The Distributed Utility Concept: Toward a Sustainable Electric Utility Sector

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The U.S. electric utility sector is entering an uncertain period as pressure mounts to cut costs and minimize environmental impacts. Many analysts believe that exposing the industry to competition is the key to reducing costs. Most restructuring proposals acknowledge the need to maintain environmental quality and suggest mechanisms for assuring continued support for end-use efficiency and renewable energy in a deregulated electric utility industry. Two of the most prominent ideas are non-bypassable line charges and portfolio standards. This paper suggests another option based on the distributed utility (DU) concept in which net metering and a form of performance-based ratemaking allow distributed generation, storage, and DSM to play an important role in a new competitive electric utility sector. A DU option directly incorporates these resources into the electric system by explicitly acknowledging their value in deferring distribution equipment upgrades.

INTRODUCTION

The electric utility sector in the U.S. is on the verge of fundamental change as regulators, policymakers, and industry officials seek a strategy for introducing competition into the industry. The move toward competition is driven by the belief that significant efficiency gains could be realized by exposing the industry to market forces. At the same time, national and international concern is increasing regarding the depletion of natural resources and environmental degradation associated with existing energy technologies. Calls for an electrical system that can satisfy the criterion of long-run sustainability are growing along side an agenda of deregulation. Some analysts believe that the role of efficiency and renewables may diminish in a deregulated electric utility sector (Rosen et al. 1995). But both resources are well recognized as key to achieving the goal of sustainability.

This paper discuses mechanisms being considered in the restructuring debate to assure that energy efficiency and renewable energy technologies play a role in a competitive electric utility industry. In particular, several restructuring proposals call for non-bypassable line charges (also referred to as system benefits charge) to satisfy a variety of social goals including the promotion of efficiency and renewable energy. In addition, most notably in California, some restructuring proposals call for minimum portfolio standards (also referred to as set-asides) which establish minimum purchase requirements for non-polluting resources like demand-side management (DSM) and renewables (Spratley & Bracken 1996). This paper suggests another approach based on the emerging distributed utility (DU) concept to assure that energy efficiency and renewables play a role in a restructured electric utility industry. In our view, the DU option has been neglected in the current debate.

A DU strategy involves a fundamental shift in the way electricity is delivered, with a move away from large-scale central generation to distributed small-scale generation and storage, and targeted demand-side management. To date, the DU concept has mainly been analyzed in terms of its technical and economic potential. This paper utilizes the DU concept as a strategy for directly integrating energy efficiency and renewables in a restructured electric utility industry. This paper highlights the differences between a DU approach and those being proposed in regulatory arenas for continued investment in efficiency and renewable energy.

Through the direct integration of end-use efficiency and renewables into a restructured industry and explicitly acknowledging the value of distribution equipment deferrals, a DU strategy would likely lead to higher levels of efficiency and greater penetration of renewables than non-bypassable line charges or portfolio standards. Thus, we conclude that a DU approach is the preferred policy option for moving an increasingly competitive electric utility industry toward long-run sustainability.

JUSTIFICATION FOR POLICY INTERVENTION

In 1994, the electric utility industry generated 2.9 trillion kilowatt-hours of electricity (EIA 1995). Approximately 91% of the electricity produced in the U.S. is generated through the use of finite fuel sources. Each year the global stock of fossil fuels are depleted many times faster than new discoveries add to the know stocks of these resources (Fulkerson, Judkins & Sanghvi 1990). Over half of the energy produced by electric utilities in 1994 relied on coal as the boiler fuel. Analysts estimate that global coal reserves will last for approximately 230 years based on current production levels (EIA 1995). Nuclear power, the second largest source of electricity in the U.S., relies on continuing supplies of uranium, a finite resource. An additional constraint is the still incompletely addressed problem of safe and secure storage of the hazardous wastes that are produced as a byproduct of nuclear electricity generation. Finally, natural gas and crude oil reserves are estimated to last for 120 and 65 years respectively at current production levels (EIA 1995). In short, the U.S. electric utility sector relies on finite energy sources that, once depleted, will not be available for future generations.

