NON-PEER-REVIEWED PAPER

Models for driving energy efficiency nationally using energy management

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Abstract

Energy management is a proven strategy for achieving clear energy, environmental, and economic benefits across industry – yet diverse barriers, risks, and challenges continue to limit broad adoption around the globe. An energy management system (EnMS) integrates energy management into existing business systems, enabling organizations to better manage their energy, sustain achieved savings, and continuously improve energy performance. Governments are now implementing various approaches to accelerate industry uptake of these systems, such as promoting compliance with the ISO 50001 energy management standard. This paper explores three approaches now in use: mandated programs (Japan); incentive programs (Sweden); and market-based certification programs (United States).

The authors examine each of these three approaches by taking an in-depth look at one real-world example. For each example, the paper identifies the specific program requirements, the larger context for the policy and role of government, existing drivers for corporate participation, key challenges and resources, and the available results (i.e., energy and cost savings and other benefits). Comparisons among these current, government-led models for accelerating the uptake of EnMS should provide insight on the effectiveness and benefits of different government approaches and their supporting policies and resources. Governments can learn from the challenges faced, solutions devised, and lessons learned by others during the implementation of these programs.

Introduction

IMPORTANCE OF INDUSTRIAL ENERGY MANAGEMENT

Energy management represents a significant opportunity for organizations to reduce their energy use while maintaining or boosting productivity. The industrial and commercial sectors jointly account for approximately 60 % of global energy use (EIA 2013). Organizations in these sectors can reduce their energy use 10 % to 40 % by effectively implementing an energy management system (EnMS) (IEA and IIP 2012; Duarte et al. 2011).

Companies in industry (as well as other sectors) can use energy efficiency as a business strategy to improve their competitiveness and also achieve societal environmental goals. However, barriers to energy efficiency include financial, technical, behavioural, organizational, and other challenges. As a result, organizations do not always consider energy efficiency to be a high priority compared to other business investments and often leave energy efficiency measures unimplemented (IEA and IIP 2012).

To help industry overcome these barriers, over forty countries working through the International Organization for Standardization (ISO) published the ISO 50001 EnMS standard in 2011. ISO 50001 builds on international best practices and provides guidelines for integrating energy efficiency into management practices—including fine-tuning production processes and improving the energy efficiency of industrial systems (McKane et al. 2009).

As of February 2014, over 6,600 sites have been certified to ISO 50001 globally, including 190 in Sweden, 35 in Japan, and 56 in the United States. While this adoption rate is promising, the overall uptake is still low compared to existing management standards, such as ISO 9001 and ISO 14001. Governments can play an important role in encouraging companies to elevate energy management as a business priority, adopt ISO 50001, and reduce their energy consumption and costs.

Several governments – including those in Japan, Sweden, and the United States – already utilize programs to promote energy efficiency in industry and have successfully increased the uptake of ISO 50001. These programs require or help encourage companies to establish EnMS. This paper will further explore three types of government programs – mandatory (Japan), incentive-based (Sweden), and market-based (United States) – including details on each program's requirements, the role of government in implementing the program, challenges to program adoption, drivers for participation, and lessons learned. This paper will also discuss the results of each program and how they generated benefits for their stakeholders and governments.

GLOBAL SUPERIOR ENERGY PERFORMANCE

The Global Superior Energy Performance Partnership (GSEP) is an initiative of the Clean Energy Ministerial (CEM), a global forum for encouraging and facilitating the transition to a global clean energy economy, and the International Partnership for Energy Efficiency Cooperation (IPEEC). GSEP aims to significantly cut global energy use by encouraging the industrial and commercial buildings sectors to continually improve their energy efficiency. GSEP's Energy Management Working Group (EMWG), the organizer for this paper, advocates the increased adoption of EnMS or ISO 50001 in industrial facilities and commercial buildings. The 11 member countries of the EMWG include Japan, Sweden, and the United States as well as Australia, Canada, Denmark, the European Commission, India, Mexico, the Republic of Korea, and South Africa. These governments work collectively to strengthen the national and international efforts to make it easier for these sectors to adopt energy management as a key aspect of their operations.

GOVERNMENT ACTIONS THAT INCREASE THE UPTAKE OF ENERGY MANAGEMENT SYSTEMS

There are several different ways governments can promote the rational use of energy in companies through the use of energy management. The three examples explored in this paper are mandatory programs, incentive programs (e.g., tax relief), and market-based certification programs. Mandatory programs (such as Japan's Energy Conservation Law) require companies to meet energy reduction targets and meet other requirements regarding energy management and conservation. Incentive programs (such as Sweden's Program for Energy Efficiency in Energy Intensive Industries) offer rewards to companies in different forms (such as reduced taxes) for meeting energy management and energy reduction measure requirements. Market-based certification programs (such as the United State's Superior Energy Performance program) enable companies to seek third-party certification that validates achieved energy performance improvements and other program requirements (such as implementing ISO 50001).

Other examples of programs might include support to the energy service market or methods to disseminate information more effectively. A country will select approaches as appropriate based on its specific governmental and business related factors, such as:

- Level of energy consumption in industry sector, energy intensity of companies, and ratio of small and medium enterprises (SMEs) to large companies.
- Whether companies are competitive and/or present on the global market.
- Culture for management systems in the country (previous uptake of other ISO management systems such as ISO 9001 and ISO 14001).
- Status of accreditation and certification bodies.
- Possibility and culture for government intervention.
- Status of energy service companies and equipment suppliers.
- Availability of financial and human resources in companies.
- Customer-supplier relations.
- Demands for environmental performance such as reduced carbon footprint and increased energy efficiency.

For a successful introduction of the ISO 50001 standard, governments can analyze different markets, skills, and approaches that can be utilized (shown in Figure 1) before designing the program.

Further, for a successful introduction of ISO 50001 and positive results of energy conservation programs, governments will need to address the individual situations of companies. The energy efficiency ladder in Figure 2 relates to the awareness of energy issues and readiness within a company to undergo the attitude and organizational change necessary for a successful energy management program outcome. For each step, possible program support actions are listed. An energy management program ideally contains action on all five levels to be successful.

