Industrial Energy Productivity: Jobs and Workforce Development in the Midwest

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Table of Contents

Introduction

The Midwest accounts for nearly one-fourth of all industrial energy usage in the U.S., including nearly half of all industrial coal consumption[1]. Yet only 10 percent of Midwestern industrial facilities are upgrading their equipment to improve productivity[2].

In 2011 the Midwestern Governors Association (MGA), launched an industrial energy productivity (IEP) initiative aimed at improving the competitiveness of Midwestern industry by highlighting the region's IEP assets and opportunities, namely the region's energy, manufacturing, financial, natural and human resources.

As a region, we have a unique opportunity for working together to:

- *Promote the benefits of improved IEP;*
- *Remove policy and regulatory barriers to IEP; and*
- *Identify new strategies for increasing the adoption rate of IEP practices and improvements.*

Many government agencies, utilities, universities and nonprofit organizations are beginning to focus on untapped opportunities to make Midwestern manufacturing more competitive through improved energy productivity.

The visibility and cache that the attention of Midwestern states' governors, legislators and agency heads bring could potentially increase the adoption of IEP techniques and prevent the expense and inefficiency of each state traveling the IEP learning curve alone.

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Numerous reports have been published highlighting the efforts of large, energy-intensive industries to make their operations more energy efficient.

This briefing focuses on IEP-related jobs and workforce development needs and assets in the Midwest. It aims to:

- *give state and local policy makers, economic developers and education and training providers a brief snapshot of the career and educational pathways for IEP in the region;*
- *explain what IEP is and provide context for identifying workforce needs in technical and non-technical skills and knowledge for IEP systems, technologies, processes and regulations;*
- *provide a snapshot for existing and emerging job opportunities in IEP and describe the related skills, training and certifications; and*
- *highlight considerations for future workforce needs related to the implementation of ISO 50001 and requisite changes in workplace behavior and workforce competencies.*

[1] Midwest Energy Efficiency Alliance (MEEA), U.S. Department Of Energy Webinar, "Regional Energy Efficiency Programs", Dec.13, 2011.

[2] 2006 Manufacturing Energy Consumption Survey, U.S. Census.

What is Industrial Energy Productivity?

The Midwest is, and has long been, America's industrial and manufacturing powerhouse. From auto assembly lines, to renewable fuel plants, to food processing facilities, the world relies heavily on goods and resources produced and manufactured in the Midwest. Improving the Industrial Energy Productivity (IEP) of these plants represents a key opportunity for Midwestern industry to reduce costs, thereby enhancing their competitive position. Not only does IEP allow industries to save money and achieve long-term productivity gains, it also has positive externalities in waste reduction and lower pollution.

Manufacturing accounts for 34 percent of all energy use in states included in the MGA footprint.[3] The region is home to many energy-intensive industries, including petroleum and coal products, chemicals, paper, primary metals and food processing. There is tremendous potential to increase IEP in the Midwest. In 2006, the U.S. Census Bureau completed a Manufacturing Energy Consumption Survey and found that only 22 percent of companies have audited their energy use to identify areas for improvement, and just 10 percent are upgrading their equipment and facilities to improve IEP (Data from the U.S. Census 2010 survey is not yet available). An examination conducted by the American Council for an Energy Efficient Economy on numerous physical studies, including those by the U.S. Department of Energy and the University of Minnesota, shows significant potential for industries to increase energy productivity.[4]

IEP can include a wide range of possible improvements – from plant or equipment retrofits, to major breakthroughs in the production process. Factors such as improved lighting or HVAC controls, installation of combined heat and power equipment or recovery of waste heat can all yield major energy and cost savings. However, to improve uptake of IEP strategies, many barriers must first be addressed, including the lack of awareness of available technologies and understanding of potential return on investment, as well as the low availability of energy management staff and affordable technical assistance.

This paper seeks to address the last point, by understanding both the occupations that comprise and the training and certification that help develop the IEP workforce.[5]

[3] Bradbury and Aden, World Resources Institute, "Midwest Manufacturing Snapshot: Energy Use and Efficiency Policies", Feb. 2012.

[4] http://www.midwesterngovernors.org/Publications/IEP/Intro.pdf

[5] *Innovation and Product Development in the 21St Century.* Hollings Manufacturing Extension Partnership Advisory Board. 2010.

What Drives Industrial Energy Productivity?

Manufacturing Innovation and Competitiveness

IEP is shaped by the same forces that shape manufacturing today – and by the same possibilities. While manufacturing's twin challenges of a poor public image and a significant skills gap are well documented, it is currently in the midst of a resurgence, the origins of which lie in its rebirth as an innovation engine. Some of the most fundamental challenges to the nation's energy future are being solved in the manufacturing domain – electric engine vehicles, wind turbines, "smart" washers and dryers, Starbucks' recyclable coffee cup. A recent paper by the Hollings Manufacturing Extension Partnership Advisory Board of the Manufacturing Extension Partnership argues that, "manufacturing is what happens when innovation turns into products: Manufacturing is not only about the making of things (production); it is about the full range from innovation, to product design, to product manufacture, to product deployment. It starts with innovation. And innovation is dependent on a skilled, flexible workforce."

