*Part Two of the Series on*

# Energy Conservation

## A New Force Has Entered the Scene: The Residential End-user, and "Sophisticated Convenience"

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***Editor's Note:*** **Part One of this series reviewed the origins and the growth of contemporary energy conservation, and the complexities which have resulted. Part Two describes energy technologies that have been around for decades, then drifted into disuse as the first "Crisis" abated, and are re-emerging with new technological vitality.**

**Next, authors Kwit and Kincaid report on another evolving technology—advanced residential metering—that puts these users in immediate control of their energy consumption. They call this "Sophisticated Convenience." The residential sector can now take command of energy usage, which both simplifies and expands the resurgent move toward energy conservation.**

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In September, Lewis Kwit accepted a prestigious "Pioneer Award" at the New York State Energy Research and Development Authority (NYSERDA) Anniversary Awards Banquet for his services as described in this two-part series. Only ten companies among many talented organizations were so recognized.

In addition to an internal evaluation panel, four external reviewers-Howard Geller, head of ACEEE, David Nemtzow, head of the Alliance to Save Energy, Pat Curren from the Energy Association, and Warren Smith, formerly from NYSEG—confirmed the merits of the analysis presented in these articles by authors Kwit and Kincaid.

# RENEWABLE RESOURCES AND CLEAN ELECTRICITY

Heightened public concerns over air quality, acid rain and global warming have raised the stakes in our quest to develop cleaner and more efficient methods of energy production. Early efforts to improve air quality promoted the use of cleaner fuels, including low-sulfur oil and natural gas, to produce electricity. Current concerns over global warming and acid rain have revived interest in the technological development of advanced renewable energy sources.

Although hydropower remains the largest source of renewable energy, it requires an extensive and costly network of man-made dams to generate electricity. In the mid-70s, solar energy began to be used to heat space and water. Primarily confined to residential uses, these early explorations of active and passive solar power generation were encouraged by federal tax credits.

**Separate schools of thought emerged in the 1970s regarding passive and active solar power. Passive systems employ southern exposures to let sun shine through windows and heat space. In New Mexico, homes were retrofitted with large drums filled with water and painted black to absorb the sun's heat during the day. Serving as a heat storage mechanism, the water released its heat into the house at night to satisfy space heating needs.**

**Active systems position solar collector panels on roofs or in the ground. Water is piped through collector cavities to extract the sun's heat and transfer it to another location. It is called an active process because the water must be piped and usually pumped using small quantities of electricity. Advocates of passive solar energy criticized active systems as less pure and less environmentally benign.**

**Today, passive and active systems are often employed in tandem, and conflicts between the schools of thought have generally fallen by the wayside.**

Unfortunately, these systems do not permit long-term energy storage. Since solar heat is unavailable when the sun is not shining, most active and solar applications are backed up by conventional fossil fuels. An answer to long-term storage is needed if solar applications are to

have broad and practical uses. However, a repeal of tax credits in the early 1980s dealt a severe blow to the development and commercialization of solar space and water heating technologies.

With its potential for the direct and cleaner generation of electricity, solar power continues to capture the imaginations of scientists and the public. Photovoltaics, which uses the sun's light rather than its heat, is a promising advanced electric generation system although it has been prohibitively expensive when compared to traditional power sources. Nonetheless, in remote regions of South America, Africa and China where traditional electric grid service is not available, it is being enthusiastically accepted and implemented wherever financially possible.

Recent technological advances in the form of solar cells promise to bring photovoltaic electricity within financial reach of the general public, and public interest has surged in response. As the World Watch Institute reports:

> The latest advance, a photovoltaic roofing material, is becoming competitive in buildings already linked to a grid. Japan, a leader in solar cell manufacturing, has announced plans to install 4,600 megawatts of rooftop generating capacity by 2010, an amount equal to the generating capacity of Chile.[11]

*Popular Science* reports the integration of two solar technologies, the collector and the photovoltaic cell, in a new device called a phototherm. The product, which is earmarked for the homeowner, is projected to cost 75% of an independently installed collector and photovoltaic system. The phototherm was jointly developed by Solar Design Associates of Harvard, Mass., and United Solar of Troy, Mich., with support from the U.S. Department of Energy.

