A Two-Part Feature

ENERGY CONSERVATION

Energy Efficiency, the Environment, and A New Role for the End-User

Part 1: A History—1973 to the Present
Part 2: Consumer-Oriented "Sophisticated Convenience"

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Editor's Note: Our society's transition from its earlier "preenergy-conservation" attitude (placid, simple, satisfied) to today's intense efforts to meet complex energy/environmental challenges has rarely been reviewed. Yet in its impact, the new energy revolution is second only to the introduction of the computer.

Part One of this series traces the origin and growth of both energy and environmental conservation. Part 2, to appear in the next issue of *Strategic Planning for Energy and the Environment*, describes some of the current developments taking place, and outlines a way that the currently-nascent role of residential end-users can be converted into a major force for continuing betterment.

America is again in the midst of an energy crisis. Just as with the oil embargo of the 1970s, increases in the cost of petroleum have been staggering. There are differences, however. In the past three decades, our dependence on foreign imports of oil has almost doubled. Unlike the

*This article is drawn from a monograph prepared for the New York State Energy Research and Development Authority entitled "Technological and Institutional Facilitation of Retail Access for Multifamily Buildings."

days of long gas lines, however, America's newest crisis centers on electricity. From strained electric grids and 40% price hikes, to environmentally unsound electric generation and rolling blackouts, the electric "problem" is easy to identify.

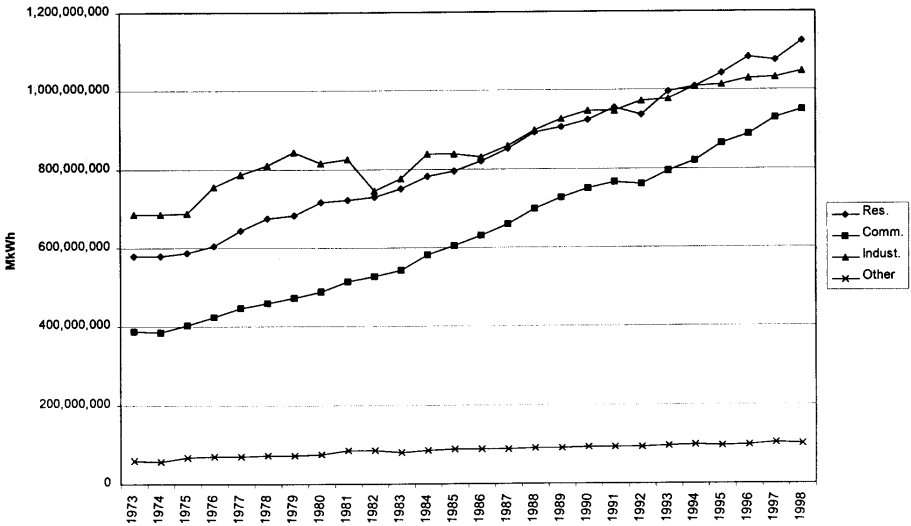
In addition to an overextended and increasingly unstable electric grid, consumers are faced with enormous price hikes and reliability issues that threaten to limit the economic well being of our nation. Perhaps more importantly, environmental and social dangers abound. When power generators struggle to meet demand, economics take precedence over environment.

When the elderly on fixed income are faced with high electric prices, they often sacrifice comfort and security. When poor people are forced to pay higher utility costs, they may give electricity priority over health care, food and housing.

The current crisis is so alarming because electric consumption in the U.S. has nearly doubled since the 1973 energy crisis. Growth has been unabated in all sectors and consumption is still growing at a rapid pace. While there have been numerous attempts to reduce energy consumption in response to environmental concerns, today's conservationists face new and significant challenges in the era of utility deregulation. How will utility deregulation (and its promise of an overall reduction in energy costs) affect the growing emphasis on environmentally sound energy usage? Will prices be higher or lower? Can an awareness of environmental protection transcend price? Is our current economic boom creating a need for new electric supplies that undermine our environmental goals? Recognizing that individual consumption is growing faster than in any other end-use sector, what role can the individual play to foster a sustainable world without compromising an advanced lifestyle?