Mandatory Energy Management: Japan

Japan's Industrial Energy Efficiency policy calls for mandatory energy management and is based on the national Energy Conservation Law. This globally unique system provides a mechanism to drive energy management actions at the overall corporate and individual factory levels (Figure 3); the energy management requirements for these levels were defined by a 2008 amendment to this law. Before the amendment, individual factories and workplaces handled energy management.

Business operators, factories, and other workplaces are currently required to (1) develop energy management organizations, (2) measure energy consumption, (3) conserve energy through daily management, and (4) measure annual energy conservation and implement energy conservation measures under medium- to long-term plans.

ENERGY CONSERVATION LAW REQUIREMENTS

At the corporate level, the law applies to businesses with an annual energy consumption of 1,500 kiloliters (kL) or more (crude oil equivalent) at its factories and workplace units. These corporations are required to apply management standards and operational standards, and determine the organization's energy baseline and energy targets. They also submit medium- and long-term plans of each business operator (including franchise)

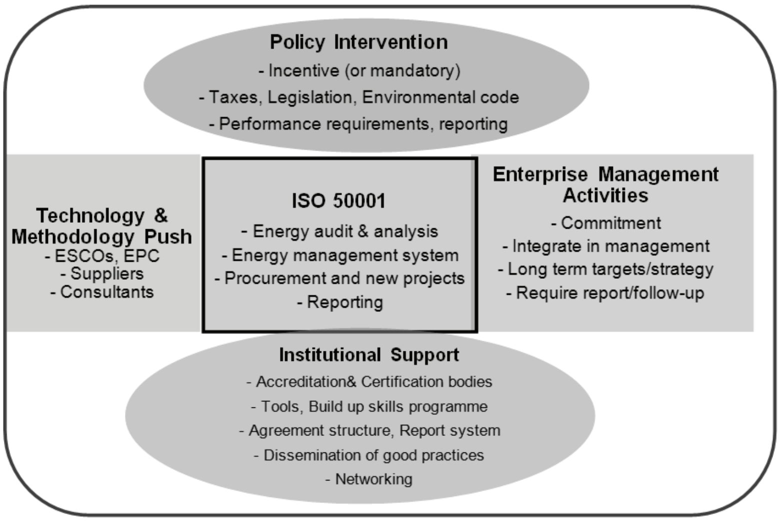

Figure 1. Factors for a favorable ISO 50001 environment.

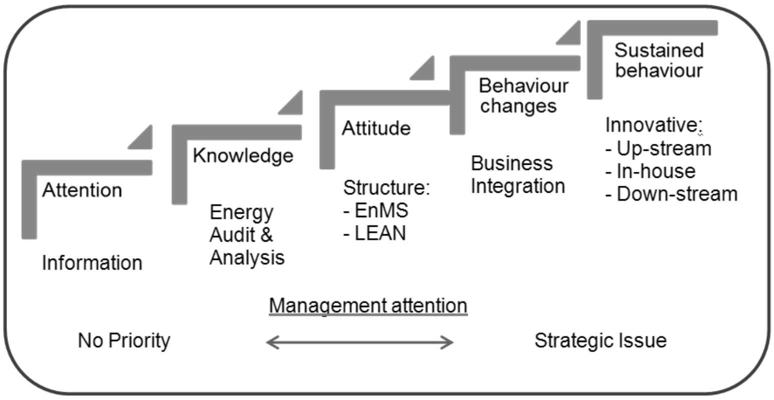

Figure 2. Progression of energy efficiency awareness and readiness to implement the necessary changes.

1. Business operators overall

Annual energy consumption (crude oil converted amount kl)		At least 1,500kl	Under 1,500kl
Classification of business operator		Specified business operator or specified chain business operator	—
Items to be observed		Judgment standards for manufacturing plants, etc. (standards components) ・Set management standards, operational standards based on management standards, measurement records, maintenance inspections, etc.	
Target		Judgment standards for manufacturing plants, etc. (target components) ・Reduce energy unit consumption by 1% or more in the medium to long term ・Attain benchmark indices (only for applicable business lines), etc.	
Obligations	Person to be appointed	Energy Management Control Officer and Energy Management Planning Promoter	—
	Documents to be submitted	Medium to long term plans, periodical reports and notification on appointment of energy management control officers, etc.	
Administrative checks		Guidance and advice, collection of reports and onsite inspections.	
		Instructions for preparation of rationalization plan (failure to follow such instruction resulting in public disclosure or issuance of an order), etc.	—

2. For each manufacturing plant of installation

Annual energy consumption (crude oil converted amount kl)	At least 3,000kl		At least 1,500kl to under 3,000kl
Type designation	Type 1 Designated Energy Management Factory, etc.		Type 2 Designated Energy Management Factory, etc.
Obligations and persons to be appointed	Manufacturing business, mining business, as well as electric power supply, gas supply and heat supply businesses	Other than those described on the left (hotels, schools, etc.)	All business lines
	Energy Manager	Energy Management Officer	

Figure 3. Measures pertaining to manufacturing plants according to the Energy Conservation Law (METI 2011).

