AIIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910

301/587-8202

Centimeter

Inches

MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 2

ORNL/CON-385

PERSPECTIVES ON THE FUTURE OF THE ELECTRIC UTILITY INDUSTRY

Bruce Tonn
Oak Ridge National Laboratory

Anthony Schaffhauser
University of Tennessee, Knoxville

April 1994

Prepared for
U.S. Department of Energy

Prepared by
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

CAAA	Clean Air Act Amendment
CEM	continuous emissions monitoring
CFC	chlorofluorocarbon
DISCO	distribution company
DOE	U.S. Department of Energy
DSM	demand-side management
EEI	Edison Electric Institute
EIA	Energy Information Administration
EMF	electromagnetic field
EP Act	Energy Policy Act of 1992
EPRI	Electric Power Research Institute
ESCO	energy service company
EWG	exempt wholesale generator
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FIRC	Federal Infrastructure Regulatory Commission
HGP	Human Genome Project
IOU	investor-owned utility
IPP	independent power producer
IRP	Integrated Resource Planning (DOE program)
IT	information technology
IVHS	Intelligent Vehicle Highway System
M&A	merger and acquisition
NEPOOL	New England Power Pool
NIMBY	not in my back yard
NOPE	not on planet earth
NUG	nonutility generator
POU	publicly owned utility
PUC	Public Utility Commission
PURPA	Public Utility Regulatory Policies Act of 1978
QF	qualifying facility
RTG	regional transmission group
TRANSCO	transmission company

ABSTRACT

This report offers perspectives on the future of the electric utility industry. These perspectives will be used in further research to assess the prospects for Integrated Resource Planning (IRP). The perspectives are developed first by examining economic, political and regulatory, societal, technological, and environmental trends that are (1) national and global in scope and (2) directly related to the electric utility industry. Major national and global trends include increasing global economic competition, increasing political and ethnic strife, rapidly changing technologies, and increasing worldwide concern about the environment. Major trends in the utility industry include increasing competition in generation; changing patterns of electricity demand; increasing use of information technology to control power systems; and increasing implementation of environmental controls. Ways in which the national and global trends may directly affect the utility industry are also explored.

The trends are used to construct three global and national scenarios—"business as usual," "technotopia future," and "fortress state"—and three electric utility scenarios—"frozen in headlights," "megaelectric," and "discomania." The scenarios are designed to be thought-provoking descriptions of potential futures, not predictions of the future, although three key variables are identified that will have significant impacts on which future evolves—global climate change, utility technologies, and competition. While emphasis needs to be placed on understanding the electric utility scenarios, the interactions between the two sets of scenarios is also of interest.

For example, a radically decentralized electric utility industry (discomania) is compatible with all three global scenarios. However, the current utility situation, as described in the frozen-in-headlights scenario, is unlikely to exist in a global world characterized by heightened environmental concerns and goals for extreme energy efficiency (as described in the technotopia scenario) or characterized by destructive competition and grim social conditions (as described in the fortress-state scenario).

The ramifications for IRP differ widely across the scenarios. In the technotopia-megaelectric future, for example, IRP would still be guided by public utility commission (PUC)-type agencies and prepared by "the" utility, albeit a much larger entity, on average. However, the IRPs would probably encompass longer planning horizons, stress environmental factors much more, need to handle uncertainty and risk better, and include more citizen involvement. In the fortress-state/discomania future, IRPs could be little more than financial statements concerning the viability of companies providing electricity products.

It is recommended that future efforts to improve IRP assume that it will be of use and value in the future. It is also recommended, among other things, that efforts focus on IRP and competition, improving citizen involvement in IRP, developing IRPs from the inputs of multiple parties, the PUCs role in future global and utility scenarios, new public interests in the scenarios which may result in new ideas about IRP and regulation in general, and improving and updating the scenarios contained in the report.

INTRODUCTION

This research was supported by the Department of Energy's Integrated Resource Planning (IRP) Program. IRP is a framework in which all power resources, including demand-side management (DSM), are evaluated against each other to develop resource options that balance supply and demand factors. In 1989, there were 14 states with IRP programs; by 1991, there were 20 (Mitchell 1992); and in 1993, 30 states required IRP (Hocker 1993).

Several other factors have contributed to the increased use of IRP.

- In many states IRP is a means for considering environmental damages of supply options and identifying conservation measures that are cost-effective alternatives.[1]

- IRP can provide for regulator involvement in utilities' resource selections in the planning stage rather than relying only on review after the fact.

- IRP's provision for public participation in utility resource decisions enjoys political favor (Johnson 1992).

- The Energy Policy Act of 1992 (EP Act) encourages IRP adoption.[2]

The goal of this research is to assess the role of IRP in the electric utility industry of the future. This is a challenging assignment because the electric utility industry is facing acute pressures for change and because IRP is a complex process that involves numerous stakeholders. Thus, as a first task, this report develops perspectives on the future of the electric utility industry of the future and uses these observations to develop a set of research recommendations designed to enhance IRP's value in the future.

Briefly, since the early 1990s, it appears that there is wide agreement within the industry that the major change factor facing the industry is competition in generation. What effect this and other change factors will have on the ultimate structure of the industry—and thus, on IRP—is unclear because many of the change factors act in contradictory fashions.

The problem is that competition and monopolies are fundamentally incompatible. Trends of competition in generation threaten utility monopolies. Will competition in generation grow and move on to transmission and distribution, leading to a disintegrated electric power industry? Will factors coalesce to reinforce the utility monopolies and ultimately produce even larger, multiregional utilities? Will the change factors negate each other to such an extent that the current utility industry will remain virtually unchanged, frozen in time?

These are key questions facing the electric utility industry as it heads into the twenty-first century. It is not the purpose of this report to answer these questions or to make predictions about the future industry; rather, this report explores these possible futures and imagines what IRP might be like in these futures. If IRP needs to change character in the future—for example, by increasing citizen involvement or handling longer time horizons—then research on such issues is needed now so that new processes, methods, and tools will be ready when needed.

This report explores the future of the industry from two viewpoints. The first viewpoint focuses on the utility industry itself. The second viewpoint examines the utility industry in the light of wider national and global trends that can profoundly affect the industry. The globalization of our economy is having profound effects on our society, and the concomitant increase in business competition is exerting pressure for greater competition and efficiency in electricity supply. The political and social fabric of our nation is facing turmoil and the turmoil wrought by the changing obligations and roles of utilities appears as a microcosm of these wider changes. Heightening environmental concern is a major political and social issue that is shaping all economic enterprises, particularly energy-related ones. For these and other reasons, a comprehensive scoping of the electric utility industry of the future needs to encompass trends at the national and global scale.

This report adopts a structure advocated by Schwartz (1991) as useful for thinking about the future. The first five sections summarize trends in five key areas: economics, politics and regulation, society, technology, and the environment. The five categories of trends are further divided by whether they are outside or within the utility industry. That is, each section is divided into two sections, one for global and national trends, the other for trends within the utility industry. Global and national trends are also related to their potential impacts on the utility industry. Thus, this chapter follows a logic whereby utility trends are presented within a larger picture of national and international trends.

Section 6 uses the observations on trends to build three global/national scenarios (Sect. 6.1) and three future electric utility industry scenarios (Sect. 6.2). The scenarios are presented in order to organize and present the trends and their potential effects in a meaningful way. Section 6.3 examines consistencies and inconsistencies between the three global/national scenarios and the three utility scenarios. IRP is discussed separately in Sect. 6.4 to foster a deeper understanding of the relationships between global and national change factors, change within the utility industry, and IRP issues.

Section 7 concludes with research recommendations to determine the future needs, opportunities, and challenges faced by IRP.

1. TRENDS DRIVEN BY ECONOMIC FACTORS

This section discusses and documents global/national and utility trends that have come about due to economic factors. A common theme of both sections is increasing competition. The discussion on global and national economic trends is presented first, followed by the discussion on economic trends within the utility industry.

1.1 GLOBAL AND NATIONAL ECONOMIC TRENDS

The major economic trend that is affecting both the United States and other countries is global economic competition. The national economies of the developed world—which include the economic successes of the Pacific Rim countries and, to a lesser degree, developing countries— are becoming increasingly intertwined in complex business relationships and trade patterns. This trend is both led and manifested by the growth of multinational corporations.

Reich (1991) argues that in the globally competitive economy there are no U.S. companies; the multinationals can move people, manufacturing facilities, ideas, and products anywhere in the world, depending on the calculations of competitive advantage. He also argues that for U.S. citizens to compete in this environment, the nation needs to have a world-class *infrastructure*, composed both of traditional items such as roads, bridges, power systems, etc., as well as more innovative items such as *people* and telecommunications systems. According to Toffler (1990), economic power in the twenty-first century will flow from knowledge, not military might or even financial resources. A people-based, knowledge-oriented national infrastructure describes succinctly one potential, favorable future for the United States.

The globally competitive environment, combined with advances in information technology and changes in society, is also prompting major changes in organizations and employment. Handy (1989) states that organizations are moving quickly away from the command-and-control, centralized, and bureaucratic structures that date back to the late nineteenth century. The new organizations, he says, resemble *shamrocks*; a small central core is serviced by contractors, and the contractors by subcontractors, etc. The core is less burdened with employee commitments and can draw on contractor support when needed. The core can also manage several separate but intrinsically related businesses in a federation of business centers. Most major U.S.-based organizations are downsizing, in part due to firms, moving to the shamrock model.

Downsizing is also due in part to the loss of jobs to overseas companies, mainly in the manufacturing sector. For example, Wilson (1993) points out that "the *Fortune* 500 companies have shed 3.7 million jobs, almost 1 of every 4, in the past ten years." These lost jobs are not being replaced by similar jobs, in terms of skills required or pay levels. Thus, as noted by Shor (1992), the American workforce is becoming bifurcated; a small but growing part have no employment, and a large part are working more hours than at any time this century in order to keep their jobs. She also describes how pressures of health care costs both keep employees at their jobs for fear of losing benefits and keep employers from hiring new employees because of the extra benefit costs.

If one combines technology, careerism, the chronically unemployed, global competition, a "sea change" in organizations, and overwork and fear in the workplace, one has drawn a picture of a rapidly changing, pressurized, anxiety-driven national and international economy. Without doubt, this environment is producing new goods and services at an ever-increasing pace. However, one must ask whether people have the time and state of mind to "enjoy" these advances or whether, as Shor argues, overwork and personal debt act to diminish such enjoyment. Future economic trends may well depend upon how these major questions play out.

These powerful national and global economic trends have directly affected the utility industry. For example, the globalization of economic activities has opened new markets for investments in electricity generation facilities in parts of the world where (1) demand is rapidly growing (in particular Southeast Asia), (2) electric industry privatization initiatives are under way (e.g., the United Kingdom and Eastern Europe), and (3) new generation technology is needed (e.g., the former Eastern Block countries). "At least 11 investor-owned utilities, as well as a number of rural cooperatives, are engaged in international utility development projects"

(Washington International Energy Group 1993). Indeed, even U.S. nonutility generators (NUGs) will be competing with U.S utilities for foreign markets (Meade and Poirier 1992).[3]

Also, the fact that developing countries have gained comparative advantages in many mining and manufacturing activities while information services have become more important in developed countries (Wilson 1993) has led to the decline of many electricity consumption industries in the United States (Faruqui and Broehl 1987). For example, information services within the shamrock model structure rely heavily on computers, faxes, modems, and other electronic technologies. These businesses may hold greater potential for electricity load growth than heavy industry due to the comparative advantage of these U.S. firms in the global economy. Indeed, a study by the Edison Electric Institute (EEI) shows losses in electricity sales to the industrial sector are expected to come close to being made up by gains in the commercial sector.

Global economic competition will create pressures for lower electricity prices. Definitely, electricity-intensive industries will argue that in order to be competitive, they will need to pay less for electricity and have more reliable access to power. These arguments are already being played out in the labor markets. Companies can take these arguments to the utilities and also to the Public Utility Commissions (PUCs). Companies are already asking for local energy subsidies in order to maintain jobs in an area or to locate new facilities. Given the global economy, PUCs and utilities may as easily have these discussions with U.S.-based companies as with European or Japanese companies.

How the United States. fares in global markets will have a great impact on electricity demand. This is because the rate of economic growth affects electricity demand. EEI demonstrates that economic growth exerts a significantly more powerful effect on electricity demand than structural changes in the economy or even drastic changes in population growth (Boroush and Stern 1990a). EEI (1994) predicts a slightly lower than 1% change in electricity demand from a 1% change in economic growth and 1.8% growth in electricity demand from 1990 to 2010.

Unfortunately, how successfully the United States will compete in the global arena is unknown. Certain sectors that now compete successfully, such as computers and other information technologies, may be overtaken. On the other hand, one should not ignore the potential for remaining U.S. manufacturing industries to become expanding markets for electricity sales. U.S. manufacturing firms will need to compete with firms in developing countries, and electrification can lower production costs (Faruqui and Broehl 1987).

Lastly, utilities will also be faced with difficult organizational and employment decisions. It will be hard for utilities to not follow business practices evolving in other industries with respect to downsizing, outsourcing, and limiting new hires because of benefits costs. Indeed, many utilities are already downsizing. On the other hand, such practices, while possibly a necessary evil in truly competitive industries, seem to be out of place for heavily regulated organizations acting out a role in a grand "social contract." These conflicting forces could cause anxiety and tension within utilities and between utilities and the public, thus compromising the utilities' ability to perform in an optimal fashion.

1.2 ECONOMIC TRENDS IN THE ELECTRIC UTILITY INDUSTRY

The major trend in the electric utility industry is competition in generation. One factor that has facilitated this trend was the passage of the Public Utility Regulatory Policies Act (PURPA) in 1978, which provided that qualifying facilities (QFs) could sell power to utilities at the utility's avoided costs.[4] In addition, the Energy Tax Act of 1978 offers tax incentives for new NUG units that use renewable energy. Lastly, the exempt wholesale generator (EWG) and transmission access provisions of the 1992 Energy Policy Act (EP Act) promise to further increase competition in generation. While the EP Act is clearly a step toward more competition in generation, how much more competition is currently unclear because the Federal Energy Regulatory Commission (FERC) is in the process of implementing its provisions.[5]

One trend that can be seen as the result of these laws is that utilities are increasingly acquiring new generation resources through competitive bidding. That is, contracts for NUG power are awarded through competitive bidding among potential suppliers (Tenenbaum, Lock, and Barker 1992). By 1989, 18 states had instituted some form of competitive bidding for acquiring new supply (Seligson 1989), by 1991 25 had (Hamrin and Rader 1992), and by 1992, 36 states had adopted or were in the process of adopting competitive procurement programs (GAO 1992). At the time PURPA was passed, there was little interest in building or purchasing power from NUG facilities (Hamrin and Rader 1992). However, as Fig. 1.1 shows, nonutility generation has been growing in recent years.

NUGs are increasing their share of the power generation market for several reasons. One important reason underlying this trend is that utilities no longer enjoy a natural monopoly in generation. Advances in small-scale generation technology have reduced the capital costs of entering the generation market. New technologies that use natural gas have had the most impact (Fig. 1.2).

On top of this, financing costs also tend to be lower for NUGs because (1) NUG projects are more leveraged than utilities' (typically 80% debt, compared to 50%) and (2) construction times are lower (typically 3-4 years, compared to 5-6 years, for example, for a coal plant) (Naill and Belanger 1989).

Utilities' ability to compete with NUGs on price is also impaired because they cannot set their rates, choose their customers, or refuse service. The administrative expenses incurred from rate hearings and other requirements of regulatory procedures must also be borne by the utility. In addition, many utilities are required to engage in activities to achieve social objectives, such as assistance to low-income customers and economic or infrastructure development, for example, by providing discounted electric rates or gratis energy efficiency measures.

Another advantage NUGs have is that they are free from the risks of oversupply. Utilities typically enter into long-term contracts to purchase power from NUGs, and therefore bear risks associated with future demand uncertainties to the extent that PUCs will disallow costs associated with excess capacity. Also, many NUGs are industrial cogenerators that may be able to produce electricity more cheaply than utilities by virtue of utilizing the "free" heat of their production processes. Industrial NUGs may also have worldwide experience in building

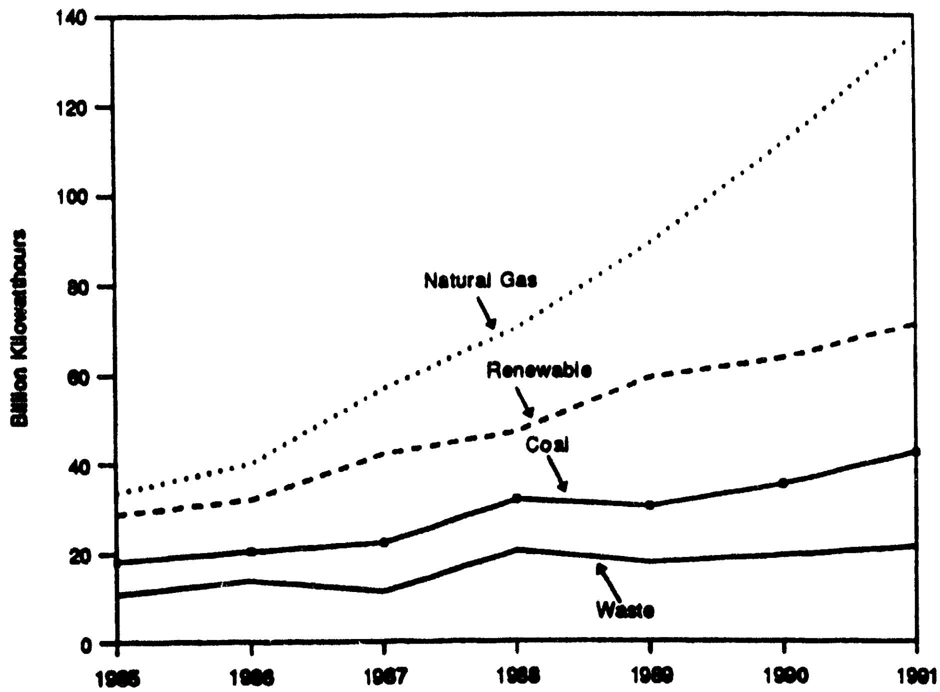
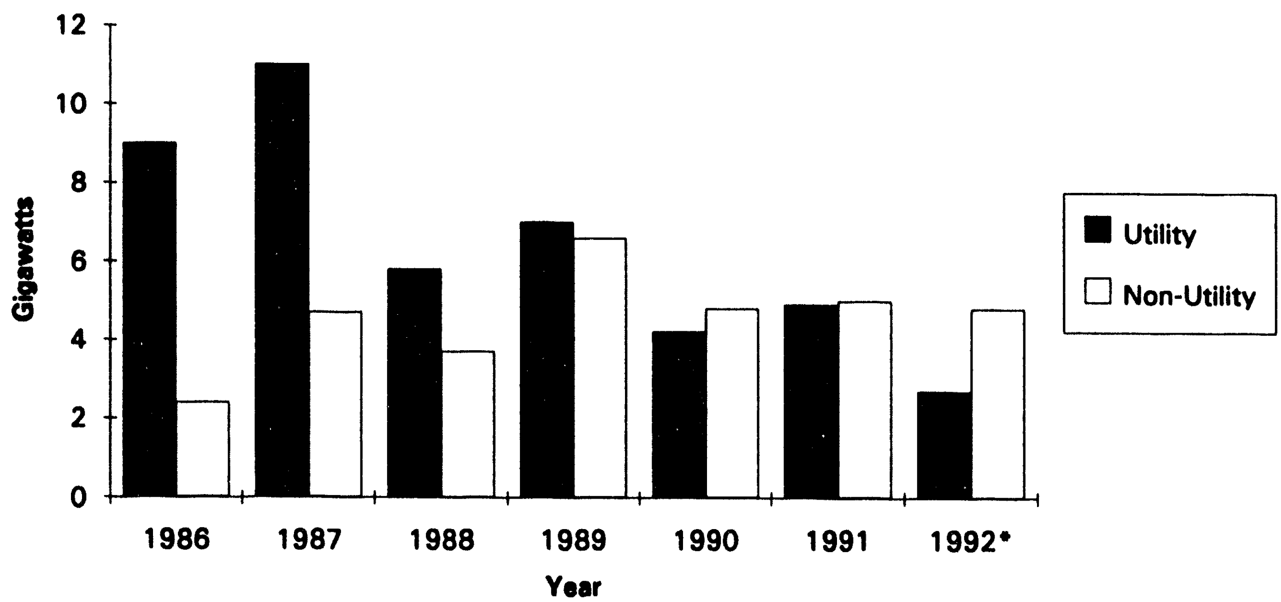


Fig. 1.1 Nonutility generation by fuel.



Notes: •Nameplate capacity is used instead of net summer capability because net summer capability is not collected for nonutilities. •The net increase in nameplate capacity has been adjusted for retirements. •Data shown in Tables C6 and C7.

Source: Utility Capacity: *1985-1991*—Energy Information Administration, *Inventory of Power Plants in the United States*, DOE/EIA-0095 (Washington, DC, 1986 through 1992). Nonutility Capacity: *1985-1990*—Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry/1991* (Washington, DC, October 1992), p. 7. *1991*—Edison Electric Institute, *1991 Capacity and Generation of Non-Utility Sources of Energy* (Washington, DC, November 1992), p. 2.

Fig. 1.2 Utility versus nonutility generation additions.

and operating these types of facilities, which gives them an experiential basis for their competitive advantage.

In the future, the EP Act is expected to give NUGs greater flexibility in selecting the size, fuel, and location of new units such that they can exploit economies of size and advantages of location.[6] This flexibility may allow NUGs to target specific wholesale purchasers, who would be able to shop for the cheapest power supply among a greater number of competing suppliers and over an expanded geographical area. However, there are no requirements or incentives embodied in the legislation to "encourage wholesale buyers to avail themselves of these new opportunities" (Stein 1993).

Given these arguments, available data indicate that utilities indeed do not appear to be competing evenly with NUGs in the United States within the traditional rate-of-return regulatory environment. Of the nearly 13,000 MW of U.S. electricity projects won through competitive bidding, only 15% were won by utilities (Hamrin and Rader 1992).[7]

Whether this trend will continue is unclear. For example, advantages bestowed by QF status do not appear to be the reason that utilities are not competitive in bids. From 1985 to 1990, most NUG electricity was produced for self-consumption, and self-generators are indifferent to QF status. Independent power producers (IPPs) are growing in number. By 1992, 5 IPPs were in operation and 38 others were under development (GAO 1992). However, it could be argued that IPPs are only filling niche markets and are basically competing among themselves. [8]

From another perspective, utilities' financial situation is difficult to predict. In the late 1980s, they were generally in a much better financial situation (mainly due to the ending of large construction projects begun by the 1970s to meet demand that never materialized), and were therefore expected to be relatively financially strong (Yokell and Violette 1988). Dividends for Standard and Poor's 40 Utilities increased every year since 1952, and doubled between 1977 and 1991, although rating agencies have recently downgraded some utilities' credit ratings.

