beyond the ability of utilities to influence. Utilities and their customers were at the mercy of a manipulated oil market.

The FAC was intended to relieve utilities of much of this uncertainty by permitting actual fuel costs to flow through to customers relatively unimpeded. Up and down changes in fuel costs relative to some base cost set in a rate case would be promptly reflected in customer prices. There would then periodically be a proceeding to reconcile a year or more of these rolling price adjustments, largely to determine if the costs being reported by the utility were accurate. Interestingly, questions of prudence were fairly low on the list of consideration at the time the FACs were developed for the simple reasons that the FAC was meant to be a protection for utilities, not an added risk.

Currently, the FAC reconciliation proceedings in Illinois have come to be mechanisms in which fuel acquisition decisions are being revisited many years after the basic choices were made and even many years after the fuel has been consumed. This represents a fundamental departure from the original design of the FAC. Some states, California being an example, continue to review fuel costs annually and make a prompt reconciliation.

In Illinois, now that prudence questions have become the central point of discussion in FAC cases, many hundreds of millions of dollars in costs for fuel consumed many years in the past are placed at risk. It can fairly be said that the delay now involved in FAC cases means that virtually no one present on the regulatory side was present during the period that the fuel acquisition decisions being reviewed were made or present even during the more recent period when the fuel was actually consumed. This is a relatively new risk factor and has increased uncertainty for utilities and their investors.

There is another side of the coin in the fuel reconciliation process, this one involving local natural gas distribution companies, in contrast to the way in which electric FAC proceedings have developed into elaborate prudence reviews of old decisions. While the fuel market for electric utilities has changed, but not radically so, that for the gas LDC's has changed radically. Far from having virtually no choices about gas prices just ten years ago, LDC's today have a vast range of choices and options. Yet, gas purchases by LDC's are treated by regulation in Illinois much as they were ten years ago — with costs flowed through the clause and only subjected to minimal review.

Gas and electric utility fuel acquisition do, however, share one important theme in terms of regulatory review. There are only risks and no rewards. Utilities, especially the electrics, run the risk of having to refund money to customers if they are judged to have made bad decisions. No matter how good their decisions were, however, the best they can do is recover their actual costs.

This particular problem is not unique to Illinois. Most states continue to treat fuel costs as a pass-through rather than applying some form of incentive regulation which affirmatively encourages more efficient fuel choices, power plant dispatching, power purchases from other utilities, more creative use of gas storage and more astute use of off-season gas purchasing.

Deferred Charges — the Loss of Faith

It is fair to say that today, any significant deferred charge booked by an Illinois utility, even if founded directly on an accounting order from the Commission, will likely be deeply discounted by investors. The expectation must certainly be, given recent events, that deferred charges are significantly at risk of non-recovery.

The problem here is far from trivial. The utility industry, along with other types of regulated industries — banking and insurance, for example — is founded on specialized accounting which permit a firm to reconcile cash flow and operational realities with the more unusual characteristics of the business as further affected by regulation.

The inability of Illinois utilities and their investors to confidently rely on established accounting mechanisms as a way of reflecting the actual worth of the enterprise must lead to greater uncertainty and therefore a higher cost of capital than would otherwise be the case.

Construction Cost Audits

It is unclear what the future is of the construction cost audit. Some might argue that the highly politicized environment which surrounded the audits of the Clinton, Byron, and Braidwood units will not be repeated in future cost audits. But the audit process itself is one which has been carried out so far on a retrospective basis such that costs long ago incurred and decisions made many years before are revisited by auditors who may or may not have much substantive knowledge about the areas they have been assigned to audit.

Exacerbating the problem of retrospection in the cost audit is that there really are no standards which are identifiable for utilities with respect to going forward projects. For instance, in most businesses one would expect that a cost would be considered reasonable or low if it were below that incurred by others in the same industry in the same time period — a benchmark. But that, of course, was not the standard in the audits of the five nuclear units. The four Commonwealth Edison units were, even before disallowances, among the least expensive in the world. The Illinois Power unit at Clinton, however, remained one of the most expensive to come on line, even after the disallowances.