Other major initiatives have been the generation of electricity using wind power, geothermal sources and even tidal power. Over the past decade wind generation has been the fastest growing energy source in the world, currently expanding at a rate of 25 percent per year.[12]

As alternative generation sources develop the ability to satisfy a higher and higher percentage of our electric needs, initial investment costs decline. Many states, require utilities to buy back excess photovoltaic power produced at residential properties. Some are also on the cusp of introducing tax incentives for buildings constructed with recycled materials, and 0% loans are now available to implement renewable elec-

tric power systems in existing buildings.

Development continues in the area of small-scale on-site production and electric storage. Fuel-cell technology is an especially promising method of generating power on-site eliminating the need for utility power generated by burning fossil fuels. Fuel cells produce electricity through a sophisticated series of electrochemical reactions that do not require fossil fuel combustion. Although natural gas is most often employed to set the reaction in motion, hydrogen is being used increasingly and promises to become the reactant of choice.

Currently, electricity must be produced as it is used. Work is underway, however, on ways to store energy for use at another time. Regenerative Power & Motion in California's Silicon Alley, one of the firms working in this field, projects a breakthrough for the commercial application of flywheel technology within three years. As efficient storage technologies become commercially available, mid-scale consumers including homeowners and apartment buildings could purchase their electricity during off-peak periods (e.g., the middle of the night) when prices are lower, store the energy and then release it for use during peak periods (e.g. dinner and prime TV hours).

This would reduce the strain on electric production and distribution systems and diminish the threat of blackouts and brownouts, which occur when electric distribution lines are asked to carry more power than they are able.

The implications of a system that combines fuel cells or other renewable energy sources with electric storage systems such as flywheels are vast. It would be clean, cheaper and more efficient, in other words, a boon for the environment, for the pocketbooks of the consumer and for the industry.

## RESIDENTIAL CONSUMPTION OF ELECTRICITY

Despite conservation and environmental initiatives, electricity usage by residential consumers and businesses alike has grown at a remarkable pace over the last 50 years. Electricity powers so many aspects of our lives, from lighting to household appliances to communications systems, that it has come to define contemporary technological civilization. According to a 1998 U.S. Department of Energy report, our passion for electricity is pervasive and inevitable.

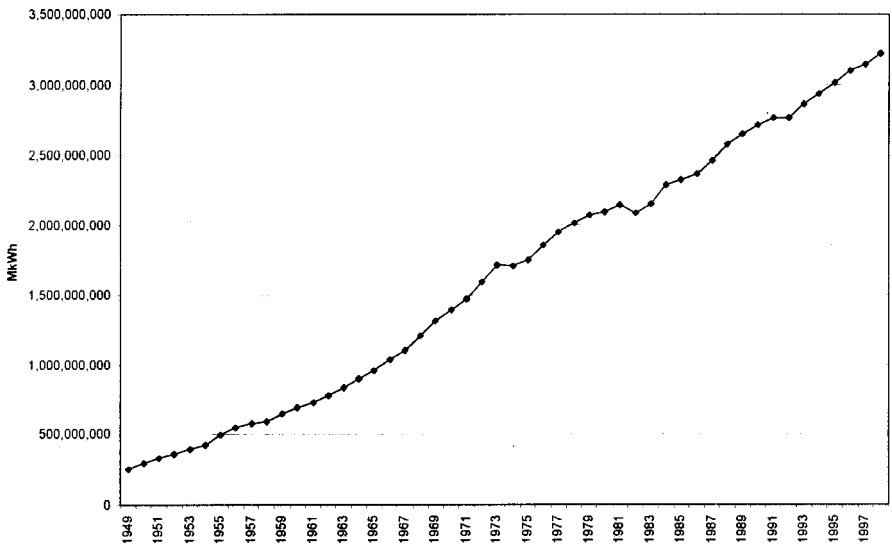
> Electricity is clean, flexible, controllable, safe, effortless, and instantly available. In homes, it runs everything from toothbrushes and televisions to heating and cooling systems. Out of doors, electricity guides traffic, aircraft, and ships, and lights up the night. In business and industry, electricity enables virtually instantaneous global communication and powers everything from trains, auto plant assembly lines, and restaurant refrigerators to the computers that run the New York Stock Exchange and the automatic pin-setting machines at the local bowling alley.[13]

Thus, while the population of the United States expanded 82% over the past half century, the amount of electricity sold mushroomed a full 1200%. Per-capita consumption of electricity was six times higher in 1998 than in 1949 as illustrated below.[14]

Residential use is the primary force behind the increase. In 1993, triggered by a robust economy and electric intensive lifestyles, residential use for the first time exceeded that of industrial, commercial and other sectors, rising to 35% of total electricity sales, and it continues to outpace all other usage.

