

Save Energy Now Regional Partnership: Advancing Energy Productivity through Government, Industrial, and University Collaboration

Kathleen Cullen and Ed Crowe, WVU National Research Center for Coal & Energy, B. Gopalakrishnan and Subodh Chaudhari, WVU College of Engineering & Mineral Resources

ABSTRACT

Save Energy Now is a national initiative that aims to drive a reduction of 25% or more in industrial energy intensity in 10 years. This paper presents a case study of an active regional partnership funded by the U.S. Department of Energy to deliver comprehensive energy assessment, implementation, energy management, and outreach services within a six state region including WV and areas of PA, OH, VA, KY, and TN. Development of strong partnerships with the U.S. DOE, West Virginia Division of Energy, West Virginia University, energy experts within the region, and industrial partners committed to energy efficiency are foundational to this effort. This project applies multiple pathways to achieve these goals including an innovative assessment process designed to accommodate the wide-ranging energy efficiency needs of industrial plants. These assessments go beyond the typical model with flexible, multi-level assistance with a strong emphasis on implementation and training for delivery of energy efficiency services and information within the region. The project also includes the engagement of two companies in the region for the implementation of energy management systems to demonstrate the effectiveness of continuous improvement in energy efficiency and compliance to the forthcoming ISO 50001 energy management standard.

This paper will explore the roles of the project partners and the resulting synergy enabling the deployment of educational, deployment, and outreach activities as well as project activity and progress to date. The efficacy of this collaborative effort will be highlighted as well as lessons learned and future plans.

Introduction

The Save Energy Now (SEN) Regional Partnership was created in the summer of 2009 in response to a solicitation from the U.S. Department of Energy Industrial Technologies Program (ITP). The ITP has a stated goal to reduce energy intensity of U.S. manufacturing as per Energy Policy Act of 2005, Section 106 and to help industrial manufacturers operate more efficiently by identifying ways to reduce energy intensity in key industrial process systems. In support of these goals, the regional SEN partnership was created to improve energy efficiency, environmental performance, and industrial competitiveness through extensive dissemination of energy efficiency technologies and operating best practices in a six state region of West Virginia, Ohio, Pennsylvania, Kentucky, Tennessee, and Virginia. To accomplish this objective, the project team applies multiple pathways, including an innovative assessment process designed to accommodate the wide-ranging energy efficiency needs of industrial plants, enhanced post assessment follow-up which promotes the adoption of energy management best practices, effective plant personnel

training, and energy efficiency knowledge dissemination at all skill levels; an energy management demonstration project, and a marketing campaign designed to target the delivery of energy efficiency services and information a wide range of industrial contacts in the region.

Rationale

Project Deliverables

The objective of the Save Energy Now Regional Partnership Program is to implement the regional delivery of a comprehensive energy efficiency package that incorporates an Enhanced Energy Assessment Process, an Energy Efficiency Knowledge Center, and an Energy Management Demonstration Project:

The deliverables of the project as outlined below provide an effective mechanism to conduct a successful energy efficiency program. The deliverables for the project are:

1. Establish partners and identify industrial sites in West Virginia, Ohio, Pennsylvania, Kentucky, Tennessee, and Virginia.
2. Develop, initiate, and conduct enhanced energy assessments (six in Phase I, ten in Phase II, and 15 in Phase III) at industrial facilities in West Virginia, Ohio, Pennsylvania, Kentucky, Tennessee, and Virginia.
3. Create information for the Energy Efficiency Knowledge Center with web-accessible resources to support delivery of the Enhanced Assessment Process with content appropriate for the post-assessment stage
4. Support the Energy Management Demonstration Project at one industrial site in the project region leading to certification to Superior Energy Performance (SEP) which includes certification to the ISO 50001 Energy Management Standard scheduled for release in 2011.
5. Creation of marketing materials including website, brochure, fact sheets, exhibit, and newsletter to promote project activities as well as energy efficiency practices in the region.
6. Incorporate investment grade energy assessments with continuing technical support to enable manufacturing facilities to fully understand the cost of implementing energy saving recommendations and the long term-benefits.