Although most Americans realize that our environment needs protection, there exists a classic "disconnect" between our electric appetite and our acceptance of planetary responsibility. We continue to seek increased comfort and convenience at home, at the same time that computers and the Internet allow more of us to earn our living there, powered by reliable and affordable electricity. This summer, however, we received a startling wake-up call regarding the perils of increased electric usage. Electric demand has outstripped supply, driving prices up by as much as 40% in some areas. Increased demand has forced older, less environmentally friendly plants on-line for longer periods, contributing to air pollution.

US Electric Utility Retail Sales of Electricity by Sector 1973-1998



State and local attention, most notably in New York and California, has centered on the need to build greater electric capacity. (In a tactic of "sharing the pain," California expects to experience rolling blackouts in broad geographic areas, which will limit catastrophes in emergency situations.) This emphasis on the "supply side" of the equation calls for increased efficiency in production, augmented transmission capabilities and technological advances in renewable sources of electric generation. While recognizing the vital importance of a greater energy supply, a realistic long-range solution must also consider the demand side of the equation, that is, how to consume electricity more efficiently and where possible to consume less.

This series outlines an approach called "sophisticated convenience," which focuses attention on electric usage and demand. Framed to ensure consistent economic growth without environmental destruction, it advocates informed electric consumption by the public and offers it the freedom to purchase electricity from nonpolluting and renewable sources. Over the next 10 years, it would allow consumers to play a fundamental role in determining the future of energy use. Part 1 will look at historical trends that have defined energy conservation over the past three decades. It will track the birth of conservation, the rise of the

environmental movement, the role of technological development and the emergence of electric industry deregulation as a force in determining our energy future.

Part 2 introduces the concept of "Sophisticated Convenience" which harks back to earlier traditional conservation efforts by empowering the individual to play a fundamental role in solving the contemporary crisis in electricity. Its strategy to achieve progress without penalty can gain firm footing as electricity opens to competition and consumers are charged for the first time with the opportunity and responsibility to make choices about their own energy use. What we make of this era of consumer choice is up to us.

DEVELOPING AN ENERGY CONSCIOUSNESS: THE BEGINNINGS OF CONSERVATION

During the 30 years following World War II, the United States experienced an unprecedented surge in energy production and usage—and as production grew, energy prices dropped and consumption increased further. Key to our growing consumption was a consumer demand for electrically-powered products, a growing reliance by the industrial sector on energy use and an increasing dependence on the automobile, especially for Americans moving into the growing suburbs. From 1954 to 1974, total energy usage grew by an average 3.5 percent each year; electric consumption alone grew almost twice as fast, at approximately 6 percent per year.[1] During the same period, the cost of energy nonetheless experienced a drop in "real" prices (adjusted for inflation).[2]

In the 1950s the U.S. produced nearly all of the petroleum and natural gas it needed. Growth in consumption, however, grew at a faster pace than supply. Electricity, a sophisticated form of energy produced predominantly through the combustion of fossil fuels (oil, coal, gas and their derivatives), pervaded nearly every aspect of modern American life. As our natural oil resources began to diminish, we increasingly looked overseas for oil to feed our growing energy appetite.

The era of burgeoning energy consumption came to an abrupt end on October 17, 1973. In the aftermath of the bitter Yom Kippur War in the Middle East, the Organization of Petroleum Exporting Countries (OPEC) declared an oil embargo against the United States for its tacit support of Israel.[3] The ensuing instability in energy prices and availability had an

immediate and profound impact on the U.S. economy, and served as a "wake-up call" for Americans regarding our energy consumption habits.

Lines sprang up at America's gasoline pumps. But beyond such inconveniences lay a more significant problem: The embargo had severely depleted strategic energy reserves, compromising U.S. national security. Just as the Vietnam War had shattered our illusions of invincibility abroad, we were vulnerable at home to foreign governments that provided us with crude oil.