The environmental and health impacts of fossil fuel use may prove to be bigger problems, in terms of sustainability, than the depletion of existing fuel reserves. Power plant emissions from fossil fuel combustion contribute to three major environmental concerns: acid rain, urban air quality, and climate change. Acid rain results when sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) combine with water in the atmosphere and produce acidified rain and snow which are then deposited on the earth's surface causing damage to natural ecosystems and made-made structures. The electric utility sector accounts for 72% and 33% of total U.S. emissions of SO_2 and NO_x respectively (Carlin 1995). Urban air pollution includes high concentrations of SO_2 that, in turn, contribute to a range of respiratory illnesses. Because nearly three-quarters of this pollutant is emitted by power plants, the electric utility sector is a major source of this problem. A second problem is excessive ground-level ozone which is produced when NO_x, carbon monoxide, and volatile organic compounds react in the atmosphere in the presence of sunlight. Ground-level ozone causes several human health problems including respiratory ailments, eye irritation, and weakened immune systems (Fulkerson, Judkins & Sanghvi 1990). While transportation accounts for a significant share of the emissions related to ozone formation, fossil-fuel combustion for electricity is responsible for about 13% (MacKenzie 1989). Finally, carbon dioxide (CO_2) is the principal greenhouse gas building up in the atmosphere that may cause temperatures on the earth's surface to rise. The electric utility industry contributes 35% of total U.S. CO_2 emissions into the atmosphere (Carlin 1995). Although the specific impacts of global climate change are uncertain, most analysts believe that coastal flooding and severe disruptions in weather patterns could result (IPCC 1990).

In light of the unsustainable nature of the global electric utility sector, it is in the public interest to find ways to bring about a transition in this sector toward a sustainable mode of operation. Several analysts have developed specific proposals for developing a sustainable electric utility systems. These proposals include decreasing reliance on fossil fuel- and nuclear-based electricity production while increasing the use of environmentally benign renewable energy sources, and achieving high levels of end-use efficiency (Flavin & Lenssen 1991; Goldemberg et al. 1987; Johansson et al. 1993; Kozloff & Dower 1993; Lovins 1977). The gist of such proposals is captured by Flavin and Lenssen (1991, 22) as follows. ''Ultimately, a sustainable economy must operate with much lower levels of fossil fuels, and probably without nuclear power. It would likely derive its power from solar resources replenished daily by incoming sunlight and by geothermal energy(resources available in far greater abundance than fossil fuels. It would also need to be much more energy-efficient, since renewable energy is unlikely to ever be as cheap as oil has been.''

The environmental and health impacts of electricity production impose hidden costs on society that are not reflected in prices. Costs that are imposed on third parties that are not directly involved in the production or use of the good or service are referred to in the economic literature as externalities (Baumol & Oates 1988). In the presence of externalities, markets are unable to secure efficient resource allocations creating what is commonly referred to as ''market failure.'' Policymakers and regulators recognize these market failures and, in the past, have utilized a variety of mechanism to correct them. For example, certain states require utilities to use quantitative externality estimates in their resource planning process. In doing so, externalities are internalized to the extent that a more expensive cleaner option is selected over a dirtier and cheaper option. To date, this policy approach has not greatly increased efficiency or renewable energy investments (Carlin 1995).[1] Other market-based mechanisms include the establishment of a tradeable emissions permit system for SO_2 established under the Clean Air Act Amendment of 1990. This approach internalizes a portion of the external costs of electricity production by forcing utilities to invest in SO_2 mitigation technologies.

As the electric utility becomes increasingly deregulated, the success of policy interventions such as these and others will depend, to some extent, on the ultimate electric utility structure that emerges. However, the need to correct market failures will remain. The next section contains a brief discussion of general guidelines for a restructured electric utility sector that have emerged through the deregulation debate.

TOWARD A RESTRUCTURED ELECTRIC UTILITY INDUSTRY

The drive to deregulate the electric utility industry is largely motivated because of the large divergence between the price of electricity and the marginal cost of new capacity (Chamberlin 1995). Analysts believe that a competitive generation market could save electric utility customers billions of dollars each year from lower prices. As a result, federal and state regulatory agencies have been aggressively investigating a variety of restructuring proposals. To date, no single ''best'' restructuring model has emerged from the deregulation debate. However, several common elements of electric utility restructuring have emerged.

The starting point for a restructured industry involves the breakup of vertically integrated utilities into three components: generation, transmission, and distribution. This disaggregation of a utility's business units could be either ''functional'' or ''corporate'' in nature. Under functional disaggregation, each separate business unit remains under the utility's ownership. In contrast, corporate disaggregation involves separating each business unit into different corporate entities. Disaggregation is necessary to assure that all competitors in the generation market have equal, nondiscriminatory access to transmission and distribution services. While the generation side of the business will be competitive, transmission and distribution companies will remain regulated monopoly franchises.