While little should be expected in the way of utility owned power plants for some time to come in Illinois — or most anywhere else — the question must be asked, what are the standards for future audits such that utilities can measure their own performance on an ongoing basis?

Finally, there is a perverse dimension to the construction cost audit which has yet to be addressed by the courts. The cost audit, its conduct and its timing are entirely under the control of the Commission. Yet no utility asset subjected to the cost audit can be given recovery and a return until the audit has been completed and evaluated. Thus, failure on the part of the ICC results in costly delay and even in deprivation of recovery costs, especially to the extent that post-construction deferred charges are booked but are made subject to the vagaries of fate regulatory decisions.

INCONGRUENCE BETWEEN PLANNING AND ACCOUNTABILITY

The problem of retrospection does not merely involve the way in which conventional aspects of regulation are being altered, but the way in which an important, recently developed feature is being handled.

Under the 1985 law, a planning process has been established in which, for all practical purposes, the ICC, the Illinois Department of Energy and Natural Resources (DENR) and various intervenors take a direct role in charting the future course of the utility. Demand forecasts, estimates of customer needs, resource type and acquisition, acquisition methods and even means of recovery for such costs as those related to demand side management are all within the purview of the new planning process.

The planning process not only involves a review of a utility's plans but those plans are ultimately delimited by an order from the Commission telling the company what it can and cannot do. However, this delimiting order is issued with the caveat that once having defined the future in such an order, the ICC specifically incurs no responsibility for the results. The ICC order does not imply any finding of prudence for the path the company has been ordered to take, nor are the associated estimated costs implied to be reasonable for purposes of a future rate case.

This represents the ultimate Catch-22 in utility regulation. The government directs a utility to do or not do certain things. However, if the company follows this direction in every detail, there is no presumption or reasonableness of cost.

LOOKING FOR SOLUTIONS

I was not charged, when given the assignment to make this presentation, to go beyond a description of the current regulatory situation in Illinois to suggesting a prescription for any changes for problems I might identify.

But it is not enough to criticize.

While Illinois regulation is quite uncertain at the moment, the Illinois Commission, in particular, does have some strengths to build on if it chooses to do so.

The first rule for change is to avoid looking to changes in the law. There is little chance that the law can be made measurably better in the current political climate.

The second rule for change is to look to the realities of the utility marketplace for guidance on the direction which should be taken to deal with the problem of regulation induced uncertainty. The key reality of the market is that it is dynamic and that competition is becoming the defining force. This would imply that the forces of competition should actually be leveraged to reduce the uncertainty that has grown up.

The following is not intended as an exhaustive list. It is only suggestive of an approach to thinking about how to move away from uncertainty toward a congruence between regulation and the market which defines the real life, every day operations of utilities critical to our public infrastructure.

Establishing Consumer Choice as the Key to Consumer Protection

The essence of competition is that multiple providers of service are struggling against one another to meet the varied needs and demands of consumers. Consumers have the choice of dealing with one provider or another, basing that choice on personal consideration of price, quality or other factors. While more and more choice is potentially available to utility consumers by reason of technology, market and federal regulatory changes, much of the effort in utility regulation still seems devoted to consumer protection predicated on the denial of choice.

Peter Huber has referred to this as "regulatory apartheid," a genuinely provocative phrase. Simply put, however, regulators do have choices about how much choice they actively work to ensure will be made available to consumers.

Uncertainty for utilities is generated by regulation to the extent that regulation and the market are out of sync. Denial of choice, while perhaps consistent with a utility's current thinking, creates the illusion that regulators can control these market forces. The truth is that market forces eventually come through but that utilities are left in the position of being less competitive and held back by a variety of rules and constraints.

The first step for the Illinois Commission could be to establish the maximizing of consumer choice as the regulatory principle against which it will measure its discretionary decisions. Thus, utilities could be on notice that the basic standard which the ICC would want argued out in front of it would be the question of whether consumers would have more or less choice given under a specific proposal.

Consumer choice operates effectively as a planning signal for industries throughout the rest of the economy and will work with utilities if it is the agreed upon standard, replacing a top-down approach in which utilities, regulators, and various professional intervenors claim the mantle of deciding what is best for consumers.