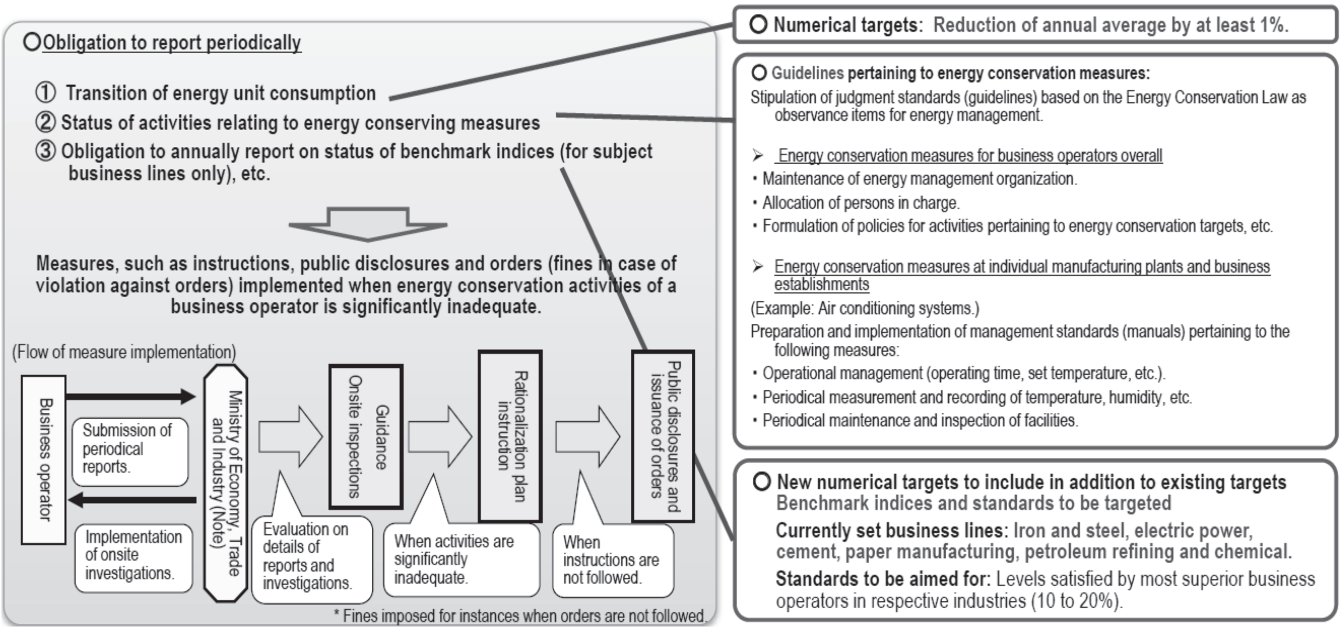

Figure 4. Current regulatory scheme at manufacturing plants (METI 2011).

and periodical reports. In addition, the corporation must appoint an energy management control officer at an executive level and an energy management planning promoter who assists the control officer (Komai 2012).

At the factory and workplace level, the law requires sites to appoint an energy manager that qualifies for the position through examination or attending seminar trainings, depending on the annual energy consumption. Energy managers at the Type 1 facilities (≥3,000 kL of crude oil equivalent annually) must pass a qualifying exam and obtain a certificate of qualification from the Ministry of Economy, Trade and Industry (METI). Energy managers at Type 2 facilities (between 1,500 and 3,000 kL of crude oil equivalent annually) qualify by attending seminars and obtaining a finish certificate from a designated seminar institute (Komai 2012).

In order to secure the implementation of energy conservation activities at designated energy management factories, the administrative sector checks the implementation of energy conservation based on the collection of reports, on-site inspections, and investigations by registered investigation bodies in accordance with factory inspection schemes and examinations of statutory reports (see Figure 4).

ENERGY CONSERVATION LAW IMPLEMENTATION

Policy context

Energy management systems existed in Japan before World War II. For more than the past half century, Japan has flexibly modified and gradually improved these systems in response to situational changes. For example, the initial energy management policy indirectly called for energy conservation promotion by encouraging business operators to make voluntary energy-saving efforts and become more conscious about energy conservation. In response to the two oil crises in the 1970s and the growing needs for global warming prevention measures in the 1990s, the present policy more directly calls for energy conservation by emphasizing the improvement of energy efficiency and the reduction of energy consumption. Japan has thus improved its energy management policy in response to situational changes over more than half of the past century (see Figure 5). Currently, on the basis of energy consumption, about 90 % of the industrial sector and about 50 % (estimated) of the commercial sector are subject to regulations. Meanwhile, government and industry have set targets between them for each industry based on voluntary action plans on the environment. Extracting the characteristics of Japan's Industrial Energy Efficiency Policy is as follows:

- Regulation (Energy Conservation Law enacted in 1979): Upgraded and improved several time in response to social needs.
- Promotion: Tax incentive, subsidies (including for R&D), preferential interest rate.
- Voluntary action (by private sector).

Resources available for companies

The Energy Conservation Center, Japan (ECCJ) and the New Energy and Industrial Technology Development Organization (NEDO) are two of the organizations supporting Japan's energy efficiency policy for industry, with various industrial bodies (JISF, FEPC, PAJ, JCASSOC etc.) carrying out supportive activities such as information sharing and network building (Noda 2013).

ECCJ implements a certification examination for Type 1 energy managers and training for the other energy managers based on the qualification system in the Energy Conservation Law. Supportive measures (pamphlets, factory surveys, award systems, presentation of successful cases, symposiums, etc.) and financial measures (subsidies, tax breaks, etc.) are implemented based on guidance and advice in the Energy Conservation Law (Noda 2013).

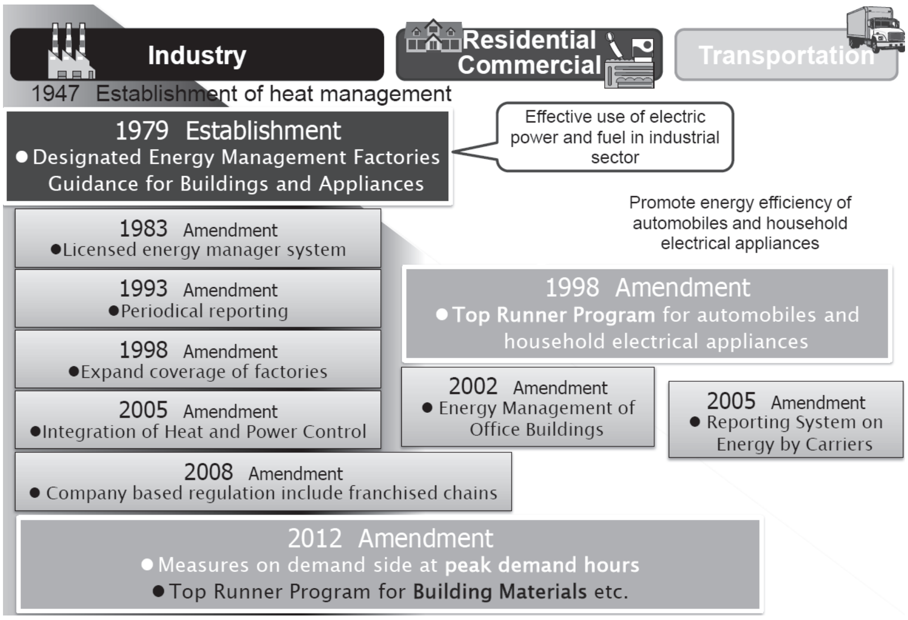

Figure 5. Historical development of the Energy Conservation Law (Nishiyama 2013).

