Energy Centers as Providers of Energy Public Benefits

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ABSTRACT

Energy utility restructuring and deregulation initiatives around the world are changing the fundamental structure and operation of electricity and natural gas markets. Competitive forces driven by private interests will not yield optimal levels of energy services, including efficiency and renewables, in restructured energy markets. As restructuring unfolds, existing or newly created research, development, and technology transfer institutions are adapting and responding to overcome market failures in markets for energy efficiency, renewables, and other services. We use the term *energy centers* to identify these organizations. By addressing RD&D (research, development, and demonstration) needs, market failures, and transaction costs, energy centers catalyze *public benefits* that result from increased levels of energy efficiency within the economy and from development of renewable energy resources.

This paper examines energy centers and the role that they can play in providing public benefits in restructured, competitive energy markets. The paper has two main components: (1) it describes promises and perils for energy public benefits from restructuring and (2) it proposes energy centers as organizations to respond to emerging public benefits needs. This paper describes how state or regional energy centers are providing services and benefits that complement private energy services markets and efforts of national organizations. Energy centers are well positioned to meet state or regional needs in energy markets.

Introduction

The evolution of a competitive energy utility market—along with the forces that enable this evolution, such as changes in federal and state legislation, new technologies, and broader socioeconomic trends— is having a profound effect on energy utilities, other energy service providers, and energy consumers. This ongoing energy utility restructuring is also changing the RD&D (research, development, and demonstration) endeavor as we identify new types of knowledge required for the emerging marketplace, new sources of funding, and changing providers of RD&D services.

Concern for reduced levels of energy RD&D and reduced investment in energy efficiency and renewable energy as a result of restructuring led the National Association of Regulatory Utility Commissioners (NARUC) (1996, 13) to conclude:

> To the extent that cost-effective investments in energy efficiency, renewable resources, and research and development are not fully valued in the marketplace, there will continue to be a need for alternative methods for capturing the benefits that they offer.

Based on this conclusion, NARUC resolves that *new or existing mechanisms should be maintained* to provide the *public benefits* that accrue from publicly supported energy research, energy efficiency programs, and renewable energy initiatives. The NARUC resolution reflects a trend in the United States and elsewhere to establish *public benefits energy programs* as a condition for deregulation and

restructuring (King et al. 1996). This paper examines the structures and objectives of state and regional organizations to provide these energy public benefits and the role that they can play in restructured, competitive energy markets.

Competitive energy markets have always provided the majority of energy efficiency and renewables services. The role of competitive services may increase with market restructuring and the demise of utility demand-side management programs in some regions. However, public benefits services will remain essential to fill in some existing and emerging gaps in the energy services marketplace. A considerable number of existing organizations provide public benefits and new organizations are likely to emerge. These organizations have often been called *energy centers*, a term we adopt in this paper to refer to these organizations. Examples of energy centers in function if not name can be found throughout the world—for example, the Czech Republic, New Zealand, Norway, Poland, Russia, Thailand and, within the United States, Wisconsin, Iowa, Florida, New York and California.

Background Definitions

The economic literature uses the term *public good* to describe the same concept conveyed by the popular term *public benefit.* A *public good* is distinguished by two key characteristics: (1) it is a good or service whose benefits can be enjoyed by additional people at no extra cost once it has been produced and (2) it is costly or impossible to exclude people from its use or consumption if it has been produced (Mills & Graves 1986, 35). The classic examples of public goods are national defense and public education.

Private interests will not provide levels of public goods that are optimal from society's perspective because of the above distinguishing characteristics of public goods—private markets will not function for goods for which sufficient exclusion is not possible and for which many if not everyone can enjoy the benefits of consumption once produced. Absent public support, the benefits attributable to provision of public goods will be foregone. *Benefit* in the economic sense is defined as a gain in welfare or utility (Pearce 1983, 12).

We measure e*nergy* public benefits in terms of impacts on (1) the environment, (2) the economy (both the macroeconomy and the microeconomies of individual market participants), and (3) national security. Energy public benefits arise whenever society's costs (*costs in the economic sense, which include environmental and social costs)* for energy are reduced. Energy costs may be reduced through improvements and innovations in technologies associated with energy production and use, and through behavioral changes.