The concept of the independent system operator (ISO) has also gained currency in the deregulation debate. The ISO would control and operate the regional transmission system which includes scheduling the delivery of electric power supplies, ensuring that actual demand is met with sufficient power supplies and that all standards for transmission service are satisfied, as well as communicating any problems in delivering power supply to the appropriate parties (CPUC 1995). The key to a well functioning competitive market for generation will be a truly independent entity operating the transmission system to assure equal access to all generators.

An important topic that has been actively debated in the restructuring arena is the stranded cost issue. Stranded costs involve those investments made by utilities, and approved by regulators, that have not yet been fully recovered and will become uneconomic in a competitive environment. Estimates of these costs range from $20 billion to $500 billion (Hirst, Hadley & Baxter 1996). In general, there is agreement that utility shareholders have a right to recover at least a portion of these costs. However, there is not agreement on what percentage should be recovered, what constitutes a stranded cost, or how to recover these costs.

The debate between wholesale and retail competition is still unresolved. Proponents of wholesale competition argue that the majority of the benefits of competition could be realized through competition at the wholesale level. Furthermore, they claim that retail competition could have a detrimental effect on smaller customers lacking market power. Proponents of retail competition primarily argue their case based on the perceived desire on the part of customers, both large and small, for greater choice of electricity suppliers. It appears that retail competition is emerging as the preferred model for competition across the country. However, a host of logistical issues will have to be addressed before a truly competitive retail market for electricity emerges.

EFFICIENCY AND RENEWABLES IN A DEREGULATED INDUSTRY

Although deregulation necessarily entails less government involvement in the electric utility industry, most states recognize the role of public policy in continuing to promote environmental protection. Policymakers realize that continued investment in energy efficiency and renewable energy is in the public interest and necessary to reduce the industry's adverse impact on the environment and human health. The ultimate structure of the industry will dictate the role that DSM and renewables will play without direct policy intervention. However, most analysts agree that certain measures will be needed to capture ''stranded benefits.''[2] This section begins with a discussion of how efficiency and renewables would fit into a deregulated electric utility industry without direct policy intervention. Next, we discuss specific proposals to foster continued investment in end-use efficiency and renewable energy, including non-bypassable line charges and portfolio standards.

The Role of Efficiency and Renewables in a Deregulated Electric Utility Industry

Although the specific structure of an emerging competitive electric utility sector will ultimately dictate the role of DSM and renewable energy, several general observations can be drawn based on the general guidelines for restructuring described in the previous section. Energy service companies (ESCOs)[3] will continue to offer customers energy-efficiency and load management. End-use efficiency and load management will no longer be considered as an energy and capacity resource; rather, it will be viewed as a customer service (Tonn, Hirst & Bauer 1995). Currently, in states with a strong IRP process, DSM is considered a viable resource along-side traditional supply-side resources. With the emergence of a competitive generation market, it becomes difficult for DSM to be considered a viable resource option. The policy concern is whether DSM, as a customer service, will lead to a socially optimal level of end-use efficiency investments.

In a retail model of competition, we would expect a reduction in the use of renewable energy technologies with prices above the prevailing market price of electricity. However, renewables could be selected by generators who are attempting to market ''green'' power (Moskovitz 1993) or have an interest in a diversified portfolio of generation options in an effort to manage risk (Awerbuch 1995). Provided full customer access comes to fruition, customers with a strong environmental ethic may be willing to pay the extra cost for electricity generated from renewable energy sources (see, e.g., SMUD 1993). In recent years, there has been several research efforts to quantify the market for ‘‘green pricing’’ and several pilot projects (Byrne et al. 1996). Renewables may also be acquired as a means to diversify risks associated with fuel price volatility in a deregulated electric utility industry.

Most restructuring proposals acknowledge the need to maintain environmental quality as the electric utility industry moves into a new competitive era. In addition, there is concern that the above possibilities will not be sufficient to achieve optimal investment levels in end-use efficiency and renewable energy. As a result, several restructuring proposals include specific provisions for additional investments in efficiency and renewable beyond what is likely to occur if left to the market. The remainder of this section discusses these proposals in greater detail.

