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A Time of Opportunity: Energy, Extension, and Economic Development

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> "It was the best of times, it was the worst of times; it was the age of wisdom, it was the age of foolishness; it was the epoch of belief, it was the epoch of incredulity; it was the season of Light, it was the season of Darkness; it was the spring of hope, it was the winter of despair; we had everything before us, we had nothing before us; we were all going directly to Heaven, we were all going the other way."—*(Dickens, 1859)*

Introduction

This article, commissioned by the Ford Foundation in conjunction with the Reducing Rural Poverty through Wealth Creation from Investments in Environmentally Appropriate Energy Strategies and Activities project, focuses on the role that a reenvisioned Cooperative Extension (Extension) organization could play in the revitalization of economically distressed communities. It argues that a refocused Extension organization could draw more extensively upon some of its current, underutilized capacities to make much more substantive contributions to communities looking to leverage emerging energy opportunities for economic gain. As evidence of the range and richness of the possible roles of Extension as a catalyst for energy-related economic development, the article provides 13 examples of the ways in which Extension acts like a community change agent. The authors begin the article with an overview of salient trends having an impact on the economy, the energy landscape, and Cooperative Extension. The article concludes with a vision of how Extension could be repositioned to play a much greater role in helping communities capitalize on energy opportunities to drive economic development.

The Shifting Economy

Today the United States finds itself in the midst of a large-scale economic transformation. This economic sea change is propelling some regions to new levels of prosperity but is leaving many regions, particularly rural and semirural regions, far behind. Drabenstott *(2005)* catalogs three eras of economic development: industrial recruiting, cost competition, and innovation. He points out that

during the first two eras, government incentives and shoring up the health of existing industries drove the economic development focus. In contrast, he asserts that the current innovation era puts the focus on the region itself. This regional focus requires the identification of economic assets and the creation of critical economic mass across jurisdictional boundaries to compete effectively in a global marketplace. In the innovation economy, regions grow when they create competitive advantage within the global marketplace. Effective economic development strategies are driven by a region's unique assets and its intellectual capital. Thus, successful regions work to identify and exploit their assets, and to compete for innovation and talent.

Moving distressed regions to economic self-sufficiency and ultimately to economic prosperity entails the development of innovation economy assets in these regions. Examples of such progress include creating competitive advantage through adoption of innovative technologies and practices, cultivating entrepreneurship, developing and attracting science and technology talent, and investing in place through the development of "creative class" *(Florida, 2003)* assets. Thus, it is no surprise that the question increasingly being asked is how to effectively partner higher education institutions with economically distressed regions to create innovation capacity *(Johnson, 2007; Mattoon, 2007)*. Universities, particularly land-grant institutions, are uniquely equipped to assist regions in transitioning to innovation-based economies, but will have the greatest impact if they organize themselves to partner in ways that can stimulate and catalyze private sector investments in those regions *(Franklin, 2008)*.

Energy Challenges and Opportunities

Economic prosperity is dependent upon access to reliable sources of energy. The U.S. Energy Information Administration *(2010)* estimates that the world's energy consumption will grow by 49% between 2007 and 2035. Evidence of the link between global climate change and the burning of fossil fuels, anticipation of peak oil, and concerns about dependency on foreign sources of fuel have contributed to a renewed interest in alternative and renewable energy development. The Council on Competitiveness *(2007)* has charted "dramatic" private investment increases in energy innovations, and predicts that energy will be the new innovation frontier.

According to U.S. Secretary of Energy Steven Chu *(2009)*, the need for more basic energy research is critical. Equally

important, however, is the need to move new developments out into the commercial sphere. In addition to increasing the strength of linkages between research scientists and private sector capitalists, new energy technologies often require "translational research" in order to become feasible and practical. Such research establishes a more interactive relationship between laboratory development and field deployment of these emerging, new technologies *(Anadon, Gallagher, Bunn, & Jones, 2009; Weiss & Bonvillian, 2009)*.

Energy may represent a watershed opportunity for Extension to engage higher education in high-impact solutions for communities both locally and nationally. Leaders and citizens in communities across the country are facing unprecedented challenges and opportunities associated with controlling energy costs, and developing new clean and renewable energy resources. These individuals are looking for guidance and assistance on such topics as technical questions about energy conservation and production, financing options associated with retrofitting existing structures and developing localized energy production capacity, workforce development for green jobs, and trade-offs between energy and environmental impacts. Research universities have much to offer on all of these fronts, with research, education, and outreach expertise spanning agriculture, engineering, business, and more.

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Alternative energy production is predicted to be a hugely disruptive economic force. In contrast to the high concentration of production in specialized facilities such as coal plants, renewable energy can be produced on a distributed basis—on both the residential and the community scale. Ownership of energy production in a renewable energy landscape shifts from the monopoly of utility companies to a more dispersed realm. This diffusion of energy production holds much promise for rural America, even though public policy in this area lags. According to Morris (2007), "The link between local ownership and rural prosperity has been overlooked" *(p. 1)*.

Most regions have assets that can be developed in conjunction with energy opportunities. Agricultural areas may look to growing

and processing biofuels. Regions with high wind volume might consider wind farms. Areas with low-cost land can investigate the feasibility of solar farms. Manufacturers of outdated industrial products might be able to retool facilities to produce wind turbine components. Industries producing large volumes of wastes, such as manure or plastics, can investigate the opportunities for waste energy production and across-industry collaboration. Electronics and appliance makers can develop more energy efficient products. Enterprising rural communities might consider community-scale, biomass-fueled combined heat and power systems.

Given the changing economic and energy landscapes, what role can and should higher education, and land-grant universities in particular, play in assisting economically distressed regions? How might such regions, specifically those that are not proximate to a research university, gain a foothold in the new economic environment? How can universities leverage their energy technology expertise to assist economically struggling communities? Can the university presence—Cooperative Extension—already embedded within counties across the country, be repositioned to facilitate the engagement of a broad cross-section of university expertise in order to address energy-related regional development? This article addresses these questions by providing a discussion and analysis of case studies in which land-grant universities, communities, and local companies have partnered to explore solutions to community- and state-based energy issues.

Cooperative Extension

Authorized by the Smith-Lever Act of 1914, the Cooperative Extension service was established to link land-grant university expertise to practical applications in society through applied research, education, and on-site demonstrations. When Extension was created, agriculture dominated the U.S. economy, and the national transportation and communication infrastructure remained underdeveloped. Given this, it made sense to develop a corps of university-affiliated people situated within communities to extend practical agricultural and home economics knowledge to rural residents. Since its establishment, Cooperative Extension, with one foot in the nation's land-grant research universities and the other foot in more than 3,000 counties across the United States, has been credited with significant contributions that have advanced human welfare and the public good. The United States is currently recognized as having one of the most productive agricultural

economies in the world, due in large part to the service of Cooperative Extension.