Regional Significance

West Virginia, Pennsylvania, Ohio, Tennessee, Kentucky and Virginia (see Figure 1) share a common bond due to their heavy manufacturing base, production of fossil fuels, and consumption and production of fossil fuel power generation. Over 90% of energy production in Kentucky and West Virginia is fossil fuel based and about 60% in Ohio, Pennsylvania, and Virginia. Tennessee is the only anomaly with about 14% of fossil fuel power generation due to the Tennessee Valley Authority's hydro capacity. These six states combined result in 18% of the nation's CO₂ emissions and their electric power industry emissions were 20% of that industry's national total in 2009. In each of these states the 2008 manufacturing employment is between 6-10% of their total employment. The total overall manufacturing employment in these six states is 15% of the total U.S. manufacturing employment. Table 1 below shows that energy intensive

manufacturing in the six state region is 73% of the total manufacturing employment in the SEN region and the energy intensive industry Gross Domestic Product (GDP) is 74% of the region's total manufacturing GDP.

Figure 1. Map of SEN Regional Partnership States

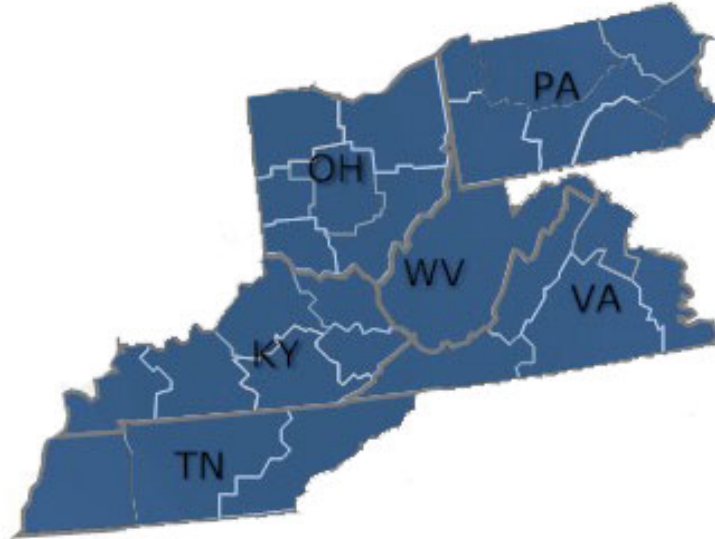


Table 1. Employment and GDP of Six State Region

	Employment	GDP
		(M of current \$)
Total Manufacturing in SEN Region	2,388,131	251,852
Wood product manufacturing	98,535	4,706
Nonmetallic mineral product manufacturing	93,129	7,435
Primary metal manufacturing	126,709	17,252
Fabricated metal product manufacturing	301,448	27,718
Machinery manufacturing	216,502	18,690
Motor vehicles, trailers, and parts manufacturing	165,631	19,641
Food manufacturing	220,313	33,196
Paper manufacturing	87,867	11,101
Printing and related support activities	114,782	6,373
Chemical manufacturing	163,031	28,789
Plastics and rubber products manufacturing	166,439	12,494
Total Energy Intensive Manufacturing in SEN Region	1,754,386	187,395
% of Total Manufacturing in SEN Region	73%	74%

The industrial energy intensity for each of these states is high when compared to the U.S. total. This is another indication of the important role that energy intensive manufacturing has on the economy of the states in the SEN regional partnership. Table 2 shows the industrial energy intensity of these states.

Table 2. 2008 Industrial Energy Intensity (BTU/\$GDP)