On the positive side, it appears that many, but not all, utilities may be able to attract capital to build new capacity, repower old capacity, or manage demand as new capacity is demanded.[9] The bulk of capacity additions through 2010 are projected to be utility projects (EIA 1993a).

Utilities have been reducing risks of new generating ventures, and thereby becoming more competitive with NUGs, by emphasizing small power units. In 1991, the average size of all new generating units was only 137 MW. While many 200-400 MW units were planned over the following 5 years, this still represents a downsizing trend in generation facilities (Washington International 1993).

In terms of utilities' existing generation plants, the economics of these facilities suggest that many will continue to be operated even under much more fierce competition. It may be a while before any new generating technology takes hold because the total costs of today's upcoming technologies may higher than the operating costs of existing capacity, although new environmental regulations could easily reverse this situation. Operating existing amortized units, repowering or switching fuels for existing units, or even putting completely new units on existing sites, may all be competitive utility ventures.[10] Difficulties in siting new plants could make these ventures even more competitive. Furthermore, repowering presents a particularly promising opportunity for near-term utility asset building because utilities will not generally be required to solicit competitive bids for these projects (Dasovich, Meyer, and Coe 1993).

Utilities are also trading off the need to build new units with demand-side management (DSM). Meade and Roseman (1992) report: "In 1990, DSM programs cut annual electricity use by 1.3 percent and summer peak demand by 3.7 percent . . . [It is estimated that] DSM will represent 21 percent of resource additions to utilities' peak capacity by 2000 . . . [and] 7 percent of total resources, . . . the equivalent of 4 percent of total generation, . . . [and] will cut national summer peak 6.7 percent or 45,000 MW."

Recently, bidding procedures for demand-side resources have come into use, thereby providing a DSM market for nonutility and utility affiliate energy service companies (ESCOs). Some 17 utilities in at least 11 states have issued solicitations for DSM bids; 12 put DSM head-to-head with supply options (Meade and Roseman 1992).[11] Thus, it appears that competitive bidding can augment utilities' selection of the least-cost mix of DSM and generation resources.

Increasing competition in generation may lead to increases in power wheeling and greater pressure for retail wheeling. One reason is that there is mounting evidence that increased and more complicated power transactions on the grid are technically feasible. It may be more that dollars instead of actual power are wheeled, but the results will be the same. This opportunity will "prompt businesses facing competitive pressures to demand the opportunity to sidestep high-priced utility services and seek out the benefits that accompany enhanced competition and increased choice" (Dasovich, Meyer, and Coe 1993). In some areas, retail access is already a reality, and in other areas pressures for retail access have emerged (see Textbox 1).

Four changes have been proposed to create a retail-level competitive electricity market: (1) separating distribution companies from bulk power suppliers, (2) making transmission systems into common carrier entities, (3) instituting futures and options markets for electricity, and (4) allowing consumers to shop around for their power supplies. Great Britain is in the process of adopting these changes, and its experience will influence our policy. Many believe that this should be the structure of the industry in the next century.

It should be noted that these ideas may meet significant resistance from the utilities because of the possibility that their physical assets could be worth less or worthless, depending on the level of industry disintegration. In other words, utilities would face the situation where their assets, which are substantially depreciated, would be "stranded," built for a customer base that was assumed not to have the opportunity to abandon utility service. The value of these assets is enormous, and utilities are likely to resist changes in the industry that would jeopardize their existing capital base.

In any case, increasing competition is leading to major changes in utility business practice. According to the Washington International Energy Group (1993), "more than half [of U.S. utilities] have made what they call 'fundamental changes' in their way of doing

Textbox 1: Is Widespread Retail Wheeling on the Horizon?

The following places have retail wheeling.

- The United Kingdom is implementing a common carrier electricity distribution system that will allow retail customers to select from competing suppliers.
- Pacific Gas & Electric currently provides the city of San Francisco with retail wheeling services.
- In Georgia, four utilities have created the Integrated Transmission System that allows any customer with demand greater than 900 kilowatts (kW) a choice of suppliers within the commonly owned grid.
- In Minnesota, the Minnesota Municipal Power Agency expects to wheel purchased or self-generated power over the Northern States Power transmission system.

Evidence of the mounting pressure for retail access has manifested itself in the following areas.

- The State of New Mexico considered and rejected legislation that would have provided retail access.
- The Texas Public Utilities Commission (PUC) has recently issued a rule proposing retail wheeling as a demand-side management tool.
- The California Large Energy Consumers Association recently requested that the state's PUC expand its study on nondiscriminatory transmission access for generators to examine retail wheeling and self-supply wheeling. The California PUC denied the request.
- In Washington, D.C., a Federal Energy Regulatory Commission (FERC) decision to exclude end users from recent utility mergers' transmission provisions was appealed to the Circuit Court. The court viewed the decision as being inconsistent "with the position [the FERC] has taken under the Natural Gas Act in the comparable situation involving end users by-passing a local distribution company," and remanded the decision to FERC for further consideration.

Sources: ["Retail Wheeling: Get Ready," *The Electricity Journal*, November 1992, 4-5.]; Burr 1992a; Dasovich, Meyer, and Coe 1993; and Tenenbaum et al. 1992.

business." These fundamental business changes include implementing new management techniques to improve profitability and efficiency; emphasizing small power plants, repowering, DSM, and customer service activities; and directing attention to potential markets outside of the utility's service area. Utilities are also downsizing and relying more on contracting firms. According to the Washington International Energy Group (1993), "more than two-thirds of U.S. utilities have downsized."

While the industry has always been fragmented, the forces of competition, disparities in rates, financial condition, management capability, and reserve capacity, as well as the potential to gain valuable transmission assets, have led to an upsurge of merger and acquisition (M&A) activity. In addition, the fact that administrative and general expenses (e.g., billing, customer service) do not increase linearly with utility size means that consolidation in the industry could reap valuable scale economies or "synergies" of operation. Seligson (1989) mentions some dozen proposed and completed M&A transactions, and of the utilities surveyed by Washington International in 1992 and 1993, 20 to 30 percent were involved in M&A activity.

Kahn (1991a) states that regional power pools can also "achieve scale economies in generation and power system operation" for both investor-owned utilities (IOUs) and publicly owned utilities (POUs).[12] In terms of POUs, smaller municipal and rural cooperative distribution entities are expected to be at a disadvantage in bargaining for bulk power purchases compared to larger utilities in larger, post-EP Act electricity markets. If this is the case, regional power pools may serve the function of gaining bargaining power for POUs.

More generally, the formation of regional transmission groups (RTGs) has been proposed as a means of coordinating the operation of separately owned, interconnected transmission facilities while providing access to owners and nonowners in the region.[13] RTGs could facilitate voluntary regional transmission agreements; all parties owning transmission or wanting access would construct "a single multi-party agreement rather than a multitude of individual transmission tariffs" (Tenenbaum, Lock, and Barker 1992). RTG-type agreements exist in Georgia and Indiana, but the companies are not involved in much direct competition. It remains to be seen if such agreements can survive with competing generation firms (Tenenbaum, Lock, and Barker 1992).

Utilities are also diversifying into unregulated ventures within or outside of a utility's service area. Diversification grew rapidly in the 1980s, and growth is expected to continue (Dasovich, Meyer, and Coe 1993).[14] Many utilities may become holding companies owning shares in separate, unregulated generation companies. The goal of this restructuring is to obtain a more equal competitive footing compared to unregulated generating companies.[15] Ownership by a nonregulated entity can facilitate advantageous capital restructuring that is more highly leveraged than regulators would allow for a utility.[16] The jury is still out as to whether the majority of these forays have been successes or failures.

It is important to note that consolidation is occurring among NUGs just as it is among utilities, manifested in part by utility-affiliate NUGs buying interests in independent power producers (IPPs) and their projects. Burr (1992a) cites "trends toward larger projects, lower avoided cost levels, a sluggish economy, siting difficulties and financing complexities" as the factors encouraging M&As and joint ventures among NUGs. Utility affiliates currently account for about 14% of NUG capacity in the United States (*Fitch Insights*, June 8, 1992, p. 9).

Lastly, some utilities are responding to competition by targeting niche markets and new products. For example, some utilities may do best to exploit niche markets by specializing in particular areas of expertise such as cogeneration, fuel cells, electrotechnology, photovoltaics, or energy storage. Utilities that own strategic transmission corridors or intersections may be able to make money collecting tariffs for transmission access (Washington International 1993). DSM and energy efficiency is another potential specialization for utilities or their affiliates.[17]

The Washington International Energy Group (1993) states that the utility industry should move its focus to the "other side of the meter." For instance, utilities have been developing and promoting the all-electric Smart House, which indicates a strong interest in customer service markets (McGrath 1990). However, utilities will likely face stiff competition from nonutility ESCOs. Utilities are also considering other customer-service oriented changes such as differential pricing for various levels of service quality or reliability. Utilities could also provide meter-reading services for gas and water utilities.

The overall conclusion is that increasing competition is a powerful force shaping both the future economy (thereby shaping the future electricity customer) and the future utility industry. In the short run, there are no longer economies of scale in generation. It is unclear (1) how major issues associated with the globalization of our economy will develop and affect the utility industry, (2) how much competition in the utility industry will increase, and (3) whether the industry will respond to increasing competition by consolidating into ever larger multiregional institutions or disintegrating into numerous, smaller size competitors.

2. POLITICAL AND REGULATORY TRENDS

This section reviews the trends in politics and government regulation that are shaping the world and the utility industry of the next century.

2.1 GLOBAL AND NATIONAL POLITICAL AND REGULATORY TRENDS

Ironically, the post-Cold War world, which enjoys a lessening of the nuclear threat, is characterized by violence rooted in religious and ethnic conflict and widespread political turmoil. Religious and ethnic strife form the heart of the 40-plus violent conflicts currently being waged in the former states of the Soviet Union, in the former Yugoslavia, in Northern Ireland, in Somalia, and in numerous other countries and regions. Many of these conflicts have been waged for many years; others have arisen after the breakup of the Eastern block and the fall of Russia from superpower status. One wonders whether any solid and lasting social organizations will emerge from these conflicts and whether existing social and business organizations will survive.

Some, such as Huntington (1993), do see the potential for long-term instability. He sees a worldwide clash of cultures, mainly Islam versus the rest of the world, as a major source of tension and insecurity. The inability of different cultures to understand and tolerate each others' values could cause instability in international trade, disrupt national economies, lead to acts of terrorism, and diminish the prospects for world cooperation to solve global problems, such as global environmental problems.

Others, such as Hadar (1993), believe that the threat of significantly disruptive worldwide instability is overrated but that the world needs strong leadership. Many believe that the United States is the only country in the world that possesses the requisite economic and military strength and moral standing to provide such leadership. Creating a strategy for leadership is a monumental challenge for the United States, given the limited usefulness of political persuasion and economic levers in the post-Cold War world (Schlesinger 1993).

Contributing to the difficulty of providing world leadership is political turmoil at home. Indeed, many of the Western democratic countries are experiencing political unrest. Their electorates are, to various degrees, dissatisfied, angry, disappointed, tuned-out, disgusted, and generally in a foul mood. Citizens see the costs of government, red tape, and litigation continuing to rise but often do not perceive any increases in benefits. Indeed, the administrative cost of running U.S. federal regulatory programs has been increasing substantially, from $4 billion in 1970 to $13.2 billion in 1992 (*The Economist*, October 10, 1992). The federal debt, combined with shrinking revenue bases at the state and local levels, adds to the problem because governments have little flexibility to offer new services or heavily invest in new ways of business.

Established political parties, in numerous cases, do not represent the views of major blocks of citizens. In part this situation is due to political inertia; in part to the decline of loyalty within and power of political parties. Politicians have also lost respect because many have been caught engaging in highly unethical behaviors. Even those politicians just elected to power are receiving record low approval ratings. In the United States, the Perot presidential campaign of 1992 and resultant spawning of new political organizations in 1993 are important signs that the political landscape is changing in the United States, as it is elsewhere in the world.

Another important force in the U.S. political landscape is the increase in special-interest lobbying. Paid lobbyists have increased from 365 in 1960 to over 40,000 in 1992, and the number of trade associations has increased from 4,900 in 1956 to 23,000 in 1989 (*The Economist*, October 10, 1992). This trend, for better or worse, has created in the public mind the opinion that lawmakers are thereby corrupted from their duty of looking out for the public interest. Didsbury (1993) voices this concern quite adeptly: "Special interests proliferate, each with its own specific agenda and adamant in its exercise of veto power, effective government may become increasingly problematic. . . [r]ising above the tumult of special interest, there must be an active concern for the public interest."

One can hypothesize that as faith in government and elected officials has fallen, faith in markets as a means for increasing the quality of life has risen. Certainly, in the former Eastern bloc countries, governments are trying to transform their economies from centralized, command and control systems to decentralized, market-based systems. In those countries, the hope is that the market-based system will raise standards of living to levels not possible under communism.

There is also a trend in the West to transfer traditional government responsibilities to the private sector. Western countries are privatizing government-owned monopolies; deregulating various industries, from airlines to trucking; and implementing market-based solutions to help solve societal problems. Governments are also making use of market-based mechanisms and taxation, as opposed to command and control regulations, as policy implementation tools. One manifestation of this trend is the SO_2 permit trading feature of the 1990 Clean Air Act Amendments (CAAA). Also, carbon taxes for combating global warming and gasoline taxes for avoiding environmental damages, reducing traffic congestion, and reducing reliance on petroleum imports keep resurfacing in political discussions.

These global and national political trends (e.g., political turmoil and increased use of market-based solutions) have impacts on the utility industry. The new global political scene provides opportunities for the U.S. electric utility industry but not without risk. For example, the fall of communism has opened up potential markets for energy investments in the former Eastern bloc. However, political turmoil, unstable economies, and underdeveloped legal systems all act to increase the risk of such investments.

In the United States, an angry electorate could hold unforeseen surprises for the utility industry. For example, public backlash against private-sector special interest groups, combined with campaign financing reform, could significantly reduce the industry's ability to make its case in the public arena. In addition, public- or citizen-staffed special interest groups may gain much more power in this advocacy environment. Not-in-my-backyard (NIMBY) and not-on-planet-earth (NOPE) opposition to power projects could become even more widespread. Some believe that public participation in utility planning can ameliorate these problems (Casazza 1993) and lead to better outcomes (Bagley 1992). However, others believe that open meetings on utility decisions benefit special interests more than the public interest (Jones 1992) and can impair good decision making (Brown 1992). In any case, the industry cannot rely on past political history to predict the outcomes of new political discussions.

The political trend toward market-based solutions has already had a major impact on the utility industry. As discussed in Sect. 1, various federal laws have helped to create competition in generation. Based on this political trend, the prospect of competition expanding to the retail level should be seriously considered as the next turning point in the trend toward a differently regulated electric utility industry.

2.2 REGULATORY TRENDS AND ISSUES IN THE ELECTRIC UTILITY INDUSTRY

Instituting competitive bidding for new resource procurement represents the first significant regulatory reform in response to competitive pressures. Preliminary evidence suggests that competitive procurement is providing efficiency improvements, and that NUG supplies are at least as reliable as supplies from vertically integrated utilities (National 1991; Kahn 1991b; Naill and Dudley 1992).

However, many issues about competitive procurement have been raised. For example, can utilities, as wholesale buyers with a monopoly over retail sales, have a direct incentive without regulation to make smart purchasing decisions on behalf of end-users? Some have argued that potential adverse impacts on reliability and equity and the desirability of maintaining a strong utility obligation to serve outweigh the potential benefits of competition (Bushnell 1990).[18] Corey (1992) states "we can *never* rely on competitive bidding for bulk power to protect the interests of the small retail customers if we tie the hands of the franchised host utilities who are the only parties that can represent these customers at the bargaining table."

The EP Act states that state PUCs should conduct generic proceedings to evaluate the following issues with respect to competitive procurement:

- the effect of EWG purchases on a utility's cost of capital,[19]

- whether an EWG's capital structure threatens reliability,

- whether to require assurances with regard to fuel supply,[20]

- whether to provide advance approval or disapproval of long-term power purchases, and

- whether an EWG's capital structure provides them an unfair advantage over utilities.

Whether states are acting on these issues is open to debate.

In addition to providing electricity at the lowest cost to the consumer, the desirability of also achieving other goals, such as reliability of supply, makes competitive procurement a complicated business. Regulators have the responsibility of ensuring that utilities make purchase decisions that benefit both the public and the utilities. The difficulty comes in balancing the need for regulation of utilities' power purchase decisions within the traditional regulated monopoly environment with regulation of a competitive market.

There are four basic modes of power purchase regulation. One is after-the-fact prudence review of power purchase decisions. This option would, in essence, be the same regulatory oversight exercised with cost-of-service regulation, and would therefore entail the same inefficiencies, unpredictability, and unintended financial incentives.

A second mode of regulation would be a "prepurchase" prudence review. A prepurchase prudence decision would reduce the risk of disallowances. A potential drawback unique to this approach is that regulators would need to provide speedy review and approval to ensure acquisition of favorable prices. Such efficiency has not been the hallmark of regulatory proceedings.

The third mode of regulation employs a benchmark price with which to compare build, buy, and conservation options.[21] Under this regulatory framework, both price and nonprice considerations can be compared to an external measure such as comparable plants or services.

The utility would charge customers the benchmark price, and reap (or incur) the difference between it and the cost of the implemented purchase or build option.

There are two major problems with this approach. First, nonprice factors such as supply diversity and environmental costs complicate the benchmark determination. However, Burr (1992b) notes that if bidding is used to qualify a group of potential producers based on price, then utilities could enter into later negotiations regarding nonprice factors. Second, it is unclear how the regulatory process should respond to significant deviations from this model. For instance, would utilities (and possibly NUGs) be able to seek rate relief if a supply option's cost exceeded the benchmark due to exogenous factors? Likewise, would a fortuitous gain for utilities be disallowed? If the answers to these questions is yes, then this mode of regulation retains a cost-of-service component and the concomitant inefficiencies and risk allocation to end-users (Phillips 1990).

A fourth regulatory framework for new resource procurement, either generation or conservation, places all options into the competitive procurement bidding process, including utility options. Thus, the utility would no longer have the option to build on a cost-of-service basis. Rather, the utility must submit a bid to compete directly with NUG supplies (either affiliate or nonaffiliate). Depending on how the contract is written, this approach has the advantage of placing construction or operating risks on the utility or its affiliate rather than on end-use customers. However, in contrast to the benchmark method, utilities would have no incentive to purchase from nonaffiliate suppliers. Thus, regulators may still need to employ other means to ensure that the utility's decision is not biased toward its own bid or a bid of an affiliate.

It is important to note that utility regulation can inhibit the ability of NUGs to compete by sheltering utilities from certain risks. For example, utilities can turn to the regulatory process for rate relief, and the regulatory compact assures the utility an opportunity to earn a fair return on all investments deemed prudent.

Of particular concern for fair competition is the issue of whether utilities will be able to cross-subsidize their competitive ventures with revenues from "captive" customers of their regulated business. For example, Dasovich, Meyer, and Coe (1993) state, "Some worry that diversification creates an incentive for the utility to have customers fund the development of assets and personnel through its regulated utility, and later transfer the most highly-valued among them to the unregulated side of the company." Another form of cross-subsidizing is lowering rates to maintain customers with competitive supply options while making up the difference by raising rates to remaining, *captive* customers.

The most important implication of cross-subsidization of this type is that risks associated with competition are borne by the less mobile customers.[22] More generally, allocating the fixed costs of the electric power system, although by no means a new problem, has become a dire equity issue for regulators as they seek to increase the efficiency of electricity markets. Yokell and Violette (1988) describe the situation quite succinctly as follows:

> The increasing rate disparity from one jurisdiction to another, combined with the threat of competition . . . has made the problem more acute. Without some regulatory oversight, price inelastic customers could end up paying a disproportionate share of the fixed costs of the utility system.

Thus, competition prompts a need for regulatory reform to allow utilities and NUGs to compete on equal footing and to achieve, in an equitable manner, the efficiency improvements that the move to competition is expected to provide.

The need for new regulations is most apparent in regard to the issues associated with the implementation of the transmission access provisions of the EP Act. The regulatory goal of expanding access is to capture interregional comparative advantages in electricity production. One underlying restraint to realizing wider competition in generation is that utilities may be able to use their monopoly power over transmission to maintain monopoly power over generation. Why would a utility provide transmission access to competitors when it is against its economic self-interest to do so (Tenenbaum, Lock, and Barker 1992)?

Another underlying restraint is that state regulators "may have no incentive to eliminate the local company's monopoly power over transmission [by ensuring that out-of-state competitors can use it] if the monopoly profits were traditionally shared with the company's retail customers" (Tenenbaum, Lock, and Barker 1992). Lesser (1990) and DOE (1991/92) have pointed out that bidding programs designed and implemented at the individual state or utility level may result in higher electricity costs than those spanning a wider geographical and corporate range. Thus, ensuring competition in generation through PUC oversight of resource selection has some limitations.

The literature on the potential impacts of the EP Act points to three avenues by which competition over a wider geographical region would be achieved. The first is that regulators could give utilities incentives to act as thrifty and wise purchasing agents on behalf of retail customers in competitive procurements. Competitive bids from outside a utility's service area would be considered (GAO 1992). To give utilities an incentive to do this, part of the savings from purchasing lower cost supplies could be conferred to the utility as an incentive to get the lowest price.[23] If transmission services were needed from an out-of-state utility, the FERC could ensure access under the new legislation.

A second means to wider competition is through voluntary regional transmission agreements.[24] All generators and transmission owners in an interconnected region could engage in a single multiparty agreement with explicit contractual commitments to establish transmission user rights. FERC could review the initial agreement, ensure that no party with a legitimate interest is excluded, level the playing field among parties with different bargaining power, and act as an arbiter when participants could not resolve disputes among themselves (Tenenbaum, Lock, and Barker 1992).

The third means to wider competition is through wholesale buyers gaining access to more sellers. Municipalities or local distribution companies could reduce buying from the customary utility and purchase cheaper power from other wholesale suppliers. FERC could grant requests from potential suppliers for transmission orders. More municipal electric companies may be created to allow locales to shop for electricity service (Willrich 1991).[25] As with the first avenue to wider competition, FERC would need to order transmission access from transmission-owning utilities that have an incentive not to grant it on a case-by-case basis.