Funded with federal monies channeled through the U.S. Department of Agriculture and matched with state funding, Cooperative Extension has continued to be tightly aligned with agricultural interests even though the economy has radically shifted, and land-grant universities have embraced a much broader portfolio of research and education expertise. Acting in an extensive network, agriculture interests at the local, state, and federal levels of government have retained the primacy of their role with Extension, thus effectively cordoning off Extension for their own purposes. This combination of forces has constrained Cooperative Extension to a narrow band of expertise and a rigid adherence to federal regulations, thus slowing it down or preventing it altogether from addressing some of the most pressing modern-day issues and opportunities of local communities. According to the 21st century vision document crafted by national Extension leaders, "The capacity of the Extension model for grass roots engagement is unparalleled, but the communities that Extension serves may be so narrowly defined as to preclude Extension from becoming a credible partner in university-wide engagement" *(Extension Committee on Organization and Policy, 2002, p. 2)*.

Under the legacy funding model, Cooperative Extension has been held captive to agricultural interests at its considerable expense. With the rise of the industrial economy, a manufacturing Extension program was created and administered separately from the agricultural Extension organization. Other parts of universities looking to interface with citizens, communities, and the public good have similarly had to develop their own systems of outreach. As a result, Cooperative Extension has been relegated to a niche role in communities and in universities. Under pressure to demonstrate higher returns on the public's investment, Cooperative Extension has also shifted much of its work to a one-on-many focus, and to standardized programming. To this end, Extension has turned its attention to creating knowledge "products" for "customers," which, according to Diebel *(2008)*, "puts citizens on the receiving end, with not only a limited voice over what they receive, but with fewer opportunities to shape their own futures" *(p. 17)*. In the face of both the increased capacity of other entities to provide similar educational programs and the pervasive access to information through the Internet, the value of such models has been increasingly difficult to demonstrate.

National funding for Cooperative Extension has shrunk as the perceived value of the organization relative to other public priorities has diminished. As federal funds for Extension have lessened, increased pressure on other funding associated with Extension (state and local) has occurred. The net result has been a cutback of funding in many states for Cooperative Extension. For example, in Michigan, a state under extreme economic pressure due to job losses associated with the auto industry, the governor's 2010 budget proposed to cut Michigan State University's Extension Service funding by 50%. Although reductions have not been as dramatic in other states, the trend line is clearly headed downward. Consequently, if ever there was a time for Cooperative Extension to embrace change, that time is now.

Nonagricultural interests in communities, in land-grant universities, and even within Cooperative Extension have held out hope that Extension could embrace a broader interface across the university. There has been the sense that, as a university-affiliated presence embedded in every county, Extension holds the promise of brokering a two-way partnership between communities and higher education in an effort to find and implement solutions to complex problems. Indeed, Extension's 21st century committee "envisions that Extension will build upon its existing capacity, credibility and network of local offices to become an integral part of university-wide engagement" *(Extension Committee on Organization and Policy, 2002, p. 2)*. This vision followed on the heels of the 1999 Kellogg Commission report, *Returning to Our Roots*, that called on public institutions, and land-grant universities in particular, to embrace the concept of "engagement"—engagement defined as a two-way, reciprocal relationship with local communities *(Kellogg Commission on the Future of State and Land-Grant Universities, 1999)*. The university movement associated with engagement grew slowly but significantly in the ensuing decade. At the current juncture, an elective Carnegie "engaged institution" classification has been developed and granted to nearly 200 colleges and universities. Within the same time frame, the National Science Foundation added a "broader impacts" merit review criterion to its competitive grant requirements, serving to further heighten higher education's attention to connecting research and education to people and issues beyond the campus.

Extension Today: A Catalyst for Energy Opportunity Development

The kinds of impacts that Extension has had within the agricultural sector of the economy could conceivably be realized in the energy sector, through the effective partnering of university expertise with community-level issues. The development and assimilation of energy-efficient approaches to building systems and the design and development of new energy technologies in American communities could move the country rapidly ahead on an energy conservation and energy independence agenda. People in far-flung communities could be educated on energy production and consumption best practices, thereby enriching their own lives as well as their community's well-being. Regional conversations about energy-related choices and strategies could ensure that a representative cross-section of voices is engaged in decision-making associated with energy challenges and opportunities.

Opportunities to implement alternative and renewable energy production on a community scale are often missed and can be derailed for various reasons. One possibility is lack of both community understanding of the project issues and discussion of these issues in a balanced approach. Such a lack of community understanding can be a difficult phase, particularly if the issue is controversial. Extension professionals can help communities assemble appropriate knowledge, and organize public forums to build public support for appropriate developments. As part of this knowledge transfer, Extension professionals can also help local communities identify other communities or university experts who can share knowledge on the issues associated with the project.

Another reason for derailment of implementation could be missed financing opportunities. Extension faculty and educators can help communities understand the external costs of conventional energy sources, and the potential ecosystems services or credits associated with a development project. Extension can interface with outside developers of energy projects to help them understand the need for community engagement early in the process, and adopt techniques that would be most effective in working with community stakeholders. Extension can also establish a dialogue among state leaders regarding the effectiveness of financial policies surrounding the development of an alternative energy resource.

A final reason for derailment could be the wrong choice of technology. Extension can play a role in identifying appropriate technologies, design of the facilities, or development of the

feedstock production base for small-scale projects or for projects that lend themselves to new technologies. Often, such small-scale projects can lead to a growth in the development of a private consulting industry. This happened in the crop consulting industry, for example, when the importance of Extension-provided services became evident to Extension clientele. In the 1980s, Extension in Pennsylvania helped farmers organize and hire an independent crop consultant to improve the crop input recommendations they were receiving. During the 1990s, the economic benefit of crop consultants became apparent, and numerous private crop consulting enterprises developed. These consulting firms then became a new market for Extension training programs. A similar process seems to be occurring in energy technology assessment and development. Initial efforts by Extension staff focus on working with community groups to identify prospective technologies and funding. Later, these tasks could be assumed by consultants who then look to Extension for training and technology updates.

Evidence to support the kinds of roles that Cooperative Extension can play with regard to energy-related community and economic development is outlined in the next section of this article. Although Extension is far from adopting a systemwide, high-impact commitment to energy-associated engagement that spans all energy production and usage sectors, small pockets of promising activity are developing. The following sections include 13 examples showing the range of roles, activities, and impacts that are occurring. With the right kinds of resource partnerships, the authors believe impacts like these could be systematized, thus creating benefits that are orders of magnitude greater than current impacts at the local, state, and national levels.

The examples that follow are drawn from the work of Cooperative Extension in six different states: Pennsylvania, North Carolina, Indiana, Virginia, Washington, and Minnesota. The examples are organized by the role of Extension in energy-related community and economic development. Far from the narrow model of mass program delivery to agriculture-associated stakeholders that characterizes the majority of Extension's work nationally, these examples demonstrate Extension's ability to develop innovative, flexible, two-way relationships with communities and university faculty members across a wide range of disciplines. Since most of the efforts described are relatively new, and targeted to yield long-term impacts, the ability to conclusively present the full benefits associated with these activities remains limited.

