

Promoting Energy Management Systems through Energy Efficiency Programmes, Incentives and Support – Lessons Learnt from Evaluations in Denmark, Ireland and Sweden

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Abstract

Denmark, Sweden and Ireland have included standards for energy management systems (EnMS) as a core requirement of energy efficiency agreements between government and industrial companies. Lessons learnt from evaluations in these countries shows that proper adoption of EnMS, coupled with a carefully designed mix of incentives and support systems, and that are embedded within energy efficiency agreements, greatly facilitates the continuous identification and realisation of energy saving opportunities. EnMSs are key to identifying opportunities. With the adoption of EnMS, energy savings far exceed what companies had been able to achieve with the agreements alone. Evaluations of the three energy saving agreements show that companies that have adopted EnMS often realise energy savings beyond the agreement's expectation. The evaluations not only rely on understanding the quantitative impacts of the package, but also on qualitative indicators about how EnMS helped participants to change practices within their own company for achieving continuous improvements.

Introduction

Energy Management Systems (EnMSs) are a means by which organisations establish the systems and processes necessary to achieve operational control and continual improvement of energy performance. Companies can use EnMS to demonstrate that they are following robust energy management practices that will result in continuous improvements and benefits to their business, and help them to achieve energy saving policies. The international standard developed by the International Standardisation Organisation ISO 50001 released in 2011 has been welcomed by governments and companies alike as a promising tool to enable companies to save energy, reap productivity gains, increase profits and be more competitive as well as achieve public policy goals of greenhouse gas (GHG) mitigation, energy efficiency and energy security. Governments around the world are now considering how best to encourage companies to implement EnMS through policies and programmes.

While many countries may have formally adopted standards for EnMS through their national standardisation bodies, far fewer have integrated EnMS (standardised or not) into government programmes. Those that have, or are planning to, include Australia, China, Denmark, Finland, Germany, Ireland, Republic of Korea, the Netherlands, Sweden, the United Kingdom and the United States.

EnMSs are increasingly recognised as a means of overcoming and reducing commonly known informational, institutional and behavioural barriers to energy efficiency. It is now widely understood that much industrial energy efficiency is achieved by changing how energy is managed as well as by installing new technologies. By following the processes and procedures outlined in an EnMS, upper management and energy management staff become involved that allow energy efficiency issues to gain a greater profile and priority within the organisation.

An EnMS is also key for identifying and prioritising the full range of opportunities that would otherwise not be uncovered through more *ad hoc* processes. It does so by requiring companies to provide baseline energy use data, track energy use, define significant energy uses, prioritise key performance indicators (KPIs), set internal targets, identify opportunities and develop and implement energy conservation plans (Gudbjerg 2011, DOE 2011). Companies are also able to optimise industrial systems and monitoring system efficiency to ensure that equipment and facilities are properly operated and maintained and therefore achieve projected energy savings (UNIDO, 2011). Finally, EnMS can help to actively manage energy costs and document savings for internal and external use, such as to apply for financing and for compliance with government schemes.

In order to understand how governments can effectively promote companies to adopt EnMS, this paper focuses on three countries that have long-standing experience with doing so - namely Denmark, Sweden and Ireland. The report does not evaluate each of the policies according to the authors' own evaluation. Rather, it collects and synthesises evaluation reports and analyses in order to draw out what are the key activities and programme components. The authors then present their conclusions based on these evaluations on what are the most important features of government programmes to promote effective adoption of energy management by companies. These lessons are intended to help policy makers in other countries design and implement their own energy management programmes.

Methodology

This paper draws on and synthesises evaluations of Denmark, Ireland and Sweden's energy management programmes (EnMPs). EnMPs are defined as government-led initiatives to promote the uptake of energy management systems. This section briefly touches upon the various evaluation methodologies. The following sections summarise the results of analysing the evaluations of the three countries' programmes, including company experiences.