RESULTS

The actual figure of the mandatory energy management based on the Energy Conservation Law (2005 & 2008 amendment) was a total of 2.73 million kL of crude oil equivalent savings and the 10.21 million tons carbon dioxide emissions reduction in fiscal year 2010 (GWPH 2013). However, even though energy management has become embedded in energy-intensive industries and large corporations, it has been pointed out that economically beneficial energy efficiency measures have not been implemented at small and medium-sized corporations, factories and workplaces (Kimura and Noda 2014).

Drivers for industry participation/challenges to program implementation or participation and solutions

According to the questionnaire survey of the "Energy Management Policy Actual State Survey in Japan[1]" (IEEJ 2010), factors that obstruct or promote energy management in business establishments include the following:

- Top obstructive factors: "fund shortage," "labor shortage, etc.," and "risk of adverse influence on the manufacturing process".
- Top promotional factors (system and institutional): "instructions from the management layer, etc.," "reports on the state of energy use," and "standardization of energy management measures" (see Figure 6).
- Top promotional factors (external factors): "regulations by laws and ordinances, etc." and "high energy prices".

The survey found that effective factors to promote energy management include energy managers that recognize top-down instructions from management, reports on the state of energy use, and standardization of energy management measures. However, the necessary resources (such as labor, goods, and funds) are not always allocated for energy management actions and these actions are obstructed by the risk of adverse effects on the manufacturing process. The survey also found that energy managers view tighter laws and regulations and a rise in energy prices as necessary to promote energy management actions.

As for the energy management actions implemented by business enterprises, some companies exceed the government's expectations, while other companies cannot meet them. Large companies respond nimbly from the viewpoint of compliance, while small and medium-sized companies give more priority to other management challenges, such as cost reduction and productivity increase, than to compliance (see Figure 7).

Lessons learned

The Ministry of Economy, Trade and Industry (METI) conducts evaluation of reports and investigations that may be considered in any future legislative changes. Japan has improved its energy management policy in response to situational changes over more than half of the past century. Developing countries can build on Japan's policy changes and create energy conservation promotion systems without consuming as much time. Of course, developing countries have various social, economic, and political situations and various energy supply/demand characteristics. Japanese systems cannot necessarily be transferred to all developing countries without modifications. From the viewpoint of "the advantage of backwardness[2]," however, it may be useful for future energy conservation policy to create systems meeting specific national conditions based on Japan's experiences. Given Japan's experiences, the following institutional proposals may be useful for any country (Ogawa et.al 2010):

1. This survey was conducted as a questionnaire survey for energy managers in Type 1 designated energy management factories (5,758 establishments) in the industrial sector in Japan (2009); number of valid responses: 1,708 (29.66 %).

2. The advantage of backwardness theory is an economic growth theory proposed by British economist Alexander Gerschenkron, meaning that developing countries can take advantage of technologies and knowledge developed by industrial countries and their development policy experiences from early stages to achieve rapid economic development (Ogawa et.al 2010).

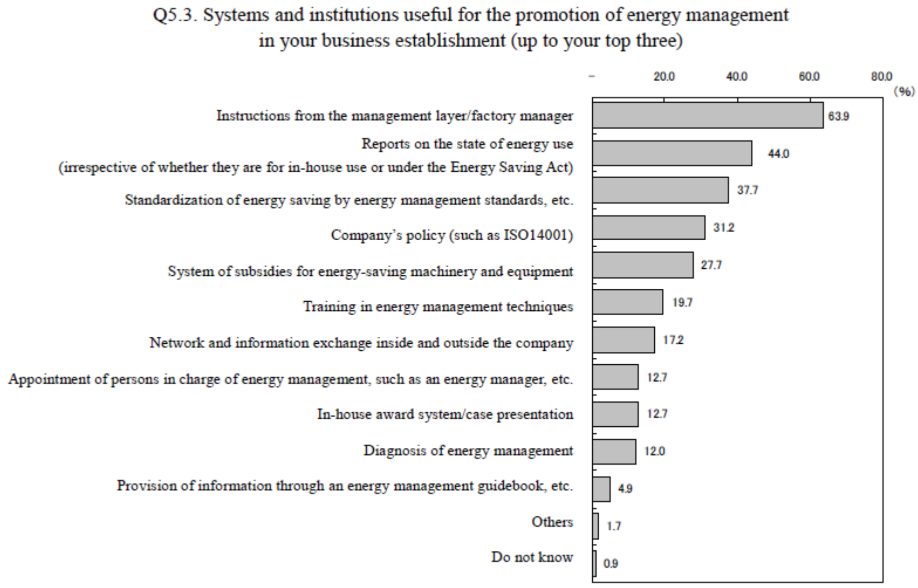

Figure 6. Systems and institutions useful for energy management promotion (IEEJ 2010).