Dick Snider offers a stark recollection of nationwide gasoline lines and mounting social tensions in "Remember the Good 'ol Days of the Oil Embargo?," *The Topeka Capital-Journal, Nov. 29, 1998:* "[The gasoline shortages] lasted about six months, until March 1974, with motorists spending a lot of time in gasoline lines… Some motorists would line up long before a station opened, and might sit there long after it opened, waiting for the transport truck, with a fresh load, to arrive. Other drivers would spot a transport and follow it to its destination to get in line. Stations were on allocation, set by the government, and based on the amount of gasoline that had been purchased in the corresponding month a year before. Some stations rationed their supply, pumping only so many gallons each day before hanging out the "No Gas" signs… Some stations, in fact, would sell gasoline only to regular customers, turning away strangers. Gasoline lines were no place to make friends. There was a lot of complaining and snarling, and shoving matches and fist fights were not all that uncommon, particularly if some motorist tried to cheat his way into line.

To insulate the country against intimidation by overseas oil markets, President Nixon announced Project Independence on November 7, 1973: "[L]et us pledge that by 1980 …we shall be able to meet America's energy needs from America's own resources."[4] This nationwide conservation movement called for a series of government actions to stimulate U.S. oil production and restore energy reserves. It also involved unprecedented policy changes directed at reducing America's dependence on imported oil, including mandates to lower the federal speed limit to 55 m.p.h., turn down thermostats in federal buildings and extend daylight savings time. He recommended "right turn on red" traffic regulations and announced he would forego the annual lighting of the White House Christmas tree. Americans embraced sacrifice as policy and as patriotic sentiment. The average passenger car, for example, traveled fewer miles, improved its ratio of miles per gal-

lon and lowered its fuel consumption for more than a decade.

At the time of the embargo, we imported 28% of our petroleum needs from OPEC, and 17% of our electricity was generated by burning oils. Both President Nixon and President Ford supported an accelerated production of nuclear power plants to achieve energy independence.

Energy conservation remained an acceptable sacrifice for national security throughout the decade. In 1977, a sweater-clad President Carter delivered a televised address in which he called energy conservation the "moral equivalent of war." Among his directives, he declared a national policy setting thermostats in all public buildings at 68 degrees. A 1979 OPEC price scare prompted President Carter's memorable "Crisis of Confidence" speech, in which he called "every act of energy conservation … an act of patriotism" and reemphasized the need for "sacrifice." He also exhorted the energy industry to explore and develop alternative domestic energy sources.

President Carter's vision is reflected in excerpts from his 1979 "Crisis in Confidence" address:

I am asking for the most massive peacetime commitment of funds and resources in our Nation's history to develop America's own alternative sources of fuel from coal, from oil shale, from plant products for gasohol, from unconventional gas, from the sun.

I will soon submit legislation to Congress... which help us achieve the crucial goal of 20% of our energy coming from solar power by the year 2000.

I am proposing a bold conservation program to involve every State, county, and city and every average American in our energy battle. This effort will permit you to build conservation into your homes and your lives at a cost you can afford...

We often think of conservation only in terms of sacrifice. In fact, conservation is the most painless and immediate way of rebuilding our Nation's strength. Every gallon of oil each one of us saves is a new form of production. It gives us more freedom, more confidence, that much more control over our own lives... Every act of energy conservation... is an act of patriotism.

We can manage the short-term shortages more effectively, and we will, but there are no short-term solutions to our long-range problems. There is simply no way to avoid sacrifice.

Spurred by the lessons of the OPEC embargo, interest re-emerged in the domestic exploration, production and transmission of petroleum and natural gas. High petroleum prices encouraged

transnational energy companies to embark on expensive oil discovery, drilling and pipeline operations. In an effort to tap new sources, there was drilling activity in the Gulf of Mexico, construction of the trans-Alaskan oil pipeline, and a greater emphasis on electricity generated by domestic coal, natural gas and plutonium.

Radical new methods of production and transmission became economically viable, including shale oil extraction processes, tertiary oil well drilling, ocean drilling in the outer continental shelf, and remote exploration and extraction activity. As oil prices soared, energy companies posted record earnings that they reinvested in research and development. Of course, the broader ramifications of the energy crisis included a severe nationwide recession punctuated by double-digit interest rates and seemingly unchecked inflation.

In 1979, Ronald Reagan ran for President on a platform of "smaller government." Seeking to curtail what he saw as wasteful spending at the federal level, Reagan targeted agencies such as the Department of Energy (DOE) and the Environmental Protection Agency (EPA) for elimination. Once elected, Reagan was unable to entirely raze these agencies, so he simply ousted them, dismantling the entire solar and renewable network that, according to energy policy expert Lindsay Auden, was just beginning to yield results. The DOE Office of Conservation (now the Office of Energy Efficiency and Renewable Energy) was cut, and the Solar Utilization Network that promoted conservation and renewable resources was eliminated.