One major innovation driver in manufacturing today is the shift to a sustainability mindset and the creation of clean technology. Annual reports by GreenBiz.com document the increasing emphasis by companies from all sectors on sustainability. They find that companies continue to care about the issue, alter production processes, and create products that address a demand for sustainable business practices and products. Their 2012 report touches on the clean tech industry, noting that for the first time, power plants operating on solar, wind and biomass energy garnered more investment than those powered by natural gas, oil and coal—$187 billion for renewables compared to $157 billion for fossil fuels, (according to Bloomberg New Energy Finance). Growth in solar and wind continue to climb. One of the top 10 trends for 2011 was the continued emphasis on energy productivity, including new federal standards for fuel productivity and buildings.[6]

Sustainability as an innovation engine has permeated the advanced manufacturing sector as well. The Manufacturing Extension Partnership's Advisory Board argues that, "marrying lean with green process concepts opens up additional opportunities to help improve the balance sheet. Companies that embrace lean and green production processes are seeking to

> "Yet, what if young workers thought of manufacturing for what it truly is - products that will be solutions to major challenges in our world (such as renewable energy and pharmaceutical manufacturing), products that young people relate to (such as automobiles and energy drinks), products that require high-tech skills and offer premium jobs? What if young workers thought about their careers in terms of occupations, skills, and learning opportunities rather than as being in an industry silo? Firms and policy makers alike should consider how working in advanced technology occupations appeals to younger generations."
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> *-Innovation and Product Development in the 21St Century, Hollings Manufacturing Extension Partnership Advisory Board*

[6] *State of Green Business 2012*. Greenbiz.com 2012

reduce their environmental impact while simultaneously increasing their efficiency, productivity and profitability."[7] A recent survey of small manufacturer's adoption of sustainability as a core business strategy reveals that 60 percent believe that sustainability is important to their firm's success. Yet less than 30 percent rate their progress as world class in this regard. Sustainability is one of six key next generation strategies promoted by the American Small Manufacturers Coalition, a trade association of manufacturing extension centers.[8]

The National Council for Advanced Manufacturing released a Sustainability Framework Model for companies to prioritize sustainable manufacturing projects, to analyze financial and environmental impacts of multiple combinations of potential projects, and allow companies to assess multiple environmental categories simultaneously.[9] Efforts like the Chicago Manufacturing Renaissance Council and the Wisconsin Profitable Sustainability Initiative highlight industry-led efforts to repackage manufacturing in the context of sustainability and to increase sustainable processes within manufacturing.

There are a number of resources in the Midwest dedicated to helping businesses, in particular manufacturing firms, increase their use of energy-efficient technologies and increase energy productivity strategies. We profile several of these resources below.

The Wisconsin Profitable Sustainability Initiative was launched in April 2010 by the Wisconsin Department of Commerce and the Wisconsin Manufacturing Extension Partnership to accelerate the adoption of sustainable practices by small and midsize manufacturers. The purpose of the Profitable Sustainability Initiative is to make Wisconsin the most sustainable manufacturing state in the nation. Initial funding of $1.75 million by the Wisconsin Department of Commerce and the State Energy program provided diagnostic, assessment and analysis activities for participating firms. Results from the first year reveal substantial benefits (see Figure 1).[10] Results were so positive that the program received a second round of funding to support additional companies in late 2011.

Figure 1: Wisconsin Profitable Sustainability Initiative First Year Results

General Category	Number of Planned Implementations	Participant Investment in Implementations	5 Yr Projected Savings	Payback in Years	ROI
Energy	49	$957,258	$2,401,267	2.0	151%
Environment	6	$248,984	$2,813,332	0.44	1,030%
Optimization	16	$1,235,390	$7,775,345	0.79	529%
Green Product	5	$1,081,573	$4,981,161	1.09	361%
Transportation	11	$126,340	$2,646,439	0.24	1,995%
Total	**87**	**$3,649,545**	**$20,617,544**	**0.85**	**485%**

Source: Wisconsin Profitable Sustainability Initiative: First Report. Wisconsin Manufacturing Extension Partnership, http://www.wmep.org/next-generation-manufacturing/sustainable-products-process-development.

[7] *Innovation and Product Development in the 21St Century.* Hollings Manufacturing Extension Partnership Advisory Board. 2010.
[8] *2011 Next Generation Manufacturing Study.* Manufacturing Performance Institute. 2011. http://www.nextgenerationmanufacturing.com/
[9] http://www.nacfam.org/PolicyInitiatives/SustainableManufacturing/NACFAMSustainabilityFrameworkModel/ tabid/102/Default.aspx
[10] *Wisconsin Profitable Sustainability Initiative: First Report.* Wisconsin Manufacturing Extension Partnership. 2011.

In Minnesota, manufacturers have access to MnTAP, an outreach program at the University of Minnesota that helps Minnesota businesses develop and implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of resources and reduce energy use and costs to improve public health and the environment. In 2011, MnTAP staff assisted Minnesota businesses by providing on-site visits, interns and team facilitation services. Businesses that implemented changes identified by MnTAP are realizing reductions of over 5 million pounds of waste, 13.8 million gallons of water and 7.7 million kWh and 2.1 million therms of energy. Established in 1984, MnTAP is funded primarily by a pass-through grant from the Minnesota Pollution Control Agency's Prevention and Assistance Division to the University of Minnesota's School of Public Health, Division of Environmental Health Sciences.

The Energy Resource Center at the University of Illinois at Chicago provides comprehensive solutions to the energy and environmental problems affecting institutional, industrial and commercial sectors. In particular, it houses expertise on combined heat and power (CHP) technology. In 2001 it was designated by the U.S. Department of Energy as the first CHP Regional Application Center (RAC)[11]. The RAC was established to provide CHP technical assistance and education to targeted audiences in the Midwestern region. That regional activity has now grown to include not only CHP, but also District Energy and Waste Heat Recovery Systems. Like other university centers described in this report, it also provides technical assistance to businesses, particularly manufacturers, on improving their sustainability efforts.

Energy Productivity and Economic Growth

Energy productivity is a driver for economic growth. The savings produced by using less energy can be applied to investment in new energy sources or new technologies, which in turn help to reduce energy use. A reduction in energy use allows firms to use capital that would have been spent on energy costs to be applied other parts of their business. Utilities play an important role in energy productivity, as they are large consumers of energy themselves and they help both individual consumers and other industrial and commercial firms reduce their own energy use. Utilities' IEP programs drive both adoption of energy productive technologies and the workforce needed to support those technologies. Xcel Energy, based in Minnesota, has been consistently recognized by the American Council for an Energy Efficient Economy for is innovation in IEP programs. In 2011, it recognized the company for "creativity and persistence in delivering exemplary energy productivity programs to industrial customers, and for providing leadership and support to the electric and natural gas utility industry in the design and implementation of IEP programs. Xcel Energy's industrial programs have established strong working relationships between the program staff and their customers, providing continuity of program staffing and offerings, a key element for success."[12]

The Midwest Energy Efficiency Alliance (MEEA) is a membership organization based in the Midwest that includes utilities, government and academic and research institutions. MEEA advocates for increased energy productivity. In 2011, MEEA launched its Midwest Industrial Initiative (MI2). MI2,

[11] RACs are now called Regional Clean Energy Application Centers by the U.S. Department of Energy.