A related—even synonymous—concept to public benefits is *public interest.* The goal of public interest energy policy has been to provide for and protect the public interest by providing public benefits related to energy supplies, resources, production and use. Utility *demand-side management* (DSM) programs are public goods that have been mandated by regulatory bodies in many jurisdictions to serve the public interest through investing in energy efficiency and related demand options (Narum & York 1996). Like utility DSM programs, much of the energy RD&D and technology transfer activities that occur at the state and national level are carried out in the public interest. Thus, Blumstein and Wiel (1997, 1) define public interest energy R&D as "R&D that is not adequately provided by the competitive market because some or all of their benefits are widely distributed and cannot be captured by individual firms." While many RD&D and DSM programs have private and

public benefits, the private benefits often are not sufficient for the private marketplace to support the activity.

Energy centers are organizations that provide public interest RD&D, technology transfer, and related services, such as DSM. We define *energy centers* according to key distinguishing features: (1) their mission is to serve the public interest by providing public benefits such as RD&D, technology transfer, and other services associated with energy supply and efficient use, (2) they serve and are governed by a broad constituency, including public interest members, (3) their services are unbiased and in the public domain, and (4) they exist at the local, state, regional or national level (if the nation is small), and provide physical and electronic locations for providing information and other services. A recent survey of state-level energy RD&D organizations in the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) shows that these organizations vary considerably in structure and operation, but generally have these key defining energy center features (Pye & Nadel 1997).

Energy centers serve and are governed by a broad constituency, typically including public interest groups, investor-owned utilities, municipal utilities, electric cooperatives, universities, trade allies, manufacturers, and other energy stakeholders and market participants. By their very nature, public interest initiatives in energy services should be collaborative ventures. It is difficult to make a case that initiatives designed to serve the public interest be governed by a narrow range of interested or affected parties. In some cases energy centers may be governed by a board that represents a broad spectrum of interested parties. In other cases energy centers may be administered by government entities charged to represent the public interest.

To serve the public interest, the products and services of energy centers clearly need to be offered in the public domain. Information dissemination is typically a key function of energy centers; such information must be unbiased and accurate, and must be available and readily accessible to all interested parties.

Our definition distinguishes energy centers from other organizations associated with energy, such as private firms, private industry collaboratives, public advocacy groups, and certain national organizations, agencies, or laboratories. Such groups may also provide energy public benefits, but our focus is on the role of centers that serve principally local, state, or regional needs and whose missions are to serve the public interest. Our definition encompasses a wide variety of organizational forms including state government, university research centers, and both publicly and privately supported not for profit organizations.

Promises and Perils from the Changing Market Landscape

The ongoing efforts to restructure the electric and gas utility industry will profoundly change the energy marketplace. Relationships among market players will change as organizations adapt to new market conditions and structures. Competitive forces will replace regulation in many key aspects of electric and gas utility operations. Regulatory boundaries will be erased or redrawn, creating competition among former collaborators. National and even international market forces will play a larger role in regional and state energy markets. New products and services will be created. Customers will be given choices, which will encourage suppliers to be more innovative and responsive to customer needs. The role of competitive energy service providers will grow—both to fill in some of the void left by the diminution of regulated utility DSM programs and to take advantage of new market

opportunities to offer customers new products and services. Some new service gaps are likely to appear.

The end result and timing of industry restructuring cannot be predicted. However, cornerstones of the future energy industry structure are likely to emerge, regardless of the detailed outcomes and variations from state to state. These cornerstones are (1) a competitive supply (generation) market, (2) a regulated transmission market—for example, through an independent system operator (ISO), (3) a regulated distribution market, and (4) an evolving retail services market.

An energy industry based on these cornerstones potentially presents both promises and perils to individual customers and to the economy as a whole. The promises include:

- Reduced energy commodity costs for many types of customers in many regions
- Greater innovation for products and services
- Greater consumer choice for energy commodities and other energy services
- Better information on customer energy use and services available to affect energy use. However, the changed motivations and conditions for customer information are also perils (see below). This will depend greatly on the individual behavior and strategies of competitive energy service providers.