Modernizing Fuel Adjustment and Purchased Gas Adjustments

The ICC could act to bring all such cases current as an important step in the direction of converting to an incentive system in which both electric and gas companies have a balance of risk and reward in their fuel acquisition decisions. The standard of prudence should ultimately be, on a going forward basis now that the rules of the fuel market itself have changed, one of competitiveness.

The risk and reward balance should be based on the ability to achieve better than average performance in fuel costs and reliability. Above average performance results in reward while worse than average will result in loss. The best mechanism for both reward and loss are those provided by the market itself. To the extent they are mediated through regulatory proceedings, they should be prompt and carried out according to prescribed, well-known standards which are adhered to faithfully.

Residential Gas Customer Choice of Supplier

Many thousands of modest sized industrial and commercial gas consumers exercise choice of supplier, utilizing the transport service of the LDC. In Toronto, something like 40 percent of all residential consumers have signed up with suppliers other than the local LDC.

The information technology, the entrepreneurial spirit and the consumer knowledge exist which would make successful competition for gas supply service to residential customers. Not only would many gas marketing companies already providing valuable savings to industrial and commercial customers be prepared to participate in such a market, the LDC should be encouraged as well.

A gas LDC could simply be required to establish two or more gas supply marketing arms which would then compete with one another and other independent marketers for the affections of residential gas consumers. The model of long distance presubscription is applicable here.

There could be several simple enough conditions. The LDC would have to treat all gas supplier companies the same, avoiding favoritism. There could be a supplier of last resort or other residual market mechanism so that all customers would be served. Overall, we should expect that the inefficiencies of the current gas acquisition system for residentials would be squeezed out by giving consumers choice.

Real-Time Pricing

Conventional electric rate design is incongruent with the actual costs of production and with the fact that available information technologies can easily make current production cost information available to many customers. In order to maximize customer choice, set the stage for effective demand-side management and to optimize system load factor, the ICC should encourage real-time pricing experiments. While one would expect these experiments to focus on the industrial and commercial sectors, it could spread to the residential and permit, for instance, penetration of the water heating market by electric utilities.

Make DSM a Profit Center

At this juncture, demand-side management in Illinois is still pretty much an orphan. The prime obstacle to an emerging role for DSM in utility planning and customer service is that utilities are entirely uncertain as to the regulatory treatment of investment in DSM. By acting soon to establish a mechanism which allows, in fact encourages, DSM as a profitable activity for utilities, Illinois utilities can more confidently plan a future which incorporates serious DSM.

Concurrent Construction Cost Audits and Upfront Prudence

Retrospective audits must necessarily be distortive. The most appropriate way to conduct future cost audits is to establish some reasonable protocol which permits a periodic review of practice and costs as a project proceeds. The objective should be to assure a reasonable congruence with the basic plan and cost provided to the ICC at the time the project is authorized or undertaken. In this way, cost audits can be concluded soon after project completion rather than perhaps years later. The Commission should take its cue from the rolling prudence associated with the periodic review of certificates of public convenience and necessity in the 1985 Public Utilities Act.

The least cost planning process can be rationalized in a way which can provide a high degree of assurance and responsibility on the part of the ICC with respect to actions the ICC itself directs a utility to take.

There is no reason that the Commission, in ordering a utility to take certain actions stemming from an approved least cost plan, should not also make a determination that it finds the actions to be prudent at that point in time.

Second, there is no reason that the Commission should not also set a cost figure which it judges at that time to be a reasonable one for the carrying out of the project.

Third, as a move toward incentive regulation, the utility could be rewarded for completion at a lower cost or could suffer loss for exceeding the reasonable cost.

A utility should be permitted to take a path other than the one specified by the order of the Commission but would have to do so under retrospective regulation of prudence and reasonableness of cost.