The examples included are not intended to be a comprehensive review of Extension work in energy nationally, but rather to provide a sampling of the range of roles Extension has assumed in the energy sphere. The authors' familiarity with energy extension work in various geographies influenced the selection of examples presented here. Information about the work associated with examples included was derived from publicly available sources, coupled in several instances with interviews of one or more key actors associated with an example.

Extension as Convener

Energy opportunities at the regional level abound, particularly in light of the federal stimulus money flowing directly to municipalities. However, many areas need to sort through options and weigh associated costs and benefits—financially, environmentally, and socially. This triple bottom line of sustainability is a critical issue for communities to consider in order to balance short-term results against long-term impacts. Although expedient decisions could be made in isolation by community leaders, an arguably sounder approach to weighing complex trade-offs is engaging a broad cross-section of citizens through community-wide dialogue. It is important to note that community organizing in rural settings was a widespread role of Extension before World War II and contributed to civic leadership development and community capacity-building to address issues of public significance *(Peters, 2002)*.

Universities are often uniquely positioned to play a convening role. Because of their educational and research missions, they can, in many cases, serve as a respected third party unbounded by the constraints of municipal lines or the composition of participants. As university agents in communities faced with new energy opportunities and challenges, Extension professionals can play a critical facilitation role. Examples in Indiana and North Carolina shed light on this facilitation function.

Benton County wind farm.

(http://extension.purdue.edu/benton)

Purdue University Extension professionals are helping Indiana landowners harness the winds of their state. In 2007, construction of a wind farm began in Benton County, a rural county 90 miles northwest of Indianapolis. The Fowler Ridge Wind Farm, the result of a partnership between BP Alternative Energy North America, Inc., Dominion Energy Marketing, the state of Indiana, Indiana

Michigan Power, Appalachian Power, and Purdue University, will be one of the largest wind-power facilities in the world. Featuring 222 wind turbines, the farm will generate enough carbon-free electricity to power more than 200,000 average American homes while bringing sources of revenue to local landowners.

Benton County became the first county in Indiana to investigate and then adopt a wind energy ordinance. Based on this experience, Extension professionals from the Benton County Office have provided information about the Benton County Commercial Wind Energy Experience to local governments and landowners throughout central Indiana. Before Jimmy Bricker, the Extension director for Benton County, and Purdue University Extension became involved in 2004, proposed wind farm development was met with local resistance by citizens concerned about environmental and aesthetic impacts. Through Bricker's work with local economic development groups to write a zoning ordinance for wind farms, and to educate community residents about the turbine technology and economic impacts, the county has embraced wind power development.

Since the Benton County wind turbines became fully operational in 2008, Bricker has spoken about landowner leases and wind conversion systems ordinances in over 45 different Indiana communities. It is estimated that over 2,500 people now have a better understanding of the process, logistics, regulatory details, and financial outcomes of wind energy development because of Bricker's educational efforts. In addition, a number of other Indiana counties have since implemented their own wind energy ordinances, thus providing the foundation necessary for the expansion of wind-energy initiatives throughout the state.

North Carolina regional energy forums.

(http://www.ncsu.edu/iei/)

In North Carolina, the state's land-grant institution—North Carolina State University (NCSU)—played an important role in convening a high-profile, statewide conference on energy in early 2008. The university-affiliated Institute for Emerging Issues (IEI) organized the event that drew together top national and North Carolina business, government, university, and public opinion leaders to outline energy challenges and opportunities. This two-day gathering was followed in the ensuing months by regional discussion forums that IEI conducted across the state in partnership with regional economic development organizations and NCSU Cooperative Extension.

Extension, through its connections with community members, helped IEI to identify key stakeholders for each regional forum. A total of seven regions participated in follow-up forums. Each of the seven forums included an agenda that presented general information about the changing energy environment within North Carolina, with panel presentations tailored to the specific energy issues of the host region. Panelists provided forum participants with examples of energy initiatives currently being employed within the region. Cooperative Extension then built on each panel presentation by convening small discussion groups that explored ways in which the information presented within each forum could be applied within each specific region. NCSU faculty members from a broad array of disciplines also helped to facilitate these small group discussions with all participants working toward the goal of identifying energy initiatives driven by the needs of each individual community. Over 230 individuals participated in these regional planning and discussion forums, and outcomes ranged from general ideas about "next steps" to the identification of regional energy partners. Each forum also helped to build momentum for subsequent discussions on the many issues—economic development, energy, education, and health care—that the state continues to face.

From these two examples, the authors can draw some lessons about Extension as a convener. The North Carolina State University example demonstrates the value Extension can bring to community-based strategic energy planning, particularly as a partner with one or more other conveners. Extension draws on its indigenous knowledge of community politics and players to ensure that appropriate organizations, leaders, and constituent groups are represented and are involved in the process. Another valuable convening role for Extension is helping a community to understand and discuss the pros and cons associated with new energy opportunities, as demonstrated by the Purdue University example. As a neutral third party with access to subject matter experts, county Extension can facilitate constructive dialogue grounded in facts rather than speculation. In essence, Extension works as a convener to build knowledge and strengthen networks.

Extension as Catalyst

Sometimes opportunity does not arrive in tidy packages with step-by-step instructions. In the fast-moving current associated with energy opportunities it is not always easy for individuals and organizations in communities to see an opportunity, or to have the knowledge base to respond when an opportunity arises.

In some cases, a catalyst is required to engage people, expertise, and resources. Such a catalyst provides innovative leadership to establish partnerships, to engage appropriate knowledge resources, and to identify potential project funding. Because Extension is an embedded presence within communities, yet has ties and access to an array of expertise, it is well-positioned to play a catalytic role. Innovative, well-networked Extension professionals can take ideas and solutions tried elsewhere and bring them to the attention of actors in local communities who may be unaware of certain possibilities. Extension has acted as such a catalyst in the following three examples taken from southwestern Pennsylvania and Minnesota.

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Southwest Pennsylvania energy business incubator.

(http://westmoreland.extension.psu edu/2008Fall West moreland-News.pdf)

In April 2008, Pennsylvania State University (Penn State) Extension educator Ed Johnstonbaugh went to officials in Westmoreland County with an idea for using woody biomass as an economic benefit to the county. The key to Johnstonbaugh's initiative was an abandoned plant built in the 1980s but shut down in 1997 due to economic shortfalls and technical challenges. Prior to its closing, the Westmoreland plant provided heat and electricity to a local nursing home and prison through the burning of the county's municipal waste. Johnstonbaugh suggested to local officials that they consider reengineering the abandoned plant to provide heat to the local Westmoreland Manor Senior Care Center via the use of woody biomass (scrap wood).