[12] http://aceee.org/press/2011/07/aceee-names-champions-energy-efficiency-industry

acting as a gateway for federal industrial initiatives, is a regional network for state, local and utility productivity programs and professionals. The initiative's Utility Industrial Forum for MEEA member electric and natural gas utilities allows participants to discuss the challenges and opportunities for engaging industrial customers to achieve greater participation in productivity programs. Like the Energy Center of Wisconsin, it also offers professional trainings and certifications and engages in policy initiatives.

Government support and policy is a key part of linking energy productivity and economic growth.

E3 (economy, energy and the environment) is a model that combines the resources of five federal agencies, working with local government and utilities, to enhance sustainability and competitiveness in local and regional economies and to spur job growth and innovation. Federal and local resources are being combined to conduct in-depth front-end assessments and gap analyses of company manufacturing processes, the results of which are used to develop comprehensive improvement plans on behalf of and in collaboration with the participating communities. The federal agencies involved in this effort are:

- U.S. Department of Commerce (Manufacturing Extension Partnership)
- U.S. Department of Energy (Industrial Technologies Program)
- U.S. Environmental Protection Agency (Pollution Prevention Program)
- U.S. Department of Labor (Employment and Training Administration)
- Small Business Administration (Small Business Development Centers)

These agencies work with local partners, utilities and manufacturers to sustain the manufacturing infrastructure of a region, make manufacturing plants more energy efficient and cost effective, reduce the environmental impact of participants and improve the economy by creating and retaining jobs.

Ohio E3 activities

American Electric Power, with the support of the Columbus mayor's office and the Solid Waste Authority of Central Ohio, nominated suppliers to take part in E3 assessments. After six assessments were completed, the companies learned of opportunities to improve operations that could result in an average annual cost savings of $800,000 per facility. E3 continues to gain momentum in Ohio, with more companies getting involved. In 2010, the E3 project team was awarded Solid Waste Authority of Central Ohio's "Emerald Award for Innovation."

Michigan E3 activities

DTE Energy, with the support of the Michigan Manufacturing Technology Center, the Michigan Department of Natural Resources and Environment, the Michigan Department of Energy, Labor and Economic Growth, the Michigan Small Business and Technology Development Center and

other partners are supporting E3. Phase 1 of this project is a pilot project focusing on 10 companies in Southeast Michigan. A notable aspect of this project is the E3 Student Internship Program, whose objective is to accelerate the adoption of E3 principles and the implementation of lean, clean, energy- efficient and environmentally sound activities, as identified in the assessment process performed by the E3 partners. The E3 interns then assist the company directly with implementing and following up on the activities. EPA supported this effort with an investment of $51,402.[13]

Continuous Energy Management and Improvement

Continuous improvements standards are well established in industrial practice, such as programs like Six Sigma and Lean Manufacturing. Up until recently, energy consumption has not been broadly targeted as an opportunity for productivity and cost structure improvements. Where it has been targeted, the focus has been almost exclusively on capital investment in energy productivity projects. However, studies show that behavioral changes incited by training and strong energy management within an organization can also yield measurable energy savings. The introduction of the Energy Star for industry energy management guidelines and the ISO 50001 standard for energy management are raising the profile of energy management across firms. The U.S. Department of Energy has recently unveiled its Superior Energy Performance (SEP) Program, which builds on the ISO 50001 standard. SEP is a certification program that provides industrial facilities with a roadmap for achieving continual improvement in energy productivity while maintaining competitiveness.[14] Firms go through a prescribed process for certification for individual facilities. The SEP program also drives workforce changes with the inclusion of certified practitioners and related credentials (discussed in the next section of this paper).

Like other ISO protocols, ISO 50001 is a management standard. It does not specify particular energy productivity improvements, but rather outlines a process for managing energy productivity within an organization. That process is based on the "plan-do-check-act" continual improvement framework as a way to incorporate energy management into everyday organizational practice. The plan component of the framework includes conducting an energy review, establishing a baseline and identifying priority actions, including the identification of large capital projects.[15] However, because it does not end with physical plant improvements and includes practices such as increased employee awareness, modified work or maintenance procedures, use of a real-time energy dashboard and regular management reviews, many of the changes are fundamentally behavioral.

In 2005 the Northwest Energy Efficiency Alliance (NEEA) launched an IEP program called Continuous Energy Improvement (CEI). While it predates ISO 50001, it shares many characteristics with the standard. Companies were provided tools and training to integrate energy management into daily operations. Key elements of the program included executive support, widespread employee training, creation of an energy team and energy champion, selection of energy projects based on return on investment and creation of the infrastructure to manage energy costs as a

[13] More information on E3 and the state-specific analysis is available at: http://www.e3.gov.

[14] http://www.superiorenergyperformance.net/index.html

[15] *Win the energy challenge with ISO 50001, International Organization for Standardization.* http://www.iso.org/iso/iso_50001_energy.pdf

controllable expense. One challenge of such a system is how to measure the impact of behavioral based programs. The results of typical capital improvement projects are directly and immediately measurable, but this is not the case for many other aspects of energy management. To address this challenge NEEA developed a methodology for measuring the impact of the CEI program, and found that companies using the CEI program had a 3 percent savings per year that could be attributed directly to behavioral change.[16]

Whether by adopting a formal program such as CEI or joining the SEP effort, manufacturers who consider energy in their management approach and continuous improvement plan stand to reduce their energy use and reap financial benefits. This management includes the use of energy champions and energy teams who help create a culture of energy productivity in an organization, leading to all workers adopting new behaviors and looking for opportunities to deliver energy savings.