Encourage Innovation

It is no secret that due to the enormous uncertainties in Illinois regulation, utilities in the state are extraordinarily reluctant to initiate a proceeding, even if the goal would be an improvement in service or an important innovation. One way for the ICC to encourage innovation and to elicit creative ideas from utilities is to provide an assurance that when presented with new ideas such as ones for incentive regulation, the ICC would issue only permissive orders which would allow the company to choose whether to ultimately proceed with the plan as modified by the Commission. The unfortunate prospect now is that to present an idea is to signal some sort of open season in which the result may well be less palatable than the current situation.

By making such orders and innovative efforts permissive rather than mandatory, the ICC is likely to begin to elicit far better ideas and greater efficiencies in a competitive market than either it or the utilities themselves thought possible.

The Commish Olympics

There is always room for new ideas in regulation since the market is always changing. Rather than permitting others to trap it in the battles of the past and to deprive it of the opportunity to look to the future in a confident way, the ICC needs input from interested people.

One way, which would be good clean fun, would be the Commish Olympics. The ICC would issue a call for ideas on new ways in which in could do its formidable job. It could then evaluate them and perhaps select three for the Gold, Silver and Bronze medals and then actually undertake to see if the ideas could be operationalized. If there is going to be uncertainty, then let it be over which best idea the Commission will select.

Table 1

THE CHANGING UTILITY ENVIRONMENT
FINANCIAL FACTORS

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
Inflation & Interest Rates	Stable Rates	Increased Inflation — OPEC Oil Embargo & Iranian Revolution	Decreasing, Stabilizing Rates
Rate Base	Declining Costs — Profitable Rate Base	Rising Costs — Unprofitable Rate Base	Uncertain Rate Base

Table 2

RESOURCE OPTIONS

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
Nuclear	Low Costs	High Costs	Uncertain Future
IPP / Cogeneration	Limited Acceptance	Utility Opposition	Growing Acceptance
DSM	Load Growth Promotion	Utility Opposition / Conservation Mentality	Potential Profit Center

Table 3

ENVIRONMENTAL FACTORS

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
Clean Air	Little Restriction	Clean Air Act of 1970 — Command & Control	Clean Air Act of 1990 — Market Mechanisms
Nuclear	AEC Promotion	NRC Regulation	Post TMI — Massive Regulation / New Licensing Law & Waste Problem

Table 4

FUEL SUPPLY

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
Oil	Relatively Stable Price	Rising Costs - 200% Escalation	Low Prices, Gulf War
Gas	Low Regulated Price	Rising Costs, Regulated, Shortages	Deregulated Declining Prices, Market Sensitive
Coal	Stable Price	Rising Prices from Environmental Controls	Prices following Gas-Oil, Acid Rain & Global Warming
Nuclear	Declining Price Projections	Fuel Price Stable	Low Prices, Russian Surplus

Table 5

REGULATORY CLIMATE

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
PUCs	Favorable	Supportive	Seeking Alternatives & Highly Varied
NRC	Favorable	Restrictive & Burdensome	Massive Post-TMI Trauma
FPC/FERC	Favorable	Increased Regulation	Promoting Competition

Table 6

GROWTH AND PRICE

Time Period	Pre-1973 Embargo	1973 — Early to Mid-1980s	Mid-1980s to Present
Peak Load	7.4% per Year — Straight Line	Dropped to 0 in 1973 — Unexpected Declines from 1973-1982 w/ 2.6% Annual Average	Utility Estimates too Low — Tracking GNP
Price	Low, Stable Reserve Margins — Fell during 60s due to Larger, More Efficient Generating Units	Rapidly Rising with Fuel Prices & Increasing Inflation	Relatively Stable vs Inflation — Enviro Costs?