The perils include:

- Loss of market power or protection for smaller customers and other at-risk groups (for example, low-income customers and rural customers)
- Potential commodity cost increases in low-cost regions
- Loss of unbiased, quality information for consumers on energy products and services (marketing by competitive merchants will replace "public service" information typically provided by regulated utilities)
- Loss of public-interest services, including information, consumer education, DSM services in some regions, and RD&D
- Reduction of power system reliability

In addition to these promises and perils, there is an added peril that is not associated with restructuring other than through coincidental timing: namely, recognition of the global impacts of energy use patterns. While there is much uncertainty regarding this threat, it appears that the necessity of ameliorating impacts on climate will place considerable pressure on the energy marketplace to provide renewable energy and increased energy efficiency.

As restructuring proceeds, the size of DSM programs in the many states where they exist is diminishing. The Energy Information Administration (1997, 4) reported 1996 DSM expenditures nationwide of $1.9 billion, a 21 percent decline from 1995. In some states, such as New York, DSM programs are not only diminishing but are also being transferred, as part of the creation of public benefits funds and programs, to administering bodies that will oversee the delivery of DSM. In other states, such as Massachusetts, utilities will continue to be the administrators and deliverers under modified governance; elsewhere, such as California, utilities may choose to compete for DSM services delivery. The decisions to reduce DSM services have not been based on economic evaluations of their performance or impact on the economy, but due to real or anticipated market pressures on energy utilities as they face restructuring and anticipated competition.

The RD&D peril of the emerging marketplace is the further loss of portions of the nation's energy RD&D effort, which is currently a $5 billion endeavor. Historically, energy RD&D has been a dynamic and complex interplay of public and private efforts, with a variety of organizations actively

and often collaboratively involved. Universities, national and state level organizations, national laboratories, industry and other consortia, and individual firms have funded and /or performed RD&D ranging from basic research to technology development for widespread application.

A comprehensive recent review of energy RD&D is provided by the President's Committee of Advisors on Science and Technology (1997, 2-1) which notes that "Technological progress plays a central role in the modern economy: It is an important contributor to economic growth and a crucial factor in determining the competitiveness of firms in the marketplace, nationally and internationally. RD&D is widely recognized to be the linchpin of technological advance, and levels and rates of growth of RD&D expenditures are viewed as reliable indicators of innovative capacity."

Despite the central role of RD&D in economic development, aggregate energy RD&D is in decline. Dooley (1997) found a significant decline from over $7 billion in 1985 to barely over $5 billion in 1994. Private-sector RD&D has had a steady decline during that period, while public-sector RD&D has oscillated into decline, growth, and now decline.

The specific threat to utility RD&D is shown in part in the trends at the Electric Power Research Institute (EPRI) and the Gas Research Institute (GRI) (Dooley 1997). Funding has fallen significantly since 1994 and recent events regarding GRI demonstrate that the threat is very serious. Data for individual states show a similar pattern. Total energy RD&D sponsored by New York investor-owned utilities declined from approximately $130 million in 1994 to $70 million anticipated in 1998 (Valentino 1997). Not only is aggregate utility RD&D declining, but there is a dramatic shift from longer term broad-based RD&D towards short term competitiveness-motivated RD&D (President's Committee of Advisors on Science and Technology 1997).

State energy RD&D efforts, largely funded by utility ratepayer revenues, is another piece of the national RD&D picture. A recent study by the American Council for an Energy-Efficiency Economy reviews these efforts for a group of 19 state level RD&D organizations which collaborate in their efforts, representing about $200 million per year of activities (Pye & Nadel 1997). These states collaborate through ASERTTI. These state efforts are notable in that they represent a growing effort, with activities exceeding $300 million in 1998, reflecting in part the movement of ratepayer funds from utilities to other organizations for public benefits DSM and RD&D.

A recurring recommendation in many states—based on input from a wide variety of stakeholder groups—is that a public benefits fund be created as a condition for industry restructuring. These funds would be used to provide energy efficiency, renewables, low-income energy services, RD&D, and other services to complement remaining required regulatory services and the expanded private services provided under a restructured and transformed market. These new state-level funds may be augmented by a national public benefits fund, which is currently being drafted in different forms.

While energy centers may be a recipient of emergent public benefits funding, most energy centers are already ratepayer supported. In many cases, public benefits funds may become part of an energy center's mix of funding sources, displacing previous ratepayer funding. Other funding sources include contributions from investor-owned utilities and other private businesses and industries, government grants, trade organizations, and fees for services.