This rapid growth rate is troubling because electricity is not simply an energy source; it takes energy to create electricity. The majority of

**Total Electric Utility Retail Sales of Electricity**

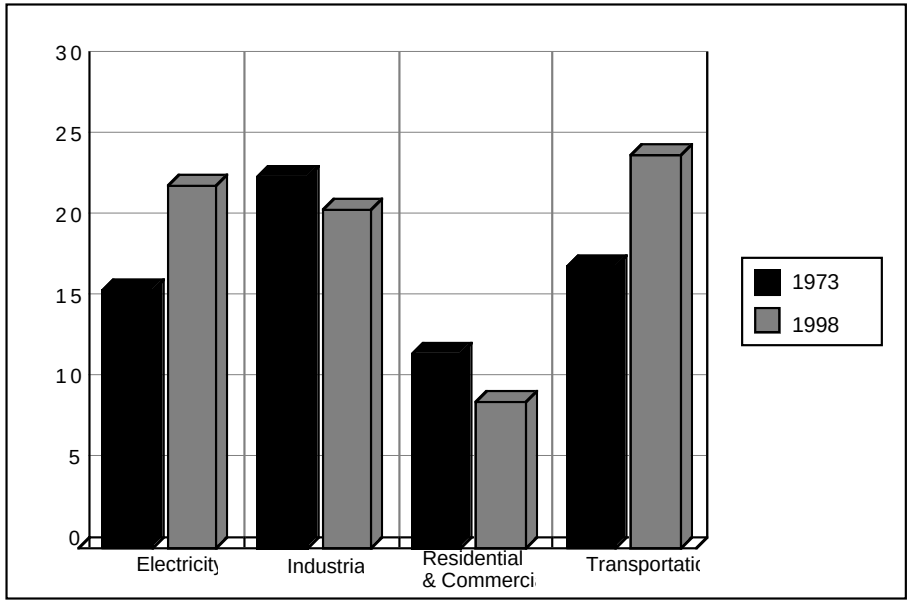


electricity is generated by the combustion of fossil fuels, which is the major contributor to today's threatening levels of air pollution, and our appetite for electricity seems insatiable. In 1997, residential use of electricity and natural gas accounted for 19% of greenhouse gas emissions in the United States, which is the single largest contributor of global emissions.

As an "end user" of fossil fuels, electricity can be compared with industrial, building and transportation sectors of American society. During the 25 years following the OPEC embargo, electricity increased its use of fossil fuels by 46% to rival transportation as the largest consumer of fossil fuels. Although transportation use also increased by 35%, efficiency seems to have taken hold in industrial and in residential and commercial sectors.

Overall fossil fuel usage over the 25-year period grew by 14%, with the electric and transportation sectors accounting for more than 60% of total use by 1998. Residential and transportation usage are the areas in which consumers have the most influence, yet it is precisely these areas that have exhibited the greatest growth in fossil fuel reliance. With little

**Primary Fuel Consumption by End-Use Sector**
**1973 & 1998, in Quadrillion Btus**



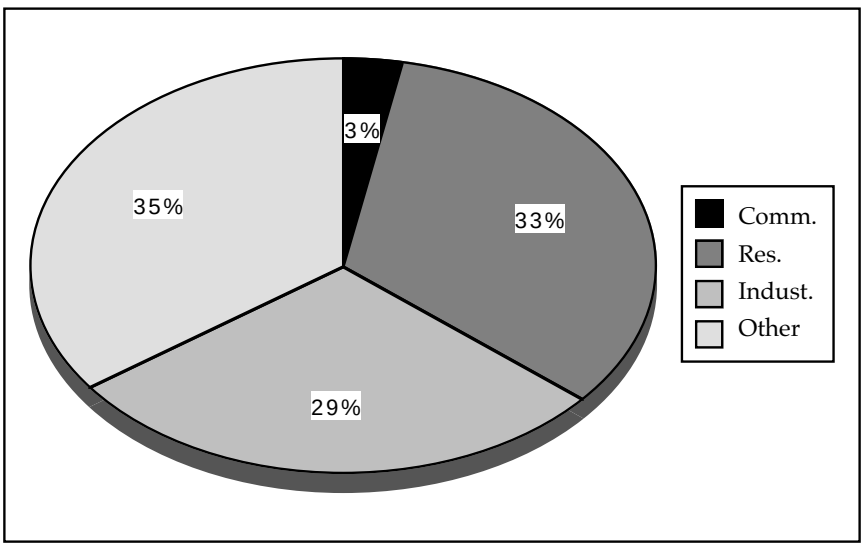
evidence that energy use, especially electric consumption, will abate in the near future, these two market sectors become the prime targets for a new consumer-driven energy awareness.