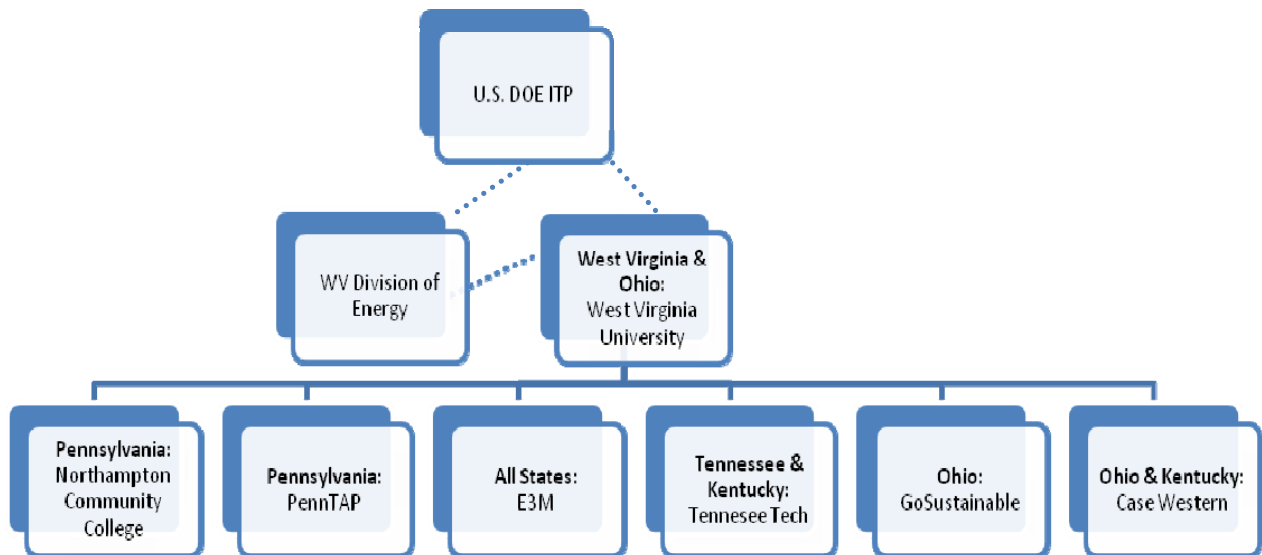
States	\$, Billions (Current)	TBtu (Industrial)	Btu/\$GDP (Intensity)
WV	61.70	391.20	6,340.36
OH	471.50	1,341.00	2,844.11
PA	553.30	1,255.80	2,269.65
VA	397.00	536.10	1,350.38
KY	156.40	890.60	5,694.37
TN	252.10	720.50	2,857.99
Total	1,892.00	5,135.20	2,714.16
US AVG	14,369.10	31,357.56	2,182.29

Management and Deliverables

Organization

The project is organized with the West Virginia Division of Energy as the primary recipient of the grant from the U.S. Department of Energy Industrial Technologies Program (ITP). The West Virginia Division of Energy contracted West Virginia University (WVU) to conduct all project deliverables, coordinate all project activities, and manage the project. The WVU team identified partners in each state actively involved in industrial energy efficiency activities and respected by their industrial clients. WVU issued contracts to the organizations to conduct the project deliverables in their state. Figure 2 outlines the organization of the project.

Figure 2: Project Organizational Chart



The industrial energy efficiency partners on the project provide support in the other states in the region that are part of SEN Regional Partnership. The strength of our partners is evident

with their experience and demonstrated accomplishments in energy efficiency. The project team and their roles are described below:

West Virginia University provides overall project management and coordination, and conducts energy assessments in West Virginia and eastern Ohio. In addition, WVU is developing the energy efficiency knowledge center, and conducting two energy management demonstrations at facilities in the region. WVU is also coordinating all marketing and outreach activities for the project. All of WVU's activities are coordinated by the following industrial energy efficiency programs:

- **Industries of the Future – West Virginia (IOF-WV)**, based at the WVU National Research Center for Coal and Energy (NRCCE) is an industrial partnership program that works with energy-intensive industries to increase energy efficiency, reduce waste and increase productivity. IOF-WV, a partnership between WVU, the West Virginia Division of Energy, U.S. DOE Industrial Technologies Program, was the nation's first state-level IOF-type program to help manufacturers increase their energy efficiency and thereby save money through R&D, energy assessments, and outreach and education.
- **WVU Industrial Assessment Center** is one of 26 centers in the country, funded by the U.S. Department of Energy to provide no-cost energy assessments to small and mid-sized manufacturers. A team of students and professors identify opportunities to save energy, reduce waste, and improve productivity. The WVU IAC conducts energy assessments within 350 mile radius of Morgantown, WV.

E3M Inc. is an energy consulting firm specializing in industrial energy efficiency management. E3M provides R&D and consulting services in the areas of energy and environmental efficiency management for major industries. E3M conducts industrial energy efficiency training using their specialized training material, manuals and delivery methods for industrial energy users, consulting companies, energy utility companies and technical or professional associations. E3M also conducts energy assessments and trainings across the region as needed. E3M conducts energy assessments throughout the region.

Northampton Community College Energy Management Institute (EMI) and PennTAP. EMI and PennTAP engineers perform investment-grade energy, pollution prevention, and process assessments for industrial and large commercial clients; develop and conduct distance learning courses on energy management and process heating; evaluate the technical and economic feasibility of renewable energy installations and combined heat and power (CHP) systems; and conduct "carbon footprint" analyses for industrial clients. EMI coordinates the project and conducts enhanced energy assessments in Pennsylvania.