Ensuring economically efficient transmission access is a difficult regulatory problem. At the heart of the problem, transmission service is currently priced neither fairly nor efficiently. Transmission is currently priced based on the average, or embedded, costs of the transmission facilities. Generally, no attempt is made to account for the distance of transmission, or for the differences in transmission capacity utilization. Also, the compensation for transmission is allocated on the basis of imaginary contract paths rather than the actual physical flow of power.[26]

Fair and efficient pricing of transmission services would require the applicant seeking transmission access to compensate the providing utility for lost profits and unavoidable costs from these foregone sales.[27] Another issue related to pricing arises if transmission access allows municipal distribution companies to bypass their traditional utility supplier in favor of lower-cost or environmentally correct wholesale suppliers. For example, Dasovich, Meyer, and Coe (1993) describe a program in California called "green pricing" whereby customers choose to voluntarily pay a surcharge on their electricity bills in order to fund a utility's development of environmentally friendly renewable power resources. The authors conclude that customers may begin to demand direct access to "green" service providers.[28] In cases such as this, must the utility's captive customers or shareholders take the loss associated with the "stranded investment" made in anticipation of meeting demand from municipal distribution companies?

Once a traditional customer leaves the system, what, if any, service obligation does the utility have should a prodigal customer wish to return? A utility could voluntarily provide transmission access or take back a prodigal customer at some price. Observers have suggested that a wholesale customer be required to pay fees (and supply reasonable advance notice) for leaving or reconnecting to a utility's power system. Thereby, the utility and its customers would receive compensation for the costs associated with accommodating a fluctuating load and revenue base. Setting the efficient and equitable level of entry and exit fees and opportunity costs could be extremely difficult, although similar issues are being faced with industrial co-generators.

Another prominent access issue is the difficult juggling act that FERC regulators must do between assuring the reliability of the power system and facilitating competition via comparable access. Deciding when the efficiency benefits from increased access outweigh the potential detriments to reliability involves many complex technical issues and is therefore difficult to determine. Furthermore, the transmission-owning utility will have better information than the overseeing regulators. Utilities may have an incentive to "cook" transmission load flow projections and engineering studies to indicate that reliability will be adversely affected in order to shut out lower-cost competitors (Tenenbaum, Lock, and Barker 1992).

FERC can order a utility to construct additional transmission to accommodate access to competitors, but this can be quite difficult to achieve in practice. Public concerns about electromagnetic fields (EMFs), environmental impacts, and aesthetic degradation from adding new transmission can block its construction. Furthermore, how would the capital cost of the additions be allocated between the utility's native load customers and the generating company seeking access? A state PUC has little incentive to include the additional costs of such transmission additions in the utility's rate base, or even grant siting approval to construct the line to begin with, especially when the competing supplier is located out of state (Disbrow 1993).

It is simply too soon to tell how the transmission access provisions will ultimately be administered. As Kahn (1991a) states, "A period of some experimentation supervised by federal regulators would no doubt be required." Some issues will likely be decided by the courts. Disbrow (1993) states in regard to the EP Act, "One thing seems certain, that we have another lawyer's relief act."

Regulations requiring IRP have been expanding, but is IRP compatible with a more competitive electricity industry? If access to the grid expanded to the retail level, or if competitive self-supply options were available to many consumers, then individual consumers would be able to choose their own supply options independent of the preferred resource plan of utilities, regulators, and the public. Even the consideration of environmental impacts and the public participation feature of IRP might be displaced by expanded competition.

Counterbalancing the seeming demise of IRP, it has been realized that selection of least-cost resource options could be improved if planning were done at a multiutility level over an expanded geographical area. In Wisconsin, where statewide planning is done, the PUC gives jurisdictional utilities incentives to do joint planning. In another example, the states of Massachusetts, Rhode Island, and New Hampshire have entered into an agreement to develop a regional integrated resource plan that involves several utilities.

In any case, the future of IRP is bound up with the future of the industry itself. Section 6.3 examines this issue in detail.

Additional regulatory issues are raised in regard to DSM. The goal of DSM incentive programs is to remove utilities' disincentive for DSM programs due to the loss of revenue associated with selling less electricity. The EP Act urges states to adopt regulatory changes to remove the bias for supply-side options. By 1992, 16 state PUCs had adopted some type of DSM incentive for utilities, and 12 others were reviewing or developing them (Meade and Roseman 1992). Different kinds of incentive programs are used by different states. Some regulators employ the stick by reducing a utility's allowed rate of return for poor DSM performance or failure to comply with DSM directives.[29] The extent to which PUC incentives make shareholders indifferent between supply-side and demand-side options has not been quantified. However, the disparate amounts of DSM between states suggest that regulator initiatives are a big factor in the amount of DSM a utility does.

Competitive bidding creates a mechanism whereby conservation programs, either provided by utilities or ESCOs, can compete directly with supply options.[30] The competition is on either a price per equivalent generated kilowatts or capacity kilowatts basis. Competitive procurement of DSM has been expanding, but methods of conducting bidding vary widely between states and even between utilities. As Roseman states, "At this point there is not even an identifiable trend in how to structure bidding" (Hocker 1993).

Where ESCO DSM and utility DSM focus on the same markets, it has been recommended that ESCO projects be selected, on the basis of a comparison with the avoided costs of utility DSM rather than comparison with the cost of solicited supply-side proposals or different

ESCO's DSM proposals. Such an arrangement is likely to provide better efficiency, as this would ensure that ESCOs are providing savings at a lower cost than utilities. Likewise, it has been recommended that ESCO savings be compared to different avoided costs based on the kilowatts cost of the utility load that would actually be saved or kilowatts of capacity actually postponed as a result of the ESCO DSM. This is better than a comparison with solicited supply proposals or other ESCO's DSM proposals that would have different load or capacity effects.

A problem with competitive bidding for DSM is that it is difficult to determine whether the process is resulting in economic efficiency (i.e., that ESCOs are more effective than utilities in identifying and implementing DSM projects). Some DSM bidding systems encourage ESCOs to propose only the projects with the highest return and most easily measured results. Utilities, on the other hand, take on DSM projects that suffer from uncertainties about their performance, from savings verification problems, or from lack of experience about the savings that will be achieved. Thus, even if the results of ESCO DSM indicate that it gets better returns than utility DSM, this does not imply that ESCOs provide DSM more efficiently than utilities.

The overall conclusions are that the global political trend toward free-market designs (1) may lead to more widespread replacement of command and control regulation with market mechanisms and (2) has induced a need for utility regulation reform in order to achieve efficiency improvements with competition and to do so in an equitable manner. However, there is a wide range of possibilities for how future regulation will be structured, from relying on competitive bidding to ensure that the lowest cost resources in an area are selected, to mandating RTGs to ensure access to all interested parties via a voluntary agreement approved by FERC, to having wholesale buyers leave and connect to utilities' systems with entry and exit fees.

3. TRENDS IN SOCIETY AND ELECTRICITY DEMAND

Societal trends, in conjunction with economic and political trends, comprise a triumvirate of forces which shape the world's societies. Societal trends encompass issues related to cultural and religious beliefs, lifestyles, and important social problems such as crime and drug abuse. One can argue that these societal factors are more fundamental than economic and political factors and that the "societal will" drives economic and political trends. In any case, discussions of future states of society or even large components of society such as the electric utility industry should admit the importance of societal factors and weave them into the analytical framework.

This section acts on this advice by examining societal trends that are national and global in scope (Sect. 3.1). These trends are related to the electric utility industry in two ways. First, in Sect. 3.2, the trends are related to trends in the demand for electricity. Second, societal trends and factors are defining characteristics in the global and utility industry scenarios presented in Sect. 6.

3.1 NATIONAL AND GLOBAL SOCIETAL TRENDS

U.S. society is undergoing dramatic, deep-seated, and, some would say, alarming social change. In the United States, the litany of social ills is familiar: crime, drugs and child abuse, homelessness, AIDs and other sexually transmitted diseases, welfare dependency, teenage pregnancy, divorce, and a failing educational system. For example, Fig. 3.1 shows a significant increase in crime in the United States in the 1980s. Murders are up dramatically in our central cities and represent a leading cause of death for young black males. AIDS became the sixth leading cause of premature death in the United States in 1991 and was among the fastest-growing of such causes of death (according to the *1993 World Almanac*, citing the Federal Centers for Disease Control). In regard to our educational system, Lamm (1993) states: "American students have slipped to an all time low in SAT scores. . . . A million U.S.

students drop out [of high school] every year; another million graduate functionally illiterate."

As alarming as these problems are, an even more alarming observation is that these problems have been growing in magnitude for at least 40 years. For example, Wilson and Herrnstein (1985) state that crimes have risen since the early 1950s after falling more or less since the late 1880s. Harris (1993) shows that since 1950, births to unmarried women as a percentage of live births has steadily risen. The divorce rate in the United States has also been rising since 1950 (Fig. 3.2 illustrates these last two trends). These and other statistics strongly suggest that U.S. society is changing in fundamental ways, ways that affect and reflect changes in values, families, lifestyles, and the ways people can, or cannot, interact with each other.

Are there any explanations for these "newsworthy" trends? No definitive argument has been put forward, although there are interesting hypotheses. Various authors assign blame for these changes to television, the Bomb and the Cold War, suburbanization, increased mobility, an overcompetitive society, corporate America, and the growth of scientific knowledge, which has led to skepticism about fundamental religious beliefs. It is likely that all these factors play some role, but it is very hard to sort out their individual influences. Regardless of the cause or causes, the trends may not be flattening out, much less reversing their direction.

A manifestation of these potential causal factors, and possibly an additional root cause for change, is the irrepressible, worldwide onslaught of American popular culture. This culture is youth-oriented, antiauthoritarian, energetic, real-time, and consumer-oriented. Barber (1992) calls this the "MacWorld." Its relevant images are blue jeans, McDonalds, the MacIntosh computer, MTV, Madonna and Michael Jackson, Rambo and the Terminator, Ninja Turtles, and the Nike "Just Do It" advertising slogan. These values are consistent with behavioral decisions that are made to satisfy impulsive desires and may have significant downsides (e.g., drug addiction). These values are also consistent with distrust of large organizations and big government, difficult employer-employee relationships, disregard for the law, short-term economic horizons, and preferences for more free-flowing forms of social organization.

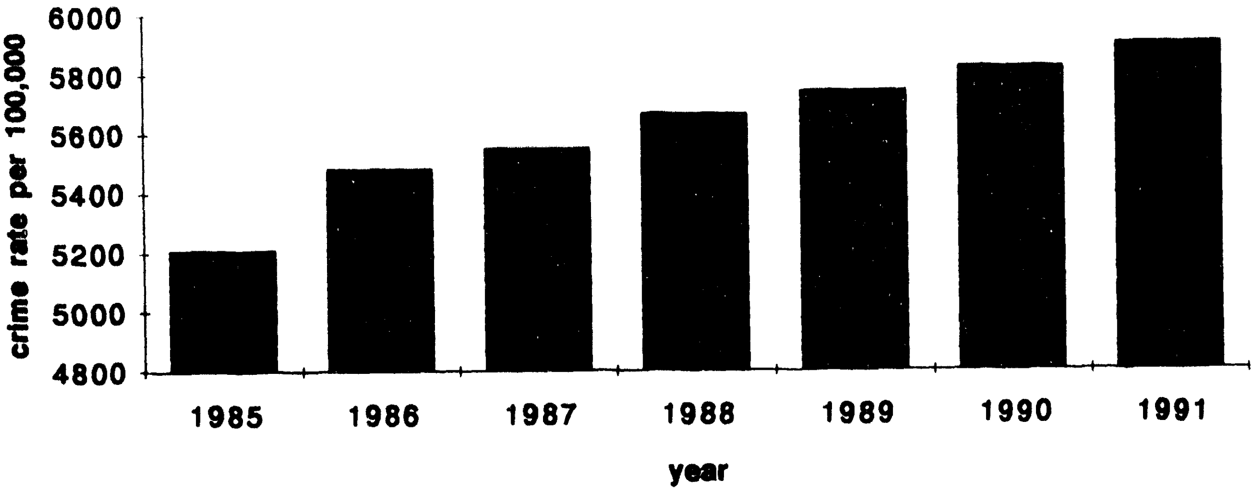


Fig. 3.1 Crime rate in the United States, 1985–1991. *Source: World Almanac 1993*

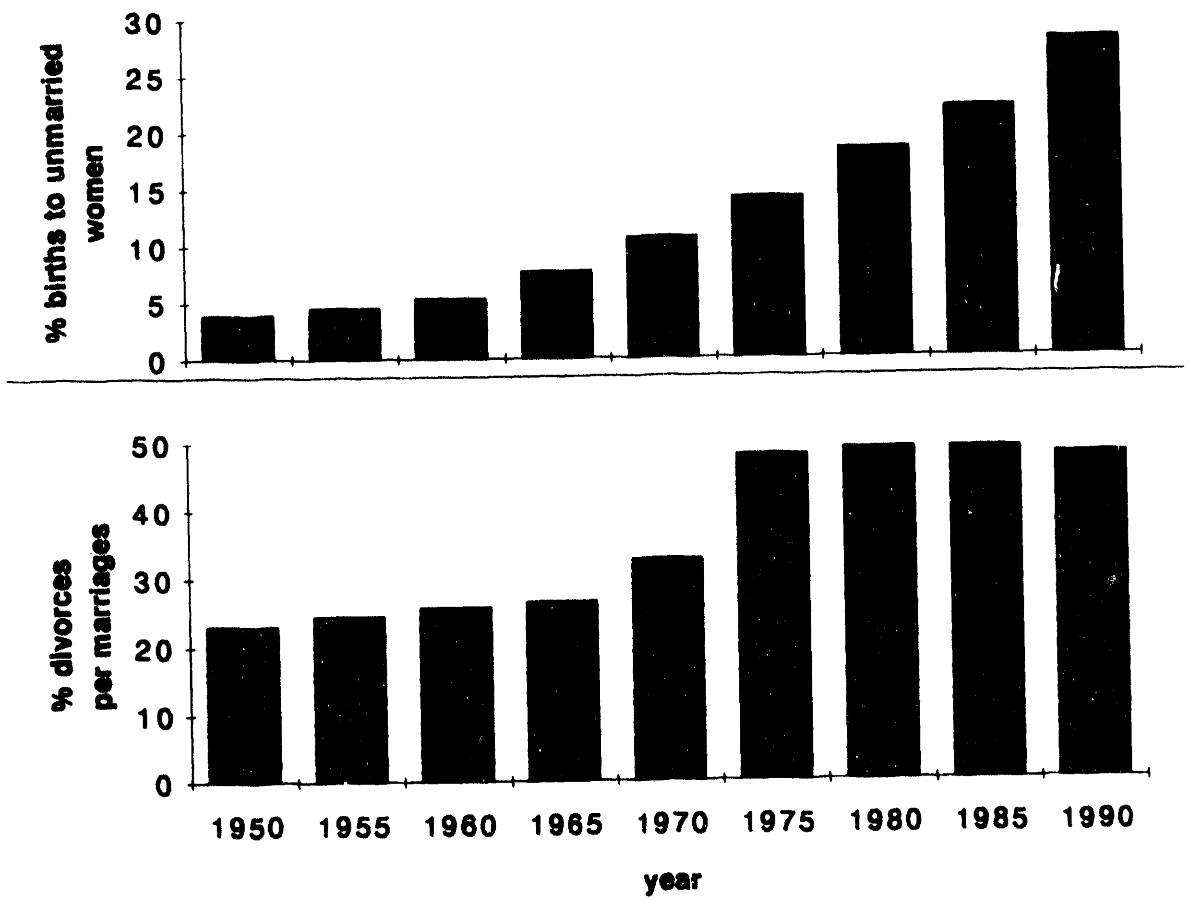


Fig. 3.2 Births to unmarried women and divorces in the United States, 1950–1990.
Source: Harris 1993, p. 52

Past the MacWorld is the middle-class world, and even there, fundamental change is taking place. Wolfe (1993) sees the emergence of two middle class groups—one which has established ties to middle-class lifestyles and one group whose members are new arrivals to the middle class. These two groups differ significantly in their views on work/productivity, savings, children, God, politics, and country. To greatly generalize Wolfe's discussion, the former class focuses on careers, is consumption-oriented, favors smaller families, approaches religion symbolically, is more involved in politics, and is less nationalistic. The latter class, the new arrivals, has more traditional notions of work, places value on saving and larger families, is more fundamental in its religious beliefs, shies away from politics, and has a stronger belief in country. Social tensions arise when these groups clash over issues such as education and the role of government in society. Political turmoil in the United States is due in part to the fact that the traditional views of the Democratic and Republican parties are inconsistent with the core beliefs of either of these two main groups of middle-class citizens.

These societal trends could affect the electric utility industry in several ways. For example, social problems such as drug abuse, divorce, teenage pregnancy, illiteracy, and poor education directly relate to the kinds of people that can be attracted to work for the electric utility industry. These people need different kinds of benefits and management, from health benefit packages that include drug treatment and counseling to day care to intensive training and retraining programs. Add to these problems the values of the MacWorld, and one can gauge that it will be much more difficult to manage and maintain the traditional electric utility organization, which is paternalistic, command-and-control oriented, and bureaucratic. The conflicting mix of middle-class values will also be played out in utilities with additional prescriptions on proper employer-employee and employee-employee relationships.

The utility industry's relationship with its host communities may also change. For example, the rising numbers of single-parent and very-low-income households may increase the prevalence of nonpayment of electricity bills. Ironically, these pressures may also increase pressure on the PUCs to push the utility industry to provide additional social services, such as low-income weatherization. Complicating further industry relationships with communities are changing beliefs about how the industry should be structured to promote social good. Political support for PURPA was based in part on a social movement, the so-called "small is beautiful" movement, exemplified by the writing of Daly and Cobb (1991), which is a vision of smaller, more decentralized industry.

Taking these observations into account, one can see a thematic link between the changes in our traditional social structure as a whole and the changes in the utility industry's relationship to society. Many observers of the utility industry interpret utility regulation as implementation of a *social contract* between the utilities and its customers. Basically, the contract calls for the consumers to agree to provide an opportunity for utilities to earn a fair rate of return in exchange for obligatory electric service on a nondiscriminatory basis. Trends such as those summarized above act to cause strains in the contract, and indeed, from the information presented in Sects. 1 and 2, it seems as though utilities and consumers are in the midst of a divorce, dissolving the traditional regulatory compact. It seems unlikely that such a change in the traditional organization of the electric utility industry would occur if social values in general had not changed. Conversely, it seems likely that the formation of a new social contract regarding the electric industry will be influenced by these same social trends.

3.2 TRENDS IN ELECTRICITY DEMAND

Changes in demographics, lifestyles, and economic activities affect patterns of electricity demand and the aggregate quantity demanded. To begin, the U.S Census Bureau forecasts a decrease in the rate of population growth (including immigration) early next century (see Table 3.1). Balanced against this trend are trends toward smaller households, more households headed by single parents, and more single-person households. Overall, utilities will have more residential customers to serve but EEI's Electricity Futures Project has concluded that residential electricity demand might actually decrease. EEI developed alternative energy demand scenarios for 2015 based on a continuation of the general population growth trend experienced over the past 15 years (about 1% growth per year) and the Census Bureau's projected lower rate of population growth between 2000 and 2015 (Boroush and Stern 1990a). They found only a small decrease (4.4%) in total energy demanded in 2015 due to the slower population growth rate. However, for the residential sector in 2015, lower population growth is predicted to cause significantly lower demand (10%).

Table 3.1. Population growth rate trend, 1980–2015

U.S. population growth per annum	
1980–1988	0.9%
1988–2000	0.8%
2000–2015	0.5%

Source: U.S. Bureau of the Census

The accuracy of EEI's macroforecast is dependent on a number of microissues. For example, high crime rates have induced many to move out of cities and stay at home and "cocoon" (Schipper 1993). Increases in traffic congestion, the improvement of home entertainment and telecommunication services, and an aging population also act to keep people at home for work and play. These trends suggest increases in per household electricity demand overall and at least increases in off-peak demands.

Fundamental beliefs about energy conservation, the environment and personal and health related issues will affect the validity of this hypothesis. However, we cannot tell what these lifestyle changes will be, nor whether or not they will affect electricity demand. For example, if people spend more time at home, will they spend more time indoors or outdoors? Will they utilize more electronic devices or fewer? Will they practice more or less energy conservation? Boroush and Stern (1990a) point out that wide differences in the electricity intensities of various industrial and commercial activities imply that changes in lifestyles, such as the kinds of goods people demand and the things they do with their free time, can have impacts on electricity demand patterns and possibly even aggregate demand.

In any case, increasing numbers and smaller sizes of households, combined with trends towards increasing numbers and smaller sizes of businesses noted in Sect. 1, will create demands for more dispersed electricity consumption. This trend could result in increases in electricity prices by increasing distribution costs for each unit of electricity sold. It could also make DSM programs harder and more expensive to implement because more residential customers would have to participate to have the same potential energy savings. Schipper

(1993) predicts that this will focus DSM more on key decision makers upstream of the end-use customer because it will be cheaper and easier.

U.S. societal trends may influence other countries in ways that then influence U.S. electricity demand. For another example, adoption or abhorrence of U.S. culture by the rest of the world affects our investment in other countries, as well as the world's propensity to buy certain kinds of U.S. goods and services. This, in turn, could affect economic activities in the U.S. and the energy consumption of businesses. It is unclear what sectors of the economy might be effected by this chain reaction (e.g., telecommunications versus textile manufacturing), but the topic warrants continued attention.

The overall conclusions are that (1) U.S. society is changing and (2) the effects of these changes can impact electricity demand. Electricity demand patterns are expected to change toward more dispersed, smaller users and uses. It is not known whether or to what extent wider social changes indicated by U.S. social ills and the global culture clash of fundamentalist versus U.S. popular culture will impact the electric utility industry.

4. TRENDS IN TECHNOLOGY

4.1 GLOBAL AND NATIONAL TECHNOLOGICAL TRENDS

In the developed world, technology is ubiquitous and changing at a rapid pace. Almost every aspect of life has a relationship to technology in some way. Homes now contain microwave ovens, personal computers, electric bread-making machines, and numerous other electronic consumer devices. Almost every job entails technology to assist communication, amplify human physical capabilities (e.g., a bulldozer), or augment one or more aspects of a user's intelligence (e.g., an expert system). Many jobs are concerned with designing, operating, administering, and maintaining technology. Lastly, every global industry is highly dependent upon advanced technology, and company survival is often dependent upon continuously improving its technological base.

Three technologies that symbolize dramatic technological change and innovation are information technology, biotechnology, and nanotechnology. Information technology (IT) is blooming in the 1990s, from the creation of massively parallel processors to powerful desktop multimedia systems to global computer networks such as the Internet. Advanced computers and telecommunications systems have led to a sea change in global economics by facilitating the management of far-flung corporate operations and the transfer of billions of dollars in financial assets anywhere in the world in seconds. IT also is at the heart of the new business organizational designs, just-in-time manufacturing, and sophisticated marketing and product sales systems. The Clinton Administration's National Information Infrastructure initiative envisions the technology as also radically changing education, health care, and the process of government.