Comfort and convenience have clearly surpassed concerns for the environment in the hearts, if not the minds, of our citizens. As we advance as a society, more and more of life's enhancements will be electrically powered. The home computer, for example, is on its way to becoming the consumer method of choice to purchase products and services—and for good reason: It costs less to purchase airplane tickets or rent cars via the Internet than by the telephone. The term "ecommerce" has been coined to describe this phenomenon.

What accounts for this dizzying growth in residential electric usage? Think back to the way we lived prior to the 1973 energy crisis. Air conditioning was relatively rare in homes throughout much of the country. The family gathered around one TV set. Modern convenience items such as dishwashers, microwaves and frost-free refrigerators with automatic ice makers were just beginning to appear in the average home.

Today, our living rooms and dens (and increasingly our bedrooms and kitchens) are filled with all sorts of entertainment equipment, beginning with TV sets of enormous proportions, plus VCRs, CD recorders

**Electric Utility Retail Sales by Sector for 1998**
**Percentages**



and surround-sound stereo systems, each of which uses electricity even when not in use. Coffee machines, food processors, blenders, electric cookers and countless other time-saving electric products have revolutionized the kitchen. Hair dryers, humidifiers, treadmills and waterpics promote our health and grooming.

Personal computers in the home are redefining entertainment, shopping and communications, while telecommuting has made the home the fastest growing workplace in the nation, bringing fax machines, scanners and copiers in its wake (along with eight more hours of lights and air conditioning). In fact, every room in the house accounts for about twice the electric use as it did a quarter century ago. New electric products and appliances will no doubt continue to appear to appease our craving for comfort and convenience.

Given the inevitable increase in electricity usage, is it possible to merge an awareness for the health of the planet with the ever present allure of convenience? We feel the tools are almost in place to accomplish a new conservation-oriented social revolution.

## INNOVATIONS IN CONSERVATION

In 1996 five leading organizations devoted to environmentally sound energy policies conducted a study that assess the implications of an environmentally sound energy policy.* The culmination of their intensive research was a hallmark report, *Energy Innovations: A Prosperous Path to a Clean Environment.* It contends that the key to maintaining economic *and* environmental viability lays in a balanced national strategy that would:

> … [place the] United States on an innovative, prosperous path leading to an economically and environmentally sustainable energy future. This *Innovation Path* is marked by a set of programs and policies that would guide our economy toward lower cost, less polluting, more secure, and more sustainable ways of producing and using energy. This approach involves setting fair performance stan-

*These groups include the Alliance to Save Energy (ASE), the American Council for an Energy-Efficient Economy (ACEEE), the Natural Resources Defense Council (NRDC), the Tellus Institute and the Union of Concerned Scientists (UCS).

> dards, creating incentives, providing better information, and reducing transaction costs in order to foster investments in clean and efficient technologies. Policy packages tailored to each economic sector would provide the push to get us onto the *Innovation Path.*[15]

This innovation path encompasses policies and programs that are designed to make the most of the energy we consume. Policies would address renewable content standards, emission performance allowances, advanced vehicle initiatives, investment tax credits, and marketing and product development incentives—each geared to enhancing the cost effectiveness of innovative technologies.

These policy and technology programs would promote research and development of clean, dependable energy that could lead to a "sustainable" society, exploring fuel cells, advanced gas turbines, "green" building design, membrane technologies, biomass, wind turbines and photovoltaics. When taken together, these approaches could have a significant effect on both the environmental and economic well being of our nation.