Different types of evaluation resources were used to draw out the lessons learned and the successful ways of promoting effective adoption of EnMS in the three countries. Firstly, governmental evaluations were used (for Sweden see Swedish Energy Agency (SEA), 2011b, for Denmark see DEA, 2002a, DEA 2002b, for Ireland see Sustainable Energy Authority Ireland 2003 and 2010). These reports focus on outlining the quantitative results of the programme in terms of energy and cost savings, uptake and compliance rates, as well as qualitative feedback from companies about their experience with the programme.

Secondly, academic papers of individual programmes were analysed to complement the studies with a more in-depth insight and using various methodologies employed by the authors (see Christoffersen 2006, Ericsson 2006, Petersson et al. 2011, Stenqvist & Nilsson, 2011, Gudbjerg, 2011). These reports take a range of approaches to evaluating the policies including: theory-based policy evaluation (see Ericsson 2006)¹ and assessments of target achievement, cost effectiveness, and net effect. The analyses also use interviews with governmental staff and company participants as well as inferences through statistical models, calculations and estimates (see Stenqvist & Nilsson 2011, Cahill and Gallachóir 2011). Finally, comparison studies of the three countries IEE programmes are reviewed (Goldberg, Reinaud & Taylor 2011, Gudbjerg 2011, and Reinaud, Goldberg & Rozite 2012).

¹ For further information on the approach by *Active Implementation of the proposed Directive on Energy Efficiency* or AID EE, see <http://www.aid-ee.org/policy.htm>

Energy Management Systems Implementation

The governments of Denmark, Ireland and Sweden, through voluntary industrial energy efficiency agreements, promote the implementation of EnMS. These are called Denmark's Agreement on Industrial Energy Efficiency (DAIEE), the Program for Energy Efficiency in Energy-Intensive Industries (PFE), and the Energy Agreements Program (EAP, which is a subset of the Large Industry Energy Network or LIEN) respectively.

Under the voluntary EnMPs of the three countries analysed in this paper, it is mandatory for participants to implement standardised EnMS. Denmark has had mandatory EnMS adoption, through the voluntary programme, in place since 2001. Sweden and Ireland also introduced similar EnMS standards requirements, in 2004 and 2006 respectively, within their voluntary programmes.

In each case, the three countries began mandating the use of their national standards in the absence of any internationally recognised standard: DS2403 in Denmark, SS 62 77 50 in Sweden, and IS393 in Ireland. In 2009, upon release of the European standard EN 16001, participants were required to adopt the Europe-wide version. They are now transitioning towards ISO 50001. The clauses and provisions of each standard are broadly compatible and do not seem to have posed any issues for companies in implementing each standard.

The reason for mandating EnMS, and other complementary program elements of the voluntary agreements (described below), was to overcome barriers to EE projects and improvements. In Denmark, the identified barriers include information barriers, and low awareness of energy efficiency at management level (Ericsson, 2006). In Sweden, lack of time, slim organisation and poor access to capital are frequently mentioned barriers for EE, which the Swedish programme targets (Petersson et al. 2011).

The following section explores and compares EnMPs, and the drivers, incentives and support mechanisms that make up a successful EnMP for effective EnMS adoption and maximising energy saving opportunities, implementation and results.

Energy Management Programmes underpinned by Voluntary Agreements

Experience has shown that the market uptake of EnMS is correlated with government-led programmes to stimulate and encourage companies to adopt EnMS (see McKane et al., 2009). In Denmark, Sweden and Ireland, energy management requirements are underpinned by and are a cornerstone of, their voluntary energy efficiency agreements between enterprises and the government. Table 1 below outlines the major elements of these programmes, including the date of mandatory EnMS adoption, participation, coverage and impacts. The Danish, Irish and Swedish programmes share the common feature in that programme participants need to demonstrate continuous improvements in energy efficiency.²

² The target setting approaches are somewhat different. In Ireland and Sweden, companies can determine their own internal targets through the EnMS implementation process. In Denmark, however, these targets are negotiated with the government. Companies submit a proposal outlining their energy policy and targets and how the company intends to reach these targets (Reinaud, Goldberg & Rozite 2012).