Biotechnology involves efforts from designing new insect-resistant crops to manipulating human genetic processes for producing new, more powerful drugs. Knowledge in this area is growing rapidly, as attested by frequent announcements that scientists have identified genes linked to major human diseases. With an eye to the future, one must appreciate the research being funded in the developed countries to map out the human genome. Known in the United

States as the Human Genome Project (HGP), the goal is to map out all base pairs of every human chromosome—some one billion—and identify all human genes and their function—some 100,000 (Davis 1990). If the HGP is substantially successful, the resulting knowledge will revolutionize medical knowledge, practice, and the technologies supporting medical treatment and the prevention of disease.

Nanotechnology refers to the art of building devices such as motors, machines, and other devices at the molecular level. Technologies now exist to allow scientists and engineers to manipulate individual atoms to build these devices. Applications of these technologies to medicine could be truly monumental (e.g., nanodevices to conduct noninvasive heart surgery). The world can also expect nanotechnology to be related to new advances in the areas of material science, bioengineering, computers, environmental technology, automobiles, household appliances, and power generation.

While difficult to quantify, one can make strong arguments that technology is inextricably linked to many of the economic, political, and social problems and changes discussed in Sects. 1-3. As noted above, IT is a major factor in company downsizing and job restructuring. Taylor (1990) argues that electronic media, which use IT, have dampened political participation in the United States. and turned presidential campaigns into shallow, image rendering, sound bite contests. The promise of using electronic town halls and other electronic media to restore informed political discussion in the United States may never be realized for many reasons, including lack of representation of the viewing public and the shallowness of "push-button democracy" (Abramson 1993).

With respect to biotechnology, Anderson (1993) discusses how biotechnological advances can increase food production while decreasing the use of chemicals and fertilizers. However, he also discusses less-considered potential adverse effects, such as increased herbicide use on genetically engineered, herbicide-resistant crops and the introduction of herbicide-resistant genes to weeds. As another example, vast knowledge of human genetics could lead to numerous ethical problems (Kevles and Hood 1991). For instance, should insurance companies or employers deny people health insurance or employment, respectively, based on the results of genetic testing? Should parents be allowed to genetically engineer their children? Is there a point at which further advances in genetics are outweighed by ethical considerations? It is very easy to become enthusiastic about technology, but it should be kept in mind that public perceptions can significantly change the outlook and adoption of technologies, with nuclear power being a case in point.

Trends in technology are inextricably linked to the demand for electricity and associated electricity services. That these technological advances have and will continue to have profound impacts on the utility industry should not be difficult to envision. IT has led to a great deal of new technologies that are now seen as indispensable (e.g., faxes, modems, and compact disks) and that rely on electricity. Further advancements will lead to greater automation and communication capabilities, many of which will be adopted by electricity customers. IT may also facilitate changes in lifestyles that lead to a greater reliance on electricity, such as shopping via telecommunications rather than transporting oneself to stores. Lastly, as is discussed more below, IT can be used to greatly improve every activity associated with the electric utility industry.

Advances in medicine and biotechnology can also affect the utility industry. Note that health care is relatively electricity intensive compared to other commercial activities (Boroush and Stern 1990a). Nanotechnology could lead to a significant breakthrough in solar energy technology and could revolutionize technologies in many other areas. In fact, it is more difficult to imagine spheres of technological advancements that appear not to have implications for the utility industry than to imagine ones that do.

Lastly, information technology in particular is likely to change the culture of the utility industry. This is because IT makes life quicker. From a societal perspective, people can order goods over the phone, and soon through their television sets, and have the goods delivered the next day. Faxes allow communication within minutes; Internet allows communication within seconds. IT has fostered a more competitive environment and a more responsive private sector. There is an overall attitude of "real time," do it now, instant gratification. Problems are not allowed to linger. In this environment, utilities and PUCs cannot take "forever" to make decisions, to remediate environmental problems, to develop and approve IRPs. Better decisions will have to be made in less time with fewer resources. This change will cause a great deal of tension. On the bright side, while IT can be seen as a cause, it is also available as part of the solution. Decision support systems, optimization software, groupware, etc., can all be used to quicken the pace of life within the utility industry to meet the demands of the outside world.

4.2 TECHNOLOGICAL TRENDS IN THE ELECTRIC UTILITY INDUSTRY

This section examines technological trends in the electric utility industry. First, technology-based trends in demand are examined. Then the discussion covers generation; transmission; distribution, dispatch, and storage; and DSM and customer service.

Technology exhibits a complex relationship to electricity demand. As a first point, technology can lead to increases in electricity demand. This can happen for several reasons. For example, new electricity-using technologies can lead to the substitution of electricity for other energy sources. Furthermore, as has been demonstrated in the preceding pages, major new technologies such as information technology, biotechnology, and nanotechnology, which can be expected to produce significant economic growth, are highly electricity dependent, both in their manufacture and operation. The homes, businesses, and industries of the future will adopt many new and advancing electric-powered technologies. Increasing reliance on advanced information and communication technologies in industry, commerce, and day to day life will not only present a sphere of increasing electricity demand, it will also require a very reliable electricity supply (Dale, Stovall, and Klein 1991).

DOE's Energy Information Administration (EIA) corroborates this assertion; electricity generation's share of the total primary energy used has been increasing for a long time and is expected to continue to increase. Starr, Searl, and Albert (1992) assert that "40% of all primary energy equivalent now goes into electricity generation. By the middle of the next century, this may exceed 50%."

On the other hand, increased use of advanced electronic and electric technologies, in conjunction with DSM, will be the means to save primary energy and improve residential, commercial, and industrial productivity as well as improving overall energy efficiency and product quality. The impact of this trend is demonstrated by EEI's alternative energy demand technology adoption scenarios. With today's technology, both demand for all end-use energy and demand for electricity is expected to grow by a little over 1.5% per year from 2000 to 2015. However, with aggressive penetration of advanced, energy-efficient technology, total end-use energy demand is expected to grow by only 0.8% per year from now through 2015, while electricity demand would grow by 2% per year from now to 2000 and 1% per year from 2000 to 2015 (Boroush and Stern 1990b).

New technology promises to make smaller-scale, less environmentally damaging power generation more economical. Technologies such as aero-derivative gas turbines, fluidized bed combustion, gasified combined cycle, and fuel cells are prime examples, with the latter likely to reach a competitive price soon in Japan. Technological advances in still smaller-scale electricity production are expected to continue. Dispersed renewable sources (solar, geothermal, low-head hydro, and wind) will likely become increasingly common in specialized settings, and economical home-size generation units should not be dismissed as a possibility (Bayless 1992). Even the future of nuclear power, if it has a future, is envisioned to be based on smaller-scale reactors with inherent safety features (Morgan 1993). It appears that only a major breakthrough in generation technology, such as fusion, would reverse the trend toward smaller units.

Even though technological advancements in renewable, natural gas-fueled, and nuclear generation technologies are foreseen, most utility industry professionals believe that coal will continue to provide the majority of baseload capacity in the first part of next century. Coal is plentiful, and clean coal technologies are poised to lower air emissions with only small decreases in conversion efficiencies. For example, developers are looking at the potential for repowering older coal plants with fluidized bed combustion technology (Seely 1993). Advanced cycle coal technology currently has higher capital costs than conventional coal, "but continuing development will eventually make them competitive, particularly because of environmental factors" (Starr, Searl, and Albert 1992). Burr (1992a) predicts that the cost of clean coal technologies will figure prominently in the effect on electricity price. Southern California Edison has already demonstrated a 100-MW integrated gas-fired combined cycle plant. It is the cleanest coal-fueled generation plant yet developed. However, in the longer term, advancements in renewables and a resurgence of nuclear power may overtake coal-fired technologies, particularly if global warming fears are heightened.

Economic and regulatory factors, among other factors, are spurring the improvement of transmission technology, especially technology related to controlling transmission systems.. Significant factors include increasing competition in generation, provisions in the EP Act that require increased access to transmission systems, concerns about the harmful health effects of EMFs, and increasing demands for bulk power transfers. These factors require transmission systems that are easy to control, have no adverse impacts on human health, can accommodate larger transfers of power, and are very reliable. Because it is becoming increasingly difficult to site new lines, Dale, Stovall, and Klein (1991) point out that "the use of transmission corridors, new or existing, must be maximized by increasing the amount of power that can be transmitted through these corridors."

Utilities would like much more control of the power flow over transmission lines.[31] "As a result, we have had to build additional margin into the system to accommodate this lack of controllability and to allow for the power redistributions which occur whenever a power plant or transmission element is lost" (Renz 1993). However, a breakthrough in power electronics is emerging from research laboratories that allows nearly instantaneous power load control and, therefore, frees up the "additional margin" described by Renz. These so-called "smart" power electronics are similar to the technology used in consumer electronics in terms of controllability, but with much higher current and voltage ratings.

The coordination and operation of these future transmission components is to be accomplished using high-speed communications, powerful control computers, and advanced modeling and information management methods. One such system has been termed a flexible alternating current (ac) transmission system by the Electric Power Research Institute (EPRI), which is spearheading research in this area (EPRI 1993b, Douglas 1992). While much of the technology necessary to support such a system currently exists, developing the computer programs and electrical sensing techniques will require additional research (Renz 1993).

Other advancements in transmission technology might include lines for ac and direct current (dc) (or hybrid designs with ac and dc lines sharing the same tower) and higher-order lines (6-phase and 12-phase). Because dc transmission is more controllable than ac, advancements in power electronics to simplify dc-to-ac conversion would greatly reduce the costs of large power transfers over long distances.

Other "smart" transmission components might be added to monitor and diagnose the internal functions and condition of the lines (such as current, voltage, temperature, contamination, and deterioration). Knowing the status of components immediately will improve the capability of the system and result in better maintenance techniques. This may necessitate advanced sensing and live-line maintenance techniques. Robotics and automated equipment might be used. Utilities have already been utilizing robots for hazardous maintenance of generating facilities (Roman and Collins 1993).

In the long term, materials research advancements could allow the power density of corridors to be increased. Materials research will become more important as the existing power system ages. Given a breakthrough, superconducting transmission cables might even be developed (Balzhiser 1988). Mitigating the potential harmful effects of electromagnetic fields (EMFs) is also a key research objective.

These new electronic and information technologies have great potential for enhancing transmission capabilities and potential for increasing the speed and flexibility of the distribution system. This is because there have been fewer advances in distribution than in transmission or generation; distribution systems are essentially the same as in previous decades. Faster, smarter, and more flexible control of distribution could be achieved through automation using information technology. Automation requires a communication technology that can tie distribution components to computer centers. Fiber optics and two-way radios are being explored as candidates for high speed and reliable communication (Renz 1993). Computer systems that can analyze information collected by the automated monitoring and decide on control actions would also be needed.

Automation of distribution has allowed utilities to better synthesize diverse generating sources and dynamic electricity pricing schemes. This increased sophistication of matching supply with demand would give energy storage a more prominent role in the energy system. Storage can provide an additional option for meeting demand as well as allowing new acquisition of generation and transmission to be deferred by allowing a reserve for peak supply. The primary storage technology in current use is pumped hydro. However, new technologies such as batteries, compressed air energy storage, and superconducting magnet energy storage might be developed. These technologies will be adopted if they present a cost advantage compared to peaking units.

Automation could also allow utilities and distribution companies to act effectively as energy service providers that can manipulate both supply and demand options to achieve greater efficiency in the electric system. Energy service providers, either utilities or affiliate or independent ESCOs, may be the future means to accomplish IRP goals in a competitive environment with diverse suppliers and dynamic markets. In terms of DSM, automation would allow the use of "smart" consumer meters capable of real-time cost of service pricing combined with advanced load-control features. Beyond simple load control devices, such as remote control of water heaters, smart consumer metering would allow a consumer to assign priorities to end-uses as a function of the real-time price of electricity. For example, the Trastext system, a technology currently being tested, continuously interacts with residential customers via various communication media providing variable pricing based on electricity production costs.

The overall conclusion is that technological advancements will shape the electric utility industry's future by advancing what electric customers and the power system can do. The role of technological advancement in accommodating more competitive generation markets, wider regional electricity supplies, and a larger role for DSM should be given due regard in assessing the potential for change in the electric utility industry.

5. ENVIRONMENTAL TRENDS

Concerns about the environment have been growing since the 1970s and now constitute a major driving force shaping the future. Modesitt (1993) states "Even if the Clinton administration develops no new regulatory initiatives, those already being implemented will have significant effects on the power industry." The impact of environmental regulations on the utility industry is twofold. They affect the industry directly, of course, because utilities must comply with the regulations. They also affect the industry indirectly because electricity customers and potential customers must comply with the regulations. Sections 5.1 and 5.2 focus on indirect and direct effects, respectively.

5.1 NATIONAL AND GLOBAL ENVIRONMENTAL TRENDS

Global environmental problems pose serious risks to the world's populations. The well-known list of major environmental problems includes radioactive and hazardous waste, global warming, ozone depletion, deforestation, species extinction, groundwater contamination and depletion, air and water pollution, and acid rain. In combination, these problems, at the very least, threaten the modern way of life based on technology and consumption and could pose risks to the very existence of life on earth as it is today. Certainly this is the message being communicated by Vice President Gore in his book *Earth in the Balance* (Gore 1992).

The fact that a major politician has published a book on the environment indicates that the environment occupies a very important position at the crossroads between economics, politics, society, and technology. The environment has an important and vocal political constituency. Organizations such as Greenpeace, the Natural Resources Defense Council, and the Sierra Club have distinct political agendas and influence on public policy. Environmentalism is not only a crusade of special interest groups. Worldwide, Schwartz (1991) sees environmentalism as a strong movement among the 20 billion or so people who will pass through their teens in the 1990s. Industries such as the electric power industry have felt the fervor of environmentalism and many such organizations are incorporating environmentalism into their corporate cultures.

Environmental values drive expensive environmental programs, such as the Superfund Program and other hazardous waste programs in the United States (Russell, Colglazier, and Tonn 1993), which have direct effects upon economic competitiveness and employment. Implementing expensive solutions to solve major environmental problems is exceedingly difficult. At the global level, it is an enormous challenge to find solutions that satisfy numerous countries possessing different cultures, economies, and potential environmental risks. At the national level, even when there is a political consensus about a problem, more often than not the "devil is in the details." What is a hazardous waste? Who ought to pay to clean up a Superfund site? Expense and implementation issues will slow but not halt progress in protecting the environment.

As a last point, it should be noted that technology can be seen both as the culprit and the savior. Manufacturing technologies and those associated with national defense are major causes of environmental problems. On the other hand, biotechnologies in particular hold promise both for remediation and for pollution prevention. Certainly, the trend in the private sector is to develop technologies that are environmentally benign as well as energy- and cost-effective.

Environmental issues have indirect effects on the utility industry by affecting electricity consumers. Specifically, environmental concerns are predicted to increase electricity demand. Environmental pressures push for the adoption of a host of industrial electric technologies aimed at environmental goals. For example, increased use of electricity can reduce the amount of fossil fuel inputs to industrial processes such as materials manufacture. Coatings that do not produce volatile organic compounds may also require more electricity (due to, say, their chemical manufacture or heat-activated bonding). Recycling—for example, of metals and plastics—also requires energy, in many cases electricity.

Also, the trend toward the development and adoption of electric vehicles owes its emergence to urban air quality concerns, particularly in southern California. By 2003, 10% of all new vehicles sold in California must be "zero-emission" vehicles. Other states are planning similar regulations, and the electric vehicle is the only current technology that qualifies as zero-emission. If most electric vehicles will be charged overnight, they will produce very desirable load growth for utilities—electricity sales without the need for building new generation facilities.

Because electricity can be produced outside of urban areas and transmitted in to supply zero-emission end-uses, increased use of other electric technologies will be a prominent means of addressing growing urban air quality concerns. Furthermore, due to economies of scale and relative efficiencies, reducing environmental impacts at electricity generation facilities is less costly than at end-use points.

Lastly, maybe more so than with the topics of the previous sections, all environmental issues being confronted by the utility industry have their roots in the environmental values of the larger society. Thus, the tie between national and utility trends is extremely strong in this area. Additional issues are discussed below.

5.2 ENVIRONMENTAL TRENDS IN THE ELECTRIC UTILITY INDUSTRY

Integrated resource planning is greatly influenced by environmental concerns. Utilities desire a mix of resources that is environmentally sound, cost-effective, and reliable. Federal laws such as CAAA and the EP Act of 1992 provide a strong regulatory framework within which utilities must work to protect the environment. For example, CAAA provides market incentives to reduce emissions related to acid rain [e.g., each ton of sulfur dioxide (SO_2) emissions avoided by utility conservation measures entitles a utility to an SO_2 emission allowance[32]], and the EP Act provides tax credits and other subsidies for environmentally sound generation technologies. In addition, IRP is the means employed in many states to address environmental impacts of resource options. As of 1990, 17 state PUCs required utilities to consider environmental externalities in resource decisions, and 5 others were developing procedures to do so (Cohen et al. 1990); as of 1992, 2 more state PUCs joined the ranks (Arizona 1992).[33]

Unfortunately, meeting the environmental, cost, and reliability objectives is not easy. For example, renewables, production of energy from wastes, and cogeneration are being pursued mainly due to their superior environmental performance. However, these technologies are not immune to environmental quandaries. Biomass causes similar air emissions to coal [with the exception of SO_2 and possibly carbon dioxide (CO_2) if "closed-loop" replanting is done]. The same is true for combustion of wastes. Changes to the Clean Water Act, expected after 1994, have the potential to curtail new hydropower projects.[34] Opposition to wind generation has also been felt due to the potential of killing endangered birds. Visual degradation is another concern with many renewables, especially wind and solar, which require a large area due to the dispersed nature of the energy. The by-products of photovoltaic cell production are potentially environmentally damaging. There are other special problems with chlorofluorocarbons (CFCs), dioxins, municipal waste, etc. Addressing these and other environmental issues is a challenge for utilities.

Because of these types of issues and the emissions of global warming gases from the burning of fossil fuels, nuclear power has resurfaced in the public debate. Even if high construction, operating, and maintenance costs could be reduced, nuclear power would not enjoy a revival in the United States until people perceive that its environmental, health, and safety risks are greatly reduced (Morgan 1993). Nonetheless, advancements in smaller-scale nuclear facilities with more inherent safety features, such as automatic shutdown, are being developed. Perhaps standardized small-scale nuclear plants will come on line later next century if global warming concerns increase and fossil fuel prices rise. For this to happen, regulation and waste disposal issues would need to be solved first, and public fears would need to be assuaged (Morgan 1993; Ahearne 1989).

There are strong indications that natural gas may play a more prominent role in integrated resource plans because natural gas combines low capital cost, short construction time, and high efficiency with relatively low emissions. Natural gas is not just for peak-load power anymore; combined-cycle gas turbines are the technology of choice for new baseload plants and natural gas also figures prominently as a repowering fuel. Natural-gas-fired power plants constitute about three-quarters of all planned new capacity. As Leone states, "It seems . . .

natural-gas-fired power plants are the only acceptable means of satisfying all the interest groups and stakeholders."

In the longer term, fuel cell development has the potential to make natural gas even cleaner and more efficient. Clean coal technologies will need to be advanced to take advantage of this plentiful resource while keeping within the bounds of tolerable environmental impacts (e.g., with respect to global warming).

Environmental concerns make DSM programs more attractive if market forces do not reduce the value of DSM to utilities. As Gibbons and Gwin (1989) state, "We can, at least for the next couple of decades, displace fossil fuels—and reduce carbon emissions—more quickly and more cheaply with energy efficiency measures than with energy supplied by nuclear or renewable sources." Thus, DSM may be a cost-effective way to achieve environmental goals.

However, "many in the electricity industry are doubtful that a more aggressive pursuit of DSM pays off environmentally or economically" (*The Quad Report* 1993). As discussed elsewhere in this paper, existing DSM practices, and more broadly IRP, may not be compatible with a decentralized, market-driven electricity industry. The push toward competition and laissez faire electricity markets, combined with the political trend toward using taxation for policy implementation, could mean that the consideration of environmental impacts might be lessened or take different forms (e.g., increased taxation over additional regulation). As *The Quad Report* paraphrases Peter Bradford, New York Public Service Commission chairman, "State regulatory bodies that are trying to internalize social costs or environmental externalities through regulatory proceedings are probably swimming against the tide. . . . National policy . . . should be used to internalize externalities, set correct prices, and encourage the correct level of conservation."

Environmental pressures also raise the cost of electricity. As mentioned in the political and regulatory trends section, increasing use of price signals to implement policy is an identifiable trend. In regard to environmental externalities, environmental criteria are explicitly included in the competitive bidding process for power in New York, California, and Massachusetts, which results in electricity customers paying a higher price for less environmentally damaging resources. The use of adders or credits to raise the return for less environmentally damaging investments in the ratesetting process, as in Wisconsin and Vermont, have similar effects.

The CAAA's continuous emissions monitoring (CEM) requirements may increase the costs of NUG generation. As White and Mitnick (1993) state, "The requirement makes no distinction between utility generating units and nonutility generators. . . . Independent power projects will be more costly and risky because of the CEM requirements, and thus, some of the competitive advantages of independent facilities relative to traditional utilities will be lost."

The capital costs of environmental damage minimization technology constitute fixed costs that are passed on to ratepayers. Also, the widespread concern about environmental damage has given NIMBY and NOPE groups immense clout in delaying and canceling new generation projects.[35] The mere threat of delays and legal costs can lead to the cancellation of a project, which has led to increased costs and risks for new projects, thereby increasing the cost of electricity.

Finally, as mentioned elsewhere in this paper, environmental concerns about transmission facilities, particularly health concerns about EMFs, could prevent them from being built, thereby increasing transmission costs.

The overall conclusion in regard to environmental trends is that they profoundly affect the utility industry directly and indirectly, and if they increase, the effects could be even more profound. If pressing environmental problems become more dire, the changes wrought on the utility industry in the next century could be drastic. However, the utility industry has already changed a great deal in response to environmental pressures and the potential for further change may be limited. In the future, there may be more pressure put on other causes of environmental harm, in particular the automobile.

6. GLOBAL AND UTILITY SCENARIOS

Scenarios are plausible stories about the future state of the world. They are useful to develop and consider when one is presented with the task of thinking about the future in a strategic fashion. A well-scripted set of scenarios allows strategic planners to move beyond conventional wisdom to consider opportunities for and threats to their organizations, disciplines, and lives over a wide range of future possibilities. Planners can then develop strategic responses for imagined future situations to reduce risk and even to help overcome events that are complete surprises.