According to *Energy Innovations,* the innovation path would stabilize if not reduce primary energy consumption and lower fossil fuel dependency to help mitigate acid rain and global warming. It would also produce nearly 800,000 new jobs, reduce per capita consumer spending on fuel and provide moderate increases in wages while contributing to the growth of the gross domestic product.[16]

Recognizing that environmentalism, energy, and economics are interrelated, *Energy Innovations* provides a comprehensive methodology to realize economic security and advance environmentally sound actions. Rather than function as a barrier to prosperity, environmentalism can become the economy's driving force. Gone are the days when the environment need be sacrificed to economic development. Technological innovations driven by environmentalism can become key contributors to the overall health of the world, both economically and environmentally.

What this does not take into account is the role of the individual in achieving an environmentally sound future. Given that residential consumers have surpassed all other sectors in their use of electricity, it behooves all of us to think about how we can use electricity more wisely and effectively. Recent technology innovations and developments in the energy marketplace now offer consumers a way to take matters into their own hands.

## THE BIRTH OF "SOPHISTICATED CONVENIENCE": A NEW PARADIGM OF CONSERVATION AND CONSUMERISM

Any effective account and application of conservation must evolve in response to a changing economic, technological and social environment. Flexibility, both in the description of the problem and the proposed remedies, is demanded given the dynamic nature of today's world. Worldwatch Institute president Lester R. Brown attests to a new awareness of energy production and consumption:

> [N]ot all environmentalists will agree with me, but I believe that there are now some clear signs that the world is in the early stages of a major shift in environmental consciousness. What is not clear to me is whether we will cross this threshold in time to avoid the disruption of global economic progress.[17]

Aggressive and sophisticated actions are needed to seize the opportunities inherent in today's changing energy marketplace. The question is not *if* current energy production and consumption patterns will change, but *how*. At issue is the tension between conservation and consumerism. Can we maintain progress in environmental protection despite mounting socioeconomic pressures that encourage our reliance on electric commodities, from robot-powered assembly lines to dishwashers? If we are to secure a clean environment, we must spur the development of technological remedies for current environmental problems and cultivate a consumer market to buy them.

"**Sophisticated Convenience**" envisions a new way of life in which consumers can enjoy the exceptional benefits of electricity while actively participating in the effort to create a sustainable environment. While the sophisticated convenience movement provides consumers with great opportunity, it also demands that we assume new responsibilities.

To date, consumers have had few ways to demonstrate their endorsement of a clean local and worldwide environment. A convergence of conservation and consumerism is, however, possible. Given the chance to act on our convictions, we believe that Americans will accept the challenge of a new sophisticated consumerism with open arms and take pride in their accomplishments.

## Deregulation and the Individual

One of the important developments in the energy arena that will direct our concerns and our actions is the advent of wholesale and retail competition in the energy marketplace. Just as deregulation changed the face of the airline and communications industries, new deregulatory policies promise to impact the way energy is produced, used and purchased. Changes are most notable in the emerging electric marketplace, where Americans are able to explore options and choices that simply did not exist under regulated service.

Prior to 1996, utilities acted as government-regulated monopolies to provide "bundled" services of production, transmission and distribution of electricity. The Federal Energy Regulatory Commission (FERC) has begun to implement an important series of deregulatory policies that will unbundle these services and allow energy service companies (ESCOs) to compete for customer business. As a first step, electric producers may compete to sell their product over utility-owned electric transmission lines and distribution grids.

Additional steps call for competition in delivery and distribution. When the owners of distribution lines are no longer the sole source of electric generation, Hal Harvey, executive director of the Energy Foundation, predicts "electricity generation companies will be highly competitive, independent actors. They will sell their power on an open market directly to consumers. They will be motivated to sell lots of electricity, since their profits will be tied directly and inescapably to their kilowatt-hour sales."[18]

It is not yet apparent what effect deregulation will have on prices. Some experts predict that deregulation will result in cheaper electricity—and that cheaper electricity will mean greater usage. Others suggest prices might rise before they come back down. This was the case with airline deregulation, which encouraged competition among carriers and choice for consumers but did little to effect lower fares.

What is more certain is that consumer choice will encourage an era of competition in which electricity providers expand their services as they vie for customers. As the pursuit of convenience (and our appetite for electricity) proceeds apace, providers will seek to identify and implement new technologies to better serve consumers. Technological advances in energy production and delivery combined with an emerging market for efficient technologies and products could help to

maximize performance and eliminate energy waste.

By helping to promote electric "smarts" among consumers, the deregulated marketplace could impact the environment positively. Consumers must be given the information, however, to make informed decisions about their energy use patterns. Deregulation is also helping to spur technological advances that could put this information in the hands of the consumer through electricity meters that can provide precise time-of-use information.