Workforce Development as a Driver for Innovation in Manufacturing

Manufacturers continue to emphasize that a highly skilled, highly flexible workforce drives innovation and innovation drives business success.[17] While manufacturing is the second largest employer of individuals in science and engineering occupations, many workers and students lack the skills to acquire credentials in these occupations.[18, 19] Across the nation, manufacturers are involved in a variety of initiatives to combat this problem. Many of these efforts in the manufacturing industry take the form of sector partnerships, collaborations of industry and educational partners created to address workforce needs. Others focus on connecting sustainability and manufacturing more directly.

Several states in the Midwest have used their multi-million dollar State Energy Sector Partnership (SESP) grants from the U.S. Department of Labor to invest in energy- and manufacturing-related skills upgrading. The department designed these grants, totaling $53 million across nine Midwestern states, to invest in workforce sector strategies that target energy productivity and renewable energy industries as well as other green industries. In particular, Minnesota, Michigan and Indiana are all investing in sector partnerships or manufacturing-related curriculum.

One of the most well known manufacturing sector partnerships in the Midwest is the M-Powered program in Minnesota. M-Powered is the collaborative effort of Hennepin Technical College and HIRED, a Twin Cities workforce development organization. The M-Powered Project offers a three-phase training program to prepare workers for five careers: computer controlled micro-machining technician, precision metal stamping technician, quality process technician, research and development lab process technician and manufacturing process technician. The program was established in 2005 in response to early concerns by manufacturers over predicted shortages of skilled workers. The program keeps material relevant to employers' needs through monthly

[16] *A generalized method for estimation of industrial energy savings from capital and behavioral programs,* Northwest Energy Efficiency Alliance, Portland Oregon

[17] *People and Profitability: A time for Change.* National Association of Manufacturers. 2009

[18] Ibid.

[19] *Rising Above the Gathering Storm Two Years Later.* The National Academies Press. 2009.

business advisory committee meetings with leaders from E.J. Ajax & Sons, Marshall Manufacturing, Medtronic, Meier Tool & Engineering, Remmele Engineering and St. Jude Medical.

Erick Ajax, vice president of precision metal stamping manufacturer E.J. Ajax and Sons, has hired 12 workers from the program. "The employers benefit because we're able to hire really skilled individuals who can create value for our customers. M-Powered is the only place that I've hired any new employees in the last five years. We think that much of it," he says. Craig Lofstuen, vice president of technology and sales development for precision machining company RevZero, has just made his first M-Powered hire. He says the program transcends industry competition, instead fostering a spirit of "coopetition" among Minnesota's manufacturers.[20] In fact, the state's U.S. Department of Labor funded SESP grant program has released additional funding to support replication efforts of the model in other parts of the state.[21]

In Indiana, the state uses SESP funds to pay for training offered by Purdue University's manufacturing extension partnership (MEP) center. The center's Frontline Green Worker program prepares graduates to receive a Frontline Green Worker certificate. The accreditation, based on Purdue's nationally recognized Green Enterprise Development (GreenED) curriculum, is used by community colleges, the National Institute of Standards and Technology, MEP centers, the Blue Green Alliance, trade unions and other organizations in 16 states. Like the GreenED program, the Frontline Green Worker Certificate training is backed by an exam from the Society of Manufacturing Engineers. Participants learn practices such as water conservation, air pollution reduction, solid waste management, toxic waste minimization and energy management.

Indiana's SESP grant is also paying for training provided by the state's community college network, which will allow participants to earn the Manufacturing Skills Standards Council (MSSC) Green Production Worker certificate. The MSSC Green Production Worker credential certifies that workers have demonstrated competency, knowledge and skills sought by manufacturing companies dedicated to increasing sustainable practices and processes.

With a focus on advanced energy storage in the automotive industry, the Michigan Academy for Green Mobility Alliance (MAGMA) represents the forefront of efforts to equip automotive engineers with the relevant skills to create new kinds of cars. The Workforce Development Agency of the State of Michigan collaborated with automotive manufacturing employers and educational institutions to establish MAGMA in 2009. Automotive manufacturers and their suppliers project a need for over 1,000 additional engineers and technicians who are trained to work in hybrid vehicle design and manufacturing over the next five years. The skill development and training provided through the MAGMA is in direct response to specific knowledge and skill demands of employers in the automotive manufacturing industry, who lead its steering committee.

MAGMA has proved so successful that it now forms the cornerstone of a broader $2 million Southeast Michigan Advanced Energy Systems Initiative funded by the U.S. Department of Labor, the U.S. Economic Development Agency, and the Small Business Administration. The funding is designed to expedite the formation of high-growth business and boost jobs.

[20] Enterprise Minnesota. *Helping Manufacturers Grow Profitably.* April 2011. http://www.enterpriseminnesota.org/resources/magazine-enewsletter/enterprise-minnesota-magazine/2011-april/m-powered-worforce.html

[21] http://www.positivelyminnesota.com/About_Us/Goals_Results/Regional_Prosperity_Initiatives/Minnesota_Sector_Partnerships.aspx

Job Opportunities within Industrial Energy Productivity

Jobs in IEP exist within the much larger overall energy productivity sector. One of the most relevant studies about the IEP workforce comes from the Lawrence Berkley National Laboratory. Its recent study of the energy efficiency services sector (EESS) provides a useful categorization of types of positions by market segment. Berkley defines this sector as including those service-oriented jobs that target improving the energy productivity of residential and nonresidential buildings. Program administrators of rate-payer funded energy productivity programs design and manage productivity programs that facilitate the implementation of energy-efficient solutions by working with program implementation contractors, manufacturers, distributors, energy service companies (ESCOs), architects, engineers, building and construction contractors, trades people and building owners.