Kahn and Weiner (1967) are often given credit for making scenario analyses a standard technique for thinking about the future in government and business planning. Schwartz (1991), drawing on his experiences at Royal Dutch Shell, recommends that each scenario be built around a thought-provoking plot or theme and that approximately three scenarios be developed, one that represents conventional wisdom and two that play off the "official future" in interesting ways. The art of scenario building is to create scenarios that are not so far-fetched as to be completely implausible and therefore useless, and yet not too similar to each other (i.e., to conventional wisdom) because few new insights will result. Scenarios are most valuable as cognitive aids, not as probabilistic predictions of the future, to assist people in formulating new ideas about the world and considering appropriate responses.

Scenario analysis is an appropriate method to use as a first step toward considering the future of IRP in the electric utility industry.[36] This is because, as documented in Sects. 1-5, the electric utility industry is undergoing significant change, and the future state of the industry is not reliably predictable. Thus, it makes sense at this time to create utility of the future scenarios and then begin to assess the potential role of IRP under the scenarios. In this process, we deal with broad issues, general themes, and widespread trends that can inform about both the future of the industry and the future of IRP. It is anticipated that future projects will build upon the best ideas presented below to more specifically address IRP in the near term as well as to consider in more detail recommendations for IRP in the future.

Our approach to scenario analysis differs somewhat from the typical are in that we present two sets of scenarios. In addition to three scenarios for the utility of the future, we first present three scenarios that are global in scope. As we have tried to demonstrate in Sects. 1-5, powerful national and global forces are significantly shaping the utility industry. The trend toward competition is global, not just within the utility industry. Political, societal, technological, and environmental factors that transcend industry boundaries are important determinants of the utility of the future. Thus, how global trends play out will have important consequences for the electric utility industry.

Section 6.1 below presents the global scenarios. Section 6.2 presents the utility scenarios. The scenarios are intended to describe a world approximately 5-10 years in the future. Section 6.3 examines consistencies and inconsistencies between the global and utility scenarios.

During the course of building and revising the scenarios, we found that several important questions arose concerning IRP. What, if any, relationships are there between the global scenarios and IRP? Is IRP a driver of change in the utility industry or a tool that helps utilities and PUCs react to and manage change? Should IRP be included in the utility scenarios? To answer the last two questions, it was decided not to include IRP in the utility scenarios because IRP will probably follow and not lead change in the industry. To provide a specific focus on IRP, we decided to discuss separately IRP's role in each of the utility scenarios and the relevance of the global scenarios to IRP (see Sect. 6.4).

6.1 GLOBAL SCENARIOS

As the earth's societies head towards the twenty-first century, they are undergoing various pressures from various sources. Among the most important pressures are global economic competition, ethnic and political strife, political unrest, global climate change, relentless technological change, AIDs and other pandemics, and population growth. Positively, one can argue that the world's societies are moving more toward democracy, increasingly respecting human rights, improving living standards, increasing knowledge, and improving the environment. The business-as-usual scenario assumes that only small progress is made toward solving these problems and moving toward more desirable futures. At one extreme, one can assume that the negative forces will dominate, as in the fortress-state scenario. At the other extreme, one can assume that more positive forces will dominate, as in the technotopia scenario. Characteristics of these scenarios are presented below.

6.1.1 Business as Usual

In the business-as-usual future, business is still king, political life is crisis-driven but resilient, major social problems remain largely unsolved, technology continues to advance at an amazing pace, and environmental concerns continue to grow.

Competition is an important aspect of this scenario, especially intense global economic competition. Belief in the benefits of competition is widely shared across the political and socioeconomic spectrum. The economic landscape continues to be dominated by large multinational private organizations whose interests drive public policy and investment decisions. International trade remains a serious issue, both from the workers' viewpoint (save jobs) and from the multinational's viewpoint (open markets). Information technology facilitates improvements in productivity, distribution, and management, which tends to increase competitive pressures. Consumerism obsesses the world's youth, which creates the seeds of a shared world culture and economic frenzy to meet fickle product demands. New products are introduced at a dizzying pace to try to meet unpredictable changes in taste. Economic disputes rise as a leading cause of international conflict but are handled through often tense and extended negotiations.

The Western politicians and governments continue to be viewed with suspicion, but, all in all, democratic processes remain stable. Campaigning continues to be done through the media, and politicians continue to focus on short-term issues. Intense press scrutiny causes widespread risk aversion among politicians and civil servants. The global economic competition archetype sweeps through government, leading to initiatives in market-based regulation (which also acts to spread risk and blame to nongovernmental sources) and some improvements in operational efficiency. However, governments reserve the option of turning back to more traditional forms of regulation and intervention should market-based solutions fail to yield promised social benefits. The U.S. government plays a slightly more active role in domestic industrial development.

Global telecommunications systems facilitate communication of ideas and values around the world, but nation-states remain the dominate political entities. The gulf between the haves and the have-nots increases within the developed countries and continues to widen between the developed and developing countries. Awareness of these inequities causes social unrest but no more than in recent decades. In the United States, the serious problems of urban crime and violence, drug abuse, illiteracy, and teenage pregnancy remain, largely because government is caught up with the private-sector paradigm. Terrorism becomes more widespread but does not seriously threaten regular commerce or everyday behavior. Regional conflicts continue to arise but are "contained." Ethnic, racial, and religious strife increases in various parts of the world, but governments are able to "manage" the situations, although without the benefit of lasting solutions.

There is a strong consensus that advances in science and technology are the best means for increasing the quality of life. New scientific breakthroughs in information technology, biotechnology, and material science provide the foundation for new products and markets. The Information Superhighway becomes a reality. Governments are barely able to regulate the flood of new products. Education, health care, and the overall quality of life improve to a small degree as a result. Limited government revenue allows society only to maintain its already deteriorated physical infrastructure.

The environment continues to be a cause of international concern. Incremental progress is made on environmental issues, although catastrophes caused by global environmental change still hang over our heads like a Sword of Damocles because international politics remains fractious and consumerism drives developing countries to increase energy use, production, and pollution. Most progress is made on local issues associated with the disposal of hazardous wastes, air and water quality, and exposure to toxins in food and at work. Limited government revenue prevents more progress.

6.1.2 Technotopia

In this future, the developed world moves on to new forms of social organization built upon two important factors, a cooperative worldview and information technology. Thus, business and government undergo major transformation, serious social problems are largely resolved, technology development focuses on life-enhancing innovations, and environmental concerns are factored into every aspect of life.

The world scene is still defined by democracy and markets, but the "myths" that underpin human happiness are drawn more from environmental themes than from capitalism and consumerism. Therefore, people are drawn to social organizational schemes that seek to soften the often harsh consequences of unbridled competition. The creative energy of the MacWorld finds new avenues in environmentalism, social service, and virtual communities.

Thus, on the economic front, consumerism fades and is replaced by vigorous competition to develop new medicines and technologies to promote a sustainable society. Multinationals lose market share, size, and power to an amorphous arrangement of networked individuals and small to medium-sized firms. International "trade" is replaced by international "collaboration" as it becomes impossible to track trade and monetary "balances" in any meaningful way. Information technology and universal health care allow people to shift from project to project and reconfigure themselves depending on the project. The need to work with many different people in a decentralized fashion via advanced telecommunications puts a premium on cooperation and reduces traditional competition between distinct economic entities. As a result, competition is not widely viewed as a precursor for increases of quality of life.

Simultaneously, government is revitalized, in part by the application of information technology. It becomes more efficient and responsive. People put more faith in the ability of collective action as implemented by government organizations to produce services and increase the quality of life. Thus, government reduces its use of market-based solutions to solve social problems. Overall, government becomes more ubiquitous, not necessarily in its present form, but in the form of smaller, novel local and regional quasi-governmental institutions created to serve specific community interests. There is even a movement to create nonspatial governments within a true "global village" managed by advanced information technologies. This movement goes international, reducing the influence of nation-states in world affairs. Politicians evolve to represent process viewpoints and stress their ability to manage consensual processes rather than representing ideological viewpoints and spatially defined constituencies.

Society continues its transformation with respect to family composition, stability, and size. However, new government initiatives based on information technology and concepts of economic sustainability make progress in creating local jobs and in bringing in telecommuting jobs to distressed urban areas. Technology and new concepts regarding skills and intelligence result in jobs being tailored to each individual's strengths, thus making most every human economically productive. Crime and unemployment are reduced. Emergence of the global village also works to reduce ethnic and racial strife through the promotion of shared values and economic ties.

New technologies are developed to significantly prevent pollution, remediate environmental problems, and improve health, education, and the quality of life. More effort is expended to create new medical treatments and less to develop new consumer products. Government has more money to spend on infrastructure, and research and development yields impressive cost saving breakthroughs.

The cooperative worldview promotes global activities to solve global environmental problems. Sustainability is practiced on a world scale. The combination of reduced consumerism and Western transfer of information, medical, and environmental technology to developing countries greatly assists international political negotiation. Progress is made in reducing air and water pollution and exposures to toxins.

6.1.3 Fortress State

This world is anarchic, dangerous, and unpredictable. Survival is the game in business, politics, and life. Technology developments are geared toward short-term profit-taking. Environmental concerns are overwhelmed by survival concerns and dysfunctional institutions.

Intense national and global economic competition is socially destructive. Movement of production to low wage areas ends up causing widespread worker unrest in developed countries, reduced incomes, and further pressures to reduce prices. Workers suffer from job insecurity, reduced wages, and reduced benefits. Plant closings destabilize communities. International economic agreements unravel. Economic survival for firms in most industries becomes problematic. A fortress mentality pervades every aspect of life. Overall, the economic quality of life decreases even as those who do have jobs work longer hours just to maintain their jobs.

The downward spiral of household income further reduces the ability of government to raise revenue. Governments are unable to respond effectively to deepening social problems because it is politically easier to reduce support across the board rather than focus on solving a few problems well. Public opinion of government continues to drop, and many in government become cynical of the public. Corruption increases. Politicians pander to the emotional side of their constituents in their efforts to gain power. Tolerance and collective good give way to intolerance and narrow self-interest.

Simultaneously, ethnic, religious, and racial violence spins out of control, in part due to people's substitution of positive economic experiences with belongingness associated with one's ethnic, religious, or racial identities. The still well-to-do barricade themselves into high-security enclaves. Terrorism becomes global and more deadly. Targets typically include institutions that are owned by, are run by, and perpetuate those who already have power. Thus, attacks on infrastructure, including utilities, can be expected to be widespread. People's needs for group identity and the basic means of survival prevent societies from totally disintegrating. Falling behind are education, health care, and social security.

Science and technology yield new products of dubious economic or moral value, and in this chaotic environment, research and development expenditures plummet. Few breakthroughs are reported. The physical infrastructure continues to deteriorate.

Environmental problems receive less attention and soon begin to accelerate economic and political problems. Global warming has the potential to lead to numerous deadly conflicts over land and resources. Reduced government effectiveness results in increased exposures to toxins in food and at work. The fortress-state mentality of many in business leads to increased illegal dumping of hazardous wastes and the skirting of other laws to cut costs.

6.1.4 Summary

Table 6.1 presents a summary of the three global scenarios.

Table 6.1. Comparison of global scenarios

	Business as Usual	Technotopia	Fortress State
Government			
Opinion of	Viewed with suspicion	Viewed positively	Distrusted
Performance	More efficient; not necessarily more responsive	Becomes more efficient and responsive	Ineffectual; corrupt
Process	Promotes market-based solutions	Evolves into new, smaller forms	Regresses to command and control regulation
Politics	Short term focus; media-based campaigning	More citizen involvement	Harsh; little consensus-building

Table 6.1 (Continued)

	Business as Usual	Technotopia	Fortress State
Economics			
Competition	Intense but manageable global economic competition	Consumerism fades; competition is in research and development area	Destructive consumer-product-based competition
Business structure	Dominated by multi-nationals	Dominated by networked small and very small firms	Mixed bag; economic survival is paramount
Economic equity	Growing gap between haves and have-nots	Gap between haves and have-nots decreases	Widespread economic hardship
Society			
Social structure	Dominated by nation-states	Evolves into global village	Fractures into regional tribes
Stability	Pockets of serious urban, racial, and ethic violence	Violence confined to limited criminal activity	Widespread violence
Quality of life	Education, health care, and quality of life maintained	Education, health care, and quality of life improve	Education, health care, and quality of life decline
Technology			
Product Development	New products introduced at dizzying pace; computer chips revolutionize product design	New products support sustainability and better health	Little added value; geared for short-term profits
Research and Development (R&D)	Biotechnology and materials science are big winners	Medical and environmental technologies are big winners	R&D falls; few new breakthroughs
Infrastructure	Maintenance just keeps up; new "information superhighway" is created	Maintenance is adequate; new "information superhighway" is created	Physical infrastructure deteriorates; infrastructure for entertainment grows

Table 6.1 (Continued)

	Business as Usual	Technotopia	Fortress State
Environment			
Status	Global problems are unresolved; progress on local problems	Progress made on both global and local problems	Global and local problems worsen
Support for	Widespread although new sources of government funding are limited	Economic sacrifices willingly made to overcome environmental problems	Limited; environmental problems lead to conflict and economic hardship

6.2 UTILITY SCENARIOS

Currently, the major force changing the electric utility industry is increasing competition at all levels of the power industry: generation, transmission, distribution, and retail. As discussed above, the future form and function of utilities will be determined by the path and extent of competition as influenced by future regulation, societal trends, technology, and environmental concerns.

A major question is whether the utility industry will become more consolidated around wider, regional markets (this is the premise of the megaelectric scenario) or more decentralized and vertically deintegrated with a multitude of players (this is the premise of the discomania scenario). Alternatively, radical changes in the electric utility industry may not occur primarily because risk adversity overcomes the best of intentions for change. This is the premise of the frozen in headlights scenario.[37] Each scenario is presented with the following structure: electric power industry outlook followed by generation, transmission, and distribution issues. IRP issues are discussed separately in Sect. 6.4.

6.2.1 Frozen in Headlights

The utility industry envisioned in this scenarios looks much like the industry of today. Over the years, there are numerous pressures for change, but these pressures often opposed each other and utility interests. Uncertainty is rampant, and there seem to be large risks associated with most decisions. As a result, the industry appears to have frozen in the headlights of the on-rushing world. Only incremental change distinguishes this world from today's utility industry.

For example, vertical integration is very high in this scenario. Utilities still own the majority of the power generation resources and maintain a monopoly over transmission and distribution. The industry ultimately faces no major changes in the demand for electricity that might force more change, although the national economy and the sources for energy demand have changed tremendously. Indeed, the stranded asset problem has produced a standoff between utilities, large industrial customers, and the regulators. Profits are squeezed due to burdens associated with additional risks for financing new generation resources, PUCs' refusal to incorporate the costs for imprudent ventures—judged very subjectively after the fact—into the rate base, and relatively small increases in productivity.

The utility industry is only incrementally more competitive in generation. NUG penetration into the market is slowed for several reasons: increasing financial risks as PUCs begin to include NUGs into rate proceedings, increased costs for environmental controls, and increasing cost competitiveness on the part of utilities. Industrial cogeneration also has decreased as manufacturers have been unable to justify increased long-term capital expenditures in any one country. Still not fulfilling their promise, there have been no technological breakthroughs in renewables that could have lead to widespread, decentralized, small-scale generation.

PUCs still oversee power generation and direct utilities, with some contradiction, to provide more reliable power at lower cost. Environmental compliance costs have increased as existing laws are now accompanied by specific but unpredictably strict regulations. The resource mix contains more natural gas and coal, due to improvements in associated generation technologies, at the expense of oil. Nuclear energy does not make a comeback due to adverse public opinion. As mentioned above, renewables also fail to make inroads. New plants average 200-300 MW in capacity.

The utilities' reign over transmission continues (i.e., utilities have control over construction, reliability, dispatch, etc.), and bulk power transfers and wheeling have patterns similar to the present ones. These patterns have continued in part because improvements in transmission technology (e.g., improved power electronics) are just enough to convince PUCs and customers that the utilities are making a sincere effort to improve this part of the utility system. Another factor is that concerns over EMF have increased greatly, forestalling the siting of new transmission lines that could have had different ownership.

This situation is also in part due to the fact that generation- and transmission-owning utilities, in the face of enormous pressure, have not acted against their economic self-interest by providing pain-free transmission access to lower-priced generation competitors. FERC ultimately proves unable to establish and mediate effective transmission access regulations. Transmission-owning utilities are simply too clever at following the letter of comparable access regulations while violating the spirit. As a result, power brokering is at minimum and involves only the largest of customers.

Lastly, the situation is also due to a decrease in the need to wheel large amounts of power as capacity-poor areas have found it in their interest to increase their indigenous supply of power resources. This is because capacity-poor areas have found they have no guarantees that contracts will be honored or renewed in the long-term (e.g., the Supreme Court has ruled that a capacity-rich area suffering a natural disaster does not have to cut back services to core customers to meet its contractual obligations to other service areas).

The distribution of electricity remains centralized and closely regulated by PUCs. Utilities continue to publish tariffs for electricity services, which only the largest customers have the ability to question and negotiate. Indeed, although rarely acted upon, large customers continue to threaten to leave utility service areas for other areas. However, because profits have been reduced, prices have been reduced somewhat, and distribution technology has improved, large customers generally stay put.

Regulatory oversight does an adequate job of ensuring that utilities do not inequitably cross-subsidize by raising rates to captive customers in order to force out competitors by lowering rates to footloose customers. Utilities and ESCOs continue to uneasily share the energy services market. Utilities continue to provide DSM services at the behest of the PUCs and because competition has not increased so substantially in generation as to make it a completely unprofitable venture. In addition, DSM programs become more innovative and dependent on advances in computers and controls.

Overall, electricity prices have risen with inflation as DSM, limited increases in competition in generation, and some productivity increases in generation, transmission, and distribution have pushed to reduce costs while aging plants, environmental regulations, and additional social obligations (e.g., low-income programs) have pushed to increase costs. Natural gas and renewable prices also have remained stable.

In summary, uncertainties conspire to retard change in the electric utility industry. Risks associated with investing in new capacity increase, and utilities' ability to forecast future demand erodes. The winners in the battle over transmission access are constantly in doubt. PUCs offered contradictory guidance and become increasingly intolerant of bad decisions, even if utilities have made them in concert with PUCs and with the best of intentions. The size and composition of the customer base have never been sure things and even the responsibilities for utilities to provide energy services are uncertain. In combination, these uncertainties make it very difficult for utilities to make the major decisions that could lead to major changes in the industry. As it happens, events external to the industry have unfolded in such a way that change has not been forced upon the industry.

6.2.2 Megaelectric

In this scenario, change factors favoring a more centralized, vertically integrated industry win out over change factors favoring a more decentralized industry. Indeed, the industry undergoes a massive consolidation, resulting in only a small number of exceedingly powerful megaelectric utilities.

Deregulation of the industry quickens during the mid to late 1990s when it benefits society most and has become inevitable in any case. However, like other deregulated industries that have consolidated (e.g., in the early twenty-first century, there are only four major national airlines, three national newspapers, four major world computer vendors, six multinational insurance companies, etc.), the electric utility industry consolidates beyond anyone's wildest dreams. Utilities merge at a quick pace in the beginning of the new millennium in order to increase capital available for investment, increase leverage over electricity rates, decrease administrative costs, decrease the threat of competition, consolidate maintenance and research and development functions, and provide better returns for their investors. Foreign investors (through international investment organizations) have supplied a considerable amount of the capital needed to finance the mergers.

Industry profits level off after many up and down years as first deregulation and then major changes in electricity demand and peaks occur. Now, instead of state PUCs, multistate PUCs and the federal government, due to the size of the megautilities, regulate the rates of the megautilities and award steady if unremarkable profits that harken back to the 1960s.

Also reminiscent of a bygone era, and facilitating steady profit allowances, are steady increases in the demand for electricity. New demands for electricity are realized, beginning with the demand for electricity for electric cars. More affluent lifestyles revolve around new electronic products, everything from smart toilets (Davis and Davidson 1991) to a plethora of smart appliances (Mayersohn 1993) and increasingly powerful, user-friendly, yet smaller home computers and faxes. Cooperation between the utility industry and the government leads to the development of environmentally sensitive industrial processes, many of which require a great deal of electricity. These technologies include a whole line of waste and chemical recycling technologies, water-based and baked-on coatings, lightweight and durable materials, and synthetic replacements for petroleum products.

Population densities increase dramatically as people move back to established central cities in order to take advantage of public transportation and walking access to shops, etc., and to reduce commuting and other traffic-gridlocked trips. Even in Western cities, densities increase as earthquake engineering improves and older core neighborhoods are gentrified with high density, mixed land use developments.

Increasing densities and environmental regulations make it much more difficult for homes and businesses to produce power on their own. In general, only the largest of industries can justify producing enough electricity on-site to make independent power production sufficiently cost efficient, reliable, and convenient. Thus, electricity demand has increased in the four major sectors: residential, transportation, commercial, and industrial.

This scenario is also characterized by the virtual elimination of nonindustrial nonutility generation of electricity. In addition to the factors mentioned above associated with the increase in mergers, major technological breakthroughs benefit the economics of large-scale, centralized power production. As seen in the 1990s, economies of scale are being realized in natural gas[38] and accelerate during the ensuing years. Additional technological breakthroughs include superconducting transmission lines; new ceramics that improve thermal efficiency and allow the development of much larger thermal units; and fundamental advances, as well as standardization, in fission power. Fusion remains a distant promise, even in this hypothetical world.

Massive regional power generation parks have been established away from population centers, the only option available to take advantage of new economies of scale and overcome NIMBY sentiments. Superconducting transmission lines and the institutional consolidation discussion above have also contributed to the creation of these parks. Environmental costs are somewhat lower per megawatt generated because of new designs, fewer power plants, and overall increases in productivity.

Renewable energy sources have made gains in niche markets in specialized settings, but their electricity production is minuscule compared to the superplants' massive output. Increased public and regulator awareness of environmental damages from alternative small-scale generating technologies have contributed to the reversal of the small-scale generation trend. For example, small-scale hydro is shunned because it modifies watershed, windpower is shunned because it kills endangered birds, and biomass- and waste-fueled combustion do not significantly expand because of air pollution and other environmental impacts.

The megautilities completely control the transmission grids. Even federal transmission systems are privatized and become absorbed into the mega-IOUs. Demands for access to the transmission grid decrease if only because the sheer size of the megautilities spatially eliminates situations in which power wheeling could be considered. Although new computer technologies improve the operation of transmission networks, transmission arrangements do not change much. Similarly, retail wheeling of power is not widespread because the regional power parks can supply electricity to large geographic areas at low cost. Thus, in this scenario, there are no power brokers, the utilities maintain control over the grid, and customers pay the published tariffs for electricity.

FERC is replaced by a mega-agency of its own that oversees all U.S. mega infrastructure companies, the Federal Infrastructure Regulatory Commission (FIRC). In addition to overseeing transmission, FIRC also oversees the large highway companies [courtesy of the Intelligent Vehicle Highway System (IVHS) project advances in laser-guided toll collecting], a reconstituted cable-phone-computer network industry, and the national water company, among other industries.