To summarize, the overarching promise of restructuring is that customers will be given a broader, more competitive range of energy service options that will provide a greater level of service at less average cost than under the existing regulatory compact. Competitive energy service providers are expected to fill in some of the gap left by the decline of RD&D, consumer information, DSM, and other services in many areas. These providers also are likely to innovate and offer new products and services. What is unknown is how large this market will be, and in turn, how much energy-efficiency

will be achieved in competitive markets compared to that achieved in the regulated utility DSM infrastructure. Private markets by themselves, however, will fail to achieve levels of energy efficiency that are least-cost from a societal perspective. Energy centers, in conjunction with other national and state organizations, can provide pivotal public interest services to complement private markets in the delivery of energy services.

Energy Centers as Providers of Energy Public Benefits

The survey of state-level energy RD&D organizations across the United States by Pye and Nadel (1997) shows that while they are quite diverse in terms of funding, size, structure and operations, their missions show similarity, and some have and others may be expanding their scopes to become energy centers. Energy centers as we envision them provide services and functions in two broad categories: (1) *foundation activities* and (2) *direct services* for energy users and providers based on foundation activities.

Foundation Activities

Foundation activities are RD&D of energy technologies, markets, and policy issues. Information from foundation activities can be used to identify and develop public interest products and services that directly serve customers and other market participants. These activities also provide the knowledge necessary to complement and support an efficient marketplace.

The broad categories of foundation activity are:

- Technology research, development, and demonstration
- Market research, development, and demonstration
- Policy research

Technology research, development, and demonstration. Technology RD&D has been and will continue to be an important and central element of energy centers. Cutting edge information is needed to support and guide the infusion of new technologies into the marketplace and to encourage ongoing energy efficiency improvements. Private interests will generally under-invest in technology RD&D (Council on Competitiveness 1996) and avoid long-term RD&D for new technologies and research on health and environmental impacts. Emerging technologies may be too risky for individual firms to privately support the necessary RD&D to bring the technologies to market and create market acceptance. Even when information can be gleaned from existing sources, there is often a need to "customize" research and development to address local concerns or conditions. For example, research on heat pumps for the southern United States may have limited application in determining the units' equivalent performance in Wisconsin. Sometimes information is simply not available and must be developed from local RD&D efforts.

As RD&D organizations, energy centers can identify information sources, assess the relevancy of available information, determine what other information may be needed, and design and execute RD&D projects to fill knowledge gaps. Having done this, the energy centers can communicate information on cutting edge approaches and technologies in energy efficiency, renewable energy, and related technologies to targeted local customers whose needs for this information are better known.

Energy centers often target technologies that are either pre-commercial or at the commercialization stage and that have not yet been widely adopted. This focus has the merits of requiring less investment in basic research and tends to shorten the potential pay-off time. Recent projects carried out by the Energy Center of Wisconsin, for example, follow this model. The Center collaborated with EPRI and others to conduct research on optimal control of commercial water loop heat pumps—an example of near-commercial RD&D. Another Center project, *biopulping* (biological treatment of wood pulp to replace conventional mechanical pulping), is an example of pre-commercial RD&D with large potential returns for Wisconsin firms, large energy savings potential, environmental advantages, and the opportunity to leverage research dollars with other local organizations. The emphasis by energy centers on near-commercial technologies demonstrates the need for longer term, high risk RD&D to continue at the national level in national laboratories, EPRI, and other organizations.

Market research, development, and demonstration. Deregulation of electric and natural gas industries is premised on the ability of competitive markets to yield more optimal energy resource decisions and allocations. To the degree possible and beneficial, markets are to be determinants of energy investments and resource allocations. Regulation will remain for aspects of the industries that retain natural monopoly characteristics, such as electricity transmission and distribution. Coincident with increased emphasis on markets to determine prices and generation choices, there will be increased emphasis on market forces for the provision of energy-efficiency and other customer focused products and services. Since many energy efficiency improvements target changes in behavior—not necessarily directly related to market transactions—private interests lack incentives to provide all the necessary RD&D to support consumer choice and changes in consumer behavior.