Non-Bypassable Line Charges

Non-bypassable line charges, also referred to as a system benefits charge, have been proposed as a means to generate revenue to meet social objectives that would not be met in a competitive environment (Rosen et al. 1995). These charges could be applied on per kWh bases at the distribution level and applied to customers of all utilities in a region to prevent any inequalities. A non-bypassable line charge is designed to allow the utility to collect revenue from all customers regardless of which generation company they purchase their electricity from. Presumably, these funds would be used to purchase renewables that are above the market price of electricity to stimulate demand for the technology thereby leading to increased production levels and, eventually, cost reductions from massproduction. In addition, the funds could be used to fund DSM programs or other social objectives.

Several states are considering this option as part of their restructuring proposal. In fact, the California Public Utility Commission (CPUC) suggests that ‘‘. . . the Legislature adopt this approach on all retail sales to fund public good research, development, and demonstration and energy efficiency activities’’ (CPUC 1995). Furthermore, the National Association of Regulatory Utility Commissions recently passed a resolution supporting the idea of non-bypassable line charges. As the debate continues, the details of how a system benefits charge would be determined and administered will have to be resolved.

Portfolio Standards for DSM & Renewable Energy

Portfolio standards, also referred to as set-asides, require electricity sellers and/or buyers to maintain a predetermined level of ‘‘clean’’ resources, such as renewables and DSM, in their overall resource portfolio (Rosen et al. 1995). These requirements can be applied to generation companies as a condition for selling energy into a certain jurisdiction or bulk power purchasers like market aggregators and distribution companies that sell to retail customers. Such standards could be established by legislation or state public service commissions based on percentage of total generation sales or power purchases.

To achieve economic efficiency, a tradeable ‘‘portfolio obligation’’ scheme could be utilized (Rosen et al. 1995). Such a system would allow generation companies or market aggregators to purchase credits from companies specializing in the development of renewable energy or delivering cost-effective DSM. If the permits are trading at a price above what the firm can acquire renewables or DSM for on their own, they would not purchase any credits. However, if the permits are trading at a cost below what they could acquire these resources for, they would purchase the ‘‘portfolio credits’’ to meet their obligation. It is argued that such systems would achieve environmental objectives at least cost.

Minimum portfolio requirements are currently being discussed in the electric utility restructuring debate. The rationale for such a policy lies in the fact that emerging technologies require time and experience before they become fully commercialized. Sustained markets provide manufacturers an incentive to increase production levels which leads to economies of scale and lower prices. Moreover, portfolio standards provide resource diversity so that the system does not depend on any single fuel source. The CPUC has concluded that ‘‘. . . a minimum renewable purchase requirement is the best way to meet resource diversity goals’’ (CPUC 1995). Other states are also looking at the feasibility of minimum portfolio requirements as part of their restructuring efforts.

DISTRIBUTED UTILITY CONCEPT

An additional strategy for continued investment in renewable energy and DSM in a deregulated electric utility sector may be a distributed utility (DU) strategy. DU describes a new approach to meeting customers energy service needs that is fundamentally different than today’s centralized approach (Weinberg, Iannucci & Reading 1993; EPRI, NREL & PG&E 1993). In such a system, distributed, small-scale generation and storage, and targeted demand-side management (DSM) augment central station generation. This type of energy system explicitly acknowledges the transmission & distribution (T&D) investment deferrals, modularity, and risk mitigation benefits associated with many renewable energy, storage, and DSM technologies.

Distributed Utility Background

The economic motive for investigating the DU concept centers around the low asset utilization rates associated with many utilities' T&D systems and rising expenditures on T&D equipment. For years, T&D planners made decisions without fully understanding the economic tradeoffs between various investment alternatives. T&D equipment was sized to meet peak load demands which, in many cases, last for only a few hours each year. As a result, most T&D assets are underutilized relative to generation assets. The utility planning process entails a system-wide perspective when making resource investment decisions. In a DU context, however, the most important planning data will be derived from the substation and below. Information on a local planning area's loads, resource availability, and other area- and time-specific data will be required for planning in a DU context.

While the current electric utility industry structure relies on technologies that have been around for many years, a DU structure involves greater investment in emerging modular technologies. For example, photovoltaics (PV), wind turbines, geothermal energy, hydrogen fuel cells, and flywheels have been shown to be technically sound and environmentally friendly while offering significant opportunities for future price reductions. While economies of scale for power plants increase with size, economies for DU technologies improve as production levels increase. In fact, the Utility Photovoltaic Group (UPVG) predicts that PV will soon reach \$3/watt, from its current \$7 to \$8/watt price, as production levels increase (UPVG 1994). As the price of PV and other modular technologies decrease, additional cost-effective markets emerge creating further opportunities for price reductions.