Tennessee Technological University (TTU). TTU in Cookeville TN has been home to one of 26 Department of Energy Industrial Assessment Centers (IACs) since 2006. During that time, 65 industrial energy efficiency assessments have been performed across Tennessee and in Kentucky, Virginia, and Arkansas. Energy assessments have also been conducted by TTU faculty through cooperation with the University of Tennessee Center for Industrial Services (UTCIS) and through DOE's Save Energy Now program. TTU conducts energy assessments in Tennessee and Kentucky.

GoSustainable is an energy-efficiency consulting firm in Columbus, Ohio. The team of eight engineers, including three Industrial Assessment Center alumni, has conducted over 100 commercial and industrial energy audits of the past four years in Ohio and surrounding states. Facility types audited include hospitals, water-treatment plants, K-12 schools, office buildings, injection molding, aluminum casting, industrial farming and many others. GoSustainable is responsible for energy assessments in Ohio.

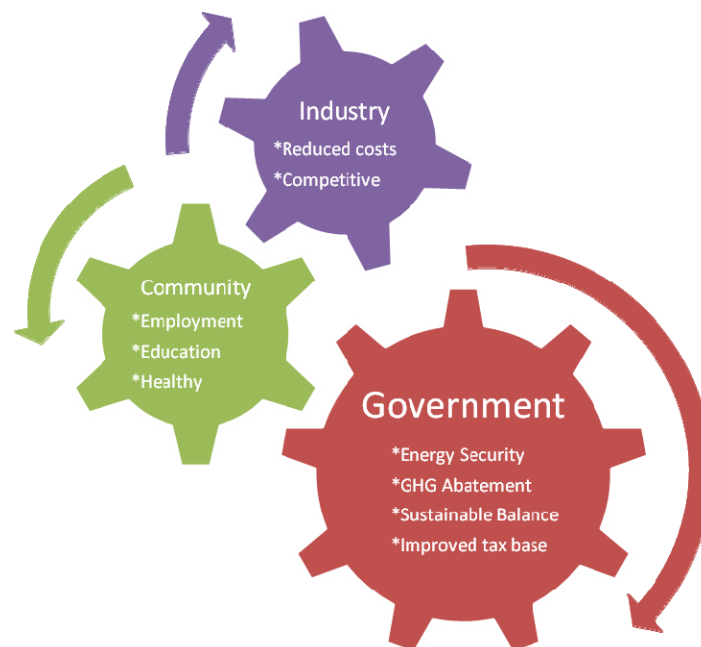
The project team has also involved Case Western Reserve University, manufacturing extension partnership programs and Technical Assistance Programs in the region to work with the team to increase industrial energy efficiency.

Project Tasks

The following tasks are designed to attain a new level of effectiveness of the energy assessment and implementation process. The tasks and deliverables discussed above add value to the energy assessment process and facilitate incorporation of the concept of energy efficiency and continuous improvement within the corporate culture.

Establish partners and industrial contacts in project region. The project team identifies partners and industrial sites throughout the region through an interaction between universities, industry assistance programs, utilities, and industrial partners to identify sites for the enhanced assessments as Figure 3 shows.

Figure 3: Government, Industry, Academic Interaction



Develop the regional energy efficiency delivery system/strategy. The “enhanced” assessment process incorporates aspects of Industrial Assessment Center (IAC), SEN, and Plant Wide Assessment protocols and provides flexible, multi-level assistance ranging from total plant

comprehensive assessments to individual component/system consultations. A post-assessment period emphasizes an ongoing relationship with companies to provide technical information, implementation assistance, and training on measurement and verification of energy savings. The Enhanced Assessment Process is a three phase intensive process of pre-assessment, assessment, and post assessment activity.