Johnstonbaugh saw additional potential for the abandoned plant, however. In order to help boost the economy of the county, Johnstonbaugh recommended that officials consider using space within the facility to develop and test other fuel sources produced within the county. The Southwest Renewable Energy Business Incubator, as it has become known, would thus help to keep money within the region by providing a venue for the development of

business models that utilize the area's own resources as fuel sources. For example, Johnstonbaugh believed that unused farm property within Westmoreland County could be used to grow and harvest grasses and other fuel materials that could, in turn, be used within the plant. Pennsylvania State University faculty and Extension professionals are currently working with individuals from Westmoreland County to make Johnstonbaugh's vision a reality. The reengineering of the former waste-to-energy plant is the first step in the Southwest Renewable Energy Business Incubator initiative, and a $40,000 grant recently received from the Mellon Foundation has provided the funding necessary to begin this reengineering process.

University of Minnesota Clean Energy Resource Teams.

(http://www.cleanenergyresouceteams.org)

Community members, the University of Minnesota, nonprofit organizations, and government entities of Minnesota have formed a public-private partnership that has helped to develop local energy initiatives within the state similar to the energy business incubator initiated by Ed Johnstonbaugh in Westmoreland County, Pennsylvania. Launched in 2003, the CERTs (Clean Energy Resource Teams) initiative aims to connect individuals with "the technical resources needed to identify and implement community-scale energy efficiency and clean-energy projects" *(http://www.cleanenergyresourceteams.org/about)*. CERTs addresses conservation, efficiency, renewable energy, and regional energy self-reliance through partnerships that span grassroots communities, local institutions, government agencies, nonprofit organizations, and university entities. Within the University of Minnesota, CERTs is tied to the College of Food, Agriculture and Natural Resource Sciences *(http://www.cfans.umn.edu)*; Extension *(http://www.extension.umn.edu)*; and the Minnesota Agricultural Experiment Station.

Like the regional forums held in North Carolina (described in the preceding section), each of the state's six CERTs regions is responsible for developing the agenda that drives the region's priorities in clean energy. In the early phase of the CERTs initiative, this included the development of the regional team's mission and strategic energy plan; the organization and facilitation of the team's meetings; and the prioritization of team projects. Any team can autonomously develop and implement regional energy initiatives; however, each team is supported, in part, by the University of Minnesota's Regional Sustainable Development Partnership, and the University of Minnesota Institute for Renewable Energy and

the Environment. These university partners serve as a resource to connect the CERTs-developed projects with the technical resources of the university. In addition, university partners help disseminate information from the region-based strategic energy plans; help conduct education and outreach on conservation, energy efficiency, and renewable energy within the community; and contribute to seed grant funding for CERTs projects.

The CERTs initiative has been a success. CERTs won the 2006 Minnesota Environmental Initiative's Partnership of the Year Award because of the "diverse collection of stakeholders the project has mobilized" *(McKeown and Nelson, 2007, p. 2)*. By 2008, 84 community-scale projects were funded with more than $2.6 million, and over 1,100 individuals have participated in CERTs meetings and educational forums throughout the state. Base funds appropriated by the Minnesota legislature to the CERTs initiative are leveraged against private foundation and federal monies to finance regional projects, many of which involve university partners.

Renewable energy credit aggregation.

(http://pubs.cas.psu.edu/FreePubs/pdfs/uc202.pdf)

One of the emerging opportunities for local organizations and communities implementing small-scale renewable energy projects is the sale of alternative energy credits. In an environment of increasing legislative mandates to shift energy production from fossil sources to renewable sources, electricity suppliers need to increase the renewable portions of their portfolios. One way this can be accomplished is through the purchase of alternative energy credits from nonutility sources. The challenge for most producers of small-scale renewable energy is understanding how to interface with electricity generation suppliers and how to function using a scale of production so small that the credits are not marketable.

A Penn State Cooperative Extension educator with a previous career in the electric utility industry has taken a leadership role in learning about Pennsylvania's laws governing alternative and renewable energy production, and in serving as a catalyst to aggregate the credits being produced by schools, hospitals, and other community organizations. Packaged as a unit, the credits from several small renewable energy producers represented sufficient value to be marketable to utility companies. In May 2008, 27 solar credits were sold in the marketplace. Through the sale of the credits, money has flowed back to these organizations. Even though only a few thousand dollars resulted from the sale, for the small organizations involved in the relationship it was a much

appreciated additional source of revenue. This partnership also provided a stepping stone to what could be a larger role for Extension in helping to develop the renewable energy credit aggregation market.

As the preceding examples demonstrate, Extension can play an important catalytic role to mobilize community action around energy opportunities. As long-term community partners, innovative Extension educators, such as the Penn State University Extension member cited above, can assist communities in identifying emerging community-scale energy production possibilities because they understand the region's assets as well as the renewable energy technologies. Identifying such emergent community opportunities effectively on a broader scale will require Extension to recruit, encourage, and support innovative people who can catalyze community action on emerging renewable energy development. One of the great strengths of the University of Minnesota model is the regional scale of grassroots energy planning, and "in-reach" to the university for appropriate faculty and student engagement. The CERTs program promotes community ownership of ideas for developing and implementing clean energy projects and suggests possibilities for systemically catalyzing to exploit energy opportunities through regional approaches. In addition, the creative ideas spawned in regions can lead to future research proposals and significantly enriched courses on the Minnesota campus.

Extension as Knowledge Translator

The most highly prioritized activity in research universities is discovery of new knowledge. Discovery and research are generally associated with faculty, but knowledge creation can and does occur throughout universities. In many cases, the applicability of newfound discoveries extends well beyond the department where they were initiated. Sometimes Extension professionals act not just as purveyors of knowledge, but as proactive generators of new approaches to issues. Whether in a research laboratory or in an applied field setting, knowledge creation generally builds on preexisting discoveries and knowledge.

Some of the great—and mostly uncharted—territory associated with new energy solutions is bridging the chasm between laboratory research and field implementation. Without strong connections between practitioners and scientists, research agendas can lag behind the most pressing needs and opportunities of the market or—in worst-case scenarios—produce completely

irrelevant discoveries. Faculty concerned with directing their research to address real-world problems welcome the opportunity to engage in community-based problem-solving. Such applied research has been a hallmark of land-grant agricultural research and has produced an extraordinary impact on the practice of agriculture. In a well-oiled Extension environment, field Extension personnel connect relevant faculty expertise with community-situated problems (or opportunities). The following examples illustrate the role of Extension in translating knowledge between researchers and practitioners.

Biodiesel research partnership.

(http://extension.psu.edu/energy/biofuels/PSUBiodiesel)

The tractors used in the fields at Penn State University are "going green." So are the vans, trucks, and cars that service the university. Currently, 9% of the approximately 20,000 gallons of fuel used by the university's diesel vehicles and tractors comes from pressed vegetable oil, and officials hope that soon every university vehicle will operate on the B20 (20% biodiesel fuel) fuel manufactured from campus food services' waste cooking oil, which originated as oilseed grown in the university's fields. This achievement marks another significant advancement in the research conducted at the university on the use of biodiesel fuels in vehicles and farm equipment.

University faculty members and Extension professionals first began to experiment with biodiesel fuel in 2002 after Glen Cauffman, the College of Agricultural Sciences' manager of farm operations, who also held an Extension appointment, brought the idea to campus. At this time, little was known about the effects of biodiesel fuels in farm equipment, and university researchers sought to better understand how the use of B20 affected the engines of tractors. By experimenting with commercial biodiesel fuel in university tractors, researchers determined that B20 was safe for farm use.