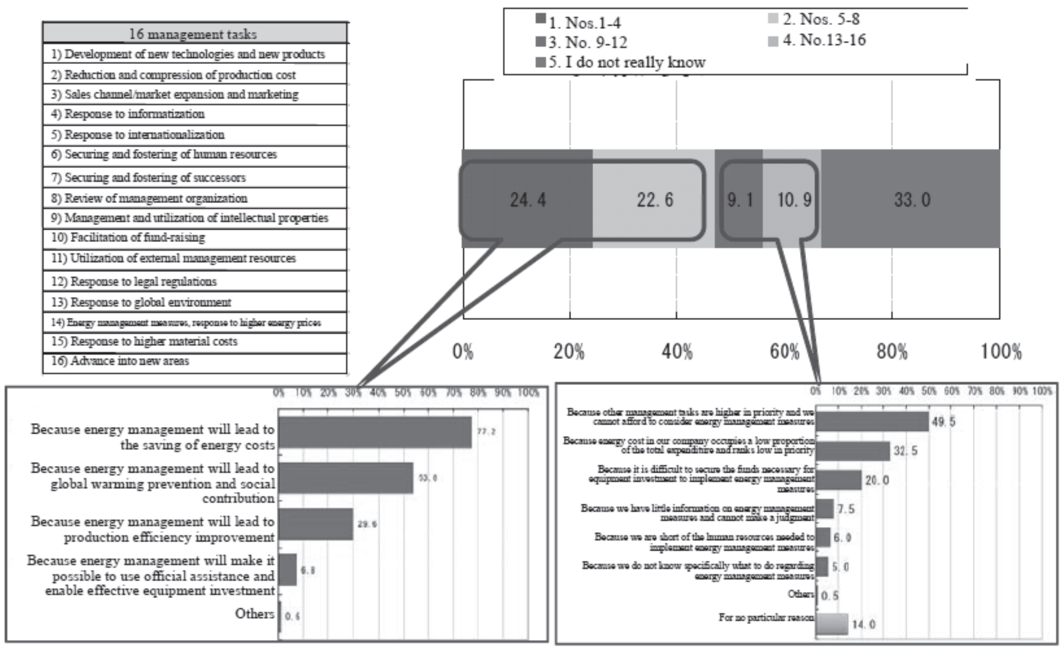

Figure 7. Priority order of energy management measures in small and medium-sized companies (Prepared by IEEJ from METI 2009).

- Securing energy conservation measures during economic growth.
- Designing various systems[3] to produce synergy effects.
- How to set targets – creation of indicators comparable with other companies.
- Frequent dissemination and enlightenment.
- Systems to improve workplace motivation – creation of incentive systems.
- Electronic reporting system.

Another important outcome is that municipalities are also calling on businesses to implement energy management. Tokyo's Metropolitan Government initiated a city-wide global warming countermeasure plan system, which lists basic energy management actions for business establishments and requires businesses to develop plans for implementing these actions. The businesses then report their progress every year. Tokyo's CO_2

3. The mandatory energy management system under the Energy Conservation Law and multiple similar systems (including the calculating, reporting and announcing system under the Act on Promotion of Global Warming Countermeasures, the Keidanren Voluntary Action Plan on the Environment, and Tokyo Carbon Reduction Reporting Program).

emissions are equivalent to that of Norway or Switzerland. Similar systems have been introduced or prepared in China, India, South Korea, Viet Nam, Thailand, Indonesia, and Malaysia.

The aforementioned Tokyo Metropolitan Government's global warming countermeasure plan system has possibly discovered the energy efficiency potential, though it cannot simply be evaluated because of the effects of the Lehman Shock and the difference in industrial structure. The system shows the major items to be implemented, and detailed guidance is given to factories in working out a countermeasure plan. Such an assistance technique is an important suggestion in implementing assistance not only for small and medium-sized companies lagging in energy management measures but also for developing countries.

The Energy Management Action networK (EMAK) under IPEEC builds networks of national policy makers and industrial practitioners to share energy management best practices, policies, and measures internationally. EMAK implements the following three activities as initiatives to improve the industrial sector's capabilities for energy management: information sharing, network building, and supporting Implementation (Noda 2013). The member countries are Japan, China, Australia, and the United States.

Example of Tax Incentive Program: Sweden

The 2003 EU directive on minimum rates of taxation on energy lead to a new tax on electric power in Sweden: 0.5 euro/megawatt-hour (MWh) for industrial companies, with the exception of certain manufacturing processes. The law also allowed for other policy measures giving the same or better result compared to the tax (European Union Council Directive 2003/96/EC). In 2004, Sweden introduced a new law for energy efficiency in the energy intensive industry and the Swedish Energy Agency responded by introducing the Program for energy efficiency in energy intensive industries (PFE) on 1 January 2005. PFE is a voluntary economic policy instrument directed to energy-intensive industrial companies in Sweden. Companies who join the PFE are eligible for a tax reduction during the five year program, provided that they meet the requirements stated in the law. The core of the program is certification to the energy management system (EnMS) standard, ISO 50001. Before the publication of ISO 50001 in 2011, the EnMS requirement included the Swedish Standard SS 637750 and EN 16001.

PFE REQUIREMENTS

To be eligible for participation, companies shall meet four criteria: (1) operate within the industry sector, (2) use electricity in production processes, (3) able to meet the requirements of the program, and (4) classified as energy intensive. In Sweden, the industrial sector uses 38 % of the total energy – with more than 80 % of the use coming from energy intensive industry. The PFE program covers about 90 % of the energy use in the energy intensive sector but only 10 % of the number of companies. Companies that are not participating in the PFE include a large number of small and medium enterprises (SME), refineries, and some chemical and steel companies (which already have a tax exemption for energy).

Components of the PFE cycle

The program runs in five year cycles for each participating company (Figure 8). More than 90 % of current PFE participants are undergoing a second cycle. The requirements for the second cycle are identical to the first. The founding idea of PFE is that the program shall provide tools to establish a structure for ongoing energy management within participating companies. The expectation is that this structure will remain in each company after the program has ended and continue to facilitate and improve the energy efficiency work.

Energy review

All the companies participating in the PFE shall perform energy reviews that are based on energy mappings and energy balances and consider electricity, fuels, and heat. The energy reviews should also address essential variations in the energy use, connections between production processes and supporting systems, and assessment related to considerable changes in both short- and long-term energy use as a result of planned production process changes.

The company uses the energy review as the basis for identifying the energy efficiency measures that it will implement. The energy review is also an important prerequisite for the introduction of a standardised EnMS. Data and results from the energy review are reported to the Swedish Energy Agency. The full energy review is only reported if the Swedish Energy Agency requests it.