Market transformation is emerging as a model and objective of intervention in energy markets. The goal of transforming markets is to increase the relative share of energy-efficient products and services in the markets and to affect long-lasting changes within these markets to increase this share over time. Much disagreement is evident regarding the current status of markets and the level and duration of intervention needed. Market transformation seeks to achieve optimal levels of energy efficiency and fairness by influencing the behavior of manufacturers, distributors, wholesalers, retailers, and customers. Adopting the market transformation paradigm forces energy market participants and stakeholders to address several questions:

- What are the relevant energy service markets and providers and how well do they provide energy efficiency, renewable energy services, and other energy public benefits?
- How do we influence markets to improve the delivery of energy efficiency and renewables when deficient?
- What, in practical terms, do we mean by market transformation?
- How can we demonstrate that market transformation is occurring and whether or not it is sustained?
- How do we ensure the effectiveness of our approaches?

Market RD&D is an important area of activity for energy centers as part of the linkage in taking technology from research and development to the marketplace. Recent examples from the Energy Center of Wisconsin include market research on the practice of commissioning commercial buildings, the sales of efficient gas furnaces in Wisconsin, the incidence and efficiency of a variety of appliances found in homes, and low-income service provider practices. As the marketplace evolves, there is a growing need for market research, tracking, and demonstration.

Low-income customers comprise a market segment that requires ongoing research to support delivery of state programs and services. In many states, there is a strong infrastructure for delivering low-income energy services and a demonstrated commitment to continuing these services. The primary gap apparent in this area concerns RD&D activities. The existing infrastructure's expertise is in delivering services to low-income households, not in assessing new service strategies or evaluating the effectiveness of existing or new approaches. Further, providers face considerable pressure to focus on delivery to ensure that allocated funds pay for concrete services. As a result, the low-income services delivery agencies do not have the resources needed for research, evaluation, and demonstration activities.

Thus, energy centers are likely to target some of their market research efforts at low-income customer segments by fulfilling two roles:

- *Research Lead.* Areas of research include new service delivery approaches, pressure diagnostics, safety issues, new technologies (for example, aerosol duct sealing), impact of services on arrearages, and short-term feedback on energy savings for weatherization operators.
- *Evaluator.* Centers can help other organizations determine the viability of new service strategies by evaluating energy service pilot projects.

Policy research. No roadmap exists for restructuring or most other public policy and regulatory issues. Restructuring demands fundamental changes in existing market and regulatory structures. Energy centers can play important roles by providing decision makers with policy research results. No one knows how newly restructured, deregulated markets will perform. Energy centers may be charged with the responsibility to monitor energy efficiency and renewable energy in emerging markets to determine the need for publicly funded services and programs. The market response should largely determine the need and direction for public benefits energy initiatives, and energy centers may measure and monitor this response.

Developing good public policy requires unbiased information about the current situation and the potential impacts of a proposed policy. Examples of past Energy Center of Wisconsin efforts include the 1995 qualitative research on consumers' knowledge of and attitudes toward electric utility restructuring. The findings from this research became a cornerstone of the Public Service Commission's Plan for Electric Utility Restructuring in Wisconsin. Another example is the Center's research on Wisconsin's rental weatherization code, which requires landlords to make energy improvements before selling a rental property. In a restructured environment, policymakers face many new energy-related policy issues, and energy centers can provide policy research to facilitate good public policy choices.

Energy centers may perform other types of policy research, such as analysis of proposed building codes, appliance efficiency standards, market research on consumer behavior, and evaluation of public benefits energy initiatives.

Services for Energy Users and Providers

Energy centers use foundation activities to identify needs and develop appropriate public benefits information and other services for energy service users and providers. These activities parallel the private sector, where a mix of private and public interest RD&D supports development of private goods and services. Services for energy users and providers fall into the following main categories:

- General Customer Information and Education
- K-16 Energy Education
- Professional Training, Education and Development
- Focused Customer Assistance
- Market Development
- Program Planning, Evaluation, Delivery and Administration

Table 1 illustrates the services that energy centers either currently provide or may provide under a restructured energy services market.

General customer information and education. Customers must have access to accurate information to make rational economic decisions within competitive markets. Energy centers can provide an objective source of information for energy-related market decisions, and they have performed this role under regulated markets. Under deregulated, competitive markets, this role will increase greatly in importance for a number of reasons. Customers will face new choices—choices that they never had to make under regulated markets. They will need to become informed about their choices, thus creating a new demand for information. Customers will not only need more information, but will also need objective sources of information. In competitive markets, objective information will not necessarily be provided by private interests, which are motivated to provide self-serving information that increases product or service sales.