In this scenario local governments become a vital player in representing the interests of customers at the distribution end of an industry dominated by fewer and larger utilities. Customers receive highly reliable service at steadily decreasing costs. However, the megautilities lose interest in conservation and other DSM activities. ESCOs have complete control over this market now but need activist local governments to block utility attempts to thwart their activities to cut energy use.

In summary, in the megaelectric scenario, the industry consolidates due to financial and organizational forces. Consolidation is supported by technological advances that create economics of scale for large regional power parks. Regulation is now handled by local, multistate, and federal agencies. Due to decreasing costs for electricity, increasing demands, satisfactory environmental controls, and increasing reliability of service, regulation is, by and large, nonconfrontational.

6.2.3 Discomania

In this scenario, the utility industry as we know it today has become extinct. It has been replaced by a vastly disintegrated industry that features separate ownership of generation, transmission, and distribution systems. The original utilities now only own local distribution companies, after participating in one of the most frenzied and by-far most expensive sell-offs of assets in the nation's history, to be forever known as discomania.

Several factors in the mid to late 1990s lead to the fast paced change in the industry: plummeting demand for electricity, widespread dispersed generation, increased liabilities associated with generation and transmission, and major improvements in intelligent information technologies needed to control the system and manage interactions among the players. Let's take each of these factors in turn.

Electricity demand has dropped precipitously for two major reasons. First, it has become apparent that the build-up of greenhouse gases in the atmosphere is actually hastening global climate change. New forecasts for 1996 emission levels predict global warming of 6°F by the mid-twenty-first century and potential devastation of almost every national economy. Only a drastic reduction in emissions could possibly hold off the most dire consequences. As a result, energy conservation has become a mania of its own overnight. Second, technologies have conveniently evolved to support this initiative. Photovoltaics, even if somewhat more costly, are now reliable and more efficient. Government and industry have worked together to produce electricity-saving technologies and processes. Biomass has replaced oil as the major source for transportation fuels because it adds no new net greenhouse gases to the atmosphere. The Information Superhighway allows further decentralization, which promotes increased use of solar technologies, yard-farming, and other sustainable activities. There are also impressive improvements in storage technology.

In this scenario, every free-standing structure has the potential to produce at least part of its own power. IPPs are cogenerating businesses, small businesses operating small generation facilities, and even households. To reduce transmission losses, small-scale generation facilities—many using photovoltaics, wind, and other renewable technologies as appropriate to the area—are located throughout population areas, much like the gas stations of old, and are owned by local generating companies (GENCOs). Only a few large power plants remain to provide power to a few industrial customers and back-up power during adverse weather situations and to ensure system reliability.

Utilities have found that their generation assets are unprofitable in this environment because it has never been possible to couple decreased sales of power with steady or even increasing profits. In addition, there are rumors that utilities might be held liable for causing irreparable harm to future generations by contributing to global climate change through their generation activities. Payouts could have stretched for decades, at least. The best way to avoid this scenario was to dump generation resources as quickly as possible.

In any case, the utilities have been unable compete organizationally or in terms of price with new, small-scale companies and technologies coming on-line. Utilities cannot turn to the PUCs for help because the PUCs have turned over regulation of generation to environmental agencies (e.g., the Environmental Protection Agency). So, generation assets are quickly sold or abandoned after this realization is made.

Because of the preponderance of local generation and major reductions in electricity demand, the demand for power wheeling on a daily basis is relatively minimal. However, in the spirit of national cooperation in times of crisis, a national cooperative effort has created a revamped and efficiently connected national transmission system. Macroelectronics and computer controls provide the needed speed, flexibility, and reliability, and require near-zero maintenance.

Utilities have opted out of owning the transmission systems due to liability concerns associated with EMFs. Another factor in this decision is the emergence of computerized power packet management and trading. Indeed, a national stock market has evolved to trade power futures. Power brokers match generators to retail customers, and electricity prices are negotiated in a competitive market environment. Outside investors from anywhere in the world can trade in the futures and spot markets for electric power. A big change in this scenario from current practice is that instead of accepting tariffs posted by utilities, retail customers have to sign contracts with power brokers and GENCOs guaranteeing some period and level of business. Contracts are needed to stabilize these agreements and provide financial incentives for generators to maintain and possibly build new capacity.

Utilities give way to government control of electricity transmission. Similar to the way that the Federal Aviation Administration (FAA) manages air traffic, a new government agency manages wheeling of power between power districts. These districts are political jurisdictions much larger in scale than areas now covered by distribution utilities and serve to ensure system reliability. The grid itself has a diverse ownership. Any piece of the grid can be individually owned, and the owners are responsible for billing and maintenance. The national grid also makes future investments in capacity to cover peak loads almost completely unnecessary. Although electricity does not actually flow across the entire continent, it is continually traded between adjacent service areas providing a leapfrog effect across vast distances.

Thus, utilities are left with the distribution networks; their major responsibility is to work with generators, power brokers, and retail customers, under the guidance of the FAA-type agency overseeing wheeling, to ensure that power is delivered to retail customers. Although smaller in total scope, this role is much more complex because of the necessity to manage thousands of potential power suppliers and many thousands of electricity customers. Following other trends in organizational design, the new utilities [actually distribution companies (DISCOs)], like the other players in the power production market, are small, flexible core companies with ever-expanding networks of power buyers and suppliers. The new utilities, for instance, do not directly engage the end customers in selling electricity delivery, marketing, and efficiency services, but instead act through a network of contractors, each specialized and responsive to specific and rapidly changing customer needs. For example, households can buy heating, cooling, lighting, telephone, and video products from small service companies with the electricity costs built into the service costs. ESCOs also have complete control over the conservation market.

Information technologies play a central role in the operation of these new utilities and in the operation of the new power markets. For example, households have smart houses that play the electricity market and control energy use. Other smart technologies also interact with markets to maximize energy efficient use and control the delivery of services.

Local governments work with the DISCOs to ensure that the interests of the public are met. The local governments, much like the courts, focus on mediating disputes and establishing satisfactory working arrangements among the local players and managing relationships with regional and national players.

In summary, the discomania world is driven by environmental fears, new technologies, and a small-is-beautiful ethic. It is a world of GENCOs, transmissions companies (TRANSCOs), and DISCOs, renewable technologies, and on-line interactive markets and systems. Electricity prices may be stable or they may go up faster than inflation, if all costs to the consumer are factored in. Prices for nonrenewable fossil fuels become irrelevant for the most part. Regulation of the new system becomes fractured but is appropriate for this new electric utility industry.

6.2.4 Summary

Table 6.2 summarizes the utility scenarios.

Table 6.2. Comparison of utility scenarios

	Frozen in Headlights	Megaelectric	Discomania
Industry Outlook			
Electricity demand	Steady	Increases more than inflation	Plummets
Vertical integration	Very high	Almost complete	Vast disintegration
Profitability	Decreases	Steady overall; determined by PUCs	Healthy overall; numerous winners and losers
Generation			
Competition	NUGs make inroads in niche markets	Utility monopoly, some cogenerators	Increases dramatically
Ownership	By local and regional utilities	By multiregional utilities	Dominated by GENCOs and cogenerators
Technology	No major breakthroughs	Major breakthroughs, medium- to large-scale	Major break-throughs, small-scale
Resource mix	Natural gas and coal gain at expense of oil	Nuclear and natural gas gain	Renewables gain dramatically
Regulation	By state PUCs	By federal government and state	By other agencies (e.g., EPA, ICC)
Environmental costs	Increase as existing laws are enforced	Decrease per megawatt generated	Hold steady; increases for old technology, decreases for new technology

Table 6.2 (Continued)

	Frozen in Headlights	Megaelectric	Discomania
Transmission			
Competition	Little or none	None	Much; fostered by brokers
Ownership	By regional utilities	By multiregional utilities	By TRANSCOs
Technology	Improved power electronics	Superconducting becomes practical	Intelligent power controls
Regulation	By state PUCs and FERC	By FIRC	By multiple federal and state agencies (e.g. EPA, ICC)
Distribution			
Competition	Retail wheeling for large customers	None	Widespread retail wheeling
Ownership	By local utilities	By multiregional utilities	By DISCOs
Technology	Better peak demand management	Increased reliability	Direct current increases dramatically
Services	ESCO-based	Limited	Integrated, "intelligent" services
Regulation	By state PUCs	By local agencies	By FERC and local government
Prices			
Electricity	Steady	Decrease in real money	Rise with inflation
Natural Gas	Steady	Increase in real money	Decrease in real money
Renewables	Some decrease	No change	Large decrease

6.3 RELATIONSHIPS BETWEEN THE GLOBAL AND UTILITY SCENARIOS

This section explores relationships between the global and utility scenarios. What factors in each global scenario affect what factors in the utility scenarios? How consistent is each global scenario with each utility scenario? These are challenging questions because each set of scenarios is composed of numerous variables. Relationships among variables within each scenario and across global and utility scenarios could take numerous forms, depending on one's assumptions and on which scenario variables are considered to be the driving forces.

To assist this analysis, Fig. 6.1 provides a modest system diagram that contains the most important global and utility scenario variables. "Societal will" represents individual and collective preferences and the general state of society. Societal will is assumed to be the central driving force in this system. In this simple system, societal will directly influences economic demand and regulation, which generally represent the economic and the political spheres, respectively. Economic demand drives production, which should be interpreted as the technological base of the economy.

Regulation, production, and economic demand influence four utility scenario variables: electricity demand, power generation, power transmission, and power distribution.
In very simple fashion, electricity demand influences power generation, which affects power transmission, which affects power distribution, which finally affects the delivery of electricity services. Electricity services is one feedback link to societal will. Power generation and production result in a certain amount of pollution, which affects the environment and human health, which in turn feeds back to societal will. Production also has relationships with income and employment, and goods and services, which also feed back to societal will.

Fig. 6.2 presents values for these variables one might assume to hold for each global and utility scenario. In most cases, these values are drawn directly from Tables 6.1 and 6.2,

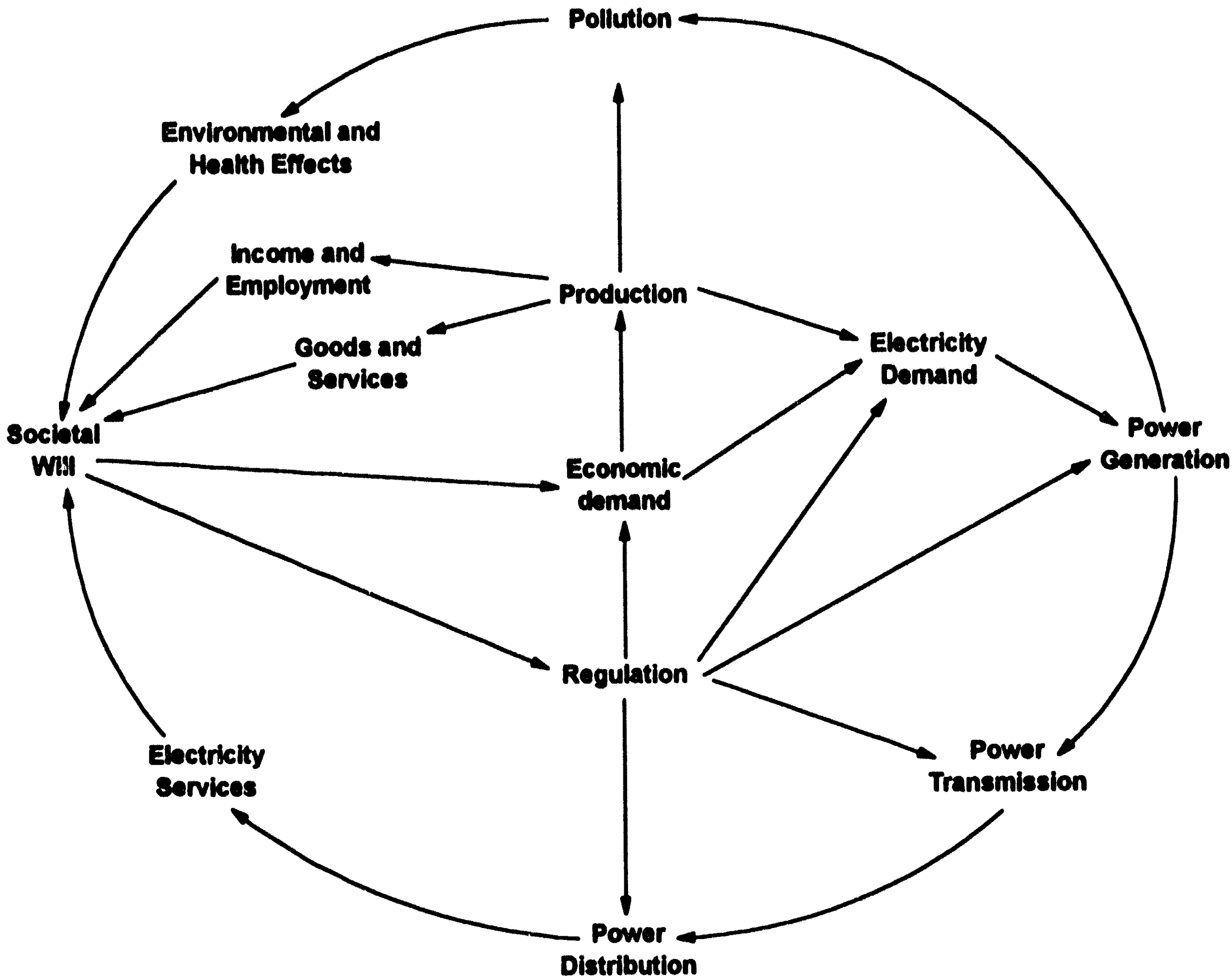


Fig. 6.1. Simple system of scenario variables.

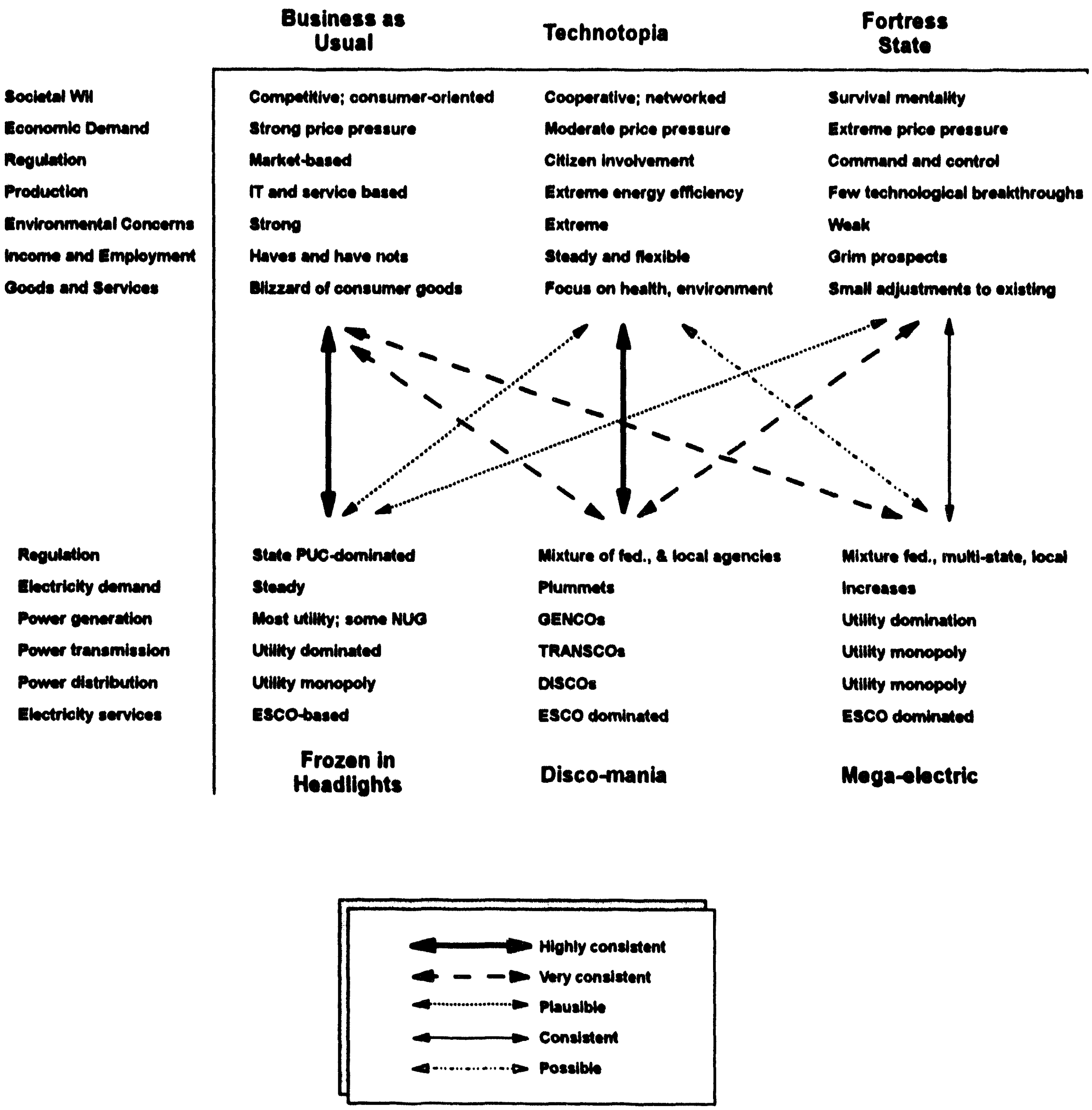


Fig. 6.2. Selected scenario variables and global-utility scenario relationships.

respectively. The middle of Fig. 6.2 indicates how consistent each global scenario is judged to be with each utility scenario. The judgments range from highly consistent (business as usual—frozen in headlights) to plausibly consistent (technotopia—frozen in headlights).

Because of the large number of variables in the analysis, no global scenario appears to be completely inconsistent with any of the three utility scenarios. Areas of consistency and inconsistency for each of the nine pairs of scenarios are noted below. This section concludes with a discussion of key variables whose values are judged to have the most significant affect upon which global and utility scenarios might emerge in the early twenty-first century.

6.3.1 Business as Usual—Frozen in Headlights

These two scenarios are highly consistent with each other because they basically represent the current world of the mid-1990s. A societal will characterized as embracing competition and consumerism will impart strong price pressure and promote market-based regulation. The changing economy, from manufacturing to information services, will influence production but not ultimately the fundamentals of electricity demand. Utility industry regulators will push for market-based solutions, allowing NUGs to increase their niche market and also allowing utilities to react to maintain their base. Strong environmental concerns will continue to be felt in the power generation and transmission areas, as they do today. The growing disparity between the haves and have-nots will continue to result in pressures upon utilities to offer programs to low-income customers at the same time that they need to rein in price increases. Factors that define the business-as-usual scenario will continue to cause major uncertainties for utility decision makers, resulting in the frozen-in-headlights behavior and incremental change in the industry.

6.3.2 Business as Usual—Discomania

This pair of scenarios generally represents what we have found to be the conventional wisdom in the industry: the larger world essentially stays the same while the industry evolves into a highly decentralized network of GENCOs, TRANSCOs, DISCOs, and ESCOs. Indeed, these two scenarios are very consistent because the competition- and consumer-goods-oriented societal will of the business-as-usual scenario offers the perfect conditions for new industry players to tender a blizzard of new electricity services along with a reorganized industry. Information technology will facilitate the evolution of the discomania scenario by allowing the real-time communication needed for these dispersed markets to operate.

The only potential inconsistency between the scenarios is that the discomania scenario is characterized by plummeting electricity demand and there are no factors in the business-as-usual scenario that would necessarily lead to this situation. One reaction is that the discomania scenario doesn't necessarily need to be characterized by plummeting electricity demand. Another reaction might be that price pressures and environmental concerns combine to reduce electricity demand more than might be associated with the business-as-usual scenario.

6.3.3 Business as Usual—Megaelectric

These two scenarios are consistent because they represent the relatively recent past. The utility industry could easily slip back to its former, overwhelmingly monopolist ways. Indeed, the industry might welcome the megaelectric scenario because of its lack of uncertainty. This scenario requires the same regulatory frameworks, capital investment processes, and social institutions (with some fine tuning) that we have today. The competitive societal will would allow the megaelectric scenario to occur if cheap, more centralized power production led to enhancements in global economic competition and high levels of environmental protection. The megautilities would be consistent with the role of powerful nation states and multinational firms. The "universal belief that technological change is the best means for increasing quality of life" in the business-as-usual global scenario is also conducive to megaelectric developments because technological advancement is a prerequisite in this scenario.

The only source of inconsistency is in the area of regulation. The megaelectric scenario paints an industry rather indifferent to providing energy services to meet equity and environmental considerations of the societal will. However, the promise of steady profits and a simpler planning environment would be more than enough to convince the megautilities to fully cooperate with the mixture of regulatory agencies.

6.3.4 Technotopia—Frozen in Headlights

These two scenarios are not very consistent with each other. Basically, the global warming situation envisioned in the technotopia scenario drives an extreme energy-efficiency ethic that would cause electricity demand to plummet. Utilities are already very anxious about how they will maintain revenues and profits in the face of more ambitious DSM programs. Unless an innovative solution is found to overcome this problem—the revenue pressures combined with the need to retool energy technology so that it is much more benign—it is unlikely that the utility industry as envisioned in the frozen-in-headlights scenario could coevolve with the technotopia scenario.

It should be noted that in other ways, the scenarios are consistent with each other. The existing PUC process can admit much more citizen involvement. Decreasing price pressures would be welcomed by the utility industry. A focus on health and environmentally related products could also be consistent with current patterns of electricity demand. The industry would also be willing to spend more on environmental control in a situation in which the public is willing to pay more for electricity.

6.3.5 Technotopia—Discomania

These two scenarios are highly consistent because the extreme drive toward energy efficiency and sustainability warranted by the confirmed threat of global climate change would result in an industry with a wholly new generation portfolio and structure. Environmentally benign technologies are likely to be small-scale renewable technologies, and small, competitive NUGs have excelled in providing these technologies up to now.

The technotopia culture, which is environmental, antibureaucratic, and tolerant, bestows favor on steady income and flexible employment and would seem to favor the "flexible" industry composed of GENCOs, TRANSCOs, DISCOs, and ESCOs that could continuously reconfigure to meet various demands of the marketplace and is characterized by low bureaucracy and high efficiency. The production focus on health and the environment facilitates new electricity services and arrangements which are also the hallmark of the discomania scenario. The stress on citizen involvement is also consistent with assignment of responsibility for industry oversight to a mixture of both local and federal agencies.