This demonstration attracted the attention of New Holland, Inc., an international farm equipment corporation. Officials from New Holland contacted researchers at Penn State and asked them, "How far can we go with biodiesel fuels?" To answer this question, New Holland and Penn State partnered for a three-year experiment of 100% biodiesel use. New Holland provided four tractors that the University used for the three-year period, each running on 100% biodiesel that could now be manufactured on-campus by Penn State. As the project progressed, chemical engineering and

fuel science faculty members became involved with Cauffman, by participating in the demonstrations and, ultimately, by providing more credibility for the science behind the biodiesel use. At the same time, the researchers were able to develop research proposals in these areas building on the success of the outreach program. In the fall of 2007, New Holland, in partnership with Penn State researchers, announced that New Holland equipment could successfully and safely operate on 100% biodiesel. This was the first announcement of its kind. Since the announcement, Cauffman has taken news of this biodiesel discovery to the farms surrounding the university. In his role with Extension, Cauffman routinely addresses farmers, and answers their questions about the use of biodiesel fuels in their farm equipment and their role in the production of biodiesel fuels. Cauffman also presents the findings of this biodiesel research at the international level with support from both New Holland and the university.

The partnership between New Holland and Penn State University continues. Cauffman wanted to take the biodiesel research one step further. He approached New Holland officials about testing the use of vegetable oil in tractors. New Holland agreed, and Penn State researchers are now testing vegetable oil pressed on-site in tractors provided by New Holland. Cauffman plans to parlay this experience into the use of recycled cooking oil from the university's dining facilities, taking the lessons learned from biodiesel engines to reengineer other university vehicles so they can run on the used cooking oil.

Fairview Swiss Cheese Plant.

(http://www.jgpress.com/archives/_free/001579.html)

What do cheese and sugar cones have in common? Tom Wilson, an agricultural engineer from Penn State University's Cooperative Extension, recognized that cheese and sugar cones have more in common than most would think. In 2005, Wilson helped to establish a biogas partnership between the Fairview Cheese Plant located in Fredonia, Pennsylvania, and the Joy Cone Company located in nearby Hermitage, Pennsylvania, after he determined that wastes from both companies could be used to generate biogas energy for the cheese plant. Wilson was able to connect the cheese plant with the sugar cone manufacturer as well as to state and federal sources of funding, to allow the project to move forward *(Greer, 2008)*.

The Fairview Cheese Plant owned by John Koller & Son utilizes an anaerobic digester that uses food wastes (cheese whey from the

cheese plant and cone process wastewater from the cone company) to make 40 million cubic feet of biogas each year—the equivalent of 28 million cubic feet of natural gas. This biogas generates up to 2,000,000 kWh of electricity and offsets 65,000 gallons of fuel oil, thereby reducing the plant's yearly energy costs and reliance on fuel oil. The owners of the Fairview Swiss Cheese Plant ultimately hope to power the facility entirely on its own biogas energy *(Greer, 2008)*.

Mason-Dixon farms.

(http://masondixonfarms.blogspot.com/)

Penn State University agricultural engineers and Extension educators helped a large dairy farm in southeast Pennsylvania to become energy self-sufficient through "cow power." Mason-Dixon Farms, located in Gettysburg, Pennsylvania, is home to 2,400 milking cows, which produce 52,000 gallons of manure and urine per day. Instead of polluting the land and water, since 1979 Mason-Dixon Farms has utilized an anaerobic digester that turns the animal waste into methane gas. This gas is then used to produce 320 kilowatts of power daily, which is more than enough to run the 2,500-acre farm. Consequently, Mason-Dixon Farms sells the excess electricity it generates to the grid, providing an additional revenue stream to the farm. In the 25-plus years since the digester first became operational, Mason-Dixon Farms has been out of electricity for only 15 minutes, and farm owner and operator Richard Waybright has shared the message of his farm's energy success in venues throughout the nation and the world.

Fuels for schools.

(http://www.pafuelsforschools.psu.edu/default.asp)

Education through collaboration is the hallmark of the Pennsylvania Fuels for Schools and Beyond initiative. Launched in 2008, the Fuels for Schools program represents more than 50 organizations, federal and state agencies, and individuals from throughout the commonwealth who are working collaboratively to promote biomass energy as a fuel source. Penn State Extension is actively involved in the organization's working group. The Fuels for Schools program, which began in Vermont as an effort to promote renewable energy use, is a statewide energy-use initiative aimed at providing reliable energy for schools and businesses within the commonwealth from locally available wood and biomass sources. Organizationally, the program aims to make Pennsylvania a leader in establishing decentralized, sustainable biomass heat and power systems for economic and community development.

Education and outreach are crucial to attaining this goal. Partcipants from Extension support the evaluation and implementation of biomass energy projects by providing education and technical guidance to interested parties. Educational workshops and site visits inform interested individuals, as well as public and private organizations, about the benefits and logistics associated with biomass energy. In addition to providing education and outreach, Penn State Extension's role has been to provide leadership to the group, add credibility to the effort, champion Fuels for Schools in policymaking circles, and develop a web site with associated educational materials.

Fuels for Schools organizers have achieved progress toward their goal of educating and informing over 10,000 end users, elected officials, and public individuals on renewable resources and biomass heating opportunities. Approximately 10 schools have already benefited from the program, and organizers would like to have an additional 50 to 60 participating schools within the next year. To reach this goal, organizers of the Fuels for Schools program aim to secure $1.5 million to fund the program and to assist in the installation of biomass heating systems.

Penn State Extension was able to leverage its experience with the Fuels for Schools program in a new partnership with wind energy experts at Penn State to successfully compete for a U.S. Department of Energy Wind for Schools grant in January 2010. In the Wind for Schools project, Penn State will be working with Pennsylvania K-12 schools to install small wind turbines that can be used to support learning experiences for students. Through the Wind for Schools program, the Department of Energy aims to educate a future workforce about wind energy technologies.

Smethport community heat and power system.

(http://smethportpa.org/boro/green-energy-biomass/)

Located in the center of a vast "wood basket," the borough of Smethport, Pennsylvania, is perfectly situated to take advantage of the natural resources that surround the town. In 2008, the Smethport Borough Council began to explore the possibility of making the town energy self-sufficient. To do this, council members hope to turn low-grade, unmarketable timber (woody biomass) retrieved from the Allegheny National Forest—located near the borough—into fuel for the town's electric system. Exploring this biomass heating option further required the establishment of the Smethport Woody Biomass Leadership Team (SWBLT) led by cochairs Ross Porter, mayor of Smethport, and Tim Pierson,

Penn State University Extension professional. Pierson and other members of the SWBLT, including five Extension staff and a dozen industry professionals, traveled to Güssing, Austria, to learn about the biomass gasification plant there. Researchers estimated that if Smethport could mirror the plant in Güssing, the borough's combined heat and power system (CHP) would utilize about five truckloads of woody biomass (wood chips) each day *(Muller, 2008)*. And, because of the borough's proximity to the Allegheny National Forest, there would be an ample supply of woody biomass to support Smethport's fuel needs.