## Technology as a Path to Energy Awareness

Metering and billing are two other utility services scheduled for unbundling that are receiving a good deal of attention. To date, utility monopolies have stymied technological growth in these areas. Meter manufacturers gear technical innovation to its customer, which traditionally has been the utility company not the electric end-user. Without the presence of competition, utilities have had little interest in streamlining metering and offering billing options that might have long-term financial benefits for consumers. In a deregulated electric arena, however, ESCOs may contend for our business by offering services that will help us save money and electricity rather than encourage us to use more.

Over the past two years, advanced meters have experienced a surge in development. Evidence of our use of electricity is currently hidden from view. "Kept in the dark" about when and how much electricity they utilize, individual consumers have been lulled into using convenience products without knowing the cost implications. As long as electric charges are within reason, consumers simply write their monthly check without paying attention to usage.

New meters currently under development can alert us to our usage and charges as we incur them, just like an odometer monitors car mileage. As they seek to compete for consumer business, ESCOs could begin to offer practical new meter hardware that provides consumers with electricity price signals.

Using a new generation of meters that display electric usage right in the apartment and home, electric companies will be able to charge customers according to the times they use electricity. Consumers will be able to save by "conserving at the peak" when prices are the highest, and they can effectuate demand side management strategies directly, without requiring government or utility involvement.

Companies will still be allowed to recover costs, ensuring them of a profit while maintaining a low competitive price. Further consumer options will include choices in billing plans, such as those seen in today's long distance and cellular telephone market.

One example of new metering technology is a "pay-as-you-go" electric meter that consumers fill up by swiping a charge card at a conveniently located kiosk to pay for electricity before it is used. The concept is similar to that of refilling your EZ Pass card or filling your automobile tank at the gas station. Electric utilities have embraced this type of display and payment device since it precludes payment collection problems. The potentially punitive nature of such systems has given pause to public utility commissions that are considering them for approval.

Nonetheless, proponents report that consumers who are apprised of their electric usage in real time through a simple display system are cutting their usage 15-20%. The incorporation of a display component from a competitive entity whose sole receipt of revenue is not dependent on the volume of electricity sold will provide consumers with valuable hands-on technology to sharpen their understanding of the use and cost of electricity and eliminate a monthly surprise—the amount of their electric bill. At a recent conference on advanced electric meters, an executive of a rural electric cooperative recounted one of his experiences with pay-as-you-go meters: Observing him installing them in residences of delinquent payers, a woman inquired, "Do I have to not pay my bill in order to get one of these meters?"

We are confident that methods will be found to facilitate the introduction of new metering technologies and pricing methods to the residential consumer. Advances in residential metering technologies and access to usage and billing information, previously available only to large industrial and commercial users, will be important steps in the right direction.

By enabling residential users to take advantage of the hourly energy marketplace that is emerging through deregulation, we will, in effect, put $5 tables into the electric casino where only $1,000 tables had existed before. By allowing residential consumers to purchase electricity when it is most plentiful and least expensive, we will empower all consumers to adopt their own demand side management strategies and save money.

## The Individual and the Environment

Today's residential consumers have surpassed all sectors in their use of electricity. The sheer magnitude of our collective individual market power is awesome. Electric competition will allow individuals to purchase power generated from renewable sources. Many states have adopted regulations to require new electric providers to identify the fuel mix and emissions characteristics of electricity sold in the competitive market.

Green power is not only available in California and parts of other states, it is preferred despite somewhat higher prices. In western Minnesota, wind power will supply about 1,000 megawatts of electric power in towns along the Buffalo Ridge by the year 2002. Reporting on the success there, James Chiles writes in "A Second Wind" in the March 2000 *Smithsonian Magazine:*

> Dozens of ordinary Minnesotans have come here today to visit three new wind turbines. They subsidize the machines by voluntarily paying a few dollars extra per month on their utility bills, through "green pricing" programs offered by their electric cooperatives.

Consumer education could yield other energy/environmental benefits. When consumers realize the significance of their usage, they will be more prone to work together to flatten peak usage. Energy producers would be able to use their power systems more efficiently, reserving older plants with the highest emission levels for emergencies.