6.3.6 Technotopia—Megaelectric

The technotopia scenario could lead to the megaelectric utility scenario, provided that the new large-scale technologies are environmentally benign and utility regulation is revamped while leaving utilities intact. For example, new nuclear and natural gas technologies might be perceived as beneficial (or at least the lesser of evils) if they do not contribute to further emissions of greenhouse gases and if renewables fail to meet demand or develop significant environmental problems of their own. However, given the current public abhorrence of nuclear power, due to its environmental and health risks, and suspicion of utilities and regulatory agencies (attitudes that would only be more acute in the technotopia scenario), these are big ifs.

One feature of the technotopia scenario that makes the emergence of megaelectric scenario plausible is the potential for straightforward cooperation among the megautilities and the various citizen groups and regulatory bodies. In return for steady profits, a reduction in price pressures, and a much more predictable future, the megautilities are likely to agree to increased citizen involvement. Indeed, in the technotopia scenario, competition has a dark side and is not the primary goal of social policy, especially given the spectre of cataclysmic global climate change. Thus, if the utilities could build and maintain credibility with the public, the technotopia and megaelectric scenarios could coexist.

6.3.7 Fortress State—Frozen in Headlights

These two scenarios bring to mind the command and control government tactics of the 1950s, with a utility industry only slightly different in organization from the industry of that time period. Thus, at first glance, the two scenarios are at least institutionally consistent.

The big difference between the 1950s and the fortress-state scenario is the incredible pressure on prices and rampant and extremely fickle consumerism that makes long-term economic survival very problematic. In this atmosphere, it is conceivable that the frozen-in-headlights scenario could occur because of the extreme consequences for incorrect financial decisions. There would be plenty of apprehension about making any decisions. On the other hand, the pressures might be so extreme that the industry could not resist change, and would either break up into numerous viciously competing pieces or quickly evolve into a more extreme type of monopolistic industry.

6.3.8 Fortress State—Discomania

Interestingly enough, the seemingly unmanageable nature of both the fortress-state global scenario and the discomania utility scenario makes them very consistent. Instability, self-interest, and lack of central control characterize the fortress-state global scenario. Such a society is inconsistent with a centrally planned, highly integrated electricity system that is regulated to serve common and widely held notions of public interest. In its place would evolve a decentralized, unintegrated, and uncoordinated system of providing electricity, probably dominated by small firms. This system, by necessity rather than choice, would promote energy conservation and result in reductions in energy demand. The fortress-state global scenario would also promote a decentralized electricity generation, transmission and distribution system that is more resilient to anarchic situations—such as terrorism, riots, and environmental disasters—than today's vertically integrated, centrally planned, and immutably fixed system. Unfortunately, in the fortress-state scenario, equity and environmental concerns will take a back seat to economic self-interest, so the equity and environmental concerns hypothesized as part of the discomania utility industry scenario would be abandoned.

6.3.9 Fortress State—Megaelectric

On the other hand, as argued above, the fortress state could just as easily result in a more monolithic industry if price pressures act to eliminate competition in generation before the industry becomes competitive in other areas (e.g., before the industry disintegrates too far to return to its monopolistic days). This could happen if new competitors wilt under the price pressures and if regulators in the fortress state allow, mostly through benign neglect, utilities to compete unfairly.

For their part, utilities could hold up their end of the bargain to reduce prices by reducing the implementation of environmental controls, reducing margins and maintenance investments, etc. The two scenarios are inconsistent because the fortress-state scenario is unlikely to yield new technologies to significantly improve economies of scale associated with the envisioned regional power parks. Also, one could argue that ever larger and integrated regional utilities need stable governments, sources of capital, stable and growing electricity demands, and customers who can pay their bills. The megautilities might not endure devastating physical attacks against expensive physical assets. None of these conditions are to be found in the fortress-state global scenario, although it has been pointed out that such utility industries do exist in rather chaotic political environments in the developing world.

6.3.10 Key Indicators

Among all the variables that compose the three global scenarios and three utility scenarios, which ones in particular hold the key to the future? This is an extremely difficult question to answer because all the variables are bound together in a complex system of influences and feedbacks. Fig. 6.1 only hints at the complexity. However, the discussions above indicate that there are three variables in particular that can be considered key indicators of the future: **global warming, utility technology**, and **competition**.

If global warming is confirmed and if climate predictions are catastrophic without concerted human response to reduce the emissions of greenhouse gases, it is likely that the world will rally around this crisis and evolve into the world envisioned by the technotopia scenario. The societal will created to save the earth is utterly inconsistent with the fortress state scenario and generally inconsistent with the market-based, have/have-not business-as-usual world.

As stated above, the utility scenario most consistent with the technotopia scenario is discomania because this scenario can support the renewable and small-scale energy technologies required to reduce emissions. The major loss of power sales would drive conventional utilities out of the generation business. Once moving quickly down the slippery slope of vertical disintegration, it is unlikely that utilities would hang on to transmission, too, thereby making the frozen in headlights scenario very unlikely. Without new technologies that could support new economies of scale in electricity generation, the megaelectric scenario would also be unlikely. In summary, global warming is a key variable, because if it comes to pass in the near-future, it could strongly and definitively define the global and utility futures.

Utility technology is a second such defining variable, at least with respect to the utility scenarios. If new technologies are developed that make nuclear, natural gas, or coal technologies very inexpensive at large scales, if new transmission technologies are developed to make transmission at long distances efficient, and if these technologies can be environmentally benign, then the industry would naturally attempt to revert back to its monopolistic heydays as envisioned in the megaelectric scenario. This could easily happen if these technologies are implemented before competition in generation pushes the entire industry toward the discomania future. As indicated above, the mega-utility world is generally consistent with each of the three global scenarios. Thus, in the absence of global warming and given new technology, the megaelectric scenario would most likely come to pass.

The third variable, competition, also represents the larger state of society. If competition becomes destructive, if incomes fall, if unemployment is endemic, if workers are driven to the brink, with the accompanying social trauma, the fortress state will most certainly evolve. People will be concerned about survival, not about the environment, not about developing neat new technologies. If the price pressures are extreme, the current utility world will not survive (i.e., the frozen-in-headlights scenario will not come to pass). It is most likely that the pressures will split up the industry into a survival-mode discomania scenario or possibly the megaelectric scenario.

There are timing considerations among these three variables. If competition becomes destructive before global warming and its impending catastrophes are confirmed, then the fortress-state scenario becomes most likely. If new, economy-of-scale technologies exist before either destructive competition or global warming is confirmed, then the megaelectric world would evolve; otherwise, the discomania world would evolve.

As a last point, if global warming is not confirmed, if competition is managed in a healthy way, and if there are no new technological breakthroughs favoring large-scale power generation, the business-as-usual scenario would appear most likely. Current conventional wisdom would probably view the resulting electric utility industry to fall somewhere between the frozen-in-headlights and discomania scenarios, although these two scenarios appear to be just valid predictions.

6.4 IRP AND THE SCENARIOS

This section ends the journey from trends to scenarios to potential ramifications for IRP. The discussion focuses on the possible value of IRP for each global-utility scenario pair. Specifically, comments are made on the possible characteristics of the IRP process, foci for planning processes, and usefulness of IRP results to utilities in the future. Table 6.3 summarizes the discussion.

To begin with, let us examine out the probable structure of IRP in each of the utility scenarios. In the frozen-in-headlights scenario, the utility industry is mostly intact (i.e., substantially vertically integrated), with some external activities in generation and energy services. Thus, for the most part, PUCs and other regulatory bodies could still efficiently deal directly with utilities about the subject of IRP. Some provisions will need to be made to bring the NUGs and ESCOs into the process for completeness. Of course, these provisions will not be needed in the megaelectric scenario.

The IRP process will need considerable modification in the discomania world. If there are regulatory agencies interested in IRP, they will have to deal with numerous players. One way to accomplish this task is to require companies providing electricity services (from generation to DSM) to submit information about their resources, assets, and plans that is needed for regional IRP. These plans could contain very detailed information, as one might expect to happen under the technotopia scenario, very little information primarily related to financial data (i.e., about economic survival) under the fortress-state scenario, or something in between under the business-as-usual scenario.

Table 6.3. Relationships between IRP, global, and utility scenarios

Global Scenarios	Utility scenarios		
	Frozen in headlights	Megaelectric	Discomania
Business as usual	Similar to today; more focus on using markets; more stress on environment; utilities use IRP in own planning	Similar content to today; focus is on economic efficiency; utilities use IRP in own planning	Consists of reports from numerous companies; focus is market efficiency; reports of little value to companies
Technotopia	Similar content to today; more stress on IRP process and citizen involvement; extreme focus on environment; utilities use IRP in own planning	Much more content and explanation than today; focus is on utility credibility and environment; utilities may not use IRP in own planning	Consists of detailed reports from numerous companies; focus is on environment and system reliability; companies will make use of these reports
Fortress state	Similar content to today; focus wholly on least cost; other social objectives ignored; utilities use IRP in own planning	Much less content than today; focus on least cost; of little value to utilities for own planning	Consists of minimal financial reporting by companies; focus is financial viability; companies will not use these statements

The focus of IRP will vary widely across the global scenarios. For example, in the business-as-usual world, IRPs will focus on the use of markets (frozen in headlights), and more generally on economic efficiency in the other two scenarios (megaelectric and discomania). In the technotopia world, people will be more concerned about citizen involvement and process than today. Thus, in the frozen-in-headlights scenario, IRP will need to more clearly involve citizens and strive to show how utility plans meet explicitly articulated public preferences. In addition to this challenge, IRPs in the megaelectric scenario will need to focus heavily on building and maintaining utility credibility with the public (e.g., providing justification for decisions in terms of the public good as opposed to bottom-line considerations). In the discomania scenario, the information submitted by the various players will be used to create an overall picture of how the public good will be furthered and how various players may need to change their plans to improve the outlook for the future.

With respect to the fortress state scenario, the focus of IRPs will be on least cost in the frozen in headlight and megaelectric scenarios and the financial viability of companies in the discomania scenario. In other words, the IRPs will need to show how the utilities are developing a mix of resources, capital investments, etc., that minimize the cost of electricity to the customer.

Other aspects of the IRPs will also differ among the scenarios. For example, environmental protection will be extremely important across the board in the technotopia world, very important in the business as usual world, and of little importance in the fortress state world. Thus, IRPs could resemble environmental impact statements at one extreme (e.g., the technotopia-megaelectric world) and simply a list of environmental control costs at the other (e.g., the fortress state-megaelectric world).

Planning horizons follow a similar pattern. One would expect IRPs to have very long horizons in technotopia world, moderate horizons in the busines-as-usual world, and very short-term horizons in the fortress-state world. In addition, uncertainty would be much more important the longer the time horizon. Thus, handling uncertainty is paramount in the technotopia world, of negligible consequence in the fortress-state world, and somewhere in between in the business-as-usual world. One might expect the longest planning horizons in the technotopia-megaelectric world, and the shortest in the fortress state-discomania world. The technotopia-discomania world would pose the most uncertainty and the fortress state-discomania would, pose the least.

How useful will the IRPs be under the scenarios? Again, usefulness varies widely across the board. One could hypothesize that regulators in the technotopia world will make good use of the IRPs and develop their own plans and reactions to action plans contained in the IRPs. IRPs would probably be most useful in the megaelectric world, given its relative simplicity. IRPs would also be of value to the regulators of the business as usual world. IRPs would be of most use to regulators of the fortress state world in situations where command and control could be exercised (e.g., the megaelectric world) and of little value otherwise (e.g., the discomania world).

The IRPs will have varied usefulness for those who are preparing them, or at least contributing information. Generally, the more time, thought, and detail put into the plans, the more valuable they may be. Thus, the plans could be expected to be of the most value in the technotopia world, followed by the business-as-usual world. It is unlikely that the plans would be of much value to companies in the fortress-state world, given the minimal reporting requirements. Across the utility scenarios, the megautilities could make most use of the plans because they should be all-encompassing, whereas the players in the discomania world would have the least use for this information.

In summary, IRP could take on widely different characteristics depending on the global scenario and the utility scenario. IRPs could be produced as they are now, by one utility at a time, or through a compilation of reports of differing detail. More citizen involvement could be required or less expected. IRPs may need to have longer time horizons, better deal with uncertainty, and have an extremely strong environmental component; or they may need short time horizons, only briefly deal with uncertainty (because there is nothing anybody can do about it anyway), and have no environmental component. The IRPs could be of immense value to the public, regulatory bodies, and the companies; or they could be of little value to anyone.

7. CONCLUDING REMARKS ON THE FUTURE OF IRP RESEARCH

In conclusion, there are several major trends shaping the future of the electric utility industry. The biggest force appears to be increasing competition in electricity generation. One could argue that global economic competition, which has caused major changes in our economy and our society, has succeeded in creating the mind-set in the industry and within regulatory bodies that competition should be encouraged and pursued within the industry. This mind-set has combined with new modular generation technologies to eliminate economies of scale of generation once enjoyed by the utility monopolies. It seems as though only bureaucratic inertia has prevented widespread competition in generation.

Increasing competition is exerting pressure for regulatory reform. Competitive bidding is a regulatory reform being widely adopted to foster fair competition, but it also raises regulatory issues. In the transmission area, there seem to be more regulatory issues arising with increasing competition than there are regulatory responses. Additional complex regulatory issues are associated with retail wheeling.

Electricity demand has the potential to significantly change its character as the U.S. economy moves more to a service and information economy and as the U.S. populace changes in household size, time-use behaviors, and the use of household technologies. Utility technology is advancing in some areas at a rapid rate (e.g., areas using advanced computer and information technologies), whereas other areas still hold tantalizing potential (e.g., photovoltaics, fusion). Environmental controls and associated costs are continuing to grow in importance. All these variables taken together produce a large amount of uncertainty about the future state of the electric utility industry.

The future of U.S. society is also quite uncertain. Social problems continue to grow, and seem to indicate the potential for even more drastic social change. While direct links between social trends and the electric utility industry are difficult to forge, society does appear to set parameters in which the electric utility industry exists (e.g., recent emphasis on competition, environmental controls). Many social variables affect electricity demand, and the major changes occurring in our society point to the possibility of greatly changed patterns of demand, although probably not very drastic changes in the aggregate growth of U.S. electricity demand.

Environmental concerns have been increasing over the past two decades, and many major environmental issues are now regional or global in nature rather than local. This points to a need for more systemic and far-reaching solutions. Electricity will no doubt play a role in the environmental drama that is unfolding, but it is unclear whether the ending will entail more or less use of electricity. Another uncertainty is how dire environmental problems will become. The future of the utility industry would be much different depending on the kinds and extent of environmental concerns.

Overall, the future of the industry appears to be caught between the forces outlined in the megaelectric and discomania scenarios, with the frozen-in-headlights scenario a possibility if decision makers cannot decide in which direction to turn. The state of the larger world, as outlined in the three global scenarios, appears to have a significant effect upon what course the electric utility industry will follow. Three key variables were identified—global warming, power industry technology, and competition—whose values could significantly affect which global scenarios will occur.

What does this all mean for IRP as practiced today by utilities and required by public utility commissions? The answer depends upon the global and utility scenarios one assumes will occur. Basically, IRP could evolve into a much more detailed, environmentally oriented, citizen-centered process that entails long planning horizons and sophisticated uncertainty techniques (e.g., a technotopia-discomania world) or it could devolve into an exercise of minimum effort requiring only the reporting of financial information and assurances that consumer costs to consumers for electrical power are minimized (e.g., a fortress-state/frozen-in-headlights world).

It is our recommendation that research and other efforts to improve IRP for the future adopt an optimistic viewpoint, that the future world will have a strong and positive use for IRP of some sort. Thus, it should be assumed that the technotopia or business-as-usual global scenarios will occur along with any of the three utility scenarios. If one makes these assumptions, then several other recommendations about IRP fall into place. Specifically, efforts should be considered to develop the following:

- improved ways to involve multiple parties in the IRP process (e.g., utilities, NUGs, ESCOs);

- concepts and methods to balance the need for IRPs to have firm statements of planned actions by identifiable parties versus relying on market-based activities that yield some uncertainty about who might do what when (i.e., how to integrate IRP and competition);

- improved process methods to increase meaningful citizen involvement and to produce IRPs that are more credible to the public and regulators;

- methods for regional IRP encompassing multiple utilities in multiple service areas;

- improved methods to handle uncertainty over long time horizons involving large perceived societal risk, especially in cases involving multiple players and intricate plans;

- recommendations especially for the discomania scenario concerning reporting requirements (i.e., how to balance planning needs with business confidentiality);

- improved methods to incorporate environmental concerns, especially those involved with global climate change; and

- better approaches to IRP that will make the plans more useful to the public, regulators, and the companies that provide input to the IRPs.

AIIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910

301/587-8202

Centimeter

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

1 2 3 4 5

Inches

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0 4.5 5.0 5.6

2 of 2

In addition, efforts in thinking about the future of IRP should be expanded to consider changes in the regulatory process and regulatory tools, of which IRP is only one tool. Specifically, the following actions are recommended:

- Notions of public interest that underlie IRP requirements should be explicitly stated.
- These notions of public interest should be analyzed over the global and utility scenarios to determine whether they might still hold true.
- New notions of public interest within the purview of regulation should be assessed over the global and utility scenarios.
- These new notions of public interest should be assessed with respect to IRP to determine whether IRP is relevant to achieving these public goals.
- The role of PUCs in representing the public interest and in managing the IRP process should be evaluated in light of the prior analyses.
- The potential roles for other and/or novel regulatory bodies should be assessed with respect to representing new public interests and managing modified and/or new IRP processes.
- The potential use of other and/or novel regulatory tools by PUCs and/or other regulatory bodies to achieve new notions of public interest across the global and utility scenarios should be explored.

It needs to be stressed that the global and utility scenarios presented herein are only six stories of many potential stories about the future. Other people could develop, and have developed, different pictures about the world and utility industry which could affect IRP in totally different ways. Thus, there is definitely a need to continue the scenario work of this report, work that should address the following questions:

- What are the prospects for each global and utility industry scenario?

- Are these six scenarios internally consistent? Should they be revised, renamed, etc.?

- Are these six scenarios as consistent with themselves as possible (e.g., do the three utility scenarios cover too broad a range or too narrow a range of possibilities)?

- What are the relationships between government and private sector science and technology research programs and the utility scenarios?

- What are the costs and benefits of new utility industry forms, given the various global scenarios and perspectives?

- What skills are needed for the utility industry of the future, given the various scenarios?

- How can DOE conduct an ongoing reconnaissance of the global and utility scenes to better inform its decision making?

- How can the scenarios be made more informative? For example, the utility of the future may in fact be an agglomeration of infrastructure services (e.g., electricity, electric technologies, natural gas, energy efficiency, water, and sewage). Should these other industries be researched more? Also, these scenarios do not explicitly account for timing of change, and this might be important. For example, it is plausible that we might end up with a revolutionarily different utility industry, but only after a long period of incremental, evolutionary changes. What are the implications for planning for this possibility as compared to the possibilities presented in the scenarios in this paper?

- What are the risks, and who bears the risks, associated with actions, both private and public, that are needed to maintain the current utility industry and/or promote other utility industry forms?

These questions can be studied separately or in various combinations. Also, it might be worthwhile to consider building a modeling and database system to support these analyses. For example, a systems analysis model could be developed, using Fig. 6.1 as a beginning point, that encompasses important scenario components in positive and negative feedback relationships. The model could assist in building internally consistent scenarios.

As another suggestion, the current ideas, trends, scenarios, and assessments can be presented to various utility, government, and consumer groups for comment. This process is meant to initiate informed conversation and dialogue among the interested parties.

8. ACKNOWLEDGMENTS

We thank Eric Hirst in particular for his reviews and comments on several drafts of this report. We also thank Doug Bauer, Ed Kahn, Charles Stallon, Chuck Goldman, Alan Commes, Les Baxter, Barbara Kates-Garnick, Richard Scheer, Bill Booth, Roger Nail, Cheryl Hamilton, David Moskovitz, Bruce Humphrey, William Hogan, and William Post for their comments. We would especially like to thank Jan Hamrin for insightful comments about the scenarios and for excellent suggestions for their names. We appreciate very much the enthusiasm of the reviewers for this topic and have made every attempt to include their insights into the report.

9. REFERENCES

Abramson, J. 1993. "Electronic Town Meetings: Proposals for Democracy's Future," in *Towards a Democratic Design for Electronic Town Meetings*, Aspen Institute Communications and Society Program Forum Report, in press.

Ahearne, J. F. 1989. "Will Nuclear Power Recover in a Greenhouse?" *Resources* **94**, Winter, 14–17.

Anderson, C. 1993. "The Biotechnology Revolution: Who Wins and Who Loses?" in *The Years Ahead: Perils, Problems, and Promises*, ed. H. F. Didsbury, World Future Society, Bethesda, Md.

Arizona (Corporation Commission) 1992. *Environmental Externalities Task Force, Report of Subcommittee 1, Monetization of Environmental Externalities*, Phoenix, Ariz., May.

Balzhiser, R. E. 1988. "Revolutionary Technologies for the Electric Utility Industry," *Pennsylvania Energy* **2**(2), Spring, 8–12.

Bayless, C. E. 1992. "Natural Monopolies: Accepting the Truth," *Public Utilities Fortnightly*, February 1, 15–16.

Bagley, W. T. 1992. "Sunshine Laws and Regulatory Agencies," *Forum for Applied Research and Public Policy* 7(2), Summer, 110–12.

Barber, B. 1992. "Jihad vs. McWorld" *Atlantic Monthly*, March.

Boroush, M., and P. Stern 1990a. "Alternative Energy Futures," *Electric Perspectives* **14**(1), January-February, 26–34.

Boroush, M., and P. Stern 1990b. "Advanced Technology and Long-Range Energy Requirements," *Electric Perspectives* **14**(2), March–April, 4–19.

Botts, P. 1993. "Power Shift: Conservation Trend Changing the Rules for Utilities—at Least for Now," *Great Lakes Reporter* **9**(2), March–April, 1–3.

Brown, A. C. 1992. "Sunshine May Cloud Good Decision Making," *Forum for Applied Research and Public Policy* 7(2), Summer, 113–16.

Burr, M. T. 1992a. "Building the Future," *Independent Energy* 22(6), July–August, 14–20.

Burr, M. T. 1992b. "The Competitive Challenge," *Independent Energy* 22(1), January, 10–14.

Bushnell, M. B. 1990. "Blinded by the Light: Restructuring Public Utilities for the Promise of a Competitive Energy Future," in *Competition in Electricity: New Markets and New Structures*, Public Utilities Reports, Inc., and QED Research, New York.

Casazza, J. A. 1993. "Linking Power System Planners, the Public, and Energy Policy Makers," *IEEE Power Engineering Review* 13(1), January, 9-10.

Chew, W. H. 1991. "Post-PURPA Regulation of the Build Options: The Future of Utilities' Reliance on Rate-based Earnings," in *The Management Exchange: The Buy vs. Build Decision*, Public Utilities Reports, Inc., New York.