Energy management system

During the first two years, participating companies implement a standardized EnMS (ISO 50001) that must be certified by an independent certification body within the first two years. Within the remaining three years of the program period, the company must continuously improve its EnMS and submit documentation from the third party certification to the Swedish Energy Agency. The Agency also cooperates with the certification bodies and SWEDAC (the Swedish Board for Accreditation and Conformity Assessment) to verify that

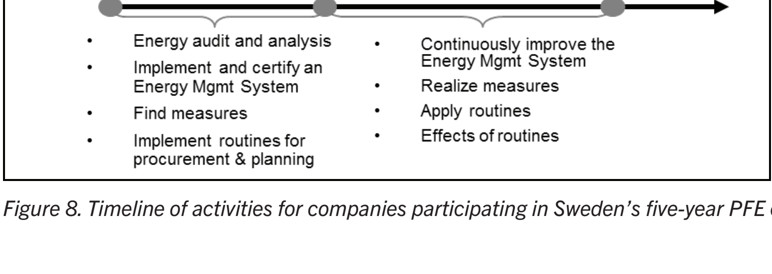

Figure 8. Timeline of activities for companies participating in Sweden's five-year PFE cycle.

the certifications and re-certifications continue according to plans.

Procedures for purchasing and planning

The PFE stimulates the inclusion of life-cycle cost considerations in procurement and investment decisions. In the first two years of participation, enterprises must introduce procurement routines for energy-intensive electrical equipment and routines for energy-efficient project planning. These routines should be based on LCC-methodology (Life Cycle Cost). The certifying bodies ensure that the EnMS has implemented the purchasing and planning procedures. The companies must also report the effects from these specific procedures.

Energy measures

Due to PFE's emphasis on electricity, the companies must focus on electricity reduction when reviewing and reporting energy measures. However, companies may also identify possible measures for fuels and heat during the energy review. The PFE allows companies to report measures related to fuels and heat to the Swedish Energy Agency, but does not require the companies to implement them.

PFE IMPLEMENTATION

Policy context

Although the program was initiated by the EU 2003 energy tax directive it has become an important tool to achieve the targets for energy efficiency in EU directives and national plans. The EnMS provides a holistic perspective on energy issues and can encourage participants to use renewable sources of energy, thereby reducing fossil fuel use and increasing energy production.

The PFE easily incorporated EnMS certification due to Sweden's existing EnMS certification infrastructure, established in 2003 with the first national EnMS standard, SS 637750. The certification infrastructure remained in place for companies that later sought EnMS certification to EN 16001and most recently, certification to ISO 50001 as part of the PFE.

SWEDAC, the only accreditation body in Sweden, is a government authority for quality and safety. To date, SWEDAC has accredited five certification bodies to certify EnMS according to ISO 50001, though companies may use certifications that are accredited to ISO 50001 in other EU countries. The certification bodies are for-profit companies. After the publication of ISO 50001 in 2011, certification bodies that were accredited to EN 16001 underwent a transition period to obtain accreditation to ISO 50001.

Resources available for companies

The PFE provides manuals to guide implementation, including topics on energy mapping and analysis, life-cycle costing, procurement, and new projects routines. The PFE also convenes networks of participating enterprises and holds meetings at regular intervals at the national and regional levels.

RESULTS

The PFE exceeded the government's expectations for electrical efficiency improvement. The Swedish Energy Agency and the Swedish Government originally projected electricity savings of around 0.5 terawatt-hours (TWh), which is equivalent with the tax reduction. Swedish companies reported a total of 1.45 TWh of electricity savings with an average payback period of 1.5 years. The government credits this success to the synergy of the PFE program with price signals, including effects from taxes and the CO_2 trading scheme.

Driver(s) for industry participation

Experiences with the PFE showed that the tax refund is a major driver for companies to implement and certify their EnMS, *but it was not the only source of motivation*. Nevertheless, the tax refund created the entry point for many companies to participate, but the EnMS generated benefits beyond the incentive. Companies also benefited from working in a more structured way and reaching a higher awareness of the energy savings potential. In some cases, the tax refund enabled the companies to hire an energy manager. In addition to energy-related benefits, the companies also identified other environmental and occupational hazard measures through the EnMS implementation process. Staff satisfaction and customer relations also improved.

Currently, 90 companies are participating in the second five-year PFE period and will be finalized for 90 % of the participants during 2014. An evaluation of the 2-year reports from the participants indicates a level of results similar to the first PFE period. This indicates that the effect of the energy price signal is not as strong (as expected from the economist model), and that companies are implementing measures beyond the low hanging fruits.

Challenges to program participation

The PFE tax exemption was very appealing to company management and generated substantial interest in participating. The main problem today is the state aid guidelines within the European Union were recently modified and no longer allow the tax exemption. No new participants will be accepted and the program ends during 2014 for most of the companies.

Another challenge involved resource limitations (in terms of cost, knowledge, and staff) and the ability to engage SMEs. Only a third of the companies in the program are SMEs.

Lessons learned

Key factors that influenced the success of the Swedish program have been the systematic approach provided by the EnMS, the program's ability to enhance the status of the energy efficiency issue, and the sharing of best practices and experiences through network meetings. Experience shows that specified requirements and clear deadlines ensure that energy efficiency is not overlooked for other acute issues. Through energy review and analysis, the EnMS creates the structure needed for planning, implementing, realizing, following-up and reviewing the progress, as well as securing continuous improvements with regards to energy-related issues.

Participating companies have cited the following benefits:

- **Economic savings** due to: lower energy consumption, an increased level of systematic work in general, and the tax refund for companies that take part in the PFE program.
- **Reduced environmental impact and improved supplier status**, which may result from customer demand for sustainable business practices. For business-to-business prod-

ucts, the choice of supplier can be based on the environmental performance of the product.