While many conservationists consider the Reagan presidency the darkest days of energy conservation, his supply side approach had some commendable economic consequences. His sale of weapons technology to Saudi Arabia stabilized the flow and costs of OPEC oil. He expanded efforts to stimulate development in domestic production, opening up previously restricted areas (wetlands and the outer continental shelf) for oil exploration and recovery.

The recession that plagued the Carter Presidency had eased by 1983, when President Reagan campaigned for a second term. He asked Americans: Are you better off today than you were four years ago? Buoyed by a better economy, lower taxes and stable energy supplies and costs, the public enthusiastically re-elected him. The sacrifices of energy conservation were far from anyone's mind. Unfortunately for the environment, so was an interest in more costly, renewable sources of energy.

FROM SACRIFICE TO EFFICIENCY

Despite a few lingering elements of sacrifice, by the 1980s the focus of conservation in American homes, offices, and manufacturing plants was shifting. Conservation modeled on short-term personal sacrifice gave way to a smarter conservation that addressed the nation's economic and environmental future. The juncture of economic reality and environmental concern was to define this next phase of energy conservation.

With a recession still in progress, industrial and commercial consumers began to view conservation as a good business practice. The economic benefits of energy conservation would in turn contribute to the economic health of the country as a whole and provide an ongoing hedge against inflation.

Social and economic support for a nationwide environmental movement had been building since the advent of the OPEC embargo. Congress helped lay the groundwork during the 1960s and 1970s by enacting federal regulations regarding air pollution and emissions. The first Earth Day in 1970 gave voice to growing concerns about the precarious ecology of the planet; it continues as an annual event to expand public mindfulness of environmentally destructive behavior.

According to Amory Lovins, there are two ways to do more with less energy. On one hand, there are social changes that involve more intensive utilization of energy outputs and reflect changing personal values. Social changes include "carpooling, smaller cars, mass transit, bicycles, walking, opening windows, dressing to suit the weather, and extensively recycling materials." On the other hand, "we can plug leaks and use thriftier technologies to produce exactly the same output of goods and services." Technical fixes include "thermal insulation, heat pumps, more efficient furnaces and car engines, less overlighting and overventilation in commercial buildings, and recuperators for waste heat in industrial processes... [as well as] cogeneration, the process by which electricity is generated as a secondary by-product of the steam used to power a large percentage of industries." Furthermore, Lovins decried the use of "electricity for many tasks for which [its] high energy quality is superfluous, wasteful and expensive" which he compared to "cutting butter with a chainsaw."

Greenpeace was established in Canada in 1971. In 1972, the U.S. government created the Environmental Protection Agency (EPA) and the United Nations convened its first environmental conference. In 1979, the first Green political party emerged in

Germany. By the 1980s, environmentalism had become an international force.[5]

While the new energy conservation still aimed to extend existing energy supplies, it went on to propose that we use existing resources more wisely. The emphasis was on energy efficiency, employing the latest technology and energy-saving products to help us meet our energy needs. Automobile advertisements were required to include "miles per gallon" ratings.

As people learned of the high cost of their wasteful energy practices, consumers abandoned large automobiles manufactured in the U.S. in favor of smaller fuel-efficient vehicles from Japan. Also from this grass roots energy conservation movement emerged a search for ways to harness renewable sources of energy, sources that did not rely on the combustion of fossil fuels to produce heat or electricity.

Amory Lovins articulated the philosophy of energy efficiency in his groundbreaking 1976 article, "Energy Strategy: The Road Not Taken," which is generally recognized as the theoretical foundation of the energy efficiency movement.[6] According to Lovins, the key to solving the energy problem lay not in increased domestic fossil fuel production, but in increased efficiency.

Lovins attacked wasteful energy practices that dominated both the production and consumption sides of the energy equation. He saw the use of electricity, which is a high grade form of energy, to heat water as especially imprudent. Lovins proposed that the answer to the energy problem was to tap the "oil fields of our attics."