As the electric utility industry is deregulated, the DU option would encourage the adoption of emerging technologies, like fuel cells and photovoltaics. A DU strategy, if properly conceived and articulated, could emerge as a viable alternative for continued investments in efficiency and renewable energy technologies. A vision of an industry focused on energy services rather than kWh sales is needed for a truly sustainable electric utility sector to emerge and a DU strategy may provide policymakers and industry officials with that vision.

DU Policies for a Deregulated Electric Utility Industry

A distributed utility (DU) strategy would involve developing a restructured industry in which distributed generation, storage, and efficiency would directly compete with electricity supplied from the grid. An important component of this strategy would be the explicit recognition of the distribution equipment deferral values and reduced line losses associated with distributed resources. Because the distribution utility retains its monopoly franchise, it will continue to be under state regulation. As a result, the distribution utility could be the focal point for a DU approach. A DU strategy would not be effective if the distribution utility was only concerned with moving electricity through the system. If revenues are tied to the number of kWhs it moves through the system, there would be no incentive for the distribution utility to consider the economic tradeoffs between distribution equipment upgrades and demand-side generation, storage, and efficiency investments. In addition, when designing distribution systems to serve newly developing areas, distribution companies would not be motivated to investigate opportunities to minimize distribution capacity needs through distributed generation and storage, and efficiency. There are two key regulatory/policy requirements to facilitate a DU strategy: net metering and some form of performance-based rate making.

The energy produced from distributed generation technologies must be valued, in terms of its capacity and energy value, similar to energy supplied from the grid. In addition, distributed resources should be credited with the avoided transmission and distribution costs associated with energy purchased from the grid. These objectives could be accomplished through a net metering provision. For example, the Massachusetts Department of Public Utilities (DPU) is considering net metering for on-site renewable energy sources of 30 kW or less as part of their restructuring proposal. In addition, several other states, including California, have some form of net metering legislation in place. As an effective DU policy, distribution companies must be required to purchase the energy from on-site generation by customers. Like the Massachusetts DPU proposal, a maximum kW value could be established during a transitional period while experience is gained with various DU technologies and issues of utility interconnection are addressed. However, as a long-term DU strategy there is no need to limit the size of distributed generation as long as it competes favorably with energy supplied from the grid.

The economics of a DU strategy are based on the variation in distribution costs not only with time, but also by region. Distribution utilities will need to understand and calculate the area- and time-specific marginal costs for providing distribution services. A form of performance-base regulation

(PBR) could be developed that provides proper incentives for distribution companies to minimize the cost of distribution services. Distributed generation and targeted DSM could be valuable tools for distribution utilities to arrive at least-cost solutions. There are two basic approaches to PBR: price caps and revenue targets. Revenue targets would be the preferred option for a DU strategy. The regulatory body would set an allowable revenue level based on actual costs for a test year (Rosen et al. 1995). Revenue targets have been suggested over price caps because it removes the disincentive for DSM investments. As a result, a properly designed PBR for distribution utilities could promote the use of DSM, distributed generation, and storage to arrive at least-cost distribution services.

COMPARISON OF POLICY OPTIONS

There are fundamental differences in the way efficiency and renewable energy technologies are viewed under the different policy options discussed above. These differences could have a profound impact on the level of efficiency investments and the penetration of renewable energy technologies. In turn, the long-run sustainability of the electric utility industry depends on those policies that are adopted as part of industry deregulation. This section highlights the key differences between non-bypassable line charges, portfolio standards, and a DU approach.

Area- and Time-Specific Marginal Costs

A DU approach acknowledges the time- and area-specific marginal costs of distribution capacity and uses this information in the decision making process. Non-bypassable line charges and portfolio standards do not inherently recognize these differences. Recent studies demonstrate that significant variations exist across areas and over time in the cost of providing distribution services (Heffner 1994). By targeting distributed resources and DSM to areas with particularly high marginal distribution costs, the value of these resources is greatly enhanced.

The technical and economic benefits of efficiency as a distributed resource were first investigated by Pacific Gas & Electric (PG&E) in their Delta district case study. The Delta district is one of PG&E's 200 planning areas and was chosen because the area was experiencing rapid growth which would spur significant distribution infrastructure investments under conventional planning strategies. Analysis was conducted to determine if the value of DSM could be enhanced if integrated into the transmission and distribution (T&D) planning process. The study concluded that high saturation of DSM programs carefully matched to the local area costs and timing of the loads can cost-effectively defer investments in T&D facilities (Orans et al. 1992). In fact, the analysis showed that PG&E could save $35 million over traditional planning practices. Since this analysis, other pilot projects have verified the value of DSM in deferring distribution equipment upgrades (Weijo & Ecker, 1994; Sparks, Goett & Dimetrosky 1994).