Cohen, S. D. et al. 1990. "Environmental Externalities: What State Regulators Are Doing," *The Electricity Journal*, July, 24–35.

Corey, G. R. 1992. "The U.S. Electric Power Industry: Regulatory Trends and Objectives," *Resources and Energy* 14(1-2), April, 77-99.

Dale, S. J., J. P. Stovall, and K. W. Klein, 1991. *Maintaining Electric Power System Performance: Preparing for the Year 2020*, ORNL-6678, report prepared for the U.S. Department of Energy, Assistant Secretary, Conservation and Renewable Energy, by Oak Ridge National Laboratory, November.

Daly, H., and J. B. Cobb, 1991. *For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future*, Beacon Press, Boston.

Dasovich, J., W. Meyer, and V. A. Coe 1993. *California's Electric Services Industry: Perspectives on the Past, Strategies for the Future*, report to the California Public Utilities Commission by the Division of Strategic Planning, San Francisco, February 3.

Davis, J. 1990. *Mapping the Code: The Human Genome Project and the Choices of Modern Science*, Wiley, New York.

Davis, S., and B. Davidson 1991. *2020 Vision*, Simon & Schuster, New York.

Didsbury, H. F. Jr. 1993. "Perils, Problems, and Promises," in *The Years Ahead: Perils, Problems, and Promises*, ed. H. F. Didsbury, World Future Society, Bethesda, Md.

Disbrow, R. E. 1993. "New U.S. Energy Legislation and Its Impact on Electric Power Utilities," paper given at the 1993 IEEE Power Engineering Society Winter Meeting, printed in *IEEE Power Engineering Review* **13**(4), April, 17–20.

DOE (U.S. Department of Energy), 1991/1992. *Electricity Transmission Access, National Energy Strategy Technical Annex 3*, DOE/S-0085P, Washington, D.C.

Douglas, J. 1992. "The Delivery System of the Future," *EPRI Journal* **17**(7), October–November, 4–11.

EEI (Edison Electric Institute) 1994. *Electricity Futures: America's Economic Imperative*. Washington, D.C.

EIA (Energy Information Administration) 1993a. *Annual Energy Outlook, 1993*, DOE/EIA-0383(93), Office of Integrated Analysis and Forecasting, U.S. Department of Energy, Washington, D.C., January.

EIA (Energy Information Administration) 1993b. *The Changing Structure of the Electric Power Industry, 1970–1991*, DOE/EIA-0562, Office of Coal, Nuclear, Electric, and Alternative Fuels, U.S. Department of Energy, Washington, D.C., March.

EPRI (Electric Power Research Institute) 1993a. *Customer 20/20: Breaking the Future Trap*, Vols. 1–3, RP 3165-10, Palo Alto, Calif., January.

EPRI (Electric Power Research Institute) 1993b. "Perspectives on the Future," *EPRI Journal* **18**(1), January–February.

Faruqui, A., and J. Broehl 1987. *Editors' Overview of the Changing Structure of American Industry and Energy Use Patterns: Issues, Scenarios, and Forecasting Models*, Battelle Press, Columbus, Ohio.

GAO (U.S. General Accounting Office) 1992. *Electricity Supply: Potential Effects of Amending the Public Utility Holding Company Act*, GAO/RCED-92-52, report to the Chairman, Subcommittee on Energy and Power, Committee on Energy and Commerce, House of Representatives, January.

Geller, H., and S. Nadel, 1993. "Implications of the Energy Policy Act of 1992 for Utility Demand-Side Management Efforts," *Proceedings: 6th National Demand-Side Management Conference*, EPRI TR-102021, 187–90.

Gibbons, J. H., and H. Gwin 1989. "Lessons Learned in Twenty Years of Energy Policy," *Energy Systems and Policy* 13(1), 9–19.

Gore, A. 1992. *Earth in the Balance*. Houghton Mifflin, Boston.

Hadar, L. 1993. "What Green Peril?" *Foreign Affairs* 72(2), 27–42.

Handy, C. 1989. *The Age of Unreason*, Harvard Business School Press, Boston.

Hamrin, J. G., and N. Rader 1992. "Non-Utility Power Development in the USA: The Independent Generators," *Energy Policy*, November, 1115–22.

Harris, I. 1993. "Education—Does It Make a Difference When You Start?" *Aspen Institute Quarterly* 5(2), 30–52.

Hocker, C. 1993. "The DSM Debate," *Independent Energy* 23(3), March, 45–50.

Huntington, S. 1993. "The Clash of Civilizations?" *Foreign Affairs* 72(3), 22–49.

Hyman, L. S. 1988. *America's Electric Utilities: Past, Present, and Future*, 3rd ed., Public Utilities Reports, Inc., Arlington, Va.

Johnson, R. K. 1992. "Consumer Advocates Want Door Wide Open," *Forum for Applied Research and Public Policy* 7(2), Summer, 106–9.

Jones, D. N. 1992. "Utility Oversight in the Sunshine: Who Benefits?," *Forum for Applied Research and Public Policy* 7(2), Summer, 96–105.

Kahn, E. 1991a. *Electric Utility Planning and Regulation*, 2nd ed., American Council for an Energy-Efficient Economy, Washington D.C.

Kahn, E. 1991b. "Risks in Independent Power Contracts: An Empirical Survey," *The Electricity Journal*, November, 41–43.

Kahn, H., and A. Weiner 1967. *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years*, Macmillan, New York.

Kelves, D. J., and L. Hood 1991. *The Code of Codes: Scientific and Social Issues in the Human Genome Project*, Harvard University Press, Cambridge, Mass.

Lamm, R. D. 1993. "America in Decline?" in *The Years Ahead: Perils, Problems, and Promises*, ed. H. F. Didsbury, World Future Society, Bethesda, Md.

Lee, R., and C. Dummer 1993. *The Latest on What State Regulators Are Doing About Externalities and Renewable Energy Set-Asides*, draft for internal review, Oak Ridge National Laboratory, Oak Ridge ,Tenn., August.

Lesser, J. A. 1990. "Centralized Vs. Decentralized Resource Acquisition: Implications for Bidding Strategies," *Public Utilities Fortnightly* **125**(13), June 21, 12-16.

Mayersohn, N. S. 1993. "Home Technology," *Popular Science*, April, 52-57.

McGrath, M. K. 1990. "Seizing the Future," *Electric Perspectives* **14**(6), November-December, 14-23.

Meade, W., and J. L. Poirier 1992. "Going Global," *Independent Energy* **22**(7), September, 32-46.

Meade, W., and E. Roseman 1992. "Make Room for DSM," *Independent Energy* **22**(1), January, 15-20.

Mitchell, C. 1992. "Integrated Resource Planning Survey: Where the States Stand," *The Electricity Journal* **5**(4), 10-15.

Modesitt, L. E. 1993. "Renewed Environmental Activism," *Independent Energy* **23**(3), March, 53-57.

Morgan, G. 1993. "What Would It Take to Revitalize Nuclear Power in the United States?" *Environment* **35**(2), 7-9, 30-32.

National (Independent Energy Producers) 1991. *Competing for Power: A Survey in Competitive Procurement Systems*, Working Paper No. 3, Washington D.C., July.

Naill, R. F., and S. Belanger 1989. "Impacts of Deregulation on U.S. Electric Utilities," *Public Utilities Fortnightly* **124**(8), October 12, 24-32.

Naill, R. F., and W. C. Dudley 1992. "IPP Leveraged Financing: Unfair Advantage?" *Public Utilities Fortnightly* **129**(2), January 15, 15-19.

Phillips, R. T. 1990. "The Future of Competitive Power Generation," *Public Utilities Fortnightly* **125**(6), March 15, 13–16.

Quad Report, The 1993. Various staff articles, **1**(8), August.

Reich, R. 1991. *The Work of Nations*, Vintage Books, New York.

Renz, B. A. 1993. "Power Engineering Trends and Challenges," paper given at the 1993 IEEE Power Engineering Society Meeting, printed in *IEEE Power Engineering Review* **13**(4), April, 17–20.

Roman, H., and S. Collins 1993. "Utilities Score Big by Exploiting 'Robo-power,'" *Power* **137**(3), March, 90–96.

Russell, M., W. Colglazier, and B. Tonn 1993. "The Hazardous Waste Legacy," *Environment* **34**(6), 12–15, 34–39.

Schipper, L. 1993. "Electricity in the Twenty-First Century: The Changing Nature of the Customer and Her Needs," paper presented at EPRI's Ninth Electric Utility Forecasting Symposium, San Diego, September.

Schlesinger, J. 1993. "Quest for a Post-Cold War Foreign Policy," *Foreign Affairs* **72**(1), 17–28.

Schwartz, P. 1991. *The Art of the Long View*. Doubleday, New York.

Seeley, R. S. 1993. "Repowering with FBC," *Independent Energy* **23**(3), March, 41–44.

Seligson, C. H. 1989. "Driving Forces for Change in the Electric Power Industry," *Public Utilities Fortnightly* **124**(8), October 12, 15–18.

Shor, J. B. 1992. *The Overworked American*, Basic Books, New York.

Starr, C., M. Searl, and S. Albert 1992. "Energy Sources: A Realistic Outlook," *Science* **256**(5059), May 15, 981–87.

Stein, G. 1993. "New U.S. Energy Legislation and Its Impact on Large Electricity Consumers," paper given at the 1993 IEEE Power Engineering Society Meeting, printed in *IEEE Power Engineering Review* **13**(4), April, 17-20.

Taylor, P. 1990. *See How They Run: Electing the President in an Age of Mediaocracy*, Alfred A. Knopf, Inc., New York, pp. 267–69.

Tenenbaum, B., R. Lock, and J. Barker, 1992. "Electricity Privatization: Structural, Competitive and Regulatory Options," *Energy Policy* **20**(12), 1134–60.

Toffler, A. 1990. *Powershift*, Bantam Books, New York.

Washington International (Energy Group) 1993. *1993 Electric Utility Outlook*, Washington, D.C., January.

White, J. P., and S. A. Mitnick, 1993. "Monitoring Emissions," *Independent Energy* **23**(5), May-June, 68–71.

Williams, P. L. 1993. "A New Energy Policy," *Independent Energy* **23**(1), January, 16–20.

Willrich, M. 1991. "A Vision of the Future," *Public Utilities Fortnightly* **128**(7), October 1, 12–14.

Wilson, I. 1993. "The New Corporate Challenge," in *The Years Ahead: Perils, Problems, and Promises*, ed. H. F. Didsbury, World Future Society, Bethesda, Md.

Wilson, J. Q., and R. J. Herrnstein 1985. *Crime and Human Nature*, Simon and Schuster, New York.

Wolfe, A. 1993. "Middle-Class Moralities," *Wilson Quarterly* **17**(3), 49–64.

Yokell, M. D., and D. M. Violette, 1988. "Market Structure and Opportunities in the Electric Utility Industry Today," *Public Utilities Fortnightly* **121**(1), January 7, 9–15.

10. NOTES

1. This will be discussed in more detail when environmental trends are discussed.

2. The EP Act has provisions requiring the Tennessee Valley Authority and the customers of the Western Area Power Administration to perform IRP. The act also requires non-IRP states to consider adopting IRP, and in addition, it authorizes DOE grants to fund the rule-making for IRP implementation. (Geller and Nadel 1993).

3. Independent power developers are expected to contribute 150,000 MW of capacity internationally by 2000. Meade and Poirier (1992) cite RCG/Hagler, Bailly, Inc. as their source for this projection.

4. QFs are defined by PURPA as cogeneration facilities of any size and plants under 80 MW of capacity using renewable energy sources (biomass, geothermal, hydro, solar, waste, or wind), provided that facilities are less than 50% owned by electric utilities or their affiliates. Avoided cost is defined as what it would have otherwise cost the utility to generate the power itself. The PURPA legislation is briefly reviewed in Appendix A.

5. Most observers expect FERC to promote increased transmission access to foster competitive supplies of electricity. While FERC is not required to order access, many see this as an insignificant distinction (Williams 1993).

6. EWG status removes size and fuel restrictions on NUG suppliers. Transmission access gives potential suppliers even greater flexibility in selecting the size of new units, as well as their sites. It allows them to produce power in a particular location whether the local utility needs it or not, so long as another connected distributor needs it and is successful in persuading or forcing (through FERC intervention) the local utility to give them access to it. Flexibility in selecting the size and location of new generating units has become an important issue over the past decade or so. In terms of size, the economies of scale of combined cycle plants, which have become more economical with the fall in natural gas prices, make obtaining access to additional markets worthwhile. (Hamrin and Rader 1992) In terms of location, not-in-my-back-yard (NIMBY) pressures can make expanded options in site selection consequential. (Burr 1992b).

7. Eighty-three percent of the projects won through competitive bidding were NUG, while the remaining 2% percent were nonutility conservation projects. Hamrin and Rader (1992) cite Hope Robertson, *Robertson's Current Competition*, Stockton, N.J., May and August 1991.

8. IPPs are NUGs that generate electricity primarily for sale in wholesale markets, but do not meet the requirements for QF status.

9. If utilities try to control an increase in demand by raising prices, they will drive customers to competing suppliers, losing that potential revenue. However, they may get those customers back if energy demand shrinks and customers want to return to a low, controlled price. (Hyman 1988).

10. Existing nuclear facilities will be the most likely exceptions to the economics of continued operation because high management and operating costs and costly upgrades make these plants uncompetitive compared to other generating options. Utilities are expected to retire some nuclear plants prior to the end of their 40-year license periods. These nuclear plants will be candidates for switching fuels or placing new units on the sites. However, it is difficult to judge the extent to which utilities will be able to turn aging nuclear plants from thorns in their side into valuable assets. Aging fossil plants, particularly coal plants made uneconomic due to the 1990 Clean Air Act Amendments (CAAA), may have better prospects for being resurrected as "new and improved" plants.

11. ESCOs have proposed 921 MW of DSM projects and won 225 MW of contracts in competitive bidding throughout the United States (220 MW were won in DSM-only bids). While total megawatts awarded are small compared to supply-side options, the success rate of these ESCO DSM proposals is quite impressive—25% as compared to 7% for supply-side proposals. It is projected that ESCOs could provide up to 4500 MW of DSM in as many as 70 utility service areas by the year 2000 (Meade and Roseman 1992).

12. The original motivation for such public joint-action power agencies was to finance and participate in large nuclear power projects.

13. Mandated RTGs were proposed as an alternative to the FERC-ordered transmission access provision of the 1992 Energy Policy Act (Williams 1993).

14. Non-energy-related diversifications have included everything from chemicals to insurance to real estate to orange growing to shoplifting prevention. However, in stark contrast to energy-related diversifications, almost every case of utility investment into unrelated business in the 1970s and 1980s is considered a failed venture (Washington International 1993).

15. Creating (i.e., spinning off) generation subsidiaries in order to escape state-level regulation, or simply to facilitate financing, has been tried with little success. Another similar reorganization done by numerous utilities is sale-leasebacks, whereby ownership changes, but the utility still operates the plant. Creating a wholesale entity out of particular generating units may benefit shareholders, especially for cases in which the unit has been disallowed due to overcapacity. The situation is similar for instances in which a utility wishes to extract itself from a difficult nuclear situation by resurrecting the plant as a nonnuclear (most likely coal) NUG subsidiary unit.

16. A utility typically sells a generating facility because it is unable to include the full cost of the facility in its rate base and earn a full current return. The proceeds from the sale of the assets have typically been used to purchase outstanding securities (Seligson 1989). If amortized units were sold, regulators would force utilities to share any profits with ratepayers.

17. For example, Wahlco Environmental, an SDG&E subsidiary, has experienced considerable growth by marketing environmental products and offering services internationally as well as in the United States (Dasovich, Meyer, and Coe 1993).

18. Note that a strong argument can be made that supplying electricity strictly through vertically integrated utilities is more efficient, technically and theoretically speaking, than

having generation supplied by separate, competitive entities. For one thing, the vertically integrated structure has lower transaction costs as utilities do not have to negotiate complex long-term contracts for a reliable and economic supply of electricity. Also, centralized dispatch of supplies is less complex when only one local firm is involved.

19. Chew (1991) asserts that the existence of the buy option creates additional risks for utilities, not credit erosion.

20. The EP Act also allows state PUCs to examine the books and records of EWGs and affiliates that sell power to utilities under their jurisdiction.

21. Benchmark comparisons have been used by FERC to assess the reasonableness of utility purchase prices from affiliate power producers (Tenenbaum, Lock, and Barker 1992). Using a benchmark for regulating the performance of all utility resource options is merely an extension of the concept.

22. Such cross-subsidization may benefit captive customers if they would be faced with even higher rates should large customers leave the system altogether. In that case, remaining customers would be squarely saddled with the utility's fixed costs, which may lead to another round of utility system by-pass by mobile customers, until only captive customers remain (typically residential customers).

23. As Willrich (1991) states, "A utility is more likely to pursue gains for its customers if there is also something in it for its shareholders." Willrich also notes that California has adopted significant shareholder incentives for utilities to implement energy efficiency programs. Desirable change would accelerate if utilities were given similar shareholder incentives to implement all-source bidding programs.

24. FERC has asked for public comment on whether to pursue such agreements (Williams 1993).

25. The intense competition of our global economy is expected to lead to pressures on municipal governments to municipalize a local distribution system from business seeking to cut costs. These pressures are predicted to be particularly great if the locality includes a large industrial electricity customer (Washington International 1993).

26. An experiment in pricing transmission based on actual flows has been proposed for eastern U.S. and Canadian utilities belonging to the Interregional Transmission Coordination Forum. However, for the utilities to legally discuss pricing issues, they must receive immunity from U.S. and Canadian antitrust legislation.

27. FERC has stated that it will approve transmission tariffs that include "legitimate and verifiable" opportunity costs.

28. Interestingly enough, the green pricing program was recently stalled at Southern California Edison (SCE) due to potential problems with the PUC. As an SCE representative said, regulation can "delay and may prevent the offering of innovative programs, such as

green pricing, to electric utility customers" (R. J. Walther, quoted in *The Quad Report*, 1993).

29. For example, the California PUC intends to raise a utility's (Orange and Rockland's) return on equity "as much as 1.05% for good [DSM] performance, and reduce it as much as 0.35 percentage points for poor performance . . . . [I]n Washington, D.C., the Public Service Commission recently penalized Potomac Electric Power Co. by reducing the utility's allowed rate of return because the utility failed to comply with its DSM directives" (Meade and Roseman 1992). Meade and Roseman (1992) list the following features of incentive programs in current use:

- compensation for lost revenues due to lower electricity use through DSM programs;
- including portions of a utility's DSM expenditures into the rate base;
- decoupling utility earnings from sales and recoupling revenues to customer growth;
- shared savings, wherein a utility is paid a percentage of the difference between the life-cycle cost of the DSM program and its avoided cost for power conserved; and
- a cost-effective performance incentive, in which a utility's earnings depend on its performance relative to a predetermined target for the cost-effectiveness of the measures and programs employed.

30. Utilities have also solicited set-aside, DSM-only bids.

31. As Renz (1993) states, "The interconnected power system is a single large, complex electrical circuit. Its electrical flows are determined by the laws of physics. We can modify flows somewhat by adjusting the sources (and rearranging the connections), but this is a slow and relatively ineffective mechanism."

32. The offer is good until 2000 or until all of the 300,000 Conservation and Renewable Energy Reserve allowances have been granted.

33. A draft paper by Lee and Dummer (1993) shows a continuing increasing trend in PUCs requiring the consideration of externalities. However, this trend may reverse in the face of competition.

34. The draft bill (S.1081) defines hydromodification as a pollutant subject to regulation as such.

35. The NIMBY phenomena is well known. A striking example of the NOPE phenomena is the cancellation by the State of New York and the New York Power Authority of a 20-year, $12 billion contract to buy electricity from the proposed Great Whale hydroelectric project in

Canada. The reason for the cancellation was environmental group and public opposition due to the potential environmental impacts of the large hydro project (Botts 1992).

36. EPRI has conducted scenario analysis more broadly on the electric power industry, as summarized in a three-volume series entitled Customer 20/20: Breaking the Future Trap (EPRI 1993a).

37. We are indebted to Jan Hamrin for her suggestions for names for the global and utility scenarios.

38. Research by Kahn et al. at Lawrence Berkeley Laboratory supports this observation.

INTERNAL DISTRIBUTION

1. D. Bauer
2. V. D. Baxter
3. D. S. Bjornstad
4. M. S. Bronzini
5. M. A. Brown
6. J. B. Cannon
7. R. S. Carlsmith
8. F. C. Chen
9. J. Christian
10. G. Courville
11. P. D. Fairchild
12. W. Fulkerson
13. M. B. Gettings
14. C. W. Hagan
15. L. J. Hill
16. E. Hillsman
17. E. Hirst
18. P. J. Hughes
19. C. R. Kerley
20. J. O. Kolb
21. M. A. Kuliasha
22. R. Lee
23. P. Leiby
24. J. M. MacDonald
25. V. C. Mei
26. W. R. Mixon
27. S. Purucker
28. D. E. Reichle
29. D. T. Rizy
30. M. Schweitzer
31. R. B. Shelton
32. J. N. Stone
33. J. Van Dyke
34. J. M. Veigel (ORAU)
35. D. L. White
36. T. J. Wilbanks
37. ORNL patent Office
38. Central Research Office
39. Document Reference Section
40. Laboratory Records (RC)

41-43. Laboratory Records Dept.

EXTERNAL DISTRIBUTION

44. Dr. Douglas R. Bohi, Director, Energy and Natural Resources Division, Resources for the Future, 1616 P Street, N.W., Washington, DC 20036
45. Dr. Thomas E. Drabek, Professor, Department of Sociology, University of Denver, Denver, Colorado 80208-0209
46. Calvin MacCracken, President, Calmac Manufacturing Corporation, 101 West Sheffield Avenue, P. O. Box 710, Englewood, NJ 07631
47. Jacqueline B. Shrago, Director, Office of Technology Transfer, 405 Kirkland Hall, Vanderbilt University, Nashville, TN 37240
48. Mr. George F. Sowers, P. E., Senior Vice President, Law Companies Group, Inc., 114 Townpark Drive, Suite 250, Kennesaw, Georgia 30144-5599
49. Dr. C. Michael Walton, Ernest H. Cockrell Centennial Chair in Engineering and Chairman, Department of Civil Engineering, University of Texas at Austin, Austin, Texas 78712-1076

50-51. OSTI, U. S. Department of Energy, P. O. Box 62, Oak Ridge, Tennessee 37831

52. Office of Assistant Manager for Energy Research and Development, DOE/ORO, P. O. Box 2001 Oak Ridge, TN 37831-8600

53-850. External Energy Efficiency and Renewables Section Distribution Mailing List and extra copies to S. A. Moore, 4500N, G-32

DATE

FILMED

7/6/94

END