By 1982 when Amory and Hunter Lovins founded the Rocky Mountain Institute as an international energy think tank, the nation's approach to energy conservation had resolutely shifted from policy to practice. This new view of conservation urged Americans to engage in both technological and social energy-saving initiatives.

In Lovins' view, current technology was a fruitful path that would help limit energy waste, in other words, to "do more with less energy," through a variety of initiatives, including efficient building construction, the redesign of car engines, household products and industrial equipment. He also called for moderate changes in the American lifestyle including carpooling, recycling and using smaller cars, mass transit and bicycles. Lovins endorsed ways to solve our problems with ingenuity, invention and technology: It was a solution that most Americans could easily embrace.

Energy prices stabilized by 1982, after which they dropped in "real" figures. Reinforced by OPEC price hikes in 1977 and 1981, however, energy conservation endured in our national consciousness—but this time with the emphasis on efficiency rather than sacrifice.

DEMAND SIDE MANAGEMENT AND CONSERVATION AT THE PEAK

Although U.S. energy prices remained steady after the early 1980s, American businesses continued to pursue energy efficient practices as a way to reduce production costs and increase profits. They enthusiastically invoked the mantra of "doing more with less" to urge higher productivity not only in the workplace, but also in the housing, construction and industrial sectors.

Owners of commercial real estate and apartment buildings added insulation to reduce heating and cooling expenditures; manufacturers elected to retrofit their plants with more efficient equipment. Determined to find the most effective use of their energy dollars, these large consumers began to seek sophisticated and efficient new energy-consuming products and technologies.* Public incentives at all levels of American government encouraged their efforts.

At the same time, utilities turned their attention to better management of their energy resources. To eliminate the need for costly new generating plants and reduce the strain on existing distribution systems, utilities launched programs to encourage large customers to reduce energy use and reshape their consumption patterns during peak periods. Demand side management (DSM) was the term used for this strategy, which focused on the demand or consumption side of the supply/demand axis.†

The 1978 National Energy Policy Act, which required utilities to implement programs to stimulate conservation in the residential sector, prompted the first utility DSM programs. By the 1980s DSM was uniting with increasingly efficient products and technologies to pro-

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*The introduction of energy usage tags on appliances during this era was one of the most visible attempts to further the concept of "smart" conservation.

†Over time, "demand" gained an added meaning specific to the calculation of electric prices, denoting the half hour of maximum electric use during an entire monthly billing cycle.

duce a vision of energy conservation that would remain central through the late 1990s.

During the late 1980s, utilities in a number of states including New York embraced DSM as a cost-effective way to manage their physical resources. To meet the needs of their various service territories, these utilities established DSM programs and a range of diverse initiatives. Since then, DSM strategies have become more aggressive in stimulating actions rather than just discussing them. Eric Hirst, formerly a corporate fellow at the Oakridge National Laboratory and a distinguished expert in energy efficiency and utility DSM initiatives, distinguishes four DSM approaches that are ascendingly hands-on ranging from general information to direct installation of energy efficient products:[7]

1. **General information** or public energy education was the focus of early utility programs, including flyers accompanying utility bills, newspaper advertisements and workshops aimed at consumers. In New York City, Con Edison prepared comprehensive brochures indicating the costs to operate a wide range of electric appliances. These manuals provided customers with some of the best information regarding opportunities to save by switching to more efficient refrigerators, air conditioners, lighting and a host of other products.

2. **On-site energy audits** by utility staff or contracted audit companies were available on request to identify energy efficiency opportunities at specific locations. The audits identified improvements to save energy and offered a simple "payback" calculation (capital cost divided by projected annual energy savings) to assist consumers in their energy planning.

3. **Financial incentives** encouraged the implementation of improvements to reduce energy use. Based on independent audits and those performed as part of government programs, these energy efficiency programs included low interest loans, rebates and a variety of interest reduction subsidies, in many places going beyond electric savings to reduce space and water heating requirements. A switch from oil or electric usage to cleaner natural gas was also actively promoted. This represented a "home run" for utilities: Since they also sold natural gas, they were able to satisfy DSM and public policy objectives while promoting the sale of their least polluting product.