Photovoltaics (PV) cells are made of semiconductor materials that convert sunlight directly into electricity and have been identified as one of the most promising renewable energy options due to its simplicity, modularity, ease in sighting, and potential for significant price reductions (Weinberg & Williams 1991). Currently, however, the price of PV limits its economic viability to certain niche markets such as remote, off-grid applications. Under a DU policy regime, photovoltaic technologies could be strategically sited within the distribution utility's service territory to defer distribution equipment upgrades, increase reliability, and offer voltage support. Analyses illustrated that PV is much closer to commercial viability when viewed as a demand-side technology as opposed to a conventional supply side option. In fact, when customers can capture the T&D benefits in the form of a utility incentive, PV-DSM is cost-effective at today's prices in certain regions of the U.S. (Byrne et al. 1995). The economics of many renewable energy technologies are such that they offer greater value to utilities and their customers when viewed as distributed resources.

Direct Integration of Efficiency and Renewables into Electrical System

A DU approach attempts to directly integrate efficiency, distributed generation, and storage in the electrical system by explicitly recognizing the localized value of these options. Non-bypassable line charges and portfolio standards, however, continue to view these resources in the context of a centralized power system. For example, Non-bypassable line charges increase the price of electricity over the market price by a predetermined level. Similarly, under a portfolio standards, companies acquire efficiency and renewables to satisfy a regulatory mandate and pass the additional costs onto customers. Customers pay the additional cost with the understanding that it will be used to capture the public benefits associated with efficiency and the adoption of non-polluting renewable energy sources. In essence, these approaches treat efficiency and renewables as separate from the existing structure, bringing them into the system through a pricing mechanism.

In contrast, a DU approach views end-use efficiency and renewables as vital distributed resources which are used in conjunction with energy from the grid to satisfy customers' energy service needs such as lighting and cooling. Through the institutional changes required to bring about distributed utilities, the value of distribution equipment deferrals becomes an increasingly important part of the evaluation process. A DU approach takes advantage of emerging metering and communication technologies to understand and manage customer loads using a host of supply- and demand-side resources. Furthermore, a DU approach could facilitate the introduction of emerging modular generation and storage technologies including flywheels, fuel cells, and photovoltaics. These technologies could have a dramatic impact on how the electric utility industry produces and delivers electricity. A new deregulated electric utility sector should be flexible enough to accommodate the introduction of these emerging technologies.

CONCLUSIONS

The electric utility industry will experience profound change over the next few years as regulators and policymakers chart a course to a competitive era. Most restructuring proposals recognize the need to maintain environmental quality as part of this process. To date, regulators have embraced non-bypassable line charges and portfolio standards as the preferred strategies for continued investment in end-use efficiency and renewable energy. We suggest that a DU approach could be a better approach to achieve these objectives. A DU approach involves a set of mechanisms that explicitly acknowledge the value of distributed resources including dispersed renewable technologies and DSM. When viewed from a DU perspective, these options offer greater value to customers by recognizing area- and time-specific marginal costs. A DU approach also represents an institutional shift in which new emerging modular technologies can play a role in a new less centralized electric utility industry.

High levels of end-use efficiency and increased use of non-polluting renewable energy technologies are the keys to a sustainable energy future. By directly integrating these resources into a restructured electric utility industry through net metering and performance-based rate making, the opportunity for sustained development of these technologies is enhanced. Regulatory mandates in the form of non-bypassable line charges and portfolio standards depend upon continued political support for government set industry goals. Recent experience with regard to DSM in the U.S. exposes the problem of depending upon such political commitments. An institutional strategy that brings about a decentralized, efficient, and renewable energy system is less vulnerable to shifting political interest and more likely to realize the goal of a sustainable electricity future.

ENDNOTES

1. For an in-depth discussion of state activities to internalize externalities associated from electricity production see, Energy Information Administration's September 1995 report *Electricity Generation and Environmental Externalities: Case Studies*.

2. Stranded benefits refer to societal benefits that were obtained through the regulated utility that may no longer be possible for society to acquire in a deregulated industry.

3. ESCO services could be offered by distribution utilities if they retain a retail function. However, if they are structured to be ''wires only'' then these options would need to be provided by other entities.

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