Table 7

RANKING OF ILLINOIS ELECTRIC UTILITIES REVENUE PER KWH SALES

Rank	Utility	Average Rev/KWH (¢)
1	Long Island Lighting	13.69
3	Consolidated Edison (NY)	12.71
8	Southern California Edison	10.26
9	Philadelphia Electric	10.25
11	Pacific Gas & Electric	10.14
15	Northeast Utilities	9.54
17	Duquesne Light	9.30
27	Centerior Energy	8.86
28	Arizona Public Service	8.76
32	Detroit Edison	8.39
35	**Commonwealth Edison**	**8.20**
41	Florida Power & Light	7.55
52	**Illinois Power**	**6.86**
53	Northern Indiana Public Service	6.81
60	**Central Illinois Public Service**	**6.43**
68	Consumers Power	6.21
69	**Iowa-Illinois Gas & Electric**	**6.21**
80	**Central Illinois Light**	**5.69**
84	Duke Power	5.59
100	**Interstate Power**	**4.85**

Source: Edison Electric Institute

Table 8

COMPARISON OF LOST MARKET VALUE TO INFRASTRUCTURE DEBT

Total Loss in Market Value in Commonwealth Edison & Illinois Power (from November 29, 1992 to September 30, 1992	=	$4.16 Billion
Total State General Obligation Debt	=	$4 40 Billion
Total City of Chicago Capital Debt	=	$1.46 Billion
Total Illinois Revenue Bond Debt	=	$1.86 Billion
Total	=	$3.32 Billion

Table 9

ILLINOIS UTILITY REGULATION SOURCES OF UNCERTAINTY

I.	Competition and Unraveling of the Monopoly
II.	Judicialization of Economic Regulation
III.	Retrospective rather than Anticipatory Regulation
IV.	Incongruence between Planning and Accountability

Table 10

COMPETITION AND THE UNRAVELING OF THE MONOPOLY

• PURPA
• NGPA
• Pipeline Open Access
• Wellhead Price Deregulation
• Electric Wholesale Competition
• PUHCA Reform
• Transmission Access

Table 11

JUDICIALIZATION OF ECONOMIC REGULATION

I.	Partial Reversal and Remand
II.	Lengthy Delays
III.	Too Much Sunshine
IV.	Bifurcation — Alienation of Staff & Commissioners

Table 12

RETROSPECTIVE RATHER THAN ANTICIPATORY REGULATION

I.	Fuel Reconciliation Cases
II.	Deferred Charges — The Loss of Faith
III.	Construction Cost Audits

Table 13

INCONGRUENCE BETWEEN PLANNING AND ACCOUNTABILITY

I.	Least-Cost Planning
II.	No Presumption of Prudence
III.	No Presumption of Reasonable Cost

Table 14

LOOKING FOR SOLUTIONS

I.	Consumer Choice as Basics for Consumer Protection
II.	Modernize FAC & PGA
III.	Residential Gas Customer Choice of Supplier
IV.	Real-Time Pricing for Electricity
V.	Make DSM a Profit Center
VI.	Concurrent Construction Cost Audits
VII.	Upfront Prudence
VIII.	Encourage Innovation
IX.	The Commish Olympics