Table 1. Voluntary agreements & EnMS standard

	Denmark	Sweden	Ireland
Date of mandatory EnMS	2001	2004	2006
Programme	DAIEE	PFE	LIEN and EAP ³
Participation	300 companies as of 2011	103 companies, 240 sites (30% are SMEs) as of 2011	85 companies, 100 sites as of 2011
Scope of Agreement⁴	Before 2010: all energy sources. Since 2010: electricity only	Electricity only	All energy sources.
Final energy/electricity demand covered by EnMS as a proportion of total industrial demand	65% energy demand in 2005 (77 PJ in 2005 out of total 116 PJ).	30TWh 55% industrial electricity demand	19 TWh 50% industrial energy demand
Proportion of total energy/electricity use	13% total energy demand as at 2006	20% total electricity demand	LIEN participants make up 39% of total industry primary energy
Programme goal	No quantified target but a CO ₂ reduction estimate of 1996-2005 of 6% among participants, equivalent to a reduction 3% of total industry	0.6 TWh/year in first phase 2004-2009.	Stimulating energy efficiency activity within the largest energy consumers that may not otherwise occur, or not occur within the same timescale or to the same scale of potential without the programme
Energy savings achieved	Typical savings of 10-15% were observed during the first years of EnMS implementation. Estimates of 2.7% annual savings. Estimates of 1.3 PJ (360 GWh) for 1996-1999 and 1.1 PJ (312 GWh) for 2000-2003 ⁵	Gross annual electricity savings of 1.45 TWh oer year (1 st phase of PFE 2004-2009) or 5% savings over 5 years.	Over a 15-year period, average energy savings of 2% per year have been achieved in the wider LIEN programme. LIEN members achieved 5.2% improvement in energy efficiency in 2008.

Sources: Björkman and Petersson, 2011, Cahill and Gallachóir 2011, Christoffersen et al. 2006, Gudbjerg 2011, DEA 2002b, Ericsson 2006, Petersson 2006, Petersson et al. 2011, O'Sullivan 2011a, Reinaud, Goldberg & Rozite 2012, SEAI 2010, Stenqvist et al. 2011, Price, de la Rue du Can & Lu, 2010.

³ EAP participants make up approximately half of LIEN participants. Note however, that savings attributable to EAP versus to the LIEN as a whole have not been evaluated.

⁴ Note that the Swedish scheme has, since its inception, covered electricity use only. Since 2010, Denmark's scheme now only covers electricity due to the implementation of the EU Emissions Trading System (EU ETS) (Reinaud, Goldberg & Rozite 2012). However, because the EnMS adoption asks companies to systematically analyse all energy uses, many opportunities to make savings from thermal energy sources are also uncovered and implemented. In Sweden, one-third of all participants voluntarily reported on non-electricity measures (Petersson et al. 2011).

⁵ See Price et al., 2010 and Petersson, 2006. Note these are highly uncertain since they are based on a sample size of 27 companies. No information is available for 2005-2012. The latest known Danish Energy Agency evaluation was conducted in 2005 (in Danish): Evaluering af Aftaleordningen om Energieffektivisering 1998-2003 (Evaluation of the Energy Efficiency Agreement 1998-2003), available at www.ens.dk/daDK/ForbrugOgBesparelser/IndsatsIVirksomheder/TilskudtilCO2afgift/Documents/Aftaleordning_Evaluering-slutrapport_april2005.pdf

Drivers and Incentives for Participation in the Voluntary Agreement

The main drivers for companies to participate in the voluntary programme are the incentives and support mechanisms associated with participation in the voluntary energy saving programmes, the sum of which form the EnMP. Evidence shows that voluntary agreements can be a more positive and constructive means to engaging companies and in harnessing the private sector's motivation, as opposed to command and control approaches.⁶ This is especially true where the design of the programme and supporting elements has been undertaken in consultation with industry. In each of the schemes, the government agencies were in close contact and discussion with the participants.