- **Pre-assessment phase:** focuses on web and conference call interactive sessions with early involvement of key decision makers along with production floor personnel to familiarize them with the assessment process, BestPractices software tools, overview of energy systems, baseline energy use analysis using QuickPEP, data collection, , and economics of implementation, safety, and confidentiality issues.
- **Assessment phase:** focuses on energy analysis and diagnostics, interdependence between energy efficiency recommendations, and sensitivity analysis with respect to key product, process, and system parameters governing energy savings, delivering energy efficiency services based on the best combination of the IAC, SEN, and Plant Wide Energy Assessments (PWEA) protocols.
- **Post assessment phase:** focuses on enhancing the relationship with client companies and providing technical information, measurement for verification of energy savings, implementation assistance, vendor evaluation, training, financial assistance information for implementation, and discussion for removal of barriers for implementation. Follow up activities will include utilization of ITP resources such as BestPractices software tools, fact sheets, and case studies.

Develop the energy efficiency knowledge center. The Energy Efficiency Knowledge Center (EEKC) is a repository for information, both as a secure website for client access use only as well as a website for public dissemination, generated by the Enhanced Assessment Process and energy efficiency knowledge specific to each of the major energy systems. The goal of the EEKC is to provide information to clients on how to obtain typical energy use for their specific energy systems by fuel type using tools such as Quick Plant Energy Profiler (Quick PEP). Typical energy efficiency recommendations for energy systems are available for review, as well as information on accessing the IAC database for understanding the extent of recommended and implemented energy savings. The EEKC is instrumental in disseminating knowledge from information, particularly non-proprietary results and broad rules of thumb for investment grade assessments which increase awareness of energy efficiency technologies and regional equipment and service providers.

Develop management resources to support the Enhanced Energy Assessment Process. This task provides web-accessible resources to support delivery of the Enhanced Assessment Process with content appropriate for the post-assessment stage. General information on the management of energy systems will be accessible to the public and will support marketing and outreach.

Develop a regional industrial energy efficiency marketing and outreach center. The main objective of this deliverable is to expand the number of companies actively involved in industrial energy efficiency through a diverse marketing and media strategy that includes electronic and print media, promotional materials, and personal contacts. The strategy is to target those resources that industries typically rely on for information: regional media outlets, industry

journals, energy efficiency publications, conferences, and websites. Information about the importance of energy efficiency will be disseminated through writing and publishing fact sheets and case studies on success stories and developing project specific marketing materials including a quarterly electronic newsletter, promotional brochures and a project website.

Launch energy management demonstration program. The project team is working with two companies in the region in the development of a sustainable energy management system that complies with the pending ISO 50001 energy management standard. This includes the completion of a baseline energy use analysis and demonstrated commitment to the continuous improvement of their energy performance. Measurement and validation protocols are applied and tested in this pilot project and are designed to document the key performance indicators and validate energy savings. The industrial participants are required to obtain Superior Energy Performance certification at the silver, gold, or platinum level. This commitment to continuous improvement and technical innovation is expected to create competitive advantages within the manufacturing sector.

Upgrade assessment process to include investment grade audits. The investment grade energy assessment process bridges the gap between the economic desirability of energy saving recommendations and the transparency of actual benefits and specific approach involved in implementation, for the manufacturing clients. This is accomplished through rigorous measurement and collection of energy use data during the assessment with “what-if” or sensitivity analysis of the data. Financing and incentive options are explored in detail for implementation.

Results

As of March 2011, twelve enhanced energy assessments (see Table 3 below) have been conducted at facilities throughout the region resulting in the identification of opportunities for 2,035,333(MMBtu/yr) in energy savings and financial savings of \$15,801,361 per year.

Table 3. Enhanced Energy Assessments as of March 2011

Company	State	Conducted by
Aluminum manufacturer	Kentucky	E3M
Motors manufacturer	Ohio	GoSustainable
Chemical manufacturer	Ohio	WVU
Aluminum manufacturer	Ohio	Case Western
Chemical manufacturer	Ohio	WVU
Tire manufacturer	Ohio	WVU
Glass manufacturer	Pennsylvania	NCC/PennTAP
Glass Manufacturer	Pennsylvania	NCC/PennTAP
Food processing	Tennessee	E3M
Poultry plant	Tennessee	Tennessee Tech
Steel manufacturer	Virginia	E3M
Steel manufacturer	West Virginia	WVU

Table 4 below outlines the recommendations of an energy assessment at one of the steel manufacturers along with potential savings, estimated costs for particular projects, and simple payback on investment. The annual energy consumed was equivalent to 1.25 trillion Btu/yr at this plant. Annual energy costs were \$10,850,000. The assessment recommendations (ARs) contained in this report could save 82,000 MMBtu/yr. The cost savings would amount to approximately \$740,000 or approximately 7% of the annual energy costs for this facility.