- **Increased knowledge, awareness and control** of the company's energy use, which makes it easier to identify areas for improvement and to make well-founded decisions (e.g., when purchasing new equipment).
- **More effective implementation and faster results**, even if the company previously took efforts to reduce their energy use. The EnMS often **speeds up the process and makes it better structured**.
- By doing an energy review, many companies quickly find areas for improvement, often small investments that give big savings.
- **Improved knowledge-sharing among different company units** because the EnMS sets up a structure for sharing knowledge and experiences, which facilitates identification of energy-savings opportunities and finds bigger savings.
- **Energy issues are included at an early stage** in various planning processes.
- An EnMS puts energy issues on the table for the top management, which **raises the acceptance and status of energy efficiency work** throughout the organization. The EnMS ensures documents and routines are followed up and updated.
- By working with energy issues continuously and in a structured way, energy **becomes a part of the daily agenda** and the awareness of its importance is raised.
- Thanks to the recurrent revisions of the EnMS, the companies can get good **external advice** from an independent certifier.

Benefits for government

For the Swedish Energy Authority, the introduction of PFE turned a difficult information task into a successful communication project. The participating companies were willing to take part in national and regional network meetings concerning energy efficiency. The knowledge gathered from these meetings, including experiences from organizational change and thousands of energy efficiency measures, has been able to be transferred to stakeholders outside the group of participants.

A well organized energy management program is a powerful tool to achieve national targets for energy efficiency and the climate issue in synergy with price signals and general policy measures. In a country such as Sweden that has a large sector of energy-intensive companies present on the global market, a tax incentivised energy management program helps these companies achieve targets while still maintaining their competitiveness.

Market-Based Certification Program: United States

The United States Department of Energy (DOE) administers the Superior Energy Performance™ (SEP) certification and recognition program as a market-based approach to spur uptake of the ISO 50001 standard and improve energy efficiency in industrial facilities. SEP builds on ISO 50001 and establishes a transparent system for certifying improvements in energy performance and management practices.

SEP CERTIFICATION REQUIREMENTS

ISO 50001 energy management system

SEP certifies industrial facilities that implement an EnMS that conforms to ISO 50001 and meets additional performance requirements, including attainment of established energy goals – as specified in the ANSI/MSE 50021 national standard. While ISO 50001 does not prescribe specific performance criteria or results with respect to energy performance (Scheihing et al. 2011), SEP goes further to define performance targets and how to verify them.

Energy performance improvement

SEP encourages participation among facilities of all sizes and levels of experience with energy management. SEP offers silver, gold, and platinum designations based on the level of energy performance improvement attained (Figure 9). Applicants may choose between two pathways to reach one of these designations. The Energy Performance Pathway requires facilities to achieve a defined percentage of improvement in their energy performance over a period of three years, as compared to a

<table>
<tr><th colspan="2">Performance Characteristics</th><th>Silver</th><th>Gold</th><th>Platinum</th></tr>
<tr><td rowspan="2">Energy Performance Pathway</td><td rowspan="2">Energy Performance Improvement</td><td colspan="3">Meets a specified energy performance threshold over the last 3 years:</td></tr>
<tr><td>5%</td><td>10%</td><td>15%</td></tr>
<tr><td rowspan="2">Mature Energy Pathway
Uses Best Practice Scorecard to earn points for energy management best practices and energy performance improvements.</td><td>Energy Performance Improvement</td><td colspan="3">Meets 15% energy performance improvement threshold over the last 10 years.</td></tr>
<tr><td>Score on Best Practice Scorecard (out of 100 total points)</td><td>• At least 35 points
• Minimum of 30 points for energy management best practices</td><td>• At least 61 points
• Minimum of 40 points for energy management best practices and 10 points for energy performance (beyond 15% over the last 10 years)</td><td>• At least 81 points
• Minimum of 40 points for energy management best practices and 20 points for energy performance (beyond 15% over the last 10 years)</td></tr>
</table>

Figure 9. Performance criteria for achieving SEP certification at silver, gold, or platinum levels.

baseline year (U.S. DOE 2014). Facilities with more experience with energy management may face greater challenges in achieving the same percentages. SEP provides the Mature Energy Pathway as another route to certification by assessing a longer performance period of ten years. The Mature Energy Pathway takes into account longstanding EnMS practices and continued efforts to institutionalize performance best practices using the SEP *Industrial Facility Best Practice Scorecard* (Scheihing et al. 2011). Facilities that apply for SEP certification must undergo an audit from an American National Standards Institute (ANSI) – ANSI-ASQ National Accreditation Board (ANAB) Accredited Verification Body.

Verification

Industrial facilities seeking SEP certification will need to use an audit team from an ANSI-ANAB Accredited SEP Verification Body to confirm that have met the requirements of ISO 50001 and SEP. This third-party verification provides independent confirmation of energy performance achievements and commitment to managing energy use. The verification is codified in the *Superior Energy Performance Measurement and Verification Protocol for Industry*, which defines the methodology to: 1) verify the results and impact of a facility's implementation of ISO 50001; 2) quantify energy savings from specific measures or projects; and 3) document energy performance normalized to production and other relevant variables (U.S. DOE 2014).

SEP Verification Bodies are required to obtain ANSI-ANAB accreditation to the ANSI/MSE 50028 standard, which defines the requirements for organizations that conduct SEP audits. ANSI/MSE 50028 is based on the ISO 17021 standard that sets requirements for bodies that audit and certify management systems. The SEP Verification Bodies select certified SEP Lead Auditors and SEP Performance Verifiers to audit a facility interested in SEP certification. The Verification Body then determines whether the applicant meets SEP requirements (U.S. DOE 2014).

SUPERIOR ENERGY PERFORMANCE™ IMPLEMENTATION

Government role

DOE initiated the development of SEP in 2007 in partnership with the U.S. Council for Energy Efficient Manufacturing (U.S. CEEM), ANSI, and ANAB. The U.S. CEEM, primarily composed of energy managers from prominent industrial companies, provided the feedback necessary to ensure that SEP is a practical, achievable program. DOE worked closely with U.S. CEEM members and other forward-thinking companies in demonstration projects to test SEP program requirements at several industrial facilities throughout the United States. These demonstration projects provided DOE with feedback to refine SEP standards and resources, and also assess the cost-effectiveness of SEP implementation and certification. DOE actively collaborated with standards developers in the ANSI process to develop the SEP standards (ANSI/MSE 50021, ANSI/MSE 50028, and their normative references).