4. **Direct installation of low-cost efficiency measures** was often found by utilities to be a less expensive and more effective step. After a walk-though, for example, utility energy auditors would often supply and install electric-efficient light bulbs (usually compact fluorescents). Following audits of customer facilities, they would often replace air conditioner filters and clean refrigerator coils.

Yet another DSM effort represents a departure from the traditional hands-on efforts in which utilities engaged: Market transformation prompted utilities to look upstream of their customers to the manufacturers of consumer-oriented products and appliances. Among their efforts to support energy efficiency, utilities have pooled resources to fund competitions for manufacturers to develop products that exceed national electric efficiency standards. Hirst reports that one competition sponsored by 25 utilities was won by Whirlpool for the production of a refrigerator that was a full 30% more efficient than the 1993 federal standard.

Another DSM initiative is peak hour pricing, which allows utilities to compensate for the added cost of producing peak electricity by charging customers more during times of high electric usage. Although the surcharge can be considerable, it allows customers to enjoy all the electricity they need whenever they want it. Nonetheless, higher prices during peak periods encourage customers to shift their usage patterns when possible, supporting the DSM *raison d'etre* to avert the need for expensive new plants. As electric deregulation and new meter technologies make it possible to price electricity by the hour, consumers will have both the incentives and the tools to shift electric loads "off the peaks."

While this DSM strategy promotes the efficient use of energy, it also introduces a significant concept—the element of time. While it is important to reduce overall use of electricity, the primary focus becomes the reduction of usage during peak demand periods. This concept of "conservation at the peak" encompasses numerous technologies to "flatten" loads and send rate pricing signals to consumers.

These DSM strategies allow utilities to rely on their base power plants and avoid new power plant construction. They help maximize the use of more efficient power plants, so that older and less efficient plants can be used sparingly when demand exceeds the base capacity. The flattening of peaks also helps reduce strain on overburdened electric transmission and distribution lines.[8]

Under DSM, utilities provide industrial, commercial and other large consumers with information about their periods of peak usage. Armed with this data, large consumers can decrease expensive peak consumption by implementing sophisticated electric monitoring and load-shaping systems that coordinate the operating time of equipment with lower electric prices. With a flatter electric consumption profile, consumers are able to get the most "energy bang for their buck" and in doing so enhance electric production efficiency as well.

While DSM strategies contribute to efficient electricity usage by augmenting systemwide production and distribution, they retain an institutional orientation. After all, they are sponsored by utilities. Although DSM strategies redistribute electric use, they have not curtailed the increase in overall electric usage or promoted more efficient independent on-site power to offset reliance on utility-sold electricity.

Some DSM models sought to influence residential consumers to alter their usage patterns through time-of-use rates. Nevertheless, most utilities have not offered residential customers the information needed to adjust usage patterns, a fact that has come to light during the current proliferation of electric deregulation activities. The electric bills of the vast majority of residential consumers who are metered directly by a utility are based on consumption alone.

With no time-of-use information or price signals to guide them, consumers have no incentive to adjust their usage to times when electricity is more plentiful and less costly. Neither have utilities encouraged or implemented metering systems that would permit residents to understand how much electricity they are using while they are using it (what energy professionals call "real time"). This is something that must and will change.

Today, utility-operated DSM initiatives have been almost entirely replaced by public programs. These public programs aim to encourage consumer-oriented load shedding and efficiency in tandem with efforts to ease the transition to a competitive marketplace.

THE ENVIRONMENT AND OUR GROWING ENERGY AWARENESS

As early as the late 1940s, the global environmental consequences of unchecked energy use were brought to public attention. Emissions

from factories, automobiles and the burning of coal in urban areas were creating a phenomenon called temperature or thermal inversion, which occurs when layers of warm air aloft trap pollutants at ground level.

Richard Andrews recounts these early emergencies in his 1999 *Managing the Environment, Managing Ourselves:* "In Donora, Pennsylvania, a dense smog over several days in 1948 sickened over 40% of the population and killed twenty people, triggering a national investigation. Similar events killed at least four thousand people during five days in London in 1952, and at least two hundred in New York City in 1953. Los Angeles experienced a severe episode in 1954, and similar crises recurred in Los Angeles, New York, and elsewhere during the 1960s."[9]

These events brought the dangers of air pollution grimly to the forefront of public consciousness, and made air quality a federal policy issue. 1955 saw the first federal air pollution law, which was extended in 1959 and grew into a nationwide policy initiative in 1963 with the passage of the original Clean Air Act. The legislation provided grants to defray the costs of state air pollution programs and enabled regulation of motor vehicle emissions and other threats to public health. In 1965, the Motor Vehicle Air Pollution Control Act prescribed emission standards for new cars. Other significant legislative policies passed in 1966 and 1967.