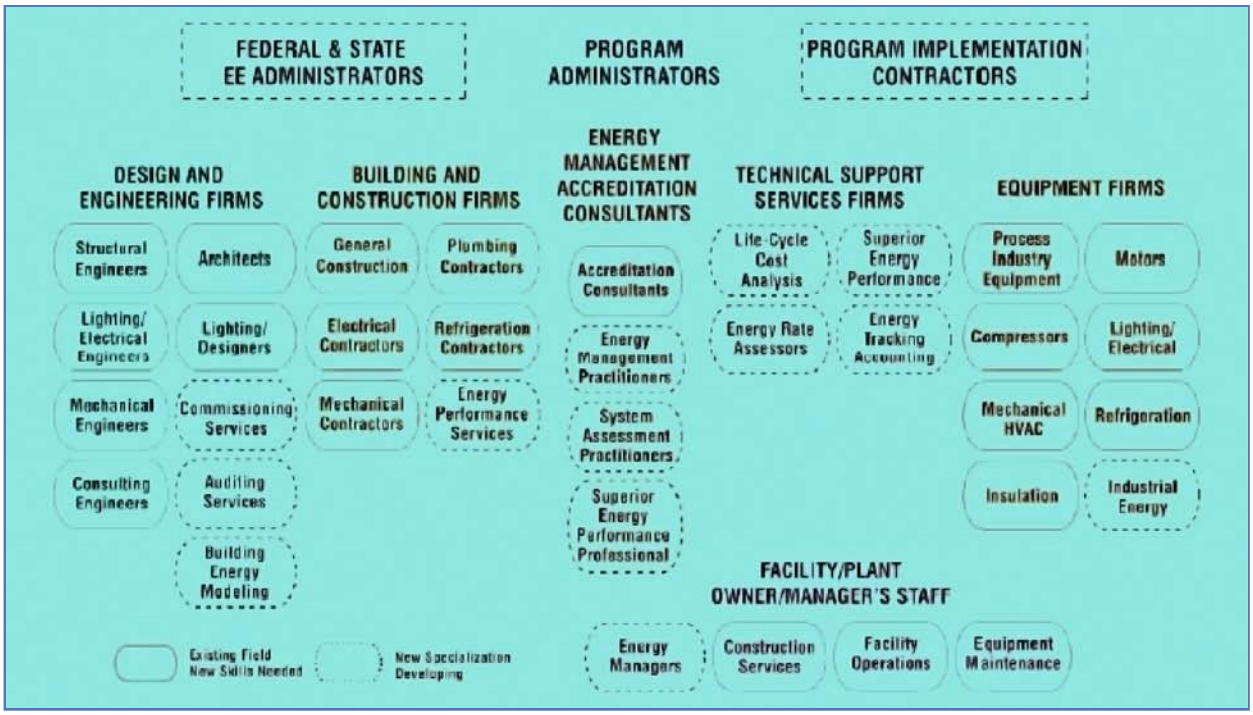
Figure 2: Energy Efficiency Market Value Chain

	Energy Efficiency Services Sector (EESS)				
Manufacturing & Distribution	**Planning and Project Management**	**Consulting and Auditing**	**Construction & Installation**	**Evaluation, Monitoring & Verification**	**Operations & Maintenance**
Firms designing & manufacturing EE equipment Wholesale distributors of EE equipment Retail distributors of EE Equipment	Program administrators Federal and state EERE staff Implementation contractors Technical support service providers Energy managers Accreditation consultants	Design and engineering firms Implementation contractors Technical support service providers ESCOs Local Weatherization agencies Energy managers Accreditation consultants	Design and engineering firms Building and construction firms Insulation firms Technical support service providers ESCOs Local Weatherization agencies	Program administrators Implementation contractors Technical support service providers ESCOs Energy managers Accreditation consultants	Building owners and managers Facilities operators

Source: Energy Efficiency Services Sector, Workforce Size and Expectations for Growth, Lawrence Berkley National Laboratory.

As illustrated above, the broad EESS sector includes a wide variety of activities, including weatherization assistance and other residential and commercial applications, in addition to IEP activities. Much of the work is conducted by consulting firms and contractors that do not necessarily specialize or limit their work to industrial applications versus commercial, institutional or residential applications. This makes it difficult to quantify what percentage of the overall EESS sector is connected to IEP. However, the authors of the Lawrence Berkeley National Laboratory report have outlined the kinds of jobs that are critical to the sector, as seen in Figure 2.

Figure 3: Industrial Energy Productivity Services Sector



Source: Energy Efficiency Services Sector, Workforce Size and Expectations for Growth, Lawrence Berkley National Laboratory

In Figure 3, darker colored boxes with solid outlines indicate job categories and firms types that exist outside of the EESS. These are existing jobs that can be refocused towards providing more energy-efficient practices and services driven by market demand. They are not generally a source of overall job creation, since an increase in the purchase of more efficient goods and services is balanced out by fewer purchases of less efficient goods and services. Lighter colored boxes with dotted outlines indicate job categories and firm types that are new, and are thus a source of potential job creation, rather than merely job retention or transformation.

Many people employed in the energy productivity services sector do not work full time on EESS activities, so the Lawrence Berkeley National Laboratory estimated the size of the sector using a "person-years" model. They estimated that in 2008, approximately 380,000 individuals spent around 114,000 person-years on EESS activities. Depending on the use of low or high growth scenario models, they anticipate that employment in the sector will double or even quadruple between 2008 and 2020.

Across the EESS, demand for certain types of workers already exceeded supply in 2008, and these shortages can be assumed to have grown with anticipated sector expansion. Specific shortages include management-level workers and engineers with energy productivity experience. Program administrators, program implementation contractors and ESCOs generally provide post-hire training because few candidates with specific training in energy productivity are available. Engineers with knowledge of energy productivity are in greatest demand. Because there are few

training programs specifically targeting energy engineering, EESS employers face stiff competition with other industries for talented engineering graduates who pursue jobs in traditional fields for their discipline. Engineering graduates often are unaware of the opportunities available in the EESS.