"Customers" include residential, commercial, agricultural, industrial, and transportation users of energy, as well as suppliers of energy services including manufacturers, distributors, retailers, builders, designers, energy service companies (ESCOs or energy service providers) and utilities. RD&D and public benefits organizations are objective sources of information that will become increasingly valuable in a marketplace that is becoming more confusing for consumers. Witness the telecommunications market: consumers are constantly subjected to mass media blitzes and telemarketing tactics that have informed, confused, and frustrated them simultaneously.

In addition to energy efficiency and renewables, the services that customers demand include integrated information such as whole-building approaches and, for industrial customers, systems approaches that consider the entire manufacturing process. Customers and service providers need to include or consider important ancillary features such as indoor air quality, embodied energy, recycleability, and environmental impacts, including climate change.

Energy centers may provide energy information through a variety of media, including publications, call-in services, internet web pages, and workshops. To perform this service effectively, energy centers will have to market these media widely to generate customer awareness.

K-16 Energy education. General energy education is an emerging role for energy centers. It is closely related to the information services discussed earlier. However, education implies a more comprehensive and directed effort to achieve specific learning objectives. Energy education applies to people at all stages of learning—from primary through secondary and post-secondary institutions and throughout life.

Table 1. Services for Energy Users and Providers

Services	General Customer Information	K-16 Education	Professional Training	Focused Customer Assistance	Market Development	Program & Planning Assistance	Program Delivery Administration
Means of Providing Service	• Library/ Reference • Publications • Newsletters • Videos • Fact sheets	• Support • Curricula materials • Teacher training • Curricula review • Post secondary training	• Workshops • Seminars • Conferences • Distance education • Internet/CD ROM based education	• Technology RD&D • Design assistance/ referral • 800 line • Product/ Service assessment	• Service provider support • Compressed Air certification • Green power certification • Sales tracking • Market research	• Program design • Program management • Program evaluation >process >impact >policy • Technology RD&D • Market research	• Program design • Bidding oversight • Monitoring • Evaluation
Target Customers	• General customer classes, e.g., residential, commercial, agricultural, industrial	• K-12 students & teachers • Post secondary students & teachers	• Adults with professional education needs, e.g., architects, HVAC installers, utility reps.	• Individuals from trade & infrastruct. groups • Individual customers	• Contractors • Low income service providers • Manufactrs.	• Program/ Project managers • Policy-makers • Regulators • Consumer advocates	• Public benefits advisory council • PSC • State government
Funding Sources	• Discos • Retailers • Public benefits • Government	• Public benefits • Industry • Government • Foundations • Universities	• Fees • Trade allies • Manufactrs. • Public benefits • Government	• Customers • Discos • Trade allies • Manufactrs. • Public benefits	• Discos • Retailers • Distributors • Manufactrs. • Public benefits	• Government • Discos • Public benefits	• Public benefits • Government

Education is an area which has emerged as a major activity area for the Energy Center of Wisconsin in the last three years with a number of initiatives, including the KEEP (K-12 Energy Education Program), Energy Education On-Line, and the School-to-Career Initiative. These programs have focused on K-12 students and teachers across the state, and represent a long-term investment in Wisconsin's economy and overall level of energy literacy.

There appears to be a substantial need for post secondary technical education to provide a skilled work force in many energy user and provider markets. Facilities managers and industrial maintenance personnel, home builders, and various trades are particular audiences that need to be trained in energy-related issues as they enter the workforce. This activity area is likely to expand in the future for energy centers.

Professional training, education and development. Not only do individual consumers benefit from improved information about energy resources and related decisions, but business owners, managers, tradespeople, equipment and service suppliers, and other professionals can benefit from publicly supported continuing education programs. Professional training and education can target a number of groups that participate in energy efficiency markets, including:

- Business owners or managers who make decisions on purchases of energy and energy-using equipment,

- Skilled tradespeople who provide services that affect energy use, such as carpenters,
- Energy service and related professionals, such as architects, engineers, technical consultants, and energy utility representatives, and
- Equipment suppliers.