Table 4: Recommended Energy Efficiency Measures

AR No.	Description	Annual Potential Conservation		Potential Savings	Resource Conserved	Simple Payback (months)
		Natural Gas (MMBtu)	Electricity (kWh)	(\$/Yr)		
1	Reduce Demand Cost via a Demand Monitoring Strategy	-	-	275,200	kW Demand	1
2	Implement a Motor Management System	-	2,180,900	74,600	Electricity	1
3	Insulate the Furnaces and Tundish Dryer	11,000	-	48,800	Natural Gas	1
4	Reduce Air Compressor Pressure Set Point After Repairing Air Leaks	-	279,000	9,600	Electricity	1
5	Replace Drive Belts on Motors with Energy Efficient Cog Belts	-	167,600	5,700	Electricity	1
6	Install Photo Sensors to Switch-off Lights in Mill Area	-	366,700	18,800	Electricity	4
7	Install Automatic Dampers with Occupancy Sensors to Regulate the Flow of Exhausted Air from the Melt Shop	-	1,827,800	42,000	Electricity	5
8	Repair Compressed Air Leaks	-	132,300	4,500	Electricity	6
9	Replace Existing Air Nozzles with Vortex Nozzles	-	2,200	1,300	Electricity	13
10	Duct Outside Air to Air Compressor Intakes	-	131,500	4,500	Electricity	14
11	Retrofit Reheat Furnaces with More Efficient Recuperators	50,100	-	221,400	Natural Gas	38
12	Replace HPS Fixtures with T5 Ganged Fluorescent Fixtures, Electronic Ballasts and Reflectors	-	1,001,400	33,300	Electricity	55
	Total	61,100	6,089,400	739,700		

There have been a total of 13 training events conducted by the project team to date and these include on-site demonstrations at the plants that had assessments, DOE’s BestPractices workshops, webinars, and energy efficiency workshops developed by the project team. All assessments included on-site demonstrations for plant personnel on DOE Software tools such as PHAST, FSAT, MotorMaster+, and AIRMaster+ to determine potential energy savings and for continuous improvement to enable plant staff maintain energy efficiency practices. The project team hosted DOE’s BestPractices workshops (both one-day and Qualified Specialist trainings) on topics such as process heat, steam, and pumps, and presented a webinar entitled, “Tools and Methods that Save Energy and Reduce Costs” and a one-day workshop on “Industrial Energy Efficiency Measures” presented by the WVU Industrial Assessment Center and IOF-WV.

The project team also assists companies with implementation by holding discussions with equipment vendors regarding implementation of the energy efficiency recommendations and by providing technical assistance. To date, there have been over 30 different types of technical assistance provided to the companies. These have included on-site visits, telephone consultations, and site visits to answer questions on topics such as insulation analysis, energy management, steam, and HVAC.

The Energy Management Demonstration project began in the 3rd quarter of 2010 and will culminate in plant certification to Superior Energy Performance (SEP) and the forthcoming ISO 50001 energy management standard in late 2011 or early 2012. The project team has

engaged two companies in the region (Dow Chemical, Institute, WV and TRACO (Alcoa Commercial Windows), Cranberry, PA) in the development of a sustainable energy management system that complies with the pending ISO 50001 energy management standard as well as establishing the measurement and validation of energy savings to prepare for SEP certification. This has included attending trainings presented by Georgia Tech. The official project kick-off was held at Georgia Tech in Atlanta in March 2010. Designed for a multi-phase approach modeled after the Plan-Do-Check-Act process made popular by the quality profession, the Phase I training was held in the summer of 2010 at Penn State and the Phase II training was held in the winter of 2011 at West Virginia University. The project team is in constant communication with the companies through conference calls and site visits to provide technical assistance and ensure progression towards their energy management system.

Figure 4: SEN Regional Partnership Website



The project team has been extensively marketing the project. The team has made six presentations to date on the Save Energy Now Program and the opportunities that exist through energy efficiency. A website, brochures, factsheets, and other marketing materials have been developed, published, and distributed. Fact sheets will be published during the coming year as companies implement recommendations and success stories result. Figure 4 above is a snapshot of the SEN Regional Partnership website showing an example of the marketing materials developed for the project. Once live, the website will include information on the project, funding opportunities, events, and energy efficiency information.