The impact of these shortages on the IEP sector can be seen in the demand for graduates from the Industrial Assessment Center (IAC) program. Described in more detail later in this report, the IAC program provides small- and medium-sized industrial plants with energy assessments to identify opportunities to improve productivity reduce waste and save energy. These assessments are conducted by engineering students at one of the 26 universities throughout the U.S. that house Industrial Assessment Centers. By 2009, more than 2,500 students had participated in the IAC program, more than half of whom were employed in jobs directly dealing with energy issues. The demand for these well-educated, highly skilled and adept energy engineers exceeds supply, and although the number of graduating students has been declining due to budget cuts to the program, the number of job postings on the organization's website has been steadily increasing. IAC graduates are highly sought as plant energy managers, energy efficiency consultants and energy productivity design engineers.[22]

Sample Occupation: Energy Engineer

Energy engineers create and/or review the design and specifications for most energy efficiency projects and also often ensure that completed projects meet energy productivity requirements. They are most often employed by engineering and design firms who are contracted by program administrators or program implementation contractors to meet energy productivity goals. Specialties include electrical systems, heating, ventilation and air-conditioning (HVAC) systems, green buildings, lighting, air quality and energy procurement. As consultants, they may enter the process at a variety of different stages, from energy productivity auditing and assessment, to development of implementation plans, oversight of implementation or evaluation of cost savings post-project.

Experienced energy engineers are in high demand. There are few training programs specifically in energy engineering, so workers in these occupations tend to be drawn from mechanical or electrical engineering programs. Their work is multidisciplinary, and to be most effective, they need knowledge and experience with fluid and thermodynamics; building energy systems; and performance optimization of existing HVAC, refrigeration or industrial process systems. Additionally, they must have strong written and interpersonal communication skills in order to develop and write plans. When faced with shortages of workers with these skills, employers look for engineers with technical aptitude who are interested in energy productivity, and then train them post-hiring to work on IEP projects.

The IAC program provides one important avenue for student engineers to learn the skills needed to be an energy engineer, particularly for the IEP sector. Seven out of the 24 IACs are located in the Midwest, co-located with universities in Illinois, Indiana, Iowa, Michigan, Missouri, Ohio and

[22] *Expanding the Industrial Assessment Center Program: Building an Industrial Efficiency Workforce,* Daniel Trombley, R. Neal Elliott, and Anna Chittum, American Council for an Energy-Efficient Economy, 2009

Wisconsin. Staffed by faculty energy productivity experts, the centers train undergraduate and graduate engineers to identify potential energy, waste and productivity savings in manufacturing facilities. This program effectively combines training for the needed workforce with helping manufacturers increase their energy productivity.[23] Students completing these programs are well versed in the most up-to-date technologies and have a broad understanding of how to improve energy productivity across product design, project engineering and organizational/facility energy management. On average, IAC students complete 18 energy assessments during their tenure, but many students complete as many as 30 or 40, and a few complete more than 100.

Sample Occupation: Plant Energy Manager and Energy Champions

A plant energy manager oversees energy consumption and usage within a manufacturing facility. Generally, only larger firms will have a devoted plant energy manger. Companies may have a related consulting or services arm that provides energy management services across a number of plants. This is the case at Davisco Foods in Minnesota, whose Davisco Engineering branch hired an Energy Manager to lead energy initiatives and serve as a resource companywide.[24] More frequently, however, this task is included in the portfolio of another position at an individual plant, such as production manager, plant manager, facility manager, or engineering manager. Lacking an energy assessment background or any specialized training, individuals in this position may not understand or perceive opportunities for energy savings.

However, this may soon change,. The introduction of the Energy Star for Industry energy management guidelines and the ISO 50001 standard for energy management is raising the profile of energy management across firms. For example, Ball Corporation (a multinational manufacturer of packaging for beverage, food and household products, with several locations throughout the Midwest) has adopted the Energy Star model for industrial energy management for its American operations. To support this model, the company employs two full-time employees that help lead the program, and each plant has an energy management champion (most often the engineering manager).

Energy champions drive and oversee a company's energy management plan, in many cases coordinating cross-functional teams who, through their combined knowledge, can identify the changes needed to improve energy productivity, quantify the return on investment and verify that those returns occur. Energy champions are usually found via the identification of individuals already employed at the plant who have a passion for energy productivity, rather than hired from outside the organization. Individuals in these positions – and other functional energy management positions, such as facilities managers – may improve their skills through the wide variety of certification programs described later in this report.

Sample Occupation: Utility Energy Productivity Program Manager

Almost all public utilities offer a variety of programs, services and incentives related to IEP as well as residential and commercial customers. These rate-payer-funded programs are a major driver of

[23] *Expanding the Industrial Assessment Center Program: Building an Industrial Efficiency Workforce,* Daniel Trombley, R. Neal Elliott, and Anna Chittum, American Council for an Energy-Efficient Economy, 2009

[24] http://www.daviscofoods.com/about/energy.html

EESS. Larger utilities may have one or more staff persons devoted to managing their industrial and commercial programs. A diverse skill set is required to administer energy productivity programs, from marketing and public relations, to engineering and technical assistance.[25] Typical job activities include creating, negotiating, developing, managing and administering vendor and customer contracts, and developing RFP and contract design for existing and new productivity and demand management programs. The position requires knowledge of the huge range of voluntary and mandatory codes and incentive programs.

Other Critical Occupations Supporting Industrial Energy Productivity

IEP improvements rely on a wide array of manufactured products, so not only do Midwestern manufacturers institute IEP in their plants, they produce goods to support it as well. Products to support IEP come from many different sectors. Many IEP assessments point to major improvements to be gained simply by installing additional or more effective insulation, for instance.[26] Motors and blowers are a major source of energy usage in manufacturing plants, so companies who innovate and create models that are more efficient will have a competitive advantage in the marketplace. This will result in more companies who specialize in creating and installing equipment specifically for the IEP marketplace, such as combined heat and power (CHP) units.