In addition to providing the borough with a clean fuel source, the harvest of woody biomass has the potential to be of great economic benefit to the Smethport community. The CHP system would help to stabilize the timber industry near Smethport through the creation of jobs for the removal of the woody biomass from the forests. New jobs in construction, trenching, pipe fitting, maintenance, installation and service, repair, engineering, process control, and eco-energy tourism would also be created, thereby helping to save the ailing Smethport economy through both the creation of jobs and the retention of local dollars within the borough's economy.

The SWBLT is well on its way to achieving its goals of energy self-sufficiency and economic recovery for the borough. In March 2009, the Smethport Board of Trade announced that the borough received a $50,000 planning and engineering grant for the project from the Richard King Mellon Foundation of Pittsburgh. This, in addition to a $25,000 grant that the project had already received from the Community Foundation for the Alleghenies, has helped the borough hire a project engineer consultant to oversee the planning phase of the project. As the planning for the Woody Biomass project continues, Extension educators like Pierson lend credibility to the initiative by offering presentations on biomass energy to the community. With examples from the Güssing plant and discussions by Penn State University faculty like Dr. Charles Ray, associate professor of wood products operations, Smethport residents have acknowledged that their community is ideal for a biomass CHP system. Ultimately, officials and residents hope that Smethport will serve as a model for other communities.

The five preceding examples demonstrate the translational value of Extension in connecting cutting-edge energy research from university laboratories to community settings. By applying their knowledge of renewable energy generation to address specific energy needs of constituents in their regions, Extension

personnel can play a key role in the adoption of sustainable energy practices. There is tremendous potential for accelerated development and adoption of renewable energy technologies; critical to achieving these goals, however, is enhancing the interface between laboratories and the dynamics associated with community implementation. Extension is uniquely positioned at this interface point to assist in finding solutions to complex problems, but to date has directed minimal focus and resources nationally on renewable energy knowledge translation.

Extension as Knowledge Transferor

Higher education is most associated with knowledge transfer, typically from faculty member to student, in a structured learning setting. Cooperative Extension itself has a long history of knowledge transfer, particularly in providing applied education to local citizens. In recent years, as outlined in the first part of this article, Extension has reinforced its educational role by recasting its field people as "educators," and by focusing predominantly on developing curricula and delivering workshops in community settings. Knowledge transfer in the networked world is much less dependent on person-to-person education; however, there are still topics and settings that lend themselves particularly well to face-to-face knowledge transfer. The following examples from Pennsylvania and Virginia address high-value Extension-delivered education. Because the Internet has vastly improved most citizens' access to information, web-based portals for energy information resources can be vital tools for communities. The third example below, from Washington State University, highlights what is arguably the most robust energy Extension web portal in the country.

Marcellus Shale.

(http://extension.psu.edu/naturalgas)

The development of new techniques to mine deep-seated natural gas brought gas industry executives with checkbooks in hand to the front doors of Pennsylvania landowners. Uncertain of the potential value of gas under their land, many property owners leased their land to industry executives at rates far below market value. Others began to question the contracts they had been offered, and wondered about the effect of gas mining on their land. Thus, they turned to Extension professionals from Penn State, who had a long history of advising rural property owners on land management, for help. The result was a partnership between Penn State Extension, landowners, regulatory agencies and commissions

within the commonwealth, and the Department of Economic and Community Development that aimed to educate and prepare the public and the state for the natural gas boom.

By providing workshops and educational resources like *Natural Gas Exploration: A Landowner's Guide to Leasing Land in Pennsylvania*, Penn State and its partners have helped landowners to better understand the lease agreements and market values of their land. More than 12,000 people have attended Extension-sponsored workshops, resulting in negotiated gas leases worth more than $100 million. Even though the Marcellus Shale gas exploration is a new issue confronting Pennsylvania communities and citizens, understanding its implications plays to the historic expertise of Extension in areas including land use, water quality, environmental management, local public policy, and family finances.

Pennsylvania, located in the heart of the Marcellus Shale play, is expected to see significant economic and workforce development impacts as a result of the gas extraction. The educational resources developed and offered by Penn State Extension have also helped to address emerging issues related to the natural-gas exploration. These include: "1) how communities can keep some of the windfall natural-gas revenues at home to create jobs and promote economic development; 2) how potential environmental impacts can be minimized to protect water-quality and quantity; 3) how competing lands can be reconciled to encourage sustainable growth and development; and 4) how gas exploration can affect local tax revenues, property values, and farmland preservation programs" *(Penn State College of Agricultural Sciences, 2008).*

Virginia Natural Resources Leadership Institute.

(http://www.virginia.edu/ien/vnrli/)

The classroom can be a place for sharing more than just ideas. At the Virginia Natural Resources Leadership Institute (VNRLI), classrooms serve to educate "students" about the commonwealth's environmental issues. These same classrooms also provide "students" with a forum for developing the leadership skills needed to enact the change about which they are learning.

The VNRLI is a partnership between the Virginia Department of Forestry, Virginia Tech's Cooperative Extension, and the University of Virginia's Institute for Environmental Negotiation. The institute was launched in 1999, its mission to "develop leaders throughout Virginia who can help groups involved in contentious natural resources issues move beyond conflict toward consensus

building and collaborative problem solving" *(Virginia Natural Resources Leadership Institute, n.d., p. 2)*. Two major objectives are key to achieving the institute's mission: 1) creating a leadership network of people who are engaged in working with natural resources within Virginia, who are drawn from all parts of the commonwealth, and who will earn each other's trust while developing the leadership skills needed to engage in problem solving around environmental issues; and 2) creating and implementing a curriculum that challenges people to gain a deeper understanding of and appreciation for the commonwealth's emerging environmental issues while also developing the leadership skills necessary for collaborative problem solving.

A number of innovative partnerships and community collaborations serve as a testament to the success of the institute. For example, to identify and advocate for sustainable solutions for both agriculture and clean water, the Agriculture and Conservations Partnership for Water Quality was formed and brought together partners such as the Virginia Farm Bureau, Virginia State Dairymen's Association, Virginia Agribusiness Council, James River Association, Chesapeake Bay Foundation, and Soil and Water Conservation Districts. Formed to address specific, place-based land-use problems, the Shenandoah Forum addresses the proposed widening of I-81, and other county growth issues. VNRLI fellows also reflect the success of the institute. A survey of all VNRLI alumni conducted in 2007 reveals that more than 90% of the responding alumni agree that VNRLI provides tangible benefits to the commonwealth's natural resources, and more than 80% of alumni indicated that they seek collaborative solutions in their work, and the skills gained from participation in VNRLI have been integral to this work.

Strategic energy management.