Business owners and managers face similar energy decisions as individual consumers and need objective, accurate information about their options, as well as means for analyzing their options. Many energy-efficient technologies are intermediate goods, such as energy-efficient building construction. Professional training of skilled tradespeople can create awareness of best practices to enhance products and benefit customers. In some cases, building codes and standards may be established or raised to assure reasonable minimum levels of energy efficiency. Building tradespeople need to understand the codes and how to achieve them. Energy service and related professionals also can benefit from training and education programs designed to teach best practices for energy efficiency. Finally, consumers can only choose energy-efficient technologies and services if they are available in the market. Equipment suppliers have choices regarding the equipment they stock and promote to their customers. Professional education programs can be targeted to equipment vendors to increase their awareness of energy-efficient products, and to provide information about the benefits that such products provide to customers.

Focused customer assistance. Focused customer assistance could expand considerably in the future, depending on the nature of the future marketplace. Focused customer assistance is one-on-one services in areas such as building design assistance, assistance in new technology adoption in manufacturing, and RD&D services not reasonably available in the private sector. The need for targeted information and other customer assistance, including information clearinghouse functions for industrial, commercial, agricultural, residential, and potentially transportation customers, is increasing in competitive markets as utility assistance declines in many areas. Energy service providers are also customers (and potential funders) for this type of service.

Market Development. Energy centers are adopting or being given the mission of *transforming markets* for energy efficiency and renewable energy technologies. Market transformation strategies generally fall into three categories: (1) strategies that accelerate the development and introduction of new technologies, (2) strategies that accelerate the rate of adoption of available technologies, and (3) strategies that expand the market penetration of available technologies (Nilsson 1992).

There is no single market for energy or energy-efficient technologies. In many—maybe even most cases—energy efficiency is simply a feature or result of market transactions, such as the purchase of an appliance. Energy centers, then, must respond to a diverse set of markets, which implies that a diverse set of efforts and approaches will likely be necessary to address the markets with their barriers and failures. An example of this type of effort is providing certification for energy efficiency or renewable services. With energy retailers selling *green power* and other services and anticipating that energy generation companies (gencos) and energy retailers (retailcos) will not be in a neutral position, there is a growing need for certification services in these competitive markets.

As an example of a market transformation effort in the industrial area, the national Compressed Air Challenge, administered by the Energy Center of Wisconsin, is developing best practice training, information, and certification for the industry. The purpose of this collaborative initiative is to improve energy efficiency and performance in the compressed air services market.

Program planning, evaluation, delivery and administration. Utility DSM, in parallel with private markets, has been a principal supplier of energy services in the United States and other nations, largely driven by public concern for achieving public benefits that result from increased levels of investment in energy efficiency and renewable energy. In many states, DSM that has been funded and implemented by utilities will not be sustained under competitive market conditions.

To the degree that programs and services provided through utility DSM are to be preserved under deregulated markets, energy centers may replace utilities as institutions charged with administering these evolving programs, with many services competitively bid to private providers. The administrative functions of centers would include program design, competitive bidding, monitoring, market tracking and benchmarking, and evaluation services.

Conclusions: Existing and Emerging Roles of Energy Centers

Experiences from energy centers and their precursors show how these centers are needed and can provide services and benefits not provided by private interests operating in competitive markets. Energy centers are well positioned to meet state or regional needs and to address state or regional problems in energy markets. Energy centers can also support national and international energy efficiency initiatives through collaboration with other energy centers and national organizations. There has been a synergistic relationship among state and national level organizations based on mutually beneficial partnership and collaborative models. These relationships will continue to play critical roles in achieving the greatest public benefits for given resources.

The creation or maintenance of energy centers is a public policy option to address market barriers and failures that exist in markets for energy services. By addressing these market barriers and failures, the benefits of increased levels of energy efficiency, renewable resource technologies, and other energy services and technologies will accrue to various market segments and the economy as a whole. Funding and activity for energy RD&D and DSM has diminished greatly in anticipation of restructuring. Such decreases threaten the provision of energy public benefits in many states and regions, as well as the nation as a whole. Energy centers can fill in emerging gaps in addressing energy RD&D and DSM needs. In some cases these organizations already exist. In other cases, energy centers must be created in conjunction with restructuring specifically to address these gaps and meet the public benefits needs. Energy centers—whether existent or newly created—will play important roles as providers of energy public benefits.

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