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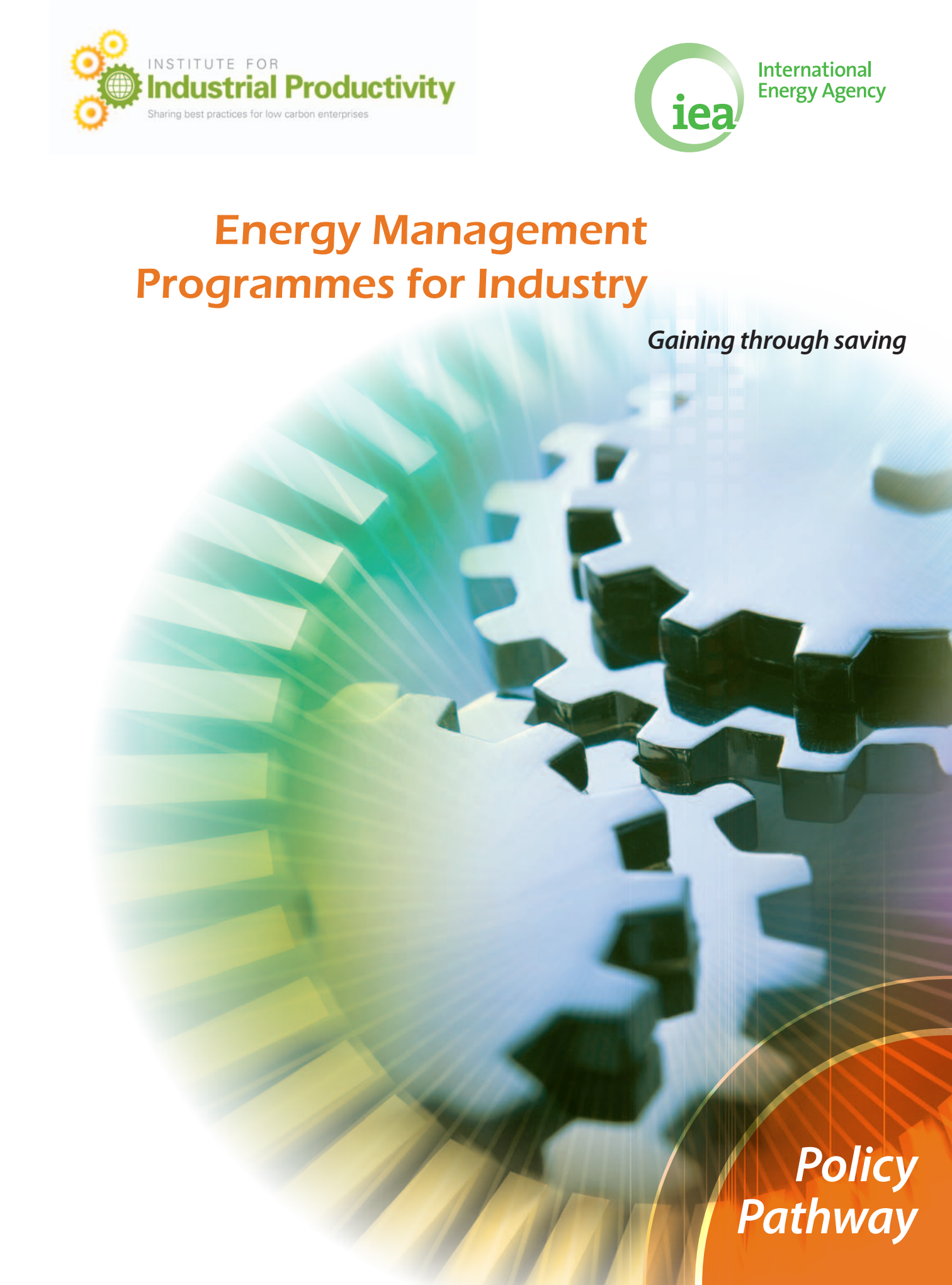
Energy Management Programmes for Industry

Gaining through saving



Policy Pathway

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Energy Agency

Energy Management Programmes for Industry

The IEA Policy Pathway publications provide details on how to implement specific recommendations drawn from the IEA 25 Energy Efficiency Policy Recommendations.

This Policy Pathway develops the critical steps for policy makers implementing energy management programmes for industry. Optimising energy use in industry is essential to improve industrial competitiveness and achieve wider societal goals such as energy security, economic recovery and development, climate change mitigation and environmental protection. While there is significant potential to decrease energy consumption in this sector, opportunities to improve energy efficiency are still under-exploited. Energy management programmes have shown to be instrumental in addressing many of the barriers that inhibit wide-scale uptake of energy management in industry. The Policy Pathway builds on lessons learned from country experiences and provides actionable guidance on how to plan and design, implement, evaluate and monitor energy management programmes for industry.

This Policy Pathways has been developed by the International Energy Agency in partnership with the Institute of Industrial Productivity.

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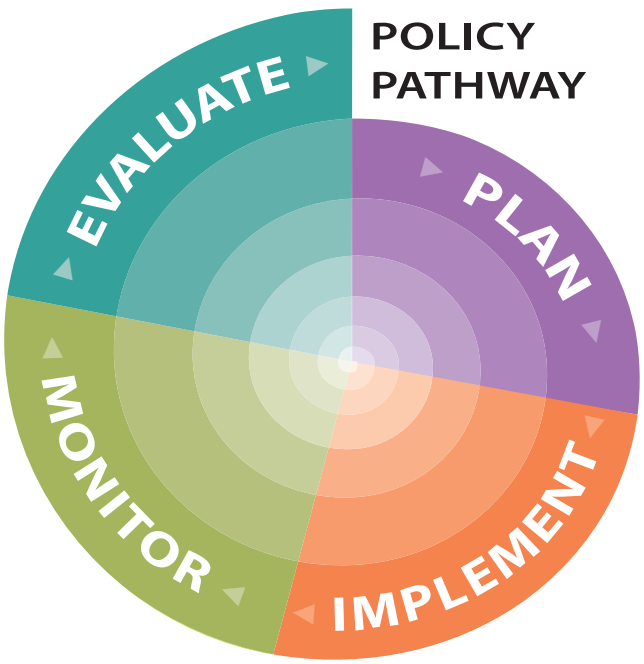
Energy Management Programmes for Industry

Gaining through saving

The IEA Policy Pathway series

Policy Pathway publications provide details on how to implement specific recommendations drawn from the IEA 25 Energy Efficiency Policy Recommendations. *Based on direct experience, published research, expert workshops and best-practice country case studies, the series aims to provide guidance to all countries on the essential steps and milestones in implementing specific energy efficiency policies. Policy Pathways have been published on:*

- ***Joint Public-Private Approaches for Energy Efficiency Finance***
  Policies to Scale-up Private Sector Investment
- ***Monitoring, Verification and Enforcement***
  Improving Compliance within Equipment Energy Efficiency Programmes
- ***Energy Performance Certification of Buildings***
  A Policy Tool to Improve Energy Efficiency



The Policy Pathways series is designed for policy makers at all levels of government and other relevant stakeholders who seek practical ways to develop, support, monitor or modify energy efficiency policies. The Pathways can also provide insight into the specific policy context(s) of different countries, so that each country derives the maximum benefit from energy efficiency improvements.

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Acknowledgements

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Executive summary

Industrial energy use accounts for roughly one-third of global energy demand. While there is significant potential to decrease energy consumption in this sector, opportunities to improve energy efficiency are still under-exploited. Although energy efficiency measures have frequently been demonstrated to contribute to the competitiveness of companies and to raise their productivity, energy efficiency actions and improvements are still not typically or widely viewed as a strategic investment in future profitability. A number of barriers to industrial energy efficiency exist including limited access to technical know-how and to capital, risk aversion and transaction costs.

Improving energy efficiency in industrial companies provides benefits for the companies themselves as well as for the economy as a whole. Company level benefits include improved productivity, optimised processes and new business opportunities. In addition, energy efficiency in industry contributes to improved energy security and emission reductions.

Systematic energy management is one of the most effective approaches to improve energy efficiency in industries, because it equips companies with practices and procedures to continuously make improvements and capture new opportunities. An energy management system (EnMS) is a collection of procedures and practices to ensure the systematic tracking, analysis and planning of energy use in industry.

Government energy management programmes (EnMPs) and associated supporting measures and drivers have been shown to effectively address many of the barriers to energy efficiency and stimulate energy management in industry. Energy management programmes are policies and initiatives that encourage companies to adopt energy management systems. Energy management programmes play an important role in showing that improving energy efficiency is not only compatible with – but can also drive – profitable business development.

This report provides guidance to policy makers on how to implement energy management programmes. Energy management programmes have existed in some countries for more than 20 years. The lessons learned during implementation and modification of programmes provide a valuable source of information and guidance for policy makers and programme managers in the process of developing or improving measures. It builds on the diversity of approaches utilised in different countries since what constitutes an effective programme depends on the existing policy framework, objectives, industrial composition and other country-specific factors.

The IEA and IIP propose a policy pathway that supports the development and implementation of programmes comprising ten critical steps in the following four phases.

- **Plan:** policy makers begin the process by defining the purpose of the programme and its role in the policy framework, which then serves as the starting point for designing the programme. The design of the programme determines the tasks that should be included in the action plan and the necessary resources.
- **Implement:** the success of the programme rests on providing appropriate institutional assistance and support including training. Securing active participation requires promotion, as well as recognising and communicating achievements.
- **Monitor:** the first monitoring step is to establish what to measure and how, this includes establishing indicators and data collection methodology. Monitoring also involves assessing compliance and results, and communicating results and outcomes to stakeholders.
- **Evaluate:** evaluation involves determining what to evaluate and how and to utilise evaluation results to develop, revise and adapt the programme.

When designing energy management programmes, investing sufficient time and resources in the planning stage can help to avoid future challenges and problems. Careful advance planning ensures that all the important elements can be incorporated at the outset, avoiding delays, duplication of efforts or confusion. Transparent planning, which involves consulting stakeholders from the beginning, will ensure critical aspects of the programme have been considered, and will help to increase target group buy-in and foreshadow any future implementation issues or difficulties.

Energy management programmes are most effective when planned and implemented as part of broader energy efficiency agreements with the government. During the planning stage, the purpose of the programme should be articulated, including inter-linkages with other policies. Important design steps include establishing what support systems need to be created to boost implementation, how progress will be monitored, and setting up plans for evaluating the results of the programme. A piloting phase can be a good way to ensure that the most appropriate programme design and supporting measures are selected. To maintain effectiveness, the set-up of programmes may need to be periodically revised, and experiences gained can be used to expand the scope to include new sectors or types of enterprises.

The success of the energy management programme is clearly correlated with the provision of appropriate resources and supporting mechanisms, including assistance, capacity building and training, and provision of tools and guidance during the implementation stage. Initially, drivers including incentives play an important role in stimulating industry to engage in energy management. In particular, small- and medium-sized enterprises may require additional support and resources. As the programme matures, programme managers can explore options to phase out support or transfer the responsibility for the programme to the private sector. Depending on the design of the programme, the implementation phase may also require training of auditors and ensuring an effective verification and certification of energy management systems.

To encourage widespread uptake and achieve the maximum programme impact, governments need to promote the energy management programme. Promotion can occur through a variety of means such as direct information campaigns, networking workshops, dissemination of case studies and recognition of companies that have demonstrated best practice.

Robust systems for monitoring and evaluation can provide essential insights into how programmes can be developed and improved. Monitoring enables compliance assessments and identifies gaps in implementation. Both monitoring and evaluation require the identification of an appropriate set of qualitative and quantitative indicators and systematic data collection. Data collection and review provide a quantitative means for governments to measure compliance and verify progress towards meeting energy efficiency targets. Programme evaluations should determine whether the programme met its goals and identify opportunities for improvement. Important evaluation issues include the time-frame for evaluation, communicating how the evaluation will be used and when the outcomes will be reported, establishing a budget and selecting the appropriate organisation to undertake the evaluation.

A key challenge is determining the net results and benefits of energy management programmes. This requires identification of what results stem from the programmes and what results are caused by e.g. other policies, market development, or other factors. Furthermore, to gauge the full impacts of energy management programmes further efforts are needed in the area of quantifying benefits beyond energy savings and emission reduction.

While some progress has been made in this area, further efforts could be instrumental in accelerating the uptake of energy management systems.

These key messages are reinforced by country examples and three case studies. The Australian case study clearly shows the value of an extensive stakeholder process and continuous dialogue with industry. The Irish, Swedish and Danish experiences demonstrate the importance of creating supporting measures to provide incentives and promote the implementation energy efficiency opportunities. The European Bank for Reconstruction and Development (EBRD) case study illustrates how financial institutions can effectively contribute to stimulating the uptake of energy management systems in industry. This case study also shows the benefits of integrated approaches that link technical assistance, capacity building and access to financing.

Designing and implementing effective energy management programmes will help governments to meet energy efficiency and climate change mitigation targets and policy objectives while promoting increased industrial productivity and creating opportunities for growth. A further benefit is that energy management programmes are flexible instruments that can be adapted to changing policy needs and changes in industry thereby ensuring continued effectiveness and relevance.

The Policy Pathway checklist for policy makers developing energy management programmes for industry includes 10 steps in four phases.

Table ES1 Policy Pathway action checklist for implementation of energy management programme

		DONE
PLAN	1 Define the programme role in the policy framework	○
	2 Design the programme	○
	3 Develop the action plan and secure resources	○
IMPLEMENT	4 Provide institutional assistance	○
	5 Promote the programme and recognise achievements	○
MONITOR	6 Establish what to measure and how	○
	7 Assess compliance	○
	8 Communicate results and outcomes	○
EVALUATE	9 Determine what to evaluate and how	○
	10 Revise and adapt the programme	○

Source: compiled by authors.

Introduction

Industry accounts for about one third of the world's final energy consumption, and that share is growing steadily. Although industrial energy efficiency has improved and CO_2 intensity has declined in many industrial sectors over recent decades, this progress has been more than offset by growing industrial production worldwide (IEA, 2010a). Substantial potential for energy efficiency improvement exists within this sector, in the order of 31 exajoules (EJ) per year, equivalent to 26% of final industrial energy demand (IEA, 2009a; UNIDO, 2011).

Actions to improve energy efficiency in the industry sector remain one of the most cost-effective options to achieve economy-wide greenhouse-gas emission reductions, and improve energy security and productivity.[1] Another advantage of pursuing efficiency in industry relative to other sectors of the economy is that relatively fewer actors are involved. The energy efficiency potential can be captured through improving the practices of thousands of entities, as opposed to millions or billions of entities worldwide (Price and McKane, 2009).

A number of barriers, however, prevent this potential from being realised. When implemented effectively by industrial companies, energy management can overcome these barriers.[2] Energy management involves the systematic tracking, analysis and planning of energy use, and enables companies to maximise energy savings and improve energy performance continuously through organisational and technology changes.

Government support measures for energy management programmes, including legislation, incentives and guidance, can counteract, reduce or remove barriers. Energy management programmes also help countries achieve wider policy goals and target-setting policies in the areas of energy efficiency, energy security and climate change mitigation. Companies also benefit by reducing energy costs, improving productivity and realising other co-benefits.

This Policy Pathway guides policy makers and relevant stakeholders in the delivery of effective energy management programmes. The report identifies success stories and analyses proven practices from around the world, including what works and what does not - and what hinders and what enables.

This Policy Pathway has been developed in response to one of the 25 IEA recommendations, namely recommendation 21: Energy management in industry (IEA, 2011).

> This recommendation calls for governments to require large, energy-intensive industry, and encourage other industrial energy users, to conform to ISO 50001 or an equivalent energy management protocol. Actions to deliver cost-effective energy savings should be implemented, and industry should periodically report on their efforts.
>
> Energy management measures should include:
>
> - Identifying and assessing energy saving opportunities by benchmarking, measuring and documenting energy consumption.
> - Implementing actions to capture identified energy-saving opportunities.
> - Publicly reporting the energy-saving opportunities identified and the actions taken to capture them.

1 Although industry may be assumed to be more conscious than other sectors of the cost benefits associated with energy efficiency, there remains potential for further improvement that can be exploited cost-effectively through energy management programmes, for example, for each EUR of taxpayer money spent in the Large Industry Energy Network programme in Ireland, average energy savings benefits of EUR 12 have been attained in the productive business sector.

2 In this publication the term energy management is applied to industrial enterprises. Energy management can also apply more widely, for example, to buildings and transport.

The publication outlines the phases, steps and actions (*i.e.* the pathway) necessary to successfully implement energy management programmes within the context of national policy frameworks. The report expands on this pathway by sharing experiences and offering insights on how governments have encouraged enterprises to adopt energy management practices, and how governments have linked their programmes to other industrial energy efficiency policies, measures, guidelines and tools.

The pathway includes:

- A brief overview of what energy management means for companies, and what types of government programmes have been designed to encourage energy management systems and practices.
- An explanation of why government programmes are important in encouraging enterprises to adopt energy management practices.
- A detailed set of critical steps to successfully plan, implement, monitor and evaluate energy management programmes.

What are industrial energy management programmes?

Energy management programmes (EnMPs) are policies and initiatives that encourage companies to adopt energy management. Energy management involves the systematic tracking, analysis and planning of energy use. Energy management systems (EnMSs) include energy management activities, practices and processes. In this paper, EnMSs mean not only standards such as ISO 50001 or EN16001 but also other frameworks for systematic energy management defined according to particular specifications. A number of other terms are useful in understanding this publication (Box 1).

This publication focuses principally on government programmes that promote and support the adoption of EnMSs. The report, however, also covers government programmes that promote only certain aspects of energy management practices, *i.e.* components of energy management.

Governments and organisations promoting the rational use of energy have recognised the important role of EnMSs and are developing and implementing programmes to promote the use of EnMSs in industry. A number of government programmes have been established around the world to encourage, facilitate or mandate industrial companies to undertake energy assessments, and to establish management systems or energy management components. Experience has already shown that the market uptake of EnMSs is correlated with government-led programmes that stimulate and encourage enterprises to apply the EnMS (Goldberg *et al*., 2011). Many governments are now turning their attention to incorporating ISO 50001 into their programme.

Box 1

Key definitions of energy management used in this Pathway

Energy management programmes (EnMPs) *are government-led initiatives to promote effective energy management systems.*

EnMP elements *are the government-led initiatives, drivers and support systems that, combined, make up the EnMP and encourage enterprises to adopt effective energy management systems.*

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.*

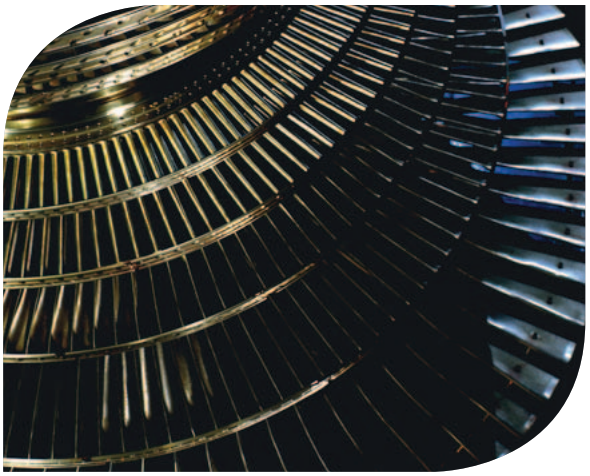
Energy management components *are the energy management activities that make up the EnMS and other management activities. Some governments have chosen to encourage or mandate only selected elements of energy management rather than a full EnMS. The level of detail in requirements for each component also varies.*

Energy management system standards or energy management system specifications *can be used to define EnMSs. Standards are developed by international or national standardisation bodies for use across a diverse range of circumstances. Specifications are usually formulated by a governmental policy agency as part of the development of a particular policy. In the case of EnMS standards, third-party certification of the proper use of the EnMS standard usually accompanies the standard. In the case of specifications, verification of compliance (third-party or governmental) ensures participants are following the requirements of the specifications.*

EnMPs define how energy management should be carried out, either through standardised methods such as the ISO 50001 standard for Energy Management Systems and the European EN 16001 standard, or through non-standardised specifications such as the Netherlands' energy management reference document under long-term agreements (LTAs) or Australia's energy efficiency opportunity assessment under the Energy Efficiency Opportunities (EEO) programme (Reinaud and Goldberg, 2011b). Many national energy management standards are now being replaced by ISO 50001, as is the European standard EN 16001.

EnMPs are generally embedded within target-setting policies, voluntary schemes or negotiated agreements to reduce energy demand or greenhouse-gas emissions. Promotional aid, as well as financial and regulatory incentives, is often included to support EnMS adoption (McKane *et al.*, 2008). Governmental support for EnMSs includes financial incentives (such as tax relief), reward programmes, ease of access to information (best practice, exchange and co-operation schemes, networking, implementation guidelines, etc.), and technical tools (support to carry out energy audits, development of technical energy profiles, benchmarking tools etc.) (Mey, 2011).

The extent of the integration into a political and fiscal framework differs considerably from country to country (Box 2).



Box 2

Three different approaches to promoting energy management in industry

The following brief descriptions of EnMPs in Australia, Denmark and the Netherlands illustrate the range of approaches taken.

***Australia's** Energy Efficiency Opportunities (EEO) programme is mandatory for large energy-using businesses. These companies are required to undertake energy assessments according to a detailed Assessment Framework (similar to an EnMS) and to report publicly on opportunities identified and implemented on an annual basis. The government, with the support of technical experts, verifies compliance with the Assessment Framework and the accuracy of the public reports. Companies are not required to use certified auditors, but must demonstrate that they have utilised personnel with appropriate expertise and experience. These people may be sourced from within and/or outside the firm. The programme does not mandate any implementation of measures and does not require companies to set energy efficiency targets in advance.*

***Denmark's** Agreement on Industrial Energy Efficiency (DAIEE) is voluntary. Participants are mandated to implement an EnMS according to the European standard 16001 and have it certified by an external accredited certification body. If companies opt into and comply with the voluntary agreement, they receive a carbon tax reduction.*

***The Netherlands'** Long-Term Agreements (LTAs) are voluntary. Participants are required to achieve negotiated energy efficiency targets and adopt an EnMS according to EnMS specifications provided under the agreements. These EnMS specifications are not standards, and companies are not mandated to seek certification. Companies are also required to implement a broader and more strategic Energy Efficiency Plan. If companies opt into and comply with the LTAs, they receive partial exemptions from the energy/carbon tax and are awarded automatic compliance with the energy-saving requirements under the Environmental Management Act.*

Some features of EnMPs play an important role in delivering effective energy management. For example, linkages with wider policies, such as an energy-saving agreement, can help to define and drive energy-saving efforts (or, put another way, achievement of targets within energy-saving agreements can be assisted by EnMPs). Standards and accompanying certification, or verification of compliance with legislation, can give confidence to governments that companies are performing according to common formats, metrics and processes.

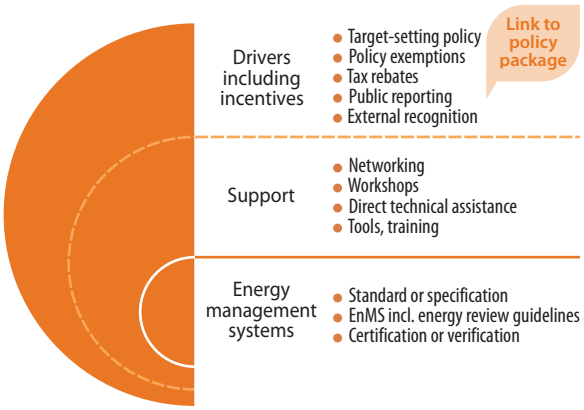
Drivers, including incentives and regulation can further encourage EnMS uptake (as described in the next subsection). Energy review and benchmarking tools assist companies in identifying energy efficiency opportunities, defining targets and establishing key performance indicators (KPIs) within their EnMSs.

Training, networking events, case studies and guidance materials ensure that energy managers, energy auditors, company personnel, certification bodies and policy makers can learn from best practice approaches. Reward programmes and external recognition for EnMS adoption can enable companies to showcase their performance to customers, peers and other stakeholders, and can serve as an important motivation to initiate EnMSs.

Requirements to develop a longer-term energy strategy, in addition to an EnMS, can help give operational staff greater mandate to support energy improvements.

Although an EnMS is the core activity of an EnMP, a number of supporting elements and linkages with other policies are necessary to stimulate adoption of an EnMP (Figure 1). The sum of all the elements makes up the government-led EnMP.

Figure 1 Elements of energy management programmes



Source: Reinaud, Goldberg and Rozite, 2012.

Most government programmes encourage or require companies to adopt an EnMS in its totality, and to report and verify/certify compliance. Some government programmes, however, may be centred only on energy management components, including: appointment of an energy manager; energy assessments or energy reviews including audits (see Annex 2 for further information); establishment of energy efficiency targets; key performance indicators or benchmarks to monitor performance; and/or public reporting.

Individual energy management components on their own will not lead to sustained energy management and on-going improvements. Rather the sum of the actions, processes and systems – *i.e.* energy management systems – will improve energy performance.

Box 3 *Energy management systems*

A first step in promoting energy efficiency in industry is to understand energy management systems and how embedded mechanisms help companies to systematically work toward reducing unnecessary energy use.

A thorough set of energy management activities consists of metering and monitoring energy consumption, analysing trends in energy use, identifying and implementing energy-saving measures, and verifying savings with proper measurements (ACEEE, 2011). Energy management helps managers and staff to identify options for increasing energy efficiency, carry out energy efficiency projects, monitor energy use and results, and learn from technical actions. Energy management is often incorporated into business management systems, allowing it to be supported from multiple levels in a company or facility, from operators to CEOs. It is widely accepted that only systematic energy review and management process can tap the full potential of energy efficiency in industry (Mey, 2011).

The core features of an energy management system are (DOE, 2011b):

- ***Energy policy,** top management's official statement of the organisation's commitment to managing energy.*
- ***Cross-divisional management team** led by a representative who reports directly to management and is responsible for overseeing the implementation of the energy management system.*
- ***Energy review** to analyse and assess current and planned energy use and energy sources, relative to production and service delivery. The review then identifies opportunities for improvement. However, in many EnMS standards, including ISO 50001, no guidance exists for how to conduct an energy review.[3] Government programmes may provide additional guidelines (see Annex 2).*
- ***Baseline** of the organisation's energy use.*
- ***Energy performance indicators (EnPIs)** that are unique to the company and are tracked to measure progress.*
- ***Energy objectives and targets** for energy performance improvement at relevant functions, levels, processes or facilities within an organisation.*
- ***Action plans** to meet those targets and objectives.*
- ***Operating controls** and procedures for significant energy uses.*
- ***Measurement, management, and documentation** for continuous improvement for energy efficiency.*
- ***Internal audit** of progress of the EnMS based on these measurements.*
- ***Revision by third-party auditor** to receive certification/verification and recognition by external stakeholders.*

3 A proposal to develop implementation guidelines for the ISO EnMS standard 50001 has recently been approved by ISO members. These guidelines will detail the establishment, implementation, maintenance and improvement of an energy management system and its co-ordination with other management systems. The guidelines are applicable to any organisation, regardless of its size, type, location or level of maturity but are not intended to provide interpretations of the requirements of ISO 50001 (ISO, 2011).

Drivers and support mechanisms

Drivers including incentives and support mechanisms are key components of EnMPs, because they help to motivate companies to implement EnMSs and provide clear guidance for how to do this. Drivers include regulation and mandatory requirements as well as incentives such as subsidies or rebates, while support mechanisms comprise information, guidance and training. Countries generally have a combination of drivers, incentives and support mechanisms (Table 1).

Table 1 Drivers and support mechanisms within EnMPs

Drivers	*Support mechanisms*
Overarching or target-setting policies such as voluntary schemes or negotiated agreements between industry and governments.	*Energy review, benchmarking and technical tools.*
Exemptions from policies in exchange for EnMP participation, such as from an energy or carbon tax.	*Direct programme and/or technical assistance.*
Rebates or other tax incentives for energy-saving equipment (may not be tied to the EnMP).	*Case studies showing peer experience.*
Subsidies for energy audits.	*Guidance materials.*
Reward programme and other forms of recognition.	*Workshops, networks and other fora for best practice exchange.*
Mandatory implementation of EnMS.	
Public reporting of company performance to encourage best-in-class behaviour.	

Why are energy management programmes important?

Energy management programmes (EnMPs) are important, because they encourage energy reduction, greenhouse-gas reduction and productivity benefits in firms. For governments, they act as a framework to encourage industry to achieve these outcomes by effectively adopting energy management systems (EnMSs) and supporting activities outlined in the EnMP. The main benefit of EnMPs is that they help companies overcome barriers to the implementation of EnMSs, and provide guidance and support for the implementation process.

Because energy-saving measures and actions in the industrial sector are one of the most cost-effective options to reduce energy use and greenhouse-gas emissions, EnMPs are an efficient way for society to achieve wider policy goals in the area of energy efficiency, energy security and climate change mitigation. EnMPs can be linked to and support policy objectives in key areas:

- Sustainable economic development, in terms of the improving the competitiveness and productivity of industry, cutting costs, reducing exposure to volatility of energy prices, managing risks, and fostering innovation and technology development/adoption.
- Energy security and demand-side management objectives.
- Energy efficiency and/or greenhouse-gas reduction targets, through energy-saving agreements and emissions trading schemes.
- Environmental objectives, such as greenhouse gas emission reductions and reducing local pollutants.

Experience in European countries has shown that EnMPs can usefully contribute to enhance energy-savings performance beyond isolated energy management activities, facilitate company achievement of target-setting policies and other policy objectives, and ease the burden of compliance checks on the government (Goldberg *et al.,* 2011).

This section first discusses the role of EnMPs in helping companies overcome barriers to taking energy efficiency actions. The section then describes the benefits that EnMSs can provide.

Overcoming barriers to energy efficiency in industry

Despite the fact that energy efficiency measures have been demonstrated to contribute to business competitiveness and raise productivity, energy efficiency actions and improvements are still not typically or widely viewed as a strategic investment in future profitability (McKane *et al.,* 2009). Because energy efficiency potentials are highly fragmented and spread across a multitude of locations and devices, this dispersion ensures that energy efficiency is the highest priority for virtually no one (McKinsey and Company, 2009).

In addition, a number of financial, behavioural, technical and organisational barriers to energy efficiency prevent companies from undertaking investments and actions (Reinaud and Goldberg, 2011b). Barriers refer to all obstacles that prevent financially and technically feasible energy efficiency measures from being implemented (IPCC, 2001) (Box 4).

EnMPs are a means of encouraging the use of EnMS to overcome a range of barriers (see Box 4). For example, initiatives for measurement of baseline energy use and emissions, energy auditing, and guidance for identifying opportunities can help reduce barriers related to lack of information and technical expertise.

Box 4 Barriers to energy efficiency and energy savings commonly faced by companies

Important financial barriers include:

- *Investments in energy efficiency projects do not meet financial criteria within companies.*[4]
- *Companies lack access to capital.*
- *Investments impose too high a risk due to lack of familiarity with energy-savings projects relative to core business projects and difficulty in predicting future energy prices.*
- *Businesses like to use capital and resources to grow and expand their business. When they want to reduce costs, they want to do so without spending too much capital. Companies will often only fund projects with an 18-month to two-year payback or less, unless it has a productivity or growth outcome as well (Vickery, 2011).*[5] *This is particularly true of shareholder businesses looking to reduce costs and maximise profit in short time frames.*
- *Energy efficiency is seen as an operating expense for which budgets are limited.*

Important market, information, behavioural and organisational barriers include:

- *Energy prices and taxes are subsidised in some countries in the industrial sector; therefore, companies may not pay the full cost of their energy use and have less incentive to reduce consumption.*
- *Transaction costs and effort are required to find out about the costs, benefits and energy-saving options; these costs can act as a deterrent to making changes and investments within a company's operations.*
- *Companies have limited knowledge and access to information about new and existing energy-saving technologies.*
- *Companies may perceive technical and operational risks of implementing energy efficiency projects due to unfamiliarity with energy-reducing technologies and practices relative to core business projects.*
- *Energy efficiency improvement is not a major driver for most companies; instead companies focus on their core activity such as production expansion or improvement.*
- *Professional and functional boundaries within the organisation limit the collaboration required to identify and support energy efficiency (Paton, 2001). For example, staff who pay the energy bills are different from staff who procure energy-using equipment, who again are different from those who maintain equipment.*

External barriers include:

- *Uncertainty caused by future technologies and potential unknown regulations and other policy developments (creating uncertainty for the optimal timing of adoption of new technologies).*
- *Lack of expertise and skill of external energy auditors and other energy service providers which can also prevent companies from maximising energy efficiency.*

Source: adapted from Reinaud and Goldberg, 2011a, and based on a survey of existing literature (Rohdina *et al.,* 2007; Groot *et al.,* 2001; Masselink, 2008; Beer *et al.,* 2000; Anderson and Newell, 2004; Harmelink *et al.,* 2010; Tanaka, 2009 (unpublished); Eichhammer, 2004; Jaffe and Stavins, 1994; Paton, 2001; McKinsey and Company, 2009).

4 As noted by UNIDO (2010a), in some sectors, high capital cost of investment in new and efficient facilities or equipment is a major limitation on the rate of energy efficiency improvement in industry. This limitation is particularly the case in countries where the economy is unstable, and where interest rates are high.

5 Based on conversations with businesses over 10 years, survey results are presented in the Report of the Prime Minister's Task Group on Energy Efficiency (2010), the Department of Climate Change and Energy Efficiency.

Having a representative from top management and staff from all of the different functions of the company participate in the EnMS administration and implementation can overcome organisational, behavioural and institutional barriers by creating transparency and facilitating communication on the management of energy resources. Johansson *et al.* (2011) document that "soft" or managerial aspects related to EnMS, in particular culture, will, acceptance, recognition and leadership are important factors in organisational change. Reporting results of assessments to the board can adjust senior management perceptions that no cost-effective savings will result and lead to decisions-making in favour of energy efficiency project implementation. Similarly, having top management articulate the company's energy policy and goals will lead to staff becoming more proactive and involved in raising energy issues and offering suggestions for improvement.

Improving a company's capabilities in energy data collection and analysis can reduce the perception that energy efficiency benefits are relatively insignificant relative to other core business concerns (assessments and audits done poorly can reinforce that position).

Life-cycle costing of products and equipment can encourage the purchase of more energy efficient technologies, help overcome information and financial barriers, and prioritise new investments.

Benefits of EnMSs

Competitiveness and productivity gains

EnMSs bring a range of corporate benefits to industrial enterprises. Introducing EnMSs allows companies to systemically analyse, manage and reduce energy use, enabling them to lower energy costs, and enhance productivity and competitiveness. Energy management becomes a dynamic process, through which new ideas and knowledge are generated, in turn producing additional energy efficiency gains (Kannan and Boie, 2003).

EnMSs are becoming ever more relevant in light of increasing and more volatile energy prices: indeed, in the most energy-intensive companies, energy costs have more than tripled since 2000, according to a survey conducted by Prindle (2010). Industries that adopt energy management practices may save between 10% and 30% of their total energy use (McKane, 2011).

Companies including Dow Chemical, United Technologies Corporation and Toyota have achieved major energy-intensity[6] improvement using EnMSs (Scheihing, 2009).[7]

The use of standardised or specified EnMSs facilitates the identification of energy-saving opportunities and improvements in operational control, which would not have been possible with self-designed systems.

6 In an industrial context, energy intensity is typically measured as the ratio of energy consumption per unit of production or per unit of value added. Increased energy efficiency entails delivery of more services for the same energy input or the same level of services for less energy input.

7 Dow Chemical achieved a 22% improvement between 1994 and 2005 (USD 4 billion savings) and is seeking an additional 25% between 2005 and 2015. United Technologies Corporation reduced global greenhouse-gas emissions by 46% per dollar of revenue from 2001 to 2006. Toyota's North American Energy Management Organisation has reduced energy use per unit by 23% since 2002; companywide energy savings efforts have saved USD 9.2 million since 1999 (Scheihing, 2009).

For example, companies using standardised EnMSs in Ireland 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 10-year period without the use of an EnMS standard.

Achievement of and compliance with related policies

For enterprises, proper adoption of EnMSs and the use of one systematic, continually operating approach may make it easier to achieve and comply with government regulations. Proper adoption of EnMSs can also help companies comply with target-setting or energy-saving agreements, and ensure that energy conservation plans, projects and targets are firmly grounded in the specific realities of a company's enterprise and suitably customised to on-site circumstances.

Facilitating access to finance

Quantifying and demonstrating the benefits of energy efficiency projects has the potential to encourage the private sector to invest in the identified opportunities. Documenting and quantifying energy use, energy savings and cost savings in accordance with a standardised methodology provided by EnMS, helps banks to better assess the risks and returns of these projects. For example, the EBRD Programme for Energy Efficiency Management Systems was launched in 2009 to address the lack of information and limited access to finance by providing support to implement integrated EnMS in a number of Central and Eastern European and Commonwealth of Independent States (CIS).

Benefits for the supply chain

If buyers (wholesalers or retailers) can help cut the energy costs of their suppliers, costs across the supply chain are reduced, which benefits the retailer as well as the supplier (Box 5).

Box 5

Reducing energy costs of suppliers

Several companies have reported saving costs by introducing energy management components within their suppliers' practices (Prindle, 2010). Such activities may also enable suppliers to win contracts with other retailers. This is the case for IKEA:

"IKEA has identified energy efficiency as a high priority topic. Through energy efficiency we will be able to reduce our (suppliers) carbon footprint and our production costs. Moreover, energy efficiency improvements often result in a better process control and a series of non-energy benefits such as increased productivity and better product quality. The result is lower product prices for our customers."

Maja Dahlgren, IKEA.

The term "supply chain" denotes those activities "upstream" from the company, conducted by the entities that supply products, materials or services to the company that is assembling either an intermediate or final product (Prindle, 2010). In the Netherlands, for example, under the LTAs, participants can choose to extend their energy-saving efforts beyond their company boundary by engaging their suppliers.

Co-benefits of EnMS

A common experience of companies that use EnMSs effectively is that many other significant benefits, referred to as co-benefits or non-energy benefits (NEBs), are also uncovered (Box 6). These benefits include productivity gains, improved product quality, lower non-energy operating costs, longer equipment life, reduced maintenance costs, less waste generation, better resource efficiency, improvement of workplace conditions and pollution reduction (Hall and Roth, 2003; Pye and McKane, 2000). Including co-benefits reduces payback times for new investments.

In fact, co-benefits often exceed the value of energy savings, so energy savings should be viewed more correctly as part of a broader set of parameters that affect company productivity and profitability (Pye and McKane, 2000). A 2003 study of commercial and industrial energy efficiency programmes in Wisconsin valued these benefits at approximately 2.5 times the projected energy savings of the installed technologies (Hall and Roth, 2003; Willoughby *et al.,* 2011). Another study for Alcoa showed that the company's initial cost of USD 5 000 in consulting fees for purchasing a three-fan, variable-inlet-valve (VIV)-controlled system created a potential incremental annual revenue of USD 375 000 by enabling the redirection of energy savings towards increased product output (Pye and McKane, 2000).[8]

Robust energy management not only saves energy, but can also open doors to innovation across a company. By engaging people across an organisation and tapping their creativity to meet energy-savings goals, companies are discovering other useful innovations (Prindle, 2010).

Communicating the co-benefits of EnMSs is thus a critical step for addressing other priorities within a company and encouraging uptake. In Ireland, EnMSs are seen as and marketed to companies as business improvement tools because of the significant gains that companies have achieved through EnMS implementation.

Wider benefits of EnMPs

EnMPs can support and build the energy efficiency market by training energy managers and developing the energy service market, and support longer-term efforts for improved energy technologies (ISO, 2011).

Box 6

Quantifying co-benefits of carbon reduction initiative for a glassware company

IKEA, a leading global retailer of home furnishings, and the World Wildlife Fund (WWF) are engaged in a partnership to reduce greenhouse-gas emissions and energy consumption, and increase competitiveness of IKEA's suppliers. One of IKEA's suppliers, the Hongwei Glassware Company in Yuncheng, China, has been involved in the initiative. The company upgraded its furnaces and switched its fuel source from coal to natural gas. As a result, in addition to reducing its greenhouse-gas emissions by 35% between 2009 and 2010, the company realised numerous non-energy benefits, reducing the costs of products by 17% (increasing the output rate and qualified rate of non-rejects due to temperature stability). The company also made improvements in product quality and health and safety conditions for workers. It then adopted the same upgrades in its two other facilities.

Source: Willoughby *et al.,* 2011.

Governments and policy makers view the co-benefits to enterprises as important additional motivating forces for EnMPs, and these co-benefits are often national priorities, especially in emerging and developing countries. Reductions in energy use, in addition to greenhouse-gas mitigation, also lead to lowering the burden of local air pollution, improving water use and efficiency, reducing waste management, and protecting the health and safety of workers. By focusing on environmental and societal benefits as well, EnMPs can contribute to meeting national priorities of energy independence, reduced price volatility, international co-operation (*e.g.* under frameworks such as the Rio Declaration on Environment and Development) and technology transfer (IIP, 2011).

8 According to the authors' assumptions, 3 346 320 kWh in saved energy was redirected to produce an additional 500 000 lbs. of aluminum, which is sold at USD 0.75 per lb market price.

Encouraging uptake of EnMSs

Despite the clear benefits of EnMSs, EnMPs are needed to encourage enterprises in the proper and widespread adoption of EnMSs.

Standards and specifications

Even though companies may actively practice several of the components of EnMSs, government programmes can use standards and specifications to facilitate and support the establishment of clear definitions for how effective EnMSs can be carried out. EnMPs provide governments and enterprises with a common understanding of EnMSs, including their content, scope, processes and methodology, and a common reporting format (Goldberg *et al.,* 2011). EnMS standards and specifications also create a transparent system to validate energy performance improvements and management practices, and can lead to a means for devolved implementation and compliance assurance.

Indeed, companies that have implemented standardised EnMSs as part of a wider EnMP have often achieved savings beyond the expectation of the wider energy-savings agreements, or what they would have achieved through self-designed systems. These companies typically achieve savings of 10% to 20% within the first five years (NRC, 2011; Goldberg *et al*., 2011).

Motivation, incentives and support

Standards or specifications for EnMS on their own are not sufficient to drive widespread adoption of effective EnMS, certification often incurs significant costs. For example, in the case of EnMS standards, the costs of having an EnMS certified can be prohibitive, especially for small and medium enterprises (SMEs) (Hrustic *et al.,* 2011).[9] To encourage EnMS adoption, incentive and support mechanisms are necessary.

In Denmark, Sweden and Ireland, an EnMS standard is underpinned by a voluntary energy-savings agreement between enterprises and the government, and linked to incentives and support. Uptake within each country is relatively high: 60%, 50% and 25%, respectively, as of 2009 (see McKane *et al.,* 2009). In comparison, the uptake of the United States standard (ANSI/MSE 2000:2008 available since 2000) was less than 5% despite this standard being in place the longest - since 2000 compared to compared to 2001 in Denmark, 2003 in Sweden and 2005 in Ireland. The difference in uptake was most likely due to the absence of a supporting programme in the US (Goldberg *et al.*, 2011). This has now been addressed through the launch of the US Superior Energy Performance programme.

EnMPs can also create motivation by disseminating case studies and best practice examples of excellent corporate management. Making the business case for energy efficiency reduces its perceived risk to management, which may, in turn, reduce the hurdle rate (or payback period) that a company requires of an energy efficiency investment (Pye and McKane, 2000). Sharing the experiences of companies with EnMSs through public reporting, networking and dissemination of case studies etc. can reduce learning costs for other companies.

9 In Sweden, the cost of receiving certification of the energy management system is approximately EUR 8 000.

How to deliver energy management programmes?

The figure below illustrates the four phases of effective energy management programme delivery: plan, implement, monitor and evaluate phases. These phases are then broken down into ten critical programme steps, and sets of actions. The steps and actions are supported by experience drawn from practitioners and are further demonstrated in two case study examples.

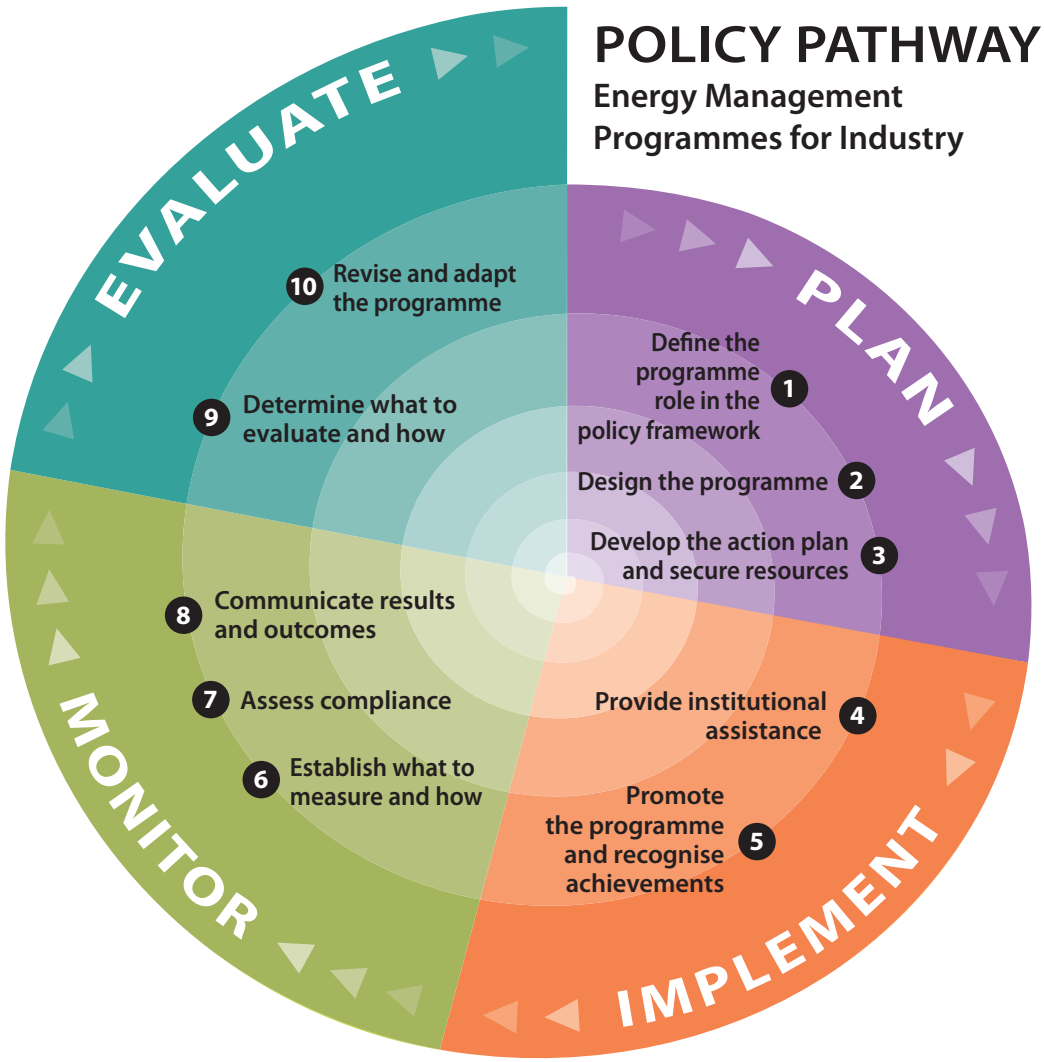
The **Planning** phase helps countries to ask the right questions and to carefully plan, in consultation with key stakeholders, the programme design and implementation.

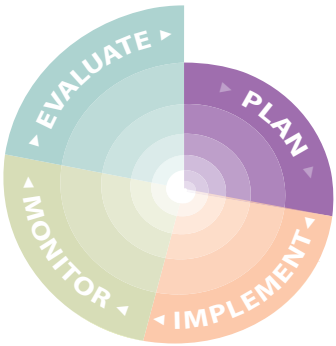
The **Implementation** phase outlines the main steps necessary for ensuring a successful outcome.

The **Monitoring** phase helps identify indicators and methods for measuring organisational change, energy savings and other results.

The **Evaluation** phase focuses on how to capture lessons learned, assess effectiveness and make improvements.

During the four phases, different types and levels of stakeholder consultation and engagement are important to help define the needed interventions, design compliance and verification requirements, comment on proposals and share experience on specific barriers.





PLAN

Prior to planning an EnMP, governments need to conduct an assessment of existing industrial energy use and energy management practices, as well as a survey of overarching national targets in the areas of energy efficiency, climate change mitigation and industrial development. This step is necessary to determine the need for energy efficiency policy measures for industry.

Careful advanced planning of an EnMP ensures that all the important elements can be incorporated at the outset, avoiding delays, duplication of efforts or confusion. Transparent planning, which involves stakeholders from the beginning, will ensure critical aspects of the programme have been considered, and will help to increase target group buy-in and identify future implementation issues or difficulties.

The purpose of the EnMP should be articulated, including inter-linkages with other policies. Once a clear purpose has been defined, the programme needs to be designed including identifying the programme's components. The programme may involve a number of activities; however, the order in which the activities are undertaken may differ, and some may be conducted concurrently. Furthermore, some activities may be optional rather than necessary to a successful programme.

1 *Define the programme role in the policy framework*

The relevance and success of a programme is clearly linked with ensuring that it is aligned with and contributes to wider policy perspectives. It is important that the programme corresponds to the needs of industry and reinforces existing policies.

Analyse the policy framework and industrial context

The first step is to define the programme's purpose and role in the national policy framework and industrial context. Understanding the context in which industries operate is a precondition for designing effective programmes. Policy makers need to establish how the programme will contribute to national objectives and targets in the areas of energy efficiency, environment, climate change mitigation and industrial development. A comprehensive review must be conducted of existing policies and impacts on industry, as well as analysis of other factors such as industrial composition and development trends in the markets in which the industries operate. The results of this review will constitute the basis for an assessment of how these policies stimulate or hinder energy management efforts, and an identification of drivers, barriers, gaps and possible synergies. The assessment must also consider possible overlap with other instruments (such as emissions trading schemes) so as to avoid duplication of efforts or support. Assessments may require the participation of, or inputs from, representatives from several line ministries and other stakeholders. The consultation process described below can be utilised for this purpose.

Consult with stakeholders

Consultation is a continuous process and may occur throughout the four phases of the policy pathway. Early consultation with industrial enterprises and energy experts can help provide input into the programme's design, uncover specific industry circumstances and needs, and identify the barriers that industries face to effective energy management. The aim of this early consultation should focus on discovering the salient issues to develop clear and relevant objectives, give policy makers guidance on what the EnMS requirements should be for adoption by participants, and to determine how these requirements can be communicated to companies in language that is relevant for them.

Box 7

Consultation as part of Australia's EEO Programme

Consultation and continuous learning are strong principles underpinning the development and implementation of Australia's Energy Efficiency Opportunities (EEO) programme.

***During the development** of the assessment and reporting procedures, the Department of Resources, Energy and Tourism held three consultation sessions in five state capital cities over a period of 18 months, with approximately 400–600 attendees from companies, the services sector, state governments and industry associations. At the first session, attendees heard lessons and company experience from a previous, similar voluntary Energy Efficiency Best Practice (EEBP) programme. Attendees were asked what elements and features would deliver the greatest energy savings and financial benefits for their businesses. Companies were also asked what the barriers were and how they could best be addressed.*

The consultation process was also used to initiate a pilot programme. After an expression of interest, 25 companies nominated themselves to pilot the programme. Consultation sessions were then used to outline proposed steps and requirements.

During the implementation phase, client liaison officers and on-going contact with companies allow the government personnel to identify programme risks early, put in place strategies to address them and target capacity-building activities. The department also uses results from verification to identify where companies are not understanding or meeting assessment and reporting requirements so that this need can be effectively addressed.

Source: DRET, 2010a.

The consultation process should also survey any challenges that the industry sector faces in relation to complying with existing policies, such as target-setting policies, or designing programme elements to better integrate with current business systems and practices.

Being clear with stakeholders about what the government is trying to achieve, in language that is most relevant to them, and asking them how to realise these goals will generate valuable input and build trust. Addressing company priorities and explaining how energy management can help them achieve their objectives will enhance buy-in.

Consultation at later stages of the planning process may include involving volunteer companies to pilot the programmeme. This pilot phase uncovers key risks or challenges early on and also serves as a promotional tool that provides incentives for others to join as they see the benefits to their peers (Box7).

2 *Design the programme*

This stage involves defining objectives, determining scope, deciding whether the programme should be voluntary or mandatory, establishing linkages with other instruments, and deciding the types of programme components and measures to incorporate.

Define objectives

An EnMP may often have multiple objectives, such as delivering energy savings, greenhouse-gas reductions and productivity benefits; more widely, it may seek to support energy security or reduce demand for energy infrastructure.

Questions to consider include:

- Does the programme aim to improve productivity, reduce emissions, and reduce energy demand or peak demand?
- Is the programme's objective to assist companies in meeting a reduction target outlined in another policy?
- How does the measure fit in with other policy measures aiming to achieve the same outcomes?
- How can the objectives be tailored to the specific barriers that companies are facing, and how can the EnMP be designed to overcome these?
- If multiple objectives exist, should governments emphasise or iterate only those of interest to the target group?
- At what scale should effective energy management be promoted (pilot or widespread adoption)?
- How should the objectives be communicated to maximise positive perception of the EnMP?

Determine scope

Determining the EnMP's scope should be informed by the objectives and a cost-benefit analysis. Decisions on scope include whether to cover only large companies or SMEs as well, and whether all industrial sectors should be incorporated or only the most energy-intensive. Many countries initially focus on energy-intensive companies, *i.e.* companies that use more than a certain amount of energy per year or companies in which energy costs constitute more than a set percentage of total costs. A cost-benefit analysis of focusing only on large companies versus including SMEs can help to determine the programme's scope. The scope also includes the forms of energy use to be covered by the programme: some programmes focus just on electricity, while others include all forms of energy.

Focusing only on big industrial companies may mean the programme is easier and less costly to administer. In many countries, especially emerging economies, however, the SMEs make up a large proportion of total energy use or emissions in the industry sector, so it may make sense to include them.

Box 8

Energy management tools and support for SMEs

In most countries that introduce an EnMP for SMEs, the cost of audits is subsidised, the EnMS may be simplified, and in-depth training and follow-up assistance are provided.

Subsidies for audits: *in Korea, the government is developing a customised EnMS for SMEs and supports 90% of the energy audit cost to ease the cost burden (Yun, 2011).*

Technical assistance: *in the United States, the US Department of Energy supports a long-running programme through university-based Industrial Assessment Centers (IACs). The IACs provide free energy, waste and productivity assessments for SMEs. Japan has also been providing free energy efficiency assessment services by certified energy managers to small and medium-size factories.*

Programme tailored to SMEs: *In Europe, the Benchmarking and Energy Management Scheme for SMEs (BESS) was developed to improve energy efficiency in SMEs. During 2005-09, a web-based toolbox was developed to facilitate SMEs in improving energy efficiency in a structured way. Along with benchmarking, a central component of the integral web-based package is a supportive structure for simplified energy management implementation based on the "Plan, Do, Check, Act" approach. This approach includes energy management checklists, case studies, best practices and a set of supporting tools to help energy management in SMEs. The project organised peer-to-peer workshops on organisational aspects, and on technical aspects such as auditing, heating, cooling and ventilation. External consultants also served as additional resources to the participating companies (Vermeeren, 2011). The CARE+ initiative for SMEs developed by the European Chemicals Industry Council (CEFIC) also provides self-audit and best practice tools for SMEs.*

Large companies will pay more attention to energy, considering energy costs make up a relatively higher proportion of their production costs, and they also usually have more capacity to undertake energy management (Reinaud and Goldberg, 2011b). SMEs usually have limited resources and capacity, and so may need further capacity building, support and/or financial assistance (Vermeeren, 2011).

If differential treatment is given to SMEs, the rationale for any differential treatment should be clearly communicated up-front to avoid perceptions of unfair treatment. If the cost or complexity of EnMS adoption is an issue for companies, additional components should accommodate these challenges through a simplified EnMS or through more in-depth training and customised tools (Box 8).

Additional decisions on scope include whether the system boundary for managing energy should be limited to a certain proportion of energy within a facility, a whole facility, all facilities within the company, or extended to companies in the supply chain. Large companies could be given the responsibility to initiate or encourage EnMS adoption in other companies in their supply chain. For example, in the Netherlands Long Term Agreements (LTAs), companies meet one third of their reduction target outside the plant boundaries through less material use or recycling, waste heat or renewables use/generation, or by making efficient products. Similarly, in Japan's benchmarking policy, companies that demonstrate that they are already at global best practice can collaborate with other companies in their supply chain.

Define the EnMS in the context of the programme

A central aspect of the planning stage is to define the EnMS in the context of the programme. This includes determining whether to use a standardised or specified EnMS. As previously discussed, a common definition of EnMSs is emerging according to ISO 50001 (released in June 2011), the European standard En 160001, or the Chinese standard GB/T 23331-2009.

If policy makers choose to use a standard, the programme should include third-party certification of the proper use of the standard third-party verification can also be useful for programmes that do not utilise a standard.[10]

Energy management can also be defined by other means, such as specifications, as in the Netherlands LTAs or legislated requirements given under the Australian EEO programme.

Another example is in China where as part of the Top-1 000 energy efficient enterprise programme, the largest energy-consuming enterprises are required to follow a number of steps called Taking Energy-Saving Measures. These steps cover several components of EnMS: companies are required to undertake energy audits, appoint an energy manager and report energy consumption. Companies can meet the targets under the Top-1 000 programme if they also undertake these EnMS components and other requirements.

10 Third parties are usually private companies that have been accredited by a national or international standardisation body.

Determine level of obligation, and establish linkages with other policies

The level of energy management obligation for a company is determined by whether the EnMP, or components of the programme, are mandatory or voluntary. For example, energy audits conducted by an external expert (certified or not) may be mandatory, but training on energy management may be voluntary. Programmes are likely to have a mixture of voluntary and mandatory components, and some clear benefits for participation (such as an exemption from another policy, financial incentives, extensive training and support) (see Box 2). A mix of complementary incentives may need to be designed, in particular for programmes that are totally voluntary. For example, participation in Ireland's EAP programme is voluntary, but once signed up, companies are required to have standardised EnMSs and conduct one Special Investigation per year. In return, participants receive free technical assistance, networking opportunities and external recognition.

In the countries with the longest and richest experience in implementing EnMPs, enterprises are required to implement EnMS as a core part of their broader energy conservation agreements with the government (Goldberg *et al.,* 2011). In these cases, energy management is most effective where it is integrated within a broader policy.

In Finland, the Netherlands, Ireland, Denmark and Sweden, EnMPs are core parts of the voluntary energy agreements.[11] Although targets within these agreements drive the impetus for effective management practices, each programme also has a mix of incentives, training, technical support and external recognition (Box 9).

Box 9

Ireland's experience with combining EnMSs with other corporate improvement methodologies and tools

The Sustainable Energy Authority of Ireland (SEAI) explored the ability to integrate an EnMS into business cultures using commonplace business improvement methodologies such as Lean Manufacturing and Six Sigma (see Glossary), rather than each being managed independently. Particular focus is placed on how each methodology guides the development and implementation of projects and how these processes can be co-ordinated or integrated to achieve efficacy. A number of demonstration projects were sponsored and participating companies were mentored by expert consultants. The projects showed that by integrating EnMS into their business development process, companies were able to identify and implement additional savings and optimisation opportunities. This process also formed the basis for new or enhanced concepts including an Energy Management Maturity Model, Value Stream Mapping with Energy (VSMe) and MUDAe (see Glossary).

Source: O'Sullivan, 2011a

In 2010, Korea introduced a mandatory target and energy management programme known as the GHG and Energy Target Management scheme. ISO 50001 will play a key role in this programme, for which a pilot certification programme is currently under way (Yun, 2011).

Australia has a mandatory programme of reporting energy efficiency opportunities rather than setting targets. The programme enforces use of data and analysis approaches that would generate larger, cost-effective energy savings up to a four-year payback and then require companies to publicly report on the savings identified. This means that the issue of energy savings is taken up to the company board level.

11 Finland's Energy Efficiency Agreements; the Netherlands' Long-Term Agreements (LTAs); Ireland's Energy Agreements Programme (EAP); Denmark's Voluntary Agreement on Industrial Energy Efficiency (DAIEE); and Sweden's programme for Energy Efficiency in Energy Intensive Industries (PFE). See also the Institute for Industrial Productivity's energy efficiency policy database: http://iepd.iipnetwork.org.

Financial rewards or policy exemptions can also be effective. In the case of the Netherlands, Sweden and Denmark, participation is supported by full or partial rebates from environmental taxes. In Finland, Korea and Denmark, companies receive discretionary subsidies for energy efficiency investments. In the Netherlands, companies in compliance with the LTAs are automatically granted compliance with energy requirements under the Environmental Management Act.

Financial assistance can be provided for implementing certain aspects of the EnMS or for energy management components, in particular, subsidies for energy audits or assessments. In a number of countries, energy audits are partially subsidised (in Denmark, Finland, Sweden and Switzerland) or totally free (India, France, Ireland, Japan and the United Kingdom) (Motiva, 2008; Price *et al.,* 2010; Price and Lu, 2011). Korean SMEs receive a 90% subsidy for energy audits.

Other countries that are linking or considering incorporating EnMSs in energy-saving programmes include: Switzerland, Germany, the United Kingdom, Canada (NRC, 2011) and Austria (Kulterer *et al*, 2010). For example, since 2009, energy-intensive companies in Germany can profit from financial incentives through the Renewable Energy Law (EEG) when holding certificate of a functional and certified Environmental Management System (ISO 14001 or EMAS) or EnMS according to EN 16001 (Kahlenborg 2010). Countries with federal systems should also be aware of the need to streamline programmes, so companies are not duplicating compliance with similar but different schemes at state and national levels.

Other requirements on the target group also need to be considered, such as data, energy efficiency opportunities and performance reporting requirements, or commitments to implement identified profitable measures. In Ireland, for example, the EnMP mandates participants to undertake at least one Special Investigation per year, in the form of a feasibility study on an aspect of their energy use as a means to identify energy-savings projects.

In Australia's Energy Efficiency Opportunities Programme, participants are required to report publicly on the energy efficiency opportunities they have identified through the required assessments and categorise these opportunities according to their payback periods (under two years, between two and four years, and voluntarily above four years).

Establish linkages with other management systems and tools

Although the standard for energy management ISO 50001 has only recently been released, energy management has been included in the ISO Environmental Management standard 14001 since 1996. ISO standards can easily be applied in combination and can also be linked to productivity tools such as Lean Manufacturing and the EU Eco-Management and Audit Scheme (EMAS) (Kahlenborn, 2010). This integration gives companies the flexibility to use various tools if they have multiple energy, environmental, productivity and other business objectives.

Companies in Ireland have seen benefits of incorporating EnMSs with other business improvement tools (see Box 10). In developing Australia's Assessment Framework, companies told officials that sites are often overloaded by different and conflicting audit programmes to improve health and safety, water, waste, etc. For continuous improvement to be maintained, energy management needs to be integrated into the business or operational improvement methodologies used by the business; otherwise they may drop off over time due to overload. As recently quoted by Macathar Coal during an EEO workshop; "EEO is not about reinventing new systems but improving on existing systems"[12].

Policy makers should consider which role the EnMP can play in the application of these other tools and standards, especially if such tools relate directly to environmental and productivity objectives.

12 Referred to in a presentation by Mick Zeljko, General Manager Carbon and Energy, Macarther Coal, Presentation at the EEO Industry Workshop (31 August, 2011; Brisbane Australia).

Define level and types of assistance

To assist companies in implementing the energy management requirements, policy makers need to develop measures such as technical support, guidance materials, and training or networking opportunities. Extremely important in this regard is the development of clear guidelines that detail how companies can implement the EnMS. Specific barriers facing the target group should inform the levels and type of assistance. For example, SMEs could benefit from adapted checklists such as for machines, lighting etc. in a simplified EnMS (Hrustic *et al.,* 2011). Specific guidance at the sub-sector level would be useful in EnMS adoption (Christoffersen *et al.,* 2006), in terms of focusing on particularly energy-intensive processes and technologies. China has plans to develop such guidance.

A further discussion on the types of assistance is provided in the "Implement" section.

Determine programme monitoring and evaluation approaches

In the "plan" stage, as opposed to the later stages in the policy pathway, it is important to establish appropriate monitoring and evaluation approaches and to develop a set of indicators for assessing the effectiveness and impact of the EnMP (and determining the frequency of these assessments) (Price *et al.,* 2008; Suomi, 2011). An annual budget for monitoring also needs to be allocated in the planning phase (Harmelink, 2011).

Establishing the parameters for monitoring and evaluation at this point will ensure that relevant and consistent information can be collected and monitored before, during and after the operation of the EnMP (or the EnMP phase). Further discussion is presented in the "monitor" and "evaluation" phases.

3 *Develop the action plan and secure necessary resources*

To ensure effective implementation, responsibilities should be clearly allocated and sufficient resources should be sourced at the outset. An action plan and a timeframe are important to make sure that all key issues are covered and dealt with in a timely manner.

Establish implementation group

A clear strategy for implementation should be developed at an early stage. An implementation group of high-level representatives from policy-relevant ministries and from major stakeholders should be established to develop an action plan, oversee the process and facilitate smooth collaboration during the entire implementation process (OECD/IEA, 2009). Early buy-in from key stakeholders will help to overcome perceived obstacles and lead to higher rates of participation. For example, a stakeholder-government board can ensure a continuous consultation process.

Create action plan

Once the programme components have been decided upon and the linkages with the wider policy framework have been established, the implementation group can develop an action plan, detailing the activities and time frames for delivery, timing and routines for monitoring and verification, and when the programme is to be evaluated. Because an EnMP involves many tasks and many actors, an action plan is a vital step to determine who will do what, within what time frame and what needs to happen for the programme to be deployed.

In particular, it is important to provide definitions and guidelines before or at the same time as the programme is initiated. Clarifying these at a later stage will create uncertainty, reduce support and delay the implementation of efficiency improvement measures (Reinaud and Goldberg, 2011a).

Consultation on proposed action plan

At this stage, the action plan should be released for consultation to seek detailed feedback on significant weaknesses and solutions. The consultation should also seek feedback on the most effective means to implement the EnMS in companies (*i.e.* EnMS implementation guidelines), including whether sector-specific guidance would be useful or necessary.

Consider piloting

The action plan can be tested by finding a group of companies willing to pilot the EnMP, before widespread implementation. In China, the Central Government has been organising pilot applications of standardised EnMSs in various provinces as well as in different industrial subsectors, and is developing the generic EnMS standard to include sector-specific information (Goldberg *et al.,* 2011).

Korea is currently piloting ISO 50001 over 2008-11. Australia and the United States also conducted pilots to optimise programme design.

From 2007 to 2010, the United States conducted an initial round of pilots to test the Superior Energy Performance (SEP) programme in five industrial facilities, which varied in industrial sector, size, and experience with energy management.

Their feedback confirmed the benefits of implementing an EnMS and also provided constructive guidance on the programme design. This feedback enabled programme designers to adjust the programme and make participation more practical for industry. The US Department of Energy (US DOE) is conducting additional demonstrations in about 30 facilities to test the final SEP programme design prior to its launch in 2012. Also the EBRD together with UNIDO has initiated a project to accelerate the uptake of energy management systems in Russia. This project includes a piloting phase with ten large industrial companies to assist in implementation of EnMS and ISO 50001 certification (case study 3 in Annex 1).

Adoption of the action plan

Once agreed upon, the action plan should be adopted and applied as closely as possible (IEA, 2009b).

Secure necessary resources

At an early stage of development, it is critical to assign programme responsibility within the public sector (*i.e.* institutional resources) and allocate financial and human resources. An evaluation, undertaken by Harmelink *et al*. (2008), of 20 energy efficiency policies indicates that an organisation or programme with a clear mandate, responsibility and adequate resources is a prerequisite for success. Because energy efficiency policy has cross-disciplinary aspects, however, cross-departmental collaboration is important.

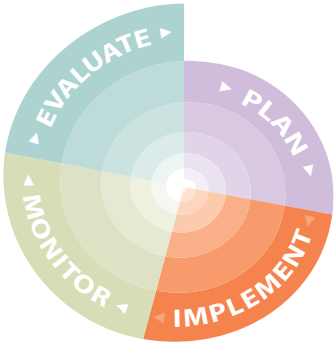
Several types of resources are needed to ensure effective implementation of certification schemes including institutional, technological, administrative, financial and personnel resources. All the resources need to be planned and allocated at the outset to avoid significant delays and complications during implementation (IEA, 2009b).

An assessment of current resources could be undertaken to establish which resources could be leveraged as part of the EnMP, as well as supporting other related polices and measures. For example, the government agency responsible for monitoring and data collection of a related effort-defining policy could also be responsible for collecting reports under the EnMP (reporting formats might be streamlined or complementary).

The question of how the programme will be sustained over time without government resources should also be considered. *Is an exit strategy envisaged, and can the private sector eventually assume some of the functions and services provided by the government?* In Germany and Switzerland's Learning Energy Efficiency Networks (LEENs), which focus on sharing energy management experience, the costs are shared between the government and private-sector companies, and the goal is to reduce government funding over time. Similarly, the SEP initially has heavy involvement by the DOE, but this involvement will decrease as the programme is fully launched and governed by a multi-sector board, the US Council for Energy-Efficient Manufacturing.

Technological and administrative capacity should be explored and developed to match the many tasks associated with delivering an EnMP. *For example, are benchmarking tools already available? Is a pool of energy experts available, who can help companies implement EnMSs?* If not, resources need to be allocated towards the development of such tools and support systems.

Financial resources for the EnMP should be established at the planning stage. Significant financial resources are needed to develop and administer the scheme and its tools and support systems. The costs of verification versus certification, and who will bear those costs, also need to be considered when deciding what option best fits the programme.



IMPLEMENT

4 *Provide institutional assistance*

A national co-ordinating body, such as the national energy agency or other government authority, should act as the central point of contact for participants in the EnMP and have responsibility for driving the implementation of the action plan.

Resources for training institutions, tools, support systems, verification/certification systems and promotional materials (among others) need to be secured. If standardisation and certification have been designed within the programme, a national standardisation body will need to have the standard ready for use, be able to accredit certification bodies and carry out regular quality assurance checks.

Provide clear guidance on programme requirements

This step involves providing definitions of the EnMS in the context of the programme and other programme requirements, such as reporting obligations or the need to conduct energy audits. Explaining the reasons for the requirements and the purposes for which submitted information will be used will facilitate compliance.

For example, if a standardised EnMS is required, the national co-ordinating body should be responsible for informing participants on how the standard can be obtained, where to find certification bodies, and when and how proof of compliance (via certification) is to be demonstrated. If reporting of information to the government is also required (*e.g.* on opportunities and results), the co-ordinating body will need to clearly outline the actions required of companies, how these actions are to be reported and how the information will be used.

Establish certification or verification systems

An EnMP's success is ascertained by robust and good quality data for which companies can be accountable. Verification or certification systems enable companies to submit data that gives governments assurance of the accuracy of the reports. Such systems are necessary to determine programme compliance.

Verification and certification also significantly enhance the credibility of energy data and support organisations in managing and optimising their energy use and energy-saving opportunities (CDP, 2011). Verification processes can also allow governments or third parties to provide constructive feedback to companies on their energy management systems.

For verification to take place, companies need to collect and monitor data, and have a set of criteria approved by the government or accredited agencies against which the verifier compares evidence (CDP, 2011). In the case of certification by accredited certification bodies, the criteria are the clauses of the EnMS standard; and the assurance statements are the identification of any non-conformities and the eventual issuance of the certificate.

Provide support systems to help companies implement the programme

The availability of tools greatly improves the quality of the programme, especially when SMEs are included (Box 10). Support to effectively carry out an EnMS can help to enhance the identification of further energy-saving opportunities and operate in parallel with EnMS implementation.

Support systems to help implement EnMSs may include:

- tools that help better assess energy use and energy effciency potentials and facilitate EnMS implementation;
- direct technical assistance;
- networking, workshops and special studies; and
- case studies.

Box 10 Tools for EnMS implementation

Because no "one-size-fits-all" tool is workable across sectors, countries and company types, companies should be aware of the different tools available to them and have the freedom to choose tools most relevant to their business operations. Below is a selection of the types of tools that can help companies identify savings opportunities that are available in their sectors.

- ***System assessment tools**, such as those provided by the American Society of Mechanical Engineers (ASME), for four different system types: compressed air, process heating, pumping and steam. They collect and analyse information on industrial system design, operation, energy use and performance data (Sheaffer et al, 2009).*
- ***The Quick Plant Energy Profiler** is a software tool provided by the US DOE that can help companies to have an overall view of major energy-consuming operations within a plant; the tool takes only about one hour to apply (US DOE website).*
- ***The Assessment to Action (A2A) tool** developed by the Institute for Industrial Productivity in China uses a benchmarking approach to assess the current energy efficiency levels of ammonia factories and identify what improvements are achievable. Companies can compare their current EnMS practices to the ISO 50001 standard, as well as their technologies compared to best practice technologies. Outputs from the tool include a report card, indicating where potential savings are possible, and an action plan, which helps companies outline roles and responsibilities and prioritise next steps.*
- ***(Ex)BESS e-learning tools** for simplified EnMS adoption include: implementation guidelines for the EnMS specification; a checklist of sector- and system-specific energy-savings measures; an implementation model that enables companies to introduce or improve their energy management; benchmarking tools; and other interactive web-based applications (Wajer, 2005a).*
- ***RETScreen's energy management software tool**, known as the Performance Analysis Module, enables users to monitor, analyse and report key energy performance data to facility operators, managers and senior decision makers.*
- ***The International Performance Measurement and Verification Protocol (IPMVP)** developed by Efficiency Valuation Organisation (EVO). It is a protocol that assists companies to reliably determine energy savings from energy efficiency projects within individual facilities. The use of this Protocol can help companies comply with the EnMP and legitimises savings for energy efficiency project applications to investors and banks (Langlois, 2011).*
- ***Energy Management Information System (EMIS)** was developed under Canada's Efficiency New Brunswick industrial energy management programme. EMIS is provided as additional support to help companies implement the Efficiency New Brunswick provisions. The Efficiency New Brunswick programme is a voluntary energy saving and carbon reduction programme for SMEs and large industrial companies. Participants receive financial incentives as well as a range of supporting tools. The EMIS provides management with relevant guidelines on monitoring, audit reports and implementation reports. Specifically, it includes guidance on how to create a comprehensive business system for data analysis, reporting tools, transforming energy metering and input data into performance reports and real-time metrics that can be used to take action (Efficiency New Brunswick, 2011).*

Direct technical expertise is another important support system. Participants in Ireland's voluntary Energy Agreements Programme (EAP) are allocated an Agreements Support Manager who can provide one-on-one advice on the agreement generally. The Manager can also accompany certification assessment personnel during their visit to the company and can provide recommendations on the company's EnMS implementation for further identifying specific energy-savings technologies, measures and practices that the certification personnel does not necessarily provide (Matteini, 2011).

Another example in Ireland's EAP programme are the Special Initiatives which are conducted by Special Working Groups convened by SEAI each year and are focused on specific technologies, initiatives and areas of particular interest to EAP members. These initiatives benefit EAP participants by: i) focusing on areas that particularly interest members; ii) enabling members to share knowledge and experiences and learn from energy experts; iii) identifying energy-saving projects, grouped special investigations, and benchmarking; iv) providing shared studies, self-assessments, methodologies and guidelines; and v) continuing to add value for members after the initial EnMS implementation phase (Goldberg *et al.,* 2011).

Government support for ***energy efficiency networks*** (EENs) can be very effective to help companies implement EnMSs (Box 11). The main goals of an EEN are to assist companies in reducing transaction costs, overcoming existing obstacles, raising the priority of energy efficiency aspects within the company, particularly in cross-cutting technologies and, hence, reducing their energy costs. For instance, Germany, Sweden, Switzerland and Ireland have launched successful EENs. Australia's EEO programme holds a series of workshops that bring in companies to share experience.

Box 11

Positive experience with energy efficiency networks (EENs) in Germany and Switzerland

Germany's first EEN was launched in 2002 in the Hohenlohe region, and the country now has over 40 networks launched by various institutions. In these networks, 10 to 15 regionally based companies from different sectors share their experiences in energy efficiency activities in meetings moderated by a senior consultant engineer. After an initial consultation and identification of profitable energy efficiency potentials in each company, all participants decide upon a joint energy efficiency and CO_2 reduction target over three to four years. Experts provide information on new energy efficiency solutions during these meetings, and the performance of each company is monitored on an annual basis.

The EENs are given an EEN manual with helpful documents (e.g. contract templates, checklists, technical manuals, presentation of energy efficiency solutions) and about 25 software-based techno-economic calculation tools that are being developed under a joint user interface. The resources provided under the EENs are intended to offer several elements needed for the EN 16001 standard.

EENs are financed and operated mainly by industry itself. In Germany, the federal Environmental Ministry (BMU) has provided initial funding with a view that over time the networks will become self-sustaining. In Switzerland, participating companies receive rebates from the carbon tax. EENs represent an innovative approach for medium-sized companies being applicable in any industry with minor adaptations.

Source: Koewener *et al.,* 2011; Rohde, 2011.

Case studies can demonstrate that companies are implementing EnMPs requirements in practice and are directly benefitting from EnMS adoption and other programme components. These case studies can give motivation and ideas to others to participate and follow best practices. Case studies also assist in promoting the programme (as discussed in step 5).

Develop training strategy and appropriate training programmes

Training at multiple levels is necessary in the implementation stage, and a wide variety of training options and methods are available, depending on the requirement of the EnMP. Training Programme should be developed as early as possible once the scope of the EnMP has been defined. If training programmes already exist, the government might consider adapting the curricula to include training needed for the EnMP. Indeed, energy efficiency training is now being incorporated within tertiary education programme in engineering, accounting and business fields.

Training programmes can be centred on helping companies to implement EnMSs; training energy managers; training energy auditors; and conducting EnMS certification and verification compliance assessments.

Training for company personnel or external parties to implement EnMSs. Governments, certification bodies and third parties can provide training on EnMSs for staff responsible for implementing EnMSs or for external bodies that may provide advisory expertise on EnMS implementation. For example, the Danish Energy Agency trains energy engineers to assist companies in implementing EnMSs. Similarly, in the United States, the SEP programme is developing Certified Practitioners in Energy Management Systems, qualified to assist companies to conform with ISO 50001 and pursue SEP certification.

Under Ireland's EAP, the government has provided a number of on-going and repeated training courses over the years targeted at different audiences: to EAP companies generally (including top management), to EAP energy managers or engineers, and to the public more generally. Training for EnMS users is now also available commercially. The government also provides special topics workshops offered to EAP members (Goldberg *et al.,* 2011).

Training of energy managers. If the appointing of an energy manager within a company is mandatory, then training programmes provided by accredited agencies, often universities and polytechnic institutions, or accredited trainers can be very useful (Box 12). For example, in Japan, industrial facilities are required to designate a certified energy manager. Training for certification is provided by the Energy Conservation Center (the Energy Management Examination and Training Center). The Minister for Economy, Trade and Industry issues the certificate after candidates have been examined.

In India, it is mandatory to have a Certified Energy Manager for Designated Consumers (*i.e.* large emitting industries). The Bureau of Energy Efficiency (BEE) provides registered candidates with curricula, guidebooks and past examination papers in preparation for the BEE Certified Energy Manager examinations held twice a year.[13] An interactive website has also been established (www.energymanagertraining.com).

Korea Energy Management Corporation (KEMCO) also operates various specialised education programmes. This education includes the provision of required training (seven-hour course) for energy managers of companies using total heat and electric power of 2 000 toe or more. In addition, KEMCO also offers fee-based training and capacity building in the areas of energy diagnosis and energy management system implementation.

In Canada, more than 100 "Dollars to $ense" energy management training workshops are held per year, contributing to capacity building of more than 2 000 professionals.

13 Curricula and guidebooks on energy management and energy audit include Energy Efficiency in Thermal Utilities; Energy Efficiency in Electrical Utilities; Energy Performance Assessment for Equipment and Utility Systems. See www.aipnpc.org/12thExamProspectus.pdf.

Training of an energy auditor. If external energy audits are mandatory, then training programmes need to be provided by accredited agencies, often universities and polytechnic institutions, or accredited trainers. In India, energy auditors are trained and certified by the Bureau of Energy Efficiency (BEE), and past examination papers are posted online.

Training of third-party certification personnel. Certification bodies also need to undergo training that is supervised by accreditation and standardisation entities to ensure that companies are being competently certified (Box 12). Training also provides market recognition of individuals with the necessary skills to properly undertake the assessments and to help potential users of these services in identifying qualified individuals (US DOE, 2011b).

Box 12 ***Training for certification***

The United States has developed a national qualifying exam for ISO 50001 auditors, with additional requirements for personnel seeking to verify that facilities meet SEP certification. The SEP auditing team comprises an SEP Lead Auditor to assess conformance to ISO 50001 and an SEP Performance Verifier(s) to assess adherence to the SEP M&V Protocol and achievement of SEP energy performance requirements. All certified professionals associated with SEP are subject to a rigorous qualification exam developed in accordance with ANSI/ISO/IEC 17024 and, once certified, must meet periodic professional enrichment requirements.

Follow-up with companies and assist in implementation

Once implementation of the programme is under way, continued follow-up with companies should be undertaken to help companies with challenges in implementation and to uncover any bottlenecks. For example, governments can assist end-users by providing information on equipment suppliers. For example, in Finland, to assist in implementing the voluntary Energy Efficiency Agreements and encourage the development and uptake of new technology and innovative solutions, the EnMP promotes networking between the developers of energy-efficient technologies and users and financiers. This networking aims to create research and development partnerships between energy technology suppliers and service providers and companies. The partnerships provide companies with a competitive edge as first appliers of new technology, as well as essential research and piloting platforms for technology producers.

5 *Promote the programme and recognise achievements*

To encourage widespread uptake and achieve maximum programme impact, governments need to promote the EnMP. Promotion can occur through a variety of means such as direct information campaigns, networking workshops, dissemination of case studies and recognition of companies that have demonstrated best practice. Aside from its role in programme promotion, external recognition is an important element for the success of the EnMP. Government agents must also be able to communicate to a way that reflects business realities and that identifies the benefits to potential participants.

Establish opportunities for networking

A good way of raising awareness of the programme and the benefits of EnMS adoption involves organising networking opportunities, where companies are able to share knowledge, information, best practices and lessons learned.

Develop case studies

As part of information campaigns to encourage participation, policy makers can disseminate case studies of company examples, which illustrate peer experience of the costs and benefits of participation.

For example, as part of the EnMP, Sweden publishes case study reports on company experiences with EnMS adoption (Swedish Energy Agency, 2011a) and organises seminars and networking for disseminating results of the programme (Petersson *et al.*, 2011). Canada publishes *Heads Up CIPEC* (a twice-monthly newsletter), which is distributed to over 9 000 subscribers and provides profiles of companies that have undertaken and benefitted from diverse energy management practices. Australia and Denmark also publish case studies.

Provide external recognition for achievements

Certification (and the proof of the certificate) is a way for companies to demonstrate to external stakeholders that they are actively managing their energy use.

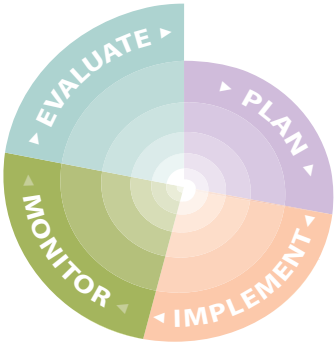
Beyond the achievement of certification, governments may initiate additional means of recognising excellent corporate energy management, and these efforts can be an important incentive for EnMS adoption. Governments may provide external recognition through awards, labels and case studies.

For example, SEP programme in the United States recognises energy performance achievements that are validated using the SEP M&V Protocol, the programme's reporting and validation methodology. Silver, gold, or platinum designations are awarded according to the level of energy performance improvement and the maturity of the EnMS.

To promote best practices regarding energy conservation, the Japanese government has established the Energy Conservation Grand Prize. The Korean government has also held the Energy Conservation Promotion Convention every year since 1979 and awarded prizes to companies and persons who have carried out best practices of energy conservation. China's Suzhou city has a labelling programme (Box 13).

Box 13 ***Suzhou's Energy Efficiency Star programme***

In China, a voluntary awards and labelling programme in the city of Suzhou focuses on the reinforcement of energy management and implementation of energy-saving technological renovation projects. Known as the Energy Efficiency Star programme, it provides an effective framework for evaluating, measuring, documenting and reporting energy performance at the factory level. It rewards and recognises factories for their energy efficiency improvements with an official government endorsement, using a number of stars as the rating system. The next step in the Suzhou energy efficiency rating and labelling system is to obtain recognition by international buyers/brands, including Walmart, as a means to measure energy and carbon performance in Chinese supply chains. The aim is to promote nationwide adoption during the 12th Five-Year Plan.



MONITOR

Monitoring of EnMPs enables compliance assessments and identifies gaps in programme implementation.

An essential part of the monitoring process involves data collection and review, which provide a quantitative means for governments to measure compliance and verify progress toward meeting energy efficiency targets and effective adoption of EnMSs and EnMS components. Collection of data needs to be relevant to allow for an evaluation of policies (Tanaka, 2009).

Collection of data can be used to create a verified record of energy consumption and energy performance improvement by using indicators such as total energy consumption, energy consumption intensity, diffusion rate of technology, thermal energy efficiency, productivity gains and product quality improvements (Tanaka, 2009). Data collection can also help to assess compliance; track participation; establish and use benchmarks; and track government and company spending.

Monitoring processes need to be realistic relative to the costs involved. Because the end-users are seldom interested in putting resources into monitoring and verification beyond their own needs, governments need to determine what costs are reasonable to obtain measured, accurate and verified data (Suomi, 2011).

6 *Establish what to measure and how*

Establishing what to measure and monitor, and how to do this, at an early stage will help avoid challenges later on in the process. To save time and efforts, existing systems for data collection should be reviewed and possibilities for building on these should be explored.

Establish indicators and data sources

Planning data collection begins with determining which indicators should be used. Indicators should be decided in the "plan" stage (but are discussed here) because they need to be developed on the basis of the programme objectives and goals (Suomi, 2011). When the objectives are clear, policymakers can more easily and effectively develop appropriate indicators. These indicators will also be relevant to the evaluation stage, so advanced planning and integration between the two stages is important (and, as noted above, should be considered in the plan phase). For example, if the evaluation would aims assess the co-benefits of an EnMP, indicators of co-benefits need to be defined and monitored.

Indicators should be used to understand: how and to what extent the EnMSs undertaken by a company are being adopted; how they are helping the company to meet other energy or greenhouse-gas reduction targets; how the EnMSs are affecting the company's overall energy performance. Indicators can also help track other improvements to productivity and co-benefits.

Indicators will be both quantitative, to understand the energy opportunities and energy savings made, as well as qualitative, to understand organisation change. For example, companies will be asked to document their savings or report on progress towards targets (*i.e.* quantitative indicators). Company uptake of EnMSs, behavioural and organisational change, and the qualitative experience in the company can also be monitored through surveys and interviews (*i.e.* to generate qualitative indicators). The results of these surveys and interviews are useful for future evaluations (see the evaluate section).

The purpose of for which indicators will be used should be clear at the outset. This includes establishing whether they are being used for the monitoring (and eventually evaluation) of

Box 14 ***Annual reporting in Finland and Australia***

In Finland's Energy Efficiency Agreements, data collection follows these categories:

- *general issues;*
- *name of organisation, contact information, name and contact information for person responsible for energy efficiency agreement, etc.;*
- *energy savings target in 2016;*
- *energy consumption data;*
- *electricity, purchased heat, fuels, and water consumption (transferred electronically in some areas from statistics gathered from other organisations);*
- *energy efficiency improvement measures;*
- *follow-up on implementation of measures proposed in energy audits;*
- *continuous improvement;*
- *subcategories, including management systems, energy consumption monitoring, training and communication, design and procurement and logistics; and*
- *innovation idea.*

Under Australia's EEO programme, companies are required to publicly report on overall energy use assessed and total energy savings by payback, and to describe three significant opportunities they have identified and or are implementing. This requirement also provides qualitative results on the kinds of opportunities being identified. The register of opportunities is listed on the Department of Resources, Energy and Tourism website (DRET, 2010a). Based on the data collected, three key performance indicators are used:

- *participation;*
- *organisational systems and processes; and*
- *changes in energy use, greenhouse-gas emissions and financial savings.*

EnMPs as well as other energy policies (*e.g.* target agreements). Isolating the impact of the EnMP from the impact of other energy and climate mitigation policies is a challenge, and strategies should be considered that can provide clarity in this regard. Indicators that apply only to the EnMPs will add value to monitoring and evaluation.

In addition, indicators can be analysed at different scales: regional and national level, within companies, at the company level, and at the sector or industry-wide level.

Programme in Finland and Australia utilise a number of indicators (Box 14).

Collect and review data

This step should consider how the data are collected, how often they should be collected and how to build upon existing systems to reduce overall transaction costs.

For efficient data collection efforts, Suomi (2011) gives four key pieces of advice:

- The monitoring system should be planned at the same time as the programme.
- Obligations for reporting should be included at the time targets are agreed upon with companies, and subsidy schemes should be granted based on reports submitted.

- Different target groups for the collected data should be taken into account.
- The monitoring system should cope with an expansion of the programme.

How data are collected will depend on the programme's objectives. The main way that governments can monitor an EnMP is through company reporting (as seen in the previous section) (Box 15).

Box 15 ***Finland's online monitoring system***

Finland has an efficient online monitoring system for companies in the Energy Efficiency Agreements. Because the web-based system is more flexible and easier to use than previous systems, the number of reporters has increased, and the overall costs of administering reporting have reduced. The reporting formats enable flexible modifications such as the inclusion of sector-specific features, and integration with the energy audit reporting database (Suomi, 2011).

The ***frequency of data collection*** also needs to be considered. In the Australian EEO scheme, for example, data is collected at three points in time through each five-year cycle, using government reports to enable effective reporting on the aggregate results and evaluation of the programme. Corporations report to the government at an entity level, which could be a business unit, key activity or site (DRET, 2010a). Many other EnMPs require companies to report annually.

Finally, ***duplication of efforts*** to report data can be an issue and lead to participating companies feeling "compliance fatigue". If EnMPs are embedded within other policies such as target-setting agreements, a single set of fully integrated monitoring requirements may streamline and reduce overall transaction costs (Box 16).

Box 16 ***Industry co-operation for data collection and confidentiality***

The issue of data confidentiality needs to be addressed in co-operation with industry. How data confidentiality is managed may affect industry's response rate and participation. Agreements need to be established on what data will be published and how it will be communicated. For example, the Industrial Assessment Centers Database does not publish the names of companies.

In China, under the Top-1 000 (now Top-10 000) programme, a comprehensive system is in place to collect, report and monitor industry energy and environmental data using detailed templates and at different levels – both national and local – to help governments supervise industry energy use and evaluate energy performance (Shen et al., 2010). Stakeholders have agreed that further reporting requirements for EnMS implementation should seek to be integrated into the existing system rather than to create a separate system.

7 *Assess compliance*

Part of the information that is collected can provide a basis for assessing compliance with the programme.

Use transparent and predefined criteria

Compliance assessments (*e.g.* certification) should be undertaken according to a transparent and predefined set of criteria in line with the requirements of the programme and the

verification or certification systems that have been established. In some instances, the main part of the compliance assessment will be devolved to accredited certification bodies or third-party verification bodies.

Establish reward or ramification mechanisms

Once compliance has been assessed against these criteria, a mechanism (which has been clearly communicated at the early stage of implementation) should be put in place that establishes for rewards for compliance and ramifications non-compliance (Box 17). Because many EnMPs are not stand-alone programmes but are embedded within target-setting policies, rewards and compliance ramifications can be executed as part of the wider package of policies.

Box 17 ***Korea's compliance policy***

Under Korea's mandatory target and EnMS scheme, introduced in 2010, major industrial energy users are required to reduce greenhouse-gas emissions and energy use by taking comprehensive measures in accordance with the plans that have been submitted and approved. The government reviews compliance and can recommend revisions to the plans. If energy users fail to achieve their target, they have to revise their actions and their plan, and have it verified by third parties. If energy users do not follow these obligations, they are fined (Yun, 2011).

Often, participation in and compliance with an energy-savings agreement, and adoption of an EnMS as part of the agreement, exempts participants from other policies or taxes. If compliance with these voluntary measures is not assured, then companies are penalised by being bound to a less preferable mandatory measure, such as a carbon tax or environmental permits.

8 *Communicate results and outcomes*

Regular reports of EnMPs are the most common way that governments communicate the results and outcomes to relevant stakeholders.

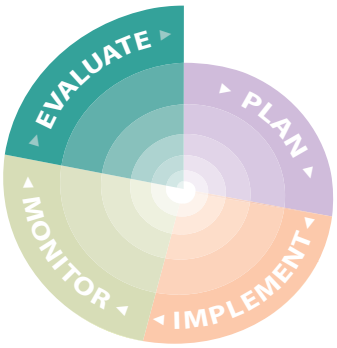
Communicate openly about strengths and weaknesses

Weaknesses and strengths of the scheme should be communicated to build trust between the government and stakeholders, and to open dialogue between the parties.

Show enterprise-level benefits

Governments need to communicate what the benefits are and have been for companies. Case studies based on companies' own accounts of experiences with the programme (used also as promotional tools) and synthesis reports[14] can be used to communicate results to current participants and potential new participants.

14 For example, the Australian EEO programme's *Continuing Opportunities Reports* synthesise the results reported by companies. *Significant Opportunity Registers* is a database that shows the different types of opportunities that have been identified for a particular sector. Both are published online. See: www.ret.gov.au/energy/Documents/energyefficiencyopps/res-material/ContinuingOpportunitiesEEO2010Report_Web.pdf.



EVALUATE

The evaluation approach should be defined and elaborated during the plan stage. For clarity, the evaluation process is detailed in this section. The approach taken to evaluate an EnMP depends on a range of variables: the regulatory requirements, policy context and linkages, objective of the evaluation, government budgets and other factors. As such, because a "best practice" evaluation method may not exist, this section details a number of practical approaches to EnMP evaluations and provides examples of EnMP evaluations in several countries, rather than describing one recommended method.

9 *Determine what to evaluate and how*

Important evaluation issues include the time frame for evaluation, communicating how the evaluation will be used and when the outcomes will be reported, establishing a budget and selecting the appropriate organisation to undertake the evaluation (US EPA, 2007). When evaluating an EnMP, governments should translate energy savings into cost savings, involve stakeholders and measure cost-effectiveness.

Evaluating the impact of the EnMP in isolation may be difficult because energy efficiency instruments often come in a package. As a result, autonomous efficiency improvements attributable to the EnMP cannot be clearly separated from savings induced from target-setting policies (Harmelink *et al.,* 2008) and other external factors. In such cases, the EnMP may be evaluated in connection with or fully integrated into the evaluation of a related policy. The discussion below offers some suggestions to isolate EnMS actions when evaluating the package of policies as whole.

Define evaluation objectives

Evaluation aims to determine whether an energy management programme met its goals, and to identify ways to improve current programme and develop future programmes (US EPA, 2007). Evaluations can also have other and multiple objectives such as: to analyse the wider benefits to enterprises and society; assess cost-effectiveness; attract new participants; revise annual programmes and plans; prioritise between different types of policy instruments; set or adjust budgets; and inform a possible exit strategy.

Evaluations do not yet have a high priority among policy makers, as evidenced by the survey by Harmelink *et al.* (2008) of 20 energy efficiency policy instruments applied across different sectors and countries. The depth of the evaluation needs to be considered in light of the associated costs and benefits.

Select evaluation approach and indicators

Typically, evaluating an energy efficiency programme focuses on the quantitative impact of the EnMP and therefore involves developing retrospective estimates of energy savings attributable to it (US EPA, 2007).

Evaluations of EnMPs can also provide a better understanding of the "softer" qualitative benefits that companies have realised. Through questionnaires and descriptive reports, a programme evaluation may also look at how the EnMP and promotion of the EnMS helped companies to achieve related energy or climate policies, whether particular EnMS components were especially effective (*i.e.* how valuable particular components were), and case studies to show examples that are replicable.

Surveys can be used to get a better understanding of the impact of EnMPs. For example, participants in Ireland's EAP were surveyed to understand how

Box 18 ***Indicators used in Sweden, Denmark and Australia***

Sweden: PFE voluntary agreement and the contribution of EnMS

- *avoided electricity use (TWh) from implemented measures by sector and category;*
- *total number of measures and routines implemented by category;*
- *value of investments in energy efficiency measures and payback periods;*
- *voluntary reports of other measures;*
- *proportion of companies that succeeded in (re) certification;*
- *interviews and surveys to determine why companies were not able to implement and certify an EnMS;*
- *results of EnMS adoption in terms of the identified energy performance indicators and how many measures were implemented as a result;*
- *qualitative interview/ survey material on the value of the EnMS for companies; and*
- *interviews with regulatory and implementation agents.*

Source: Petersson *et al.*, 2011; Swedish Energy Agency, 2011a.

Denmark: voluntary agreement programme

- *energy savings achieved overall;*
- *contribution to energy savings by EnMSs and other requirements under the agreement (e.g. special investigations);*
- *how the EnMS benefited the company; and*
- *Indirect benefits generated as a result of the programme.*

Source: Gudbjerg, 2011.

Australia: EEO Programme

- *level of energy use assessed by corporations;*
- *energy savings identified by corporations;*
- *industry share of identified energy savings;*
- *financial benefits of identified energy savings;*
- *business response to energy savings by payback period;*
- *net financial benefits associated with emissions reduction;*
- *impact of fuel type; and*
- *identified energy savings by fuel type.*

The Australian mid-cycle review questionnaire (DRET, 2010a) included questions designed to determine the extent to which companies had altered their management practices in areas such as:

- *senior management accountability for energy management;*
- *establishing objectives to improve energy efficiency;*
- *implementing documented processes for energy data collection;*
- *evaluating energy efficiency opportunities through the involvement of a cross-section of people and management support; and*
- *communication of energy issues and EEO outcomes within and outside the organisation.*

Source: DRET, 2010a.

the Irish EnMS standard had contributed to their energy efficiency efforts. Past surveys report that 67% of the projects implemented to save energy were derived or driven by the EnMS process. Since the introduction of EnMS in Ireland in 2005 (I.S. 393), the pace of energy savings has increased (O'Sullivan, 2011a).

Evaluations may also consider wider benefits such as how the EnMP generated co-benefits for enterprises, helped to develop the energy services market, or create better integration between suppliers and buyers of energy efficient equipment (US EPA, 2007).

Another area of evaluations involves process, design and implementation issues, such as how efficiently, cost-effectively or timely the EnMP was implemented.

Examples from Sweden, Denmark and Australia illustrate the types of approaches and indicators available (Box 18). In each of the three countries, the evaluation also included interviews and questionnaires to understand the benefits of energy management within companies.

10 *Revise and adapt the programme*

The results of the evaluation can provide recommendations to make adjustments at the end of a programme, or of a programme phase, and can identify lessons learned for the design of future programmes (Price *et al*., 2008). Revisions to an EnMP should seek to:

- **Address identified challenges and failures**. For example, if an EnMP requires the adoption of an EnMS standard to be certified, but certification costs are too prohibitive, support mechanisms for certification need to be reinforced.
- **Adjust to new circumstances**. For example, if a new target-setting policy requires targets to be formulated according to a percentage reduction over a defined period, as opposed to a point in time, the EnMP needs to reflect these changes and provide the relevant guidance materials for adjusting data systems towards progression of this new expression of the target.
- **Consider strengthening and up-scaling to encourage additional continuous improvements**. For example, the EnMP could not only stimulate energy management in single installations but induce large companies to persuade their supply chain to adopt EnMS. Similarly, companies can be prompted to pursue other business improvement methodologies, as is the case in Ireland where SEAI offers new business improvement tools for companies with long-standing EnMS experience.
- **Consider whether an exit strategy is relevant**. For example, *can the private sector eventually assume some of the functions and services that were initially provided by the government?*

Conclusions

Key lessons learned from existing energy management programmes ….

Energy management programmes (EnMPs) are effective instruments for governments to counteract barriers to energy efficiency improvement and promote the transition toward more sustainable energy use in industry through the use of energy management systems (EnMSs). The main objectives of EnMPs are to decrease industrial energy use and reduce greenhouse-gas emissions. If properly designed, EnMPs can also help attain other objectives. By supporting industry in using energy more productively, EnMPs can boost competitiveness and redirect savings to more productive uses.

In implementing EnMPs, governments can play an important role in establishing a framework to promote uptake of EnMSs, by developing methodologies and tools, and promoting the creation of new business opportunities in the area of energy services. The systematic approach embedded in energy management systems can help businesses to develop innovative solutions and optimise production processes, including the use of other resources. EnMPs can also be used to stimulate the development and uptake of energy efficient technologies and solutions.

If EnMPs are to be successful, governments must undertake consultations and continuous dialogue with industry, industry associations and other relevant stakeholders. EnMPs should align their objectives and activities with other policy instruments directed at industry. Similarly, the elements of EnMPs should be linked to other business management systems to avoid putting additional burdens on businesses. Complementary systems and synergies should be sought.

Establishing the appropriate combination of EnMP components that address the specific barriers and that are effective in the national context is essential. This includes making sure that the programmes are a cohesive part of the national policy framework.

Supporting measures such as guidance documents, tools, training and capacity building facilitate implementation. A wealth of experience exists in this area that can be used as a basis for developing the specific types of support needed for the programme.

Evaluating the impacts and outcomes of EnMPs is challenging. Efforts should be made to identify appropriate and useful indicators and include their monitoring in the programme design. Policy makers must acknowledge that energy management is not just about technological change but also about organisational change. Valuable insights can be achieved by exploring qualitative indicators and ways in which to measure important, but less tangible, results.

EnMPs are flexible instruments that can be adapted to changing policy needs and changes in industry. By continuously monitoring implementation and through regular evaluation, policy makers can identify opportunities to include new mechanisms or establish linkages to emerging policies. Capturing and sharing lessons learned are valuable for businesses, as well as for the international energy efficiency policy community.

Promoting international dialogue and knowledge sharing ……..

The Energy Management Action Network (EMAK) is an international forum to promote energy management in industries by interconnecting policy makers and industry practitioners. The network is managed by the International Energy Agency and the Institute for Energy Economics, Japan (IEEJ) on behalf of the International Partnership of Energy Efficiency Co-operation (IPEEC) and the Government of Japan. To date, three international workshops have been held, which have enabled practitioners and policy makers from around the world to share effective practices, lessons learned, and to discuss solutions to shared challenges. For further information see: http://sites.google.com/site/emakbiz/.

The Policy Pathway for Energy Management Programmes

Four phases	Ten critical steps	Twenty-four actions
PLAN	1 **Define the programme role in the policy framework**	• Analyse policy framework and industrial context • Consult with stakeholders
	2 **Design the programme**	• Define objectives • Determine scope • Define the EnMS in the context of the programme • Determine level of obligation and establish linkages with other policies • Establish linkages with other management systems and tools • Define level and types of assistance • Determine programme monitoring and evaluation approaches
	3 **Develop the action plan and secure resources**	• Establish implementation group • Create action plan • Secure necessary resources
IMPLEMENT	4 **Provide institutional assistance**	• Provide clear guidance on programme requirements • Establish certification or verification systems • Provide support systems to help companies implement the programme • Develop training strategy and appropriate training programmes • Follow-up with companies and assist in implementation
	5 **Promote the programme and recognise achievements**	• Establish opportunities for networking • Develop case studies • Provide external recognition for achievements
MONITOR	6 **Establish what to measure and how**	• Establish indicators and data sources • Collect and review data
	7 **Assess compliance**	• Use transparent and predefined criteria • Establish reward or ramification mechanisms
	8 **Communicate results and outcomes**	• Communicate openly about strengths and weaknesses • Show enterprise-level benefits
EVALUATE	9 **Determine what to evaluate and how**	• Define evaluation objectives • Select evaluation approach and indicators
	10 **Revise and adapt the programme**	• Address identified challenges and failures • Adjust to new circumstances • Consider strengthening and up-scaling

Annex 1. Case studies

Towards energy management through voluntary agreements: the cases of Ireland, Sweden and Denmark

Voluntary, sometimes called long-term agreements (LTAs), between energy authorities and industrial end-users have become an increasingly relevant policy instrument since the 1990s, due to their flexibility and consensual character. As demonstrated by Price (2005), such agreements can assume a variety of forms but have the same aim – namely, to improve industrial energy efficiency and/or to decrease CO_2 emissions. One main reason for the success of voluntary agreements is that they effectively harness the private sector's motivation to make financially attractive investments and contribute to ensuring and communicating a sound business case for energy efficiency in industry.

Ireland, Sweden and Denmark have all introduced voluntary agreements with industry to promote systematic energy management practices. These agreements share the common element that a standardised energy management system (EnMS), which can be certified, has to be implemented. At present, the applied standard is EN 16001. The three countries have different political traditions and framework conditions, and use diverse approaches to promote energy efficiency. Although the three cases show different pathways to stimulate the uptake of EnMS in industry, they also highlight common success factors and challenges (Table A1).

Table A1 Overview of voluntary agreement schemes in Ireland, Sweden and Denmark

	Ireland	*Sweden*	*Denmark*
Requiring general energy efficiency improvement	*Yes*	*Yes*	*Yes*[1]
Occurrence of national energy and carbon tax[2]	*Yes*[3]	*Yes*	*Yes*
Reimbursement of energy or carbon tax in connection with agreement	*No*	*Yes*	*Yes*
Demand for certification	*Yes*	*Yes*	*Yes*
Focus on LCC (life-cycle cost)	*To some extent*	*Very highly*	*To some extent*
Sanction if breach on an agreement	*No*[4]	*Yes*	*Yes*
Standard for energy management (before) now	*Yes (IS 393) EN 16001*	*Yes (SS 62 77 50) EN 16001*	*Yes(DS 2403) EN 16001*
Industrial target group	*Based on expenditure >1m/ year, any sector*	*Energy-intensive manufacturing industry*[5]	*Enterprises with relatively high energy use*
Participation in terms of number of firms	*85 enterprises in EAP, 160 in LIEN*[6]	*100 enterprises, 240 sites*	*106 enterprises*[7]

	Ireland	Sweden	Denmark
Participation in terms of energy use and share of total industrial energy demand	*19 TWh, 50%*	*30 TWh electricity, 55% of industrial electricity demand*	*N/A*
Quantified targets	*Yes, but non-binding*	*No(8)*	*N/A*

Notes: (1) From 1 January 2010, the scheme covers only electricity.

(2) National tax levels are differentiated for different sectors. Manufacturing industry, and especially energy-intensive firms in the trading sector, are often largely exempted from general tax levels.

(3) For kerosene, marked gas oil, liquid petroleum gas (LPG), fuel oil and natural gas; exemption from the tax applies to participants in the EU Emissions Trading Scheme (ETS) in respect to fuels covered to minimum prescribed level per energy tax directive 2003/93/EC.

(4) As support is provided for participants, the indirect penalty is less than or proportional to the support.

(5) Energy-intensive firms according to the EU energy tax directive 2003/96/EC.

(6) The Large Industry Energy Network (LIEN) and the Energy Agreement Programme (EAP).

(7) 106 participating enterprises included 40 greenhouse growers with a collective agreement. Totally there are five collective agreements with potato flour producers, hotels, camping grounds, tile-works and greenhouse growers.

(8) The effect of the measures is required to equal the effect of the alternative to pay the tax. Most programme participants have interpreted this target as 1% increased efficiency.

Ireland: a holistic and integrated approach to foster continuous improvements

The Sustainable Energy Authority of Ireland (SEAI) large business programme consists of two interconnected initiatives. The Large Industry Energy Network (LIEN) was established in 1995 with the aim of promoting energy management, conducting energy auditing, disseminating information and sharing best practices. LIEN consists of 160 companies representing 70% of Irelands total industrial primary energy requirement.[15] The Energy Agreement Programme (EAP) was established in 2006 to further stimulate the uptake of energy management systems (EnMSs). Enterprises participating in EAP enter into three-year agreements and are required to implement and maintain a certified EnMS (EN 16001) and complete one Special Investigation per year. After the first three-year agreement, enterprises can continue with successive agreements. Currently 85 enterprises are participating in the EAP. Trends show that over time, more companies from the LIEN join EAP. The main incentive for participating in the programme is the support provided by SEAI, including technical advisory services, financial support in the form of a small grant for Special Investigations and training. No linkage currently exists to an energy or CO_2 tax rebate. No specific energy-saving or greenhouse-gas reduction targets are set; rather the programme relies on the combination of EnMS implementation, certification and the impact of Special Investigations to ensure that savings appropriate to each business are made.

From the beginning of LIEN in 1995, founding member companies have achieved energy savings, on average, of over 30% (corresponding to 4 150 GWh),[16] with members achieving successive annual energy reductions