IEP also relies on building and construction firms to implement energy productivity installations, although not nearly to the same extent as in the residential energy productivity sector.

[25] http://www.ecw.org/publicpowerguidebook/content.php?chapterid=2&sectionid=2

[26] *Expanding the Industrial Assessment Center Program: Building an Industrial Efficiency Workforce,* Daniel Trombley, R. Neal Elliott, and Anna Chittum, American Council for an Energy-Efficient Economy, 2009

Training, Certifications and Skills

Data from the few reports analyzing IEP workforce demands, rather than more general energy productivity workforce needs, reveal difficulties finding workers with specific training in energy productivity.[27, 28] No U.S. universities offer a concentration or degree program in IEP. Collegiate trainings are offered via engineering programs, largely through Industrial Assessment Centers, but there are not enough graduates of these programs to meet demand. However, professional membership societies, trade associations, non-profit organizations and government agencies offer several valuable licenses and certifications for industry and other stakeholders. A non-exhaustive sample of some of the most important programs is provided below.

American Public Power Association

The American Public Power Association's Energy Efficiency Management Certificate Program is a training program designed for utility staff interested in starting or enhancing an energy productivity program. The program covers all aspects of development, implementation, budgeting, marketing and management. To earn an Energy Efficiency Management Certificate, participants must complete six required courses within a year of completing the course work, pass a written exam and submit an energy productivity program business plan. To maintain certification, participants must complete 20 hours of additional approved continuing education training every two years.

Association of Energy Engineers

The Association of Energy Engineers offers a wide variety of certification programs covering many aspects of the field.

Of these, the Certified Energy Manager (CEM) is among the mostly widely recognized. The CEM designation recognizes individuals who have demonstrated high levels of experience, competence, proficiency and ethical fitness in the energy management profession. Since its introduction in 1981, it has become widely accepted and gained industry-wide use as the standard for qualifying energy professions. It is recognized by the U.S. Department of Energy, the Office of Federal Energy Management Programs (FEMP) and the U.S. Agency for International Development, as well as by numerous state energy offices, major utilities, corporations and energy service companies. To qualify for certification, candidates require minimum combinations of both experience and education, ranging from a bachelor's degree in engineering or architecture and three or more years in energy engineering or management, to a two-year technical associate's degree and eight or more years of experience. Individuals who can pass the CEM test but do not yet meet experience requirements may qualify for an Energy Manager in Training certification.

[27] *Expanding the Industrial Assessment Center Program: Building an Industrial Efficiency Workforce,* Daniel Trombley, R. Neal Elliott, and Anna Chittum, American Council for an Energy-Efficient Economy, 2009

[28] *Energy Efficiency Services Sector, Workforce Size and Expectations for Growth,* Lawrence Berkley National Laboratory, 2010

Building Operator Certification (BOC)

The Building Operator Certification (BOC) program is a training and certification program designed to help facilities personnel assist their workplaces in becoming more energy-efficient and environmentally friendly. BOC offers Level I and Level II certifications with differing levels of required hours of training. Certification is based on work experience and education, as well as completion of BOC classes, exams and on-the-job projects. Training is widely available through a network of providers and information on Midwestern training opportunities is available through the Midwestern Energy Efficiency Alliance. Many different companies send their employees for certification

U.S. Department of Energy

The U.S. Department of Energy offers certification as a Qualified Specialist to professionals working with compressed air, pumping, process heating, steam and fan systems. Qualified Specialists help manufacturers identify ways to improve system productivity using DOE system-specific software tools. To be certified, they must meet certain prerequisites, complete two to three-and-a-half days of classroom instruction and pass practical and written exams. The U.S. Department of Energy provides the contact information of all Qualified Specialists on their website for the benefit of manufacturers seeking assistance.

U.S. Department of Energy Superior Energy Performance/ ISO 50001

In June of 2011, the International Standards Organization released ISO 50001, covering Energy Management. ISO 50001 establishes a framework for industrial plants, commercial facilities or entire organizations to manage energy. To support the standard, the U.S. Department of Energy created the Superior Energy Performance (SEP) program. SEP Certified Practitioners provide assistance to facilities in assessing energy productivity opportunities in various types of energy systems and conforming to the requirements of the ISO 50001 energy management system plus additional SEP requirements.

Certified Practitioners in Energy Management Systems (EnMS) are crucial positions to help implement the ISO 50001 standard receive certification by the Institute for Energy Management Professionals (IEnMP).

Additionally, the SEP program has two further levels. SEP Lead Auditors and SEP Performance Verifiers serve as third-party auditors to verify that an applicant meets the Superior Energy Performance requirements.

- SEP Lead Auditors assess a manufacturing plant's management system conformance to ISO 50001 and additional SEP requirements documented in ANSI/MSE 50021.
- SEP Performance Verifiers assess a manufacturing plant's conformance to the (1) measurement and verification protocols and (2) energy performance improvement levels defined by the SEP program.

The Institute for Energy Management Professionals (IEnMP) administers the certification of individuals for Certified Practitioner in Energy Management Systems, SEP Lead Auditor and SEP Performance Verifier. Candidates will be subject to a rigorous qualification exam and, once certified, periodic professional enrichment requirements. IEnMP is certified by the American National Standards Institute to provide these types of certification. The program to certify Certified Systems Practitioners is under development.

Northwest Energy Education Institute

The Northwest Energy Education Institute offers both an Energy Management Certification program and a two-year program in energy management. The certificate teaches energy management principles and techniques during a two-week classroom portion. At the end of that time, students return to their place of employment where they must implement their energy productivity project based upon information obtained during classroom instruction. Students gather project baseline data, implement the project and then measure and verify project energy savings.