This would move us toward "doing more with less," the view of energy efficiency that Amory Lovins espoused a quarter century ago. While Lovins called on us to tap the oil fields of our attics, today's deregulation will enable us to retire the inefficient power plants demanded by our refrigerators, air conditioners and microwaves. Advances in renewable resources and efficiency hold the potential to allow the best of both worlds: affordable electricity and a safe environment.

Product manufacturers now appeal to our growing energy IQ by developing and promoting more energy efficient household appliances and entertainment products. Informed energy consumers can make intelligent decisions about products that cost more to purchase but

are cheaper to operate. At this point, the environmental dividend comes into play.

## CONCLUSION: CONSUMERISM AND CONSERVATION REDEFINED

The marketability of new energy technologies will determine the future of conservation efforts in all its forms. This emphasis on marketability and consumerism means more than promoting gadgets with fashionable logos. It involves three components: an emphasis on education and consumer access to information regarding energy choices, the development of political and economic incentives for the production and consumption of environmentally sound electricity, and an increasing emphasis on the technological development of environmentally sound alternatives.

The cornerstone of future conservation efforts is education. Consumers must have accessible, credible and genuine information on the impact of their choices on the environment and the American economy. Industrial and commercial consumers will face choices on a multitude of levels, from building design and management to consumer choices regarding energy product purchases, transportation, entertainment, and habitation all of which have energy consequences. Individuals will also become active participants as advances in metering technology and choices they make about energy suppliers and service providers enable them to join the movement for sophisticated consumerism.

The ability to mitigate the environmental threat of combustion-based power production requires innovation on both the supply and demand sides of the electric meter. A conservation revolution cannot succeed if it is based solely on reducing consumption. Our unquenchable desire for life-style enhancements is based on a literal "touch of a button" access to electricity, and a decrease in consumption is simply not in sight. When individuals are able to choose to purchase cleaner and more efficiently generated electricity, however, they may help effect a feasible solution from the supply side.

Competition in the electric arena provides consumers with choices that they have little experience in making. Education, public incentives, and information regarding the impact of products that use electricity and the nature of the electricity itself must be more readily available.

The pending competition as electric service is unbundled, combined with metering technologies and information access, will empower consumers through choices yet to be developed.

Responsibility for efficiency and environmental protection will filter from industrial and commercial users to individuals. Given the tools of choice, and the right sort of marketing program to promote energy efficient household products, information and incentives, choices can be made with confidence. In this sense, conservation ceases to be paternalistic and becomes self serving. People will rise to the occasion, and the new ethic of sophisticated convenience will take hold, not as a fad but as a way of life.

Once choices are available, residential customers can be offered the same type of incentives as large institutions. Measures could include tax incentives for purchasing green power, reduced sales taxes for certified electric efficient appliances, and rate structures that reward off-peak and judicious usage. Policy incentives should be promoted for firms to develop sustainable technologies and consumer-oriented efficient products. Grants should be provided to inventors who explore innovative energy production techniques and who conceive of products that facilitate knowledgeable choice.

These actions will contribute to a robust market for electric efficient products and consumer-driven initiatives. Fulfilling joint objectives to enhance individual comfort and convenience without threatening the environment, need not be mutually exclusive.

What is the good news and the bad news regarding our ability to effect positive environmental change? It is as Pogo observed: "**We have met the enemy and he is us**." The news is bad because we have no one else to blame for our planetary woes. They are the result of our unquenchable thirst for comfort and convenience.

Yet this is also good news. Armed with the tools of consumer choice, renewable electric generation and efficient product technologies, we can embrace our responsibilities and have a positive impact on our environment. Sophisticated convenience will nourish our ability to make wise choices, enjoy the benefits, and claim the "bragging rights" of our accomplishments.

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**Lewis M. Kwit** is the founder and president of Energy Investment Systems, Inc., a corporation that specializes in implementing energy savings and related improvements in multifamily buildings. Over the past sixteen years, EIS has developed financing strategies that access a variety of public and private programs, from governmental incentives to commercial bank loans, in order to rehabilitate multifamily buildings in low and moderate income communities.

Earlier, Mr. Kwit worked as an independent energy policy consultant, and had directed a national energy policy project for the Cooper Union Research Foundation. He worked with a policy committee of energy directors from fifteen of the nation's largest cities to develop

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Currently, under a NYSERDA contract, he is developing methods to aggregate apartment energy usage to save about 25% of electric costs.

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