Figure 1
ILLINOIS UTILITY MARKET CAPITALIZATION CHANGES

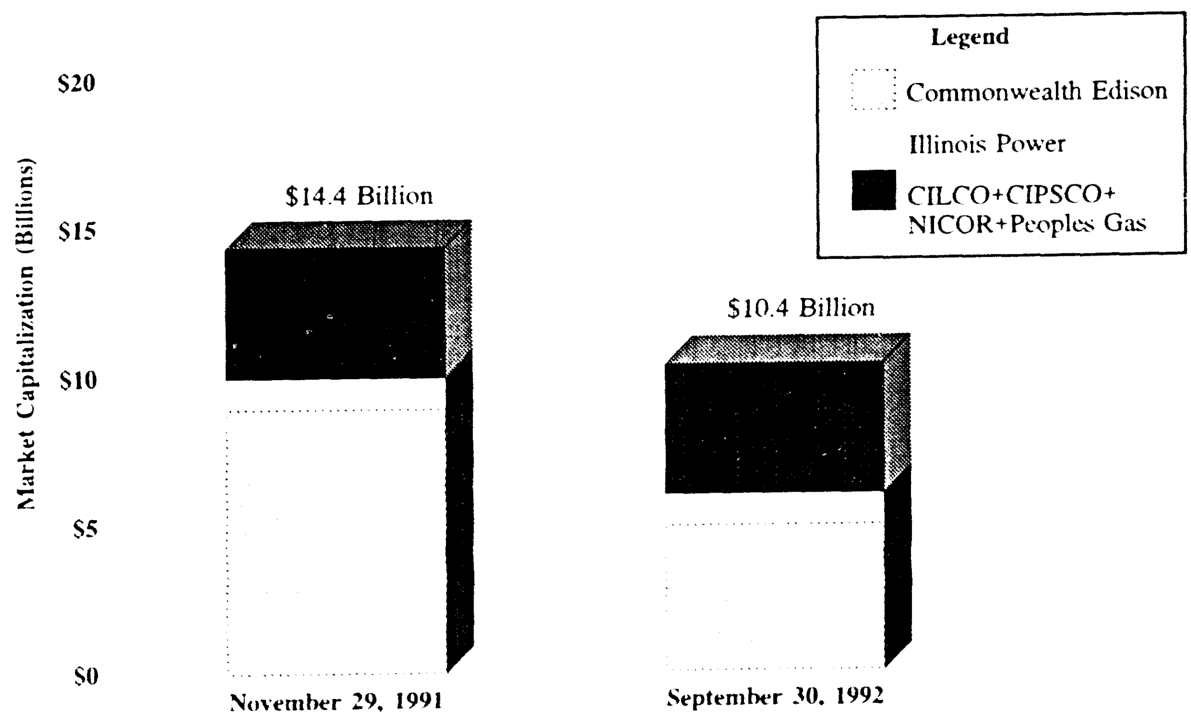
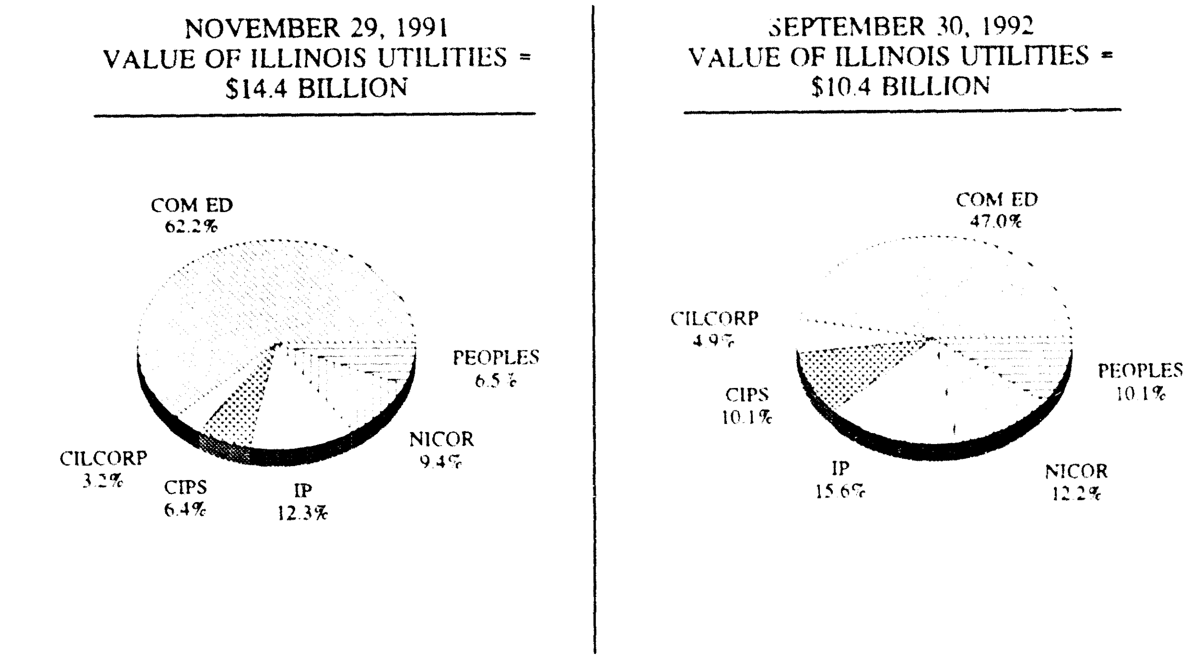


Figure 2
COMPANY SHARE OF MARKET VALUE



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