Resources

To help facilities prepare for SEP certification, a professional credential was created for Certified Practitioners in EnMS to assist facilities with implementing ISO 50001 and meeting SEP requirements. A facility may apply for SEP certification without engaging a Certified Practitioner in EnMS, but these individuals are available to provide assurance that a facility is properly implementing the standards. Companies may also choose to send their staff to receive the Certified Practitioner in EnMS training, even if they do not pursue the certification exam.

DOE also created technical resources and software tools to assist facilities with implementing SEP. For example, the DOE eGuide for ISO 50001 contains step-by-step guidance for ISO 50001 implementation with forms, checklists, templates, and examples for each step. The DOE Energy Performance Indicator Tool helps facilities establish a baseline of energy consumption and track the changes in performance over time (U.S. DOE 2014).

RESULTS

As of January 2014, seventeen facilities have achieved SEP certification – all in the United States with the exception of one Canadian facility that was supported by the Canadian government through GSEP (U.S. DOE 2014). Each of these facilities achieved SEP certification through their participation in the demonstration projects with DOE, though SEP is now open for any U.S. industrial facility to apply for certification.

SEP implementation has yielded impressive results and enabled facilities to realize greater persistence in energy savings and higher returns on energy efficiency investments. DOE examined the business value of SEP certification through in-depth interviews with nine SEP-certified facilities. These nine SEP-certified facilities saved $87,000 to $984,000 annually using no-cost or low-cost operational measures. On average, they achieved a 10 % reduction in energy costs within 18 months of implementing SEP. In addition, facilities with annual energy costs greater than $1.5 million enjoyed payback periods of less than two years. Analysis of data showed that all nine facilities achieved greater energy savings percentages during participation in the SEP program than beforehand (Therkelsen et al. 2013).

Drivers and benefits

Several SEP-certified companies offered testimonials on the benefits of certification:

- SEP helps facilities justify energy expenditures to their management, and the resulting cost savings from energy projects allow them to reinvest those savings into additional projects.
- The energy targets defined by SEP highly motivates industrial facilities and enables facilities to demonstrate their achievements.
- Third-party verification improves the company's public image and shines a positive spotlight on the participating facility.
- Certification provided confidence in the energy savings and calculations and enhanced the value of the EnMS.
- Verification provides a performance metric that helps to substantiate the actual savings and giving credibility to any savings claims (U.S. DOE 2014).

Challenges and next steps

The analysis of nine SEP-certified facilities identified challenges that facilities face to SEP implementation. The largest cost to an industrial facility was the internal staff time to implement the ISO 50001 EnMS and prepare for the SEP audit. Other large costs included external technical assistance, metering and monitoring equipment, and the cost of the certification audit (Therkelsen et al. 2013).

To help reduce the cost of SEP certification, DOE is currently exploring methods to make certification more cost-effective through the DOE Industrial SEP Accelerator. The Accelerator is testing how to implement SEP at an enterprise-wide level to help companies benefit from economies of scale. DOE is also partnering with utilities and energy efficiency program administrators to test SEP as a program offering for industrial customers in their service territories.

Conclusions

ISO 50001 and similar EnMS standards enable organizations to engage staff at all levels to assess and better manage energy on an ongoing basis. An effective energy management program should support a wide range of energy-saving strategies through continuous improvement, process development, improvements in existing equipment, and higher capacity in existing lines. An ISO 50001 certification program mainly gives results in these areas. However, an enterprise cannot expect that EnMS implementation by itself will immediately generate large energy savings – it is simply a tool. To achieve greater impact, the EnMS needs to become an integrated part of enterprise management and an innovative approach will be increasingly valuable in the relations with suppliers and customers as well as with public stakeholders (e.g., district heating or similar). A national EnMS program can respond by stimulating enterprises to be proactive by focusing the benefit of EnMS in business development, and facilitating cooperation with public and other stakeholders. .

Governments that seek to promote EnMS and ISO 50001 uptake should consider a variety of factors in program design, such as those mentioned in Figure 1 – policies, institutional support and infrastructure, enterprise management activities, and technology and methodology services. A balanced approach of these factors can help motivate different types of enterprises, though governments can emphasize particular areas that are appropriate for their country's conditions.

Experiences from the three national programs described in this report indicate that mandatory programs and attractive incentives can quickly generate uptake in an EnMS program, as experienced in Japan and Sweden, respectively. In Japan, mandated energy management generated substantial energy savings at large regulated corporations, and a majority of the companies exceeded government expectations. In comparison, other corporations, including small- and medium sized corporations, that are also subject to the same mandate typically have not integrated energy management into their business practices as much as the larger corporations. For further promotion, the Japanese government has implemented various support measures and financial measures. In Sweden, the tax incentives created an entry point for many enterprises to participate, and the companies eventually found greater benefits that improved their business practices more broadly. A market-based program, such as the SEP certification in the United States, would need to apply more effort into motivating enterprises to participate. Market-based program in general should concentrate on presenting a compelling business case to stakeholders and building capacity in the supporting infrastructure, such as certification bodies, training organizations, credentialed consultants, tools, and technical assistance. Although a market-based program would need to apply effort to generate increased uptake, participating enterprises will be more apt to integrate the EnMS in regular management practices.

Multilateral initiatives such as CEM and IPEEC provide forums for countries to share experiences, exchange lessons learned, and collaborate on actions to strengthen national efforts to promote EnMS implementation. Early adopters will generate good examples, tools, and partnerships for expanding upon their knowledge base. Countries focusing to build skills and promote the business case for EnMS implantation can challenge the early adopters to strengthen their tools and resources. Collectively, these efforts will help countries foster continual energy improvement in the industrial and commercial buildings sectors and help meet national energy and climate mitigation goals.

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