The six-quarter energy management program teaches students the specific technical skills of energy auditing, as well as increases students' awareness of broader energy and sustainability issues. As with the Energy Management certificate, students gain practical experience by completing a full study of a commercial building, developing a technical report using simulation software and making a presentation to the building owner. Graduates of the program receive an Associates of Applied Science degree and are prepared for positions in engineering firms, utilities, government, community action programs and energy service companies, as well as with facility owners.

Implications of Research: Where Do We Go From Here?

As states design and implement workforce development strategies and policies to support the IEP sector, it is critical to fully consider the implications of the rapidly evolving and somewhat ambiguous environment of the IEP sector. Some of these industry environment implications include:

- Industry standards, certifications and credentials are emerging – with no consensus on which standards or certifications are likely to gain traction and credibility. For several years, the Center on Wisconsin Strategy has documents the proliferation but confusing volume of "green" credentials. A consensus among industry, training providers and workers is needed to clarify which credentials have the most value.[29]
- Education and training programs in this sector are only beginning to emerge, many of which are not reflective of industry standards.

[29] *Greener Skills: How Credentials Create Value in the Clean Energy Economy.* COWS. 2010.

- Labor market information about available jobs and training requirements is difficult to quantify and analyze in this newly emerging sector.
- Many occupations that are likely to be needed in the IEP sector five to 10 years from now have not yet been identified or created.
- Small- and medium-sized firms' adoption of new energy productivity technologies is often tied to the cost of energy. When the cost of energy remains relatively low, the urgency to make energy related improvements is less. Therefore, stable (and relatively low) energy costs may negatively affect the number of new hires or retrained incumbent workers in IEP occupations.

Within this context, states must look toward strategies that make sense in today's evolving environment. **Strategies** for consideration include:

1. **Working closely with energy-related professional societies and sector partnerships.**

   Working with these alliances is important for a number of reasons. In the case of professional societies:

- These societies (whose membership consists of individual practitioners in a specialty profession) can provide excellent access to actual industry practices and benchmarks as this field continues to grow, as well as a delivery mechanism for knowledge building and credential attainment for individual practitioners.
- The conferences, events, publications, websites and social media avenues of these societies offer opportunities to listen to the critical issues that practitioners are facing and the questions they are asking about opportunities in these fields.
- Most professional societies maintain job boards where companies interested in hiring their members can post jobs. Many societies have a social media presence on Facebook and LinkedIn where job opportunities are shared among members and "friends." These channels offer a window into current and future demand for these professions.

  Sector (industry) partnerships, profiled earlier in this report, create a hub for training and education to respond rapidly, in collaboration with industry, to changing workforce needs. Sector strategies are regional, employer-driven partnerships of industry, education and training and other stakeholders that focus on the workforce needs of a key industry in a regional labor market. Sector partnerships harness employers' collective expertise about talent needs and workforce challenges, and create relevant workforce solutions. Sector partnerships are dynamic, ongoing alliances—and as such, are responsive to rapidly changing and evolving environments.

  Professional societies and sector partnerships are ideal mechanisms for identifying the core workforce issues that face the industry, and developing solutions to address those issues. More specifically this would include engaging employers in: 1) identifying the critical occupations and the specific competencies and standards for those occupations; 2) helping to

identify emerging occupations and career pathways; and 3) providing work-based learning opportunities, including pairing mentors with emerging professionals.

2. **Engaging education to design and deliver curriculum and credentials that align with industry competencies and "market relevant" standards.**

   Regional groups have a tremendous opportunity to develop foundational curriculum frameworks that are portable and transparent across the region. These curricula and credentials should developed from evidence-based competency identification (i.e. job task analysis), and can then be customized by state or sub-state region to meet the specific needs of the industries in that area. Additionally, in order for these educational frameworks to be responsive to industry changes, they must have straightforward processes for developing curriculum for emerging occupations and updating competencies and curriculum for evolving occupations.

3. **Aligning with the emerging curriculum and credentialing work of the U.S. Department of Energy and U.S. Department of Labor Employment and Training Administration.**

   The U.S. Department of Energy's Superior Energy Performance (SEP) program offers new credentials related to the ISO 50001 Energy Management standard. Certified SEP Practitioners will provide assistance to facilities in assessing energy productivity opportunities in various types of energy systems and conforming to the requirements of the ISO 50001 energy management system plus additional SEP requirements. The Institute for Energy Management Professionals (IEnMP) will administer the certification of individuals for Certified Practitioner in Energy Management Systems, SEP Lead Auditor and SEP Performance Verifier. Candidates will be subject to a rigorous qualification exam and, once certified, periodic professional enrichment requirements. IEnMP is certified by the American National Standards Institute to provide these types of certification. The program to certify Certified Systems Practitioners is currently under development.

   The U.S. Department of Labor Competency Model Clearinghouse offers the Building Blocks for Competency Models Tool to guide partners through the creation of a competency model for a given industry. The Building Blocks for Competency Model consists of a set of competency "building blocks," arranged in nine tiers. The arrangement of the tiers in a pyramidal shape represents the increasing level of specificity and specialization of content, from foundational workplace competencies, to industry-wide, to occupationally specific competencies.

4. **Working with labor market analysts to develop more effective models to quantify and analyze IEP labor market information.**

   Traditional labor market information models and analysis are largely retrospective, or their national or state level scope lacks the specificity needed for local regions to design relevant training opportunities. Particularly in the case of emerging industries, traditional labor market research lags behind, because it relies on a classification system of occupations that can take two to three years to reflect new kinds of jobs. Some proprietary labor market firms scan job

openings posted on internet job boards and analyze their frequency and skills needed in order to generate more specific, current labor market information. Given the fluidity of the IEP sector, it is even more important for workforce development to be deeply engaged with industry to learn their needs, rather than relying on labor market studies as a sole source of information.

5. **Benchmarking and promoting success stories and establishing a learning network.**

   In the rapidly evolving and changing environment of the immature IEP sector, it is important to identify promising workforce development practices and success stories so that constituents can learn from each other as they move forward with workforce development strategies. The establishment of a learning network of policy-makers and practitioners would also assist in distributing this peer learning.

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