(http://www.energy.wsu.edu/Projects ResourceConservation Management.aspx)

Washington State University's (WSU) Extension Energy office provides a program to prepare people to assume responsibility for strategic energy management in their organizations, the Shared Resource Conservation Manager Program (RCM). The RCM program is designed to help participating municipalities reduce expenditures for energy, water, and waste through improved resource management practices, analysis of utility bills, and installation of resource conservation equipment and technologies. Created with funding from the U.S. Department of Energy and Washington

State Department of Commerce, the RCM program is aimed at the development of long-term energy efficiency strategies associated with the management of county and city buildings. Target program participants are small cities and counties that can benefit by pooling resources to create a regional RCM program. Through the RCM program, WSU Extension Energy personnel provide training and tools for participating municipalities as well as ongoing technical and programmatic support.

With escalating energy costs, and increasing legislative mandates to curb energy use, organizations are interested in managing their energy resources more strategically. Extension is well positioned to provide energy efficiency education on a mass scale. Its reach into every county offers the opportunity to provide equitable access to information that is as critical in rural places as it is in urban areas. Extension's community knowledge and relationships permit it to readily connect with local government, school systems, hospitals, local businesses, and nonprofit organizations. Unlike many entities beginning to offer energy efficiency programs, Cooperative Extension is not selling energy products or services, so it can act as an unbiased source of information to citizens and organizations.

As these examples demonstrate, face-to-face education on applied topics still has a place in Extension activity despite the wide prevalence of electronically available information. In the case of the Penn State Marcellus Shale education programs, individuals have a significant financial stake in ensuring that they have the most current, trustworthy information to use as a basis for their decision making. In addition, the speed of the leasing and drilling activities and imminent need for dependable information is spurring people to attend in-person education programs. As the Virginia Natural Resources Leadership Institute example demonstrates, another viable context for Extension to engage in person-to-person knowledge transfer is targeted leadership development. High-quality energy and environment leadership programs designed by Extension in partnership with other credible entities can have a notable impact on community development decision-making. Finally, the topic of energy efficiency has gained such widespread interest that virtually every organization is looking at close management of its energy resources. Consequently, a well-designed program to train strategic energy managers, as in the example of Washington State University's Resource Conservation Manager program, lends itself well to Extension on a broad scale.

The Future of Extension as an Energy Catalyst in Communities

Based on the examples presented in this article, the authors envision an energy Extension organization that plays a number of vital roles in connecting communities to university expertise. A set of mass education programs constitutes just a small part of the opportunity for Extension to be a major force in catalyzing community and economic development around emerging energy challenges. A reenvisioned Extension role as it relates to energy should encompass the range of functions outlined in this article, including convening, catalyzing, translating, and transferring people, organizations, and knowledge. As a convener, Extension can bring communities together to do strategic planning and to address strategic energy opportunities. In this role, Extension field personnel can bring research experts on new energy technologies, environmental impacts, and economic analyses into community conversations and state policy forums to arm citizens and decision makers with critical information.

Energy Extension personnel can play an active role in catalyzing small renewable energy business development, and can serve as regional aggregators of alternative energy credits in ways that complement existing business development support systems and commercial energy credit traders. Renewable energy can be a game-changing opportunity for communities because production can be done effectively and efficiently on a small scale. Clayton Christensen's *(1997)* now famous notion of "disruptive innovation" speaks to the possibility for distributed energy production that occurs in communities via renewable sources to displace some of the highly centralized utility-owned energy production. This disruptive innovation is already changing cost structures and market incentives in ways that offer financial returns on renewable energy investments even to very small-scale producers. Organizations and communities can consider options

"Extension's intimate knowledge of community assests, people, and issues provides a vital knowledge base for appropriately connecting university expertise to energy-related economic and community development opportunities"

to generate their own power, thus keeping dollars saved close to home. They can also evaluate opportunities for selling excess power to the grid, and for harvesting renewable energy credits.

Translating research knowledge and new technologies into broad-scale use is another highly important need that Extension is uniquely positioned to address. Extension's connections to engineers and scientists who are developing the new energy technologies, business school faculty members with expertise in entrepreneurship and markets, and social scientists who study human behavior can link universities to emerging energy opportunities in communities. And, on the other side of the equation, Extension's intimate knowledge of community assets, people, and issues provides a vital knowledge base for appropriately connecting university expertise to energy-related economic and community development opportunities. In addition, Extension benefits from being a long-standing, highly credible organization, which opens the door to partnerships with a wide range of other relevant entities spanning government, education, business, and nonprofit sectors.

Given the broad landscape of opportunity for Extension to assist in catalyzing energy-related community and economic development, it is not sufficient to think about an energy Extension organization that only interfaces with colleges of agriculture and faculty members associated with agriculture. Extension's expertise in agriculture, however, provides it with some important core knowledge as it relates to energy. Crop-related renewable energy, land use planning, and energy efficiency of farms are related to skill sets that can be expanded or applied to a broader portfolio needed for effective community interface within the new energy terrain.

A New Model: A University-wide Energy Extension Program

To create an effective energy focus for Extension, a coordinated field staff of energy-savvy, community-oriented individuals must be developed. These individuals must be conversant with various aspects of renewable and alternative energy. In addition, they need the skills to engage community leaders, and to guide the development of projects. A thorough knowledge of policy and funding opportunities associated with energy is also essential.

Training.

Many Extension educators have little formal training in the development of community-based energy programs, but do have

considerable experience working with community leaders and other professionals. This imbalance has yielded an emerging need to design formal training that will enhance the skills necessary for developing community-based energy projects. Potential topics should include developing effective teams and partners, securing funding, accessing technical knowledge, coping with political and regulatory issues, and developing good project management skills. The training should also review previous case studies relevant to local resources as well as potential project roadblocks that can surface and strategies to cope with them. Development of these skills should help Extension professionals create projects with the best potential for success.

The authors envision the development of an energy Extension field staff created through the retraining of some existing Extension educators who have demonstrated the capacity to apply their expertise in new ways, as well as through the recruitment of new personnel, particularly individuals with engineering backgrounds. In addition to full-time Extension field staff, the authors advocate the inclusion of part-time, targeted expertise in conjunction with specific project deliverables. Such part-time personnel could be selected on the basis of particular expertise needed in conjunction with a grant or project and drawn from an array of domains, including industry and government, thus facilitating tighter connections between communities, researchers, and relevant business interests. Field personnel in energy Extension would be tied to a statewide energy Extension program leader, an individual who ideally would be hired on a senior Extension associate appointment. Senior Extension associates typically are charged with the responsibility for conducting a substantive outreach program, often involving cross-departmental, multiuniversity, and federal agency collaborations. They are mentored by and report to a faculty researcher. The statewide energy Extension program leader the authors envision would likely report to a single faculty member but would be responsible for regularly interfacing with faculty mentors in disciplines associated with an array of energy technologies, issues, and opportunities.

Campuswide coordination.