Emphasis on Continuous improvement

The partnership approach to the Save Energy Now Enhanced Energy Assessment is designed to facilitate continuous improvement by incorporating the knowledge and experiences of plant personnel. It also emphasizes a collaborative approach specifically aimed at building

internal capability to find and eliminate wasted energy through the study and improvement of processes and energy systems. This is further enhanced by training and coaching in energy efficiency in addition to actively involving cross-functional teams in the study, change, and improvement of their product, process, and energy system parameters. The project team has already had success in this area as evidenced by the 13 training events conducted to date. The keys to the success of continuous improvement in energy efficiency are the support of upper management leadership, an infrastructure to support energy efficiency efforts, training, and the availability of simple but powerful methodologies and tools. The project is designed to foster a sustainable plant-wide energy efficiency culture incorporated within a continuous improvement framework. The project team has already seen the potential when upper management becomes involved. The CEO of the steel manufacturer in West Virginia has been and continues to be actively involved in all aspects of the assessment process. This allows for a wider acceptance of the assessment recommendations and energy efficiency practices.

The deliverable of web-based management resources will play a key role by enhancing the multiple pathway delivery activities of Enhanced Assessment Process and Knowledge Center and contribute to energy efficiency. These web-based resources will support the post-assessment process, the management of energy systems, and a continuous process to reduce energy intensity

Conclusions

The project team has completed all Phase I (year 1) deliverables of the project, but Phase II and III deliverables must still be met. The project team will conduct ten energy assessments, and conduct marketing activities such as industry conference presentations, publication of two articles, and the publication of success stories during Phase II. Year 2 began in February 2011. Therefore, the project team will be continuing to deploy the Enhanced Energy Assessment Process in the project region throughout years 2 and 3. Two enhanced energy assessments have been already conducted since year 2 began in February 2011.

The Enhanced Energy Assessment Process will result in energy and cost savings to manufacturing clients in the expanded area. The companies that benefit due to the savings are likely to invest in expanding their businesses in terms of personnel, infrastructure, and market share. This will result in job growth and economic development in the respective geographic region as well as have a positive economic "ripple" effect on their supply chain. By working with regional partners, the project team is able to reach out to more companies, identify greater energy savings, train more companies on energy efficiency best practices, and produce more energy savings.

But what does the future hold for energy efficiency and the regional SEN Program?

- Through the enhanced assessment process and continuous improvement, companies raise energy efficiency to be part of their business strategic plan. This may eventually include the adoption of new enabling technologies such as wireless communication and sensors, diagnostics, and real time data acquisition allowing companies to continuously monitor their own energy use.
- The broad acceptance and adoption of energy management strategies and the forthcoming ISO 50001 energy management standard will lead to continuous energy efficiency and energy intensity improvement as well as a reduction in operational costs and carbon

emissions. This will require continuous monitoring and verification of energy performance improvements.

- The partnerships that have been developed during the course of this project will continue to be beneficial in pursuing opportunities. The team has developed excellent working relationships and as opportunities arise in the future will continue to work together and expand the team as necessary. In addition, the partnership expands the knowledge base of the energy saving experts in the region allowing the team to make recommendations for energy assessment expertise when clients request it.
- However, the partners cannot limit themselves to only working with one another. The team should include other Universities, energy assistance programs, economic development programs, utilities, and energy service providers. The growth of the partnership will enhance our capabilities and foster new relationships with industry and among the assistance programs in the region. More companies will have immediate access to someone who can assist them and more opportunities will exist to sustain and grow the program.
- The future of the program also depends upon availability of funding, but where will that funding come from? Potential funding sources include, fee for service; state-level assistance programs, utilities that have demand side management programs, DOE and other federal agencies, as well as Foundations such as the Benedum Foundation which funds projects in Pennsylvania and West Virginia.

The activities in the Regional Energy Efficiency Delivery System provide a significant impact in the geographic region, resulting in significant energy benefits due to the on-going interactive relationships with industrial clients. The project team works with companies to enhance implementation, foster a culture of energy management, and facilitate continuous improvement resulting in a reduction in energy intensity and carbon footprint while enhancing global competitiveness and increasing profits. Our goal is that all of the companies that participate in the SEN Regional Partnership are efficient, sustainable, competitive manufacturers in the future and contribute to the national goals for energy efficiency.

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