Stringent state and local standards were passed in New York City, California and Pennsylvania, triggering nationwide action. In 1970, New York City limited to 0.3% the amount of sulfur allowed in fuels, necessitating the use of highly refined and more costly oil. In response to tougher emission standards, the nation used less "dirty" domestic coal and increased its reliance on highly refined, primarily imported "sweet" oil and natural gas to satisfy its energy needs.

Temperature inversions result when layers of warm air aloft trap pollutants at ground level. Normally, air temperatures are warmest near the ground, but in a temperature inversion (occurring due to normal nocturnal cooling of surface air, or more significantly, associated with large high pressure systems) the cool air near the ground is trapped. One of the most important effects of thermal inversions is the tendency of the slow-moving, cooler air near the ground to concentrate air pollutants. Temperature inversions are blamed for the prolonged smog events that killed thousands in London, New York, Los Angeles and Donora, Penn., in the 40s, 50s and 60s.

All of this culminated in the Clean Air Act of 1970, which established primary

federal authority on nationwide air quality. It called for automobile manufacturers to install catalytic converters using lead-free gasoline in new cars by 1975, thereby reducing overall automotive pollution and contributing to large declines in ambient lead levels in the atmosphere. Also in 1970, Congress declared April 22 as the first national Earth Day, sending home the message of our own environmental culpability.

As attention was called to the environmental dangers of burning coal, the United States, like much of the industrialized world, grew steadily more dependent on the combustion of oil and natural gas, a trend that was thrown into reverse by the 1973 OPEC embargo. Prior to the embargo, petroleum accounted for 17% of electric power generation; today it has dwindled to about 2%. Following the embargo, the burning of domestic coal has surged to replace petroleum as a major source for electric power, for nearly three decades generating more than half of U.S. electricity. Hydroelectric power was an early and dependable source of renewable energy, although its contribution has dwindled over the years to about 10%.

Against the changing currents of practice and policy over the last three decades of the 20th century, the conservation movement has maintained a search for new technologies and cleaner energy sources that promise to positively impact the environment. Well before the 1991 Gulf War, which again focused attention (albeit briefly) on the national dependence on foreign oil, public interest revolved around the environmental impact of the combustion of fossil fuels. As the American appetite for electricity swells unabated among residential and commercial consumers, the pursuit of renewable energy resources becomes ever more urgent.

Environmental concerns over air quality led many to tout nuclear power as a "clean" method of producing electricity. Perceived as the antidote for the economic and environmental ills of fossil fuel consumption, nuclear power grew rapidly through the mid-70s to surpass hydroelectric power as an energy source. The much-publicized March 1979 meltdown of a nuclear reactor at Pennsylvania's Three Mile Island, however, forced even the most avid supporters of nuclear energy to acknowledge concerns over the safety of nuclear energy.

In an eerie case of "life imitating art," *The China Syndrome,* a movie depicting a fictional nuclear accident and the subsequent government cover-up, was released two weeks before the Three Mile Island incident. The media turned the spotlight on the dangers of nuclear waste and the

need to stockpile and locate waste disposal facilities. The 1986 Chernobyl nuclear disaster confirmed American fears about nuclear power although it had little negative impact on nuclear generation in Russia and Europe.

Perhaps more fateful, nuclear power plants proved costly for utilities to build, failing to live up to the nuclear promise to make electricity "too cheap to meter." Swayed by economics and public opinion, the U.S. energy industry turned its back on nuclear power as the alternative of choice to coal-generated power.

Scientists and policymakers continued to assess the impact of energy generated through the burning of coal and oil, identifying a cadre of deleterious effects stemming from the release of sulfur and carbon dioxides and hydrocarbons into the earth's atmosphere. Environmental concerns began to take on a far broader meaning, one with global atmospheric effects and potentially grave environmental consequences.