Policy Exemptions

Policy exemptions have been shown to be a strong driver for companies to adhere to the voluntary agreements and implement EnMS. In Denmark and Sweden, in return for participating in and meeting the requirements of the voluntary agreements, companies receive CO₂ tax rebates.⁷ For example in 2002, a heavy process company that participated in the Danish agreement paid only 3 percent of the standard tax compared to 25 percent if it had not signed the agreement. For many companies in Denmark, the main benefit of signing the voluntary agreement is the CO₂ tax rebate. For some, the rebate is of such considerable size that the agreements are perceived as necessary rather than voluntary (Ericsson 2006). Despite a carbon tax being introduced on natural gas and other fuels in 2010 (but not for the generation of electricity), the Irish scheme does not currently explicitly exempt LIEN or EAP participants from the tax. In practice however, many will be exempt since EU ETS participants are exempt from the tax (Reinaud, Goldberg & Rozite 2012) and EU ETS participants accounted for around 76% of LIEN members' energy consumption between 2006-2008 Cahill and Gallachóir (2011).

Financial Incentives

Financial incentives, in addition to exemptions from a carbon or energy tax, can play a role, particularly in the early part of the scheme to bring in participants and before companies witness first-hand the benefits the EnMS can have on their operational efficiency. In Denmark, two additional financial measures were initially provided in addition to the CO₂ tax rebate. Firstly, companies could receive subsidies for independent energy audits covering up to 50 percent of the costs of the audits. Companies could also receive subsidies for energy efficiency investments. As the programme matured and companies became more familiar with energy management and experienced the benefits of implementing profitable opportunities, the government discontinued financial assistance in 2001 (Reinaud, Goldberg & Rozite 2012, Ericsson 2006). In Denmark and Ireland, companies can receive grants of 50 percent for Special Investigations, a complementary requirement to EnMS (described in the next section).

Financial incentives can also be an important driver for small and medium-sized companies, since SMEs may find the costs of certification prohibitive. Experience in Sweden showed, that of the few PFE participants that did not comply with the programme, these were SMEs that had no prior experience with any type of management system (e.g. quality or environmental management system)

⁶ For example, the negotiated agreements in the Netherlands known the Long-Term Agreements are often cited for their ability to have garnered industry support as opposed to more prescriptive measures (see Reinaud and Goldberg, 2011)

⁷ In Sweden, this rebate is worth €0.5/MWh electricity use (Björkman 2011). In Denmark in 2010, the energy tax was 0.062 DKK/kWh. The rebates vary for different end-uses (process or heating), and on the basis of whether the process is deemed as heavy or light. The tax rebates are adjusted annually in the period 2010-2015 by 1.8% (Reinaud, Goldberg & Rozite 2012). Proposed changes to the EU Tax Directive may restrict Member States' ability to apply the rebates in the future.

(Petersson et al. 2011). In Ireland, SMEs can receive some potential support from Enterprise Ireland for Special Investigations (Goldberg, Reinaud & Taylor 2011).

Mechanisms for Effective EnMS Implementation

While subsidies and policy exemptions may encourage participation in the overarching agreement, mechanisms for effective EnMS implementation are crucially important for the success of an EnMP. Companies might need assistance to define KPIs and identify energy saving opportunities. Mechanisms considered in this section include both implementation support systems and complementary requirements, such as detailed procedures to undertake energy reviews, Special Investigations and lifecycle costing. These will ultimately help companies achieve higher energy savings. EnMS may contain some of these overarching elements but the EnMS standard does not provide guidance as to how companies should go about undertaking them. For example, while an energy review is part of EnMSs, it does not describe how companies can or should undertake an effective review to enable them to maximise the identification of opportunities.

Implementation Support

EnMS implementation within the voluntary agreements is underpinned by comprehensive and targeted implementation support. Support systems include technical assistance, information resources and manuals, training, special initiatives, networking, workshops and dissemination of case studies and best practices. Table 2 below outlines in further detail some of the support systems in place in the three countries.