An important skill set for the statewide energy Extension leader is the ability to facilitate coordination across the university. The predominant modus operandi in research universities tilts heavily toward single investigator research and individual contributions to society, limiting the capacity of many institutions to adequately

address complex societal issues *(Kellogg Commission, 2009)* and big problems. The coordination needed from the statewide energy Extension leader should occur in two domains: on campus and in the field. On campus, the program leader needs to effectively engage faculty members with various kinds of energy expertise, as well as other Extension associates working in the energy domain, and to gain the support of their respective department chairpersons. In the field, the program leader needs the cooperation of Extension educators and their respective county and regional leadership.

A link between community and university.

Energy Extension professionals dispersed throughout a state could build on each other's successes by sharing the knowledge generated through participation in various project development activities. The resulting knowledge network would not only enable future projects to be streamlined, but would also facilitate the rapid spread of possibilities and best practices in energy-related community and economic development. Extension energy professionals would also serve as a conduit between university academicians and the local knowledge generated in community applications of energy technologies and practices. Through this knowledge exchange, university research agendas would be strengthened and student learning enhanced. University energy Extension professionals would develop linkages with counterparts in key state and federal agencies. Through these relationships, energy Extension professionals could serve as facilitators to efficiently identify candidates, based on community interest and capacity, for funding effective renewable energy projects.

Funding and organizational structure.

A new source of base funding beyond the U.S. Department of Agriculture would be required to establish a university-wide energy Extension program. First, although an important segment of energy work in communities is associated with agriculture, many segments are not. Thus, a federal funding entity with interests across the energy spectrum (or multiple entities with diverse energy foci) would be essential. The authors believe that several federal agencies might see the value of funding a limited cadre of targeted energy Extension professionals, particularly if such a new investment effectively leverages the existing Extension organization infrastructure. The Department of Energy, the Department of Housing and Urban Development, the National Institute of

Standards and Technology, and the National Science Foundation all have some energy interests that would lend themselves to one or more of the Extension functions outlined in this article.

Second, it would be important to allow and encourage a university-wide energy Extension program to be nimble and flexible by establishing its own culture, operational methods, and accountability mechanisms rather than being tightly tied to the culture and expectations associated with agriculture Extension programs or traditional academic departments—yet still retain close working relationships with both. Since Extension programs exist within the context of major research universities, one important consideration is the difficulty inherent in developing successful collaborations across numerous units in large institutions. To address this concern, the establishment of a successful energy Extension program would need to prioritize the careful hiring and evaluation of staff members who are committed to the concept and who have some background in working with either agricultural Extension or the various departments involved in energy-related research and education across campus.

Third, an energy Extension program funded by federal dollars from one or more agencies should be supported by state and local contributions, which will ground the work of the organization in addressing state and local needs. The authors advocate looking beyond the public sector for matching dollars, by engaging the private sector. Private sector engagement that is centered on regional industry clusters could strengthen not just individual businesses or communities but also interrelated groups of companies and their associated regional economies. New funding for Extension work in energy should make use of the existing administrative infrastructure and overhead in Cooperative Extension organizations. To not use these existing organizations would result in the loss of an opportunity to capitalize on a university presence that already is conveniently located in every county. Existing partnerships that Cooperative Extension has established with local and state governmental entities and many segments of private business would also be leveraged by building from the existing Extension organization. In addition, energy-related information and educational content could be accessible via Cooperative Extension's local and national Internet portals.

New resources provide opportunities to explore new partnerships, engagement mechanisms, staffing, and program models. As intimated above, linking to existing agricultural Extension programs may limit new energy programs to farms and agricultural

or rural audiences, or it may limit energy generation to bioenergy production systems. The authors suggest that a university-wide energy Extension program should not necessarily be linked to any one academic college within the university unless there is a clear interdisciplinary connection from that college to all the other academic colleges that conduct energy research and education.

Further, because they envision a university-wide energy Extension organization that is interdisciplinary and intercollege in nature, the authors suggest that funding for a university-wide energy Extension program be channeled into the university through an interdisciplinary, college-agnostic unit. At Penn State, as in some other research universities, energy and environment research that spans multiple disciplines, departments, and colleges is coordinated through an interdisciplinary unit. Such a unit provides a logical and highly credible base for anchoring an Extension organization that engages with faculty members associated with a wide range of energy issues. This model provides the opportunity to make meaningful commitments to a range of energy programs and community engagement activities.

Since the university-wide energy Extension program would include educators and extension associates from agriculture as well as other colleges, some portion of the funding for this effort would be contributed by agricultural Extension. Conversely, a portion of the funding emanating from nonagricultural Extension sources would be used to establish a financial relationship with the existing agricultural Extension to leverage its statewide presence. Essentially, the energy Extension program, through its fiscal interdisciplinary energy unit, would connect to and leverage with Cooperative Extension's county-based administrative infrastructure. By doing so, energy Extension would connect to the far-reaching Cooperative Extension county presence to develop and maintain ongoing relationships with key community stakeholders. These embedded community relationships could assist in triggering the engagement of energy Extension professionals with expertise applicable to current opportunities and challenges.

Conclusion: The Promise for Community Development

Experts have argued that the land-grant university system, with its focus on applied research, geographically distributed experiment stations, Cooperative Extension service, and commitment to practical education, played a central role in transitioning

the United States economy from an agrarian society to an industrial powerhouse. The nation is on the threshold of another major economic transition, and faces daunting challenges with regard to meeting future needs with our industrial energy models. New energy technologies rooted in renewable sources, distributed energy production options, and emerging market models all point to a critical juncture of opportunity for the advancement of community welfare. The equitable distribution of this opportunity is possible through an interface that is embedded at the county level, thereby connecting communities with cutting-edge energy expertise and technologies.

Initiating a university-wide energy Extension service will create a new, more flexible entity while leveraging an existing human infrastructure that has historically linked communities and universities. The promise of simultaneously creating sustainable environments, advancing economic prosperity, and improving the quality of life for citizens can be fulfilled if the emerging energy opportunities are broadly understood and accessible. The model proposed in this article could yield a win-win-win outcome for land-grant universities, too: the successful Extension concept could be expanded to nonagricultural disciplines, the support base for agricultural Extension could be broadened, and a higher degree of support for land-grant university outreach could be created. The authors submit that an energy Extension organization is an effective vehicle to ensure the equitable distribution of opportunity among America's communities and modernize the land-grant vision of Justin Morrill.

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using a "triple-bottom line" framework to measure impacts. The cases focus on best practice efforts, policy inventories, and assessment tools at the community scale.

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Daney G. Jackson was named the director of Penn State Cooperative Extension, associate vice president for outreach, and associate dean, College of Agricultural Sciences, in August 2004. As director of Cooperative Extension he provided leadership for policy, educational programming, budget administration, facilities, and human resource management. Dr. Jackson also served on the Executive Leadership Team for University Outreach. In this capacity, he assisted the vice president for outreach in the overall administrative leadership and facilitation of collaboration across the College of Agricultural Sciences as well as other colleges and outreach units across the university. Jackson earned dual bachelor's degrees (forestry, banking and finance) and a master's degree (extension education) from Mississippi State University in 1984 and 1990, respectively. He received his doctorate in agricultural education from the Ohio State University in 1994.