In March 1979, an automatic valve that controlled the circulation of cooling water around the reactor's core at Pennsylvania's Three Mile Island nuclear power station malfunctioned, setting in motion a series of human and mechanical errors that brought the nuclear plant to the brink of catastrophe. As the specter of a meltdown mounted, hydrogen gas built up inside the reactor and threatened to explode. The crisis lasted 12 days, during which thousands of residents fled the area. It took more than a decade, however, to decontaminate Three Mile Island's ruined reactor. A federal moratorium on nuclear activity and mushrooming public resistance hobbled the U.S. nuclear industry for years.

In April 1986, an explosion ripped through the Ukraine's Chernobyl Nuclear Power Plant, spewing radiation into the atmosphere that was six million times greater than had escaped from Three Mile Island. The plant burned for two weeks, forcing the evacuation of 135,000 Ukrainians, contaminating their farmlands and groundwater, and reaching beyond to irradiate milk in Scandinavia and poison crops across Europe. Experts estimate 6,500 deaths and 40,000 cancer cases resulted from the worst nuclear disaster of all time, but they warn the toxic impact may still not be fully known. Although Western Europe reevaluated its nuclear policies in the aftermath of Chernobyl, it is still dependent on nuclear power for 30% of its electricity.

Air pollution was the first to gain widespread attention. Citing fossil fuel combustion as a significant environmental concern, the 1965 Motor Vehicle Air Pollution Act was the first of many legislative instruments to support stringent standards on

automobile emissions. States and municipalities followed with the enactment of numerous "clean air" laws that have led to a considerable reduction in automotive pollutants, most especially in California and states throughout the Northeast. Industrial emissions and power generation emissions have been similarly restricted.

The American public became aware of "acid rain" in 1982 when Canada charged that pollution blown in from the United States was killing fish in its lakes. When rainwater absorbs air pollutants, it can reach dangerous levels of acidity capable of harming forests, lakes, crops and human lungs.

Regulations limiting emissions were passed in Europe in 1984 and the United States in 1990, but not in time to halt its effects on of ecological systems around the world. Acid rain affected forests from Russia's Ural Mountains to Brazil's Amazon Region and reduced freshwater fish populations from Canada to Scandinavia. Closer to home, coal-fired plants in the Midwest have for years blown eastward into the Northeastern United States, contributing to acid rain and smog that have been lethal to the region's fish and wildlife.

Scientists cannot yet predict the full extent of long-term damage to the earth's fragile ecology. They acknowledge however that acid rain, the result of unchecked production of energy from fossil fuels, will significantly alter the planet for centuries to come.

Another significant environmental concern is a threat of global warming due to a rise in atmospheric levels of energy-related emissions, primarily carbon dioxide. These airborne pollutants trap solar heat reflected from the ground, producing a "greenhouse effect" that some scientists believe is responsible for a steady increase in climactic temperatures. In fact, during the past 132 years of record keeping, the 13 warmest years on the planet have occurred since 1979.[10]

New York State has been a leader in the fight to improve the environment, imposing tough emission standards on local industry and automobile manufacturers. Taking the battle beyond its borders, in September 1999 New York State threatened to sue 17 coal-burning power plants in Indiana, Kentucky, Ohio, Virginia and West Virginia unless they reduced emissions. The action prompted the federal government the next month to file proceedings against 32 coal-fired plants in the Midwest and the South to force their compliance with the Clean Air Act. In November, 1999, Connecticut announced its intent to file suit.

In 1997, the nations of the industrialized world convened in Kyoto, Japan, solely to address concerns about pollution-induced global warming. The environmental impact of global warming is still disputed among scientists and the validity of the conference debated among policymakers. Nonetheless, the fact that the conference took place at all demonstrates the growing concern over the environment. As the world's greatest consumer of energy, the United States must reflect upon its unbridled consumption of petroleum for transportation, coal burned by utilities, and natural gas used by industry, homes and businesses.

Part 2 of this series by authors Kwit and Kincaid will appear in the next issue of *Strategic Planning for Energy and the Environment*. It will introduce new technologies that are becoming important, and reviews the equally powerful growth of a social influence: how residential endusers are becoming much more important in the energy/environment equation.

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Notes

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