Table 2 Implementation support

	Denmark	Sweden	Ireland
Technical Assistance	The Danish Energy Agency trains energy engineers to assist companies in implementing EnMS. Contact information for consultancy agencies that offer services to help companies comply with the programme requirements is available on their website.	Over the last couple of years, the Swedish Energy Agency in cooperation with other partners has initiated a training course for practitioners in “LEAN production/energy management”.	Agreements Support Managers are SEAI agents that have direct contact with companies. They conduct site visits, provide energy management advice, respond to queries, and can also assist with data collection and administration of funding.
Training	Training on EnMS by DEA.	Training on life-cycle costing calculations and routines for EE procurement.	SEAI provides training courses dependent on needs of the members until the training can to be provided commercially. SEAI provided training on IS393 and EN16001 until 2009, when the training was turned over to a number of independent training providers.
Networking and Workshops	Workshops and seminars	Seminars for program participants and best practice dissemination. Working with participants as a network has substantially lowered the	Networking activities and workshops enable the dissemination of best practices, share experiences and knowledge. Every year a number of workshops, site visits and

		perceived risk of introducing new EE solutions.	conferences are organised.
Case Studies and information resources	Case studies, guidelines and practical and operative tools help companies implement EnMS.	Case studies, manuals on energy management, energy review, life-cycle costing, and procurement.	Statistics and reports, Technical Guideline for EnMS, case studies, benchmarking data and special tools and methodologies <i>e.g.</i> the Energy MAP tool to facilitate energy assessments.
Other	Collective agreements that are specially designed for companies with similar processes, products or energy consumption patterns are to reduce administrative costs.		Special project initiatives are planned each year to help enterprises undertake activities on significant energy end-uses. The aim of these projects varies, <i>e.g.</i> , a specific technology user, a new methodology or a specific sector

Sources: Reinaud, Goldberg & Rozite 2012, SEAI 2009, SEA 2011a.

Requirements beyond EnMS

Energy Reviews. In Sweden, even though participants must conduct an energy review as part of the EnMS, the EnMP also explicitly states that participants should conduct an energy review and guidebooks and manuals for how to conduct these are provided (SEA 2011b). In Denmark under the initial agreements, companies were to conduct an energy audit prior to signing the agreement but these have now been replaced by an energy flow screening – or energy review – that helps to identify parts of the production process are relevant to study further in a Special Investigation (described below) (Ericsson 2006).

Special Investigations. In Ireland and Denmark, Special Investigations supplement the EnMS process and to do a “deep dive” on specific technologies, equipment or processes. In Ireland, participants conduct one Special Investigation per year, a feasibility study focused on significant energy uses and integrated into the EnMS through the process of identifying and registering EE opportunities (O’Sullivan 2011). The Special Investigations in Denmark focus on the more complicated process that are not included in the energy reviews and include an evaluation of the profitability of energy efficiency projects.

Procurement and Life Cycle Costing (LCC). In Sweden, companies must implement specific procedures for planning (modifications and renovations) and for purchasing high-consumption electrical equipment, based on LCC methodology. When purchasing high-consumption electrical motors, the highest efficiency class must be chosen (Pettersson et al. 2011, Sweden Energy Agency 2011b).

Implementation of profitable measures. In Denmark, through the Special Investigations process, companies must implement all projects identified with a simple pay-back horizon of less than four years. In Sweden, the payback requirement is three years (Stenqvist & Nilsson 2011).

Reporting. In addition to having the EnMS certified in each of the three countries, reporting to government on energy use, the opportunities identified and the opportunities implemented is an important component of the scheme. As well as informing the government on the progress of companies, it also motivates companies to pay greater attention to their energy use and improvement opportunities. For example, in Sweden, documentation from the EnMS certification body is submitted to SEA to establish whether certification and recertification is going according to plan. Companies must also report on the data and results from the energy review, the number of measures they have implemented and the associated savings, and the effect (in MWh savings) of the use of the

purchasing and planning procedures (Pettersson et al. 2011). Participants are also publicly listed on SEA’s website. Ireland and Denmark have similar reporting systems.

Table 3 below outlines some of the areas where the three EnMPs provide additional support or requirements to that of EnMS adoption in order to enhance EE opportunity identification and implementation.

Table 3 EnMS provisions and policy mechanisms for enhancing implementation of EnMS and/or identifying EE opportunities

Basic EnMS provision	Complementary EnMS support or requirements
Define an energy policy	Participate in a voluntary energy efficiency agreement or EnMP and agree to the programme’s goals (Sweden, Denmark, Ireland).
Conduct an energy review and establish KPIs	Methodologies for conducting energy reviews (Sweden) or value stream mapping (Denmark). Special Investigations (Ireland and Denmark) and Special Initiatives (Ireland).
Set internal targets	Targets agreed with government (Denmark)
Action plans/ opportunities identified through energy reviews	Implementation of profitable measures (Denmark, Sweden).
Periodic reporting of progress to management and management review	Report energy use, opportunities identified and opportunities implemented to government (Sweden, Denmark, Ireland).
Procurement of energy services, products, equipment, energy	Procurement and life cycle costing (e.g. Sweden).

Lessons Learnt from Evaluations

Based on a review of evaluations studies of the three energy saving programs, and how well the programmes were able to promote EnMS, the following key lessons learnt have emerged.

Uptake of EnMS. As indicated in Table 1, uptake of EnMS by industry through participation in the voluntary agreement is relatively high, where on average half of industry energy/electricity demand is covered by participants. This is in comparison to the uptake of EnMS in the US using the standard ANSI/MSE 2000:2008, available since 2000, where the absence of a supporting programme was likely the cause of the low market uptake (less than 5%, see McKane et al., 2009), despite the standard being in place the longest. Note that the new Superior Energy Performance is a new supporting programme led by the US Department of Energy and being launched nationally in 2012 that is expected to greatly enhance ISO 50001 adoption.

Companies witnessed clear benefits from EnMS implementation, which often delivered results that went beyond what was expected of the programme. In Sweden, the implementation of EnMS turned out to be more valuable than most companies had thought (Pettersson et al. 2011). In Ireland, companies using EnMS have reported an increased pace in energy performance improvement, despite not being new to energy management and having already achieved significant savings over a previous ten year period without EnMS standards (pers. comm. O’Sullivan in Goldberg, Reinaud & Taylor 2011). In Denmark, EnMS was the main driver of energy savings (Ericsson 2006).

Attribution of Savings to EnMS. This paper argues that for EnMS to be effective and applied by a significant number of industrial energy users, it needs to be embedded within an EnMP that includes incentives for participation and additional mechanisms that help companies implement EnMS effectively and maximise opportunity identification. However, it is challenging to isolate the quantitative impact - in terms of energy savings - of the EnMS from other programme elements, or even other external factors. Rather, it is a yes/no answer as to whether EnMS has been or not implemented according to objective criteria and verified/certified by an external party. In Denmark for example, the evaluation process highlighted the difficulties in isolating the effect of the programme from the influence of other factors such as the introduction of new products or production processes, and changes in the composition of raw materials (Reinaud, Goldberg & Rozite 2012).

Instead, the studies analysed all point to the importance of collecting both qualitative and quantitative data through surveys and interviews to obtain first-hand experience of companies as to the effect of the EnMS and energy efficiency throughout their operations, as well as relying on the EnMS implementation/certification rates.

In Denmark, the programme has been evaluated several times, typically on a three- to five-year basis. Independent experts are contracted to carry out the evaluations. The evaluations initially focused on quantitative results. The evaluations then shifted to more qualitative analyses based on in-depth interviews with 28 programme participants (Danish Energy Agency 2005). The evaluation indicated that EnMS plays a very important role in the agreements and that more than 50 percent of the savings can be attributed to the implementation of the EnMS due to the high priority given to energy management (DEA 2002b, Price et al. 2010).

In Sweden, companies reported that 43 percent of measures were identified through the PFE (Stenqvist & Nilsson 2011). Implementation of EnMS turned out to be more valuable than most companies had expected. The EnMS led to more elaborated measurement, calibration and monitoring of energy use in most companies. The certification bodies also conclude that all certified companies have found new efficiency opportunities that they have not found otherwise (Pettersson et al. 2011).

In Ireland, participants reported that that 67 percent of the projects implemented to save energy were derived or driven by the EnMS process (SEAI 2010). In addition, since the introduction of EnMS, the pace of energy savings has increased and companies are now probing deeper than previously and conducting critical assessment of energy service needs and process reconfiguration to reveal new opportunities (SEAI 2010).

Staff capacity. In Sweden, several (some?) companies have now educated all employees in energy issues due to EnMS. By involving more people in energy management, organisations are also benefitting from new ideas and savings. Positive effects of the introduction of EnMS include the engagement of new personnel and expertise to a great extent: electrical engineers, energy specialists (including consultants), process engineers, buyers of production equipment resulting in many new ideas for energy efficiency improvements (Pettersson et al. 2011). Similar results are also reported in Ireland and Denmark.

EnMS as a management issue. For participating companies in the Swedish EnMS programme, energy-related issues now have a higher priority, both regarding access to capital and personnel thanks to the provisions in the EnMS. In Ireland and Denmark, programme evaluators have also noted that upper management in companies have indeed become more involved thanks EnMS.

Devolved quality assurance through certification. EnMS certification can ease the burden of reporting to government and ensuring compliance with government regulations. For governments, the proof of certification can give them confidence that companies have undertaken robust management practices to maximise their energy efficiency. In Denmark, in the initial phases of the scheme, DEA spent a lot of time reviewing and verifying the accuracy of the reports. However, increased reliance is now placed on the EnMS certification (Reinaud, Goldberg & Rozite 2012).⁸

Conclusion

This paper has provided a synthesis of the various evaluations of three voluntary EnMPs that mandate EnMS. The paper has shed light on the individual programme components as well as how the programme works as a whole to promote effective adoption of EnMS by industry. The evaluations have shown that an EnMS plays a central, if not the most important, role in achieving energy savings as it enables companies to overcome and reduce the various well-documented barriers to profitable energy efficiency options.

Voluntary EnMPs combined with incentives for participation and additional implementation mechanisms are key elements to promote widespread and effective EnMS adoption. Voluntary programmes can enhance the motivation of companies to participate, especially if companies are involved in key aspects of the design such as which types of support and what is the best way to report their information for monitoring and evaluation purposes.

Drivers and incentives typically include an exemption from a related policy, such as a carbon or energy tax rebate. Financial incentives such as subsidies for audits or Special Initiatives can play an important role, at least initially. As companies gain maturity and witness the benefits of EnMS and the considerable cost savings they can achieve, additional financial incentives may lose their importance. The exception could be for SMEs, who often grapple with energy management and certification/verification costs. This is why subsidies may remain for these types of participants.

Implementation mechanisms such as training, technical assistance, best practice sharing, peer-to-peer networks and case studies have an important role to play. The knowledge that other companies within the same sector are undertaking and achieving savings from EnMS through peer-to-peer networks can be as important as the information itself. Complementary requirements and tools defined by governments have also proven their worth. Tools such as how to conduct energy reviews and special investigations, and purchasing routines that integrate the lifecycle cost of equipment can provide additional insights and a deeper dive into some of the processes of using and reducing energy.

Finally, quantitative measurements or estimates of savings are, on their own, not sufficient to understand what makes companies save energy and improve their energy productivity and it is often challenging to measure energy savings from EnMS implementation. This means that assessing the additionality of the EnMS relative to the other energy savings goals and elements within the programme is difficult. An important component of monitoring and evaluation is to use interviews and surveys to ask companies which measures they identified and implemented could be attributed to

⁸ While the authors reviewed programmes that included EnMS standards and mandatory certification, this does not necessarily preclude that non-standardised EnMS is not effective. What is important in this alternative is that EnMS specifications need to be clearly outlined, that it covers the commonly understood elements of EnMS, coupled with robust governmental monitoring and verification systems. Here the burden of quality assurance is placed programme administrators rather than being devolved to accreditation and certification bodies.

EnMS as well as what were, in their view, the benefits of EnMS. In order to reduce the reporting and monitoring burden on both participants and government agencies, evaluation methods of EnMPs could be inspired by those taking shape in the three countries profiled in this paper. Methods include self-reporting of quantitative and qualitative parameters using an online system that automatically generates results from enterprise reports. This online self-reporting system is then complemented by in-depth interviews with random checks by independent verification agents, in addition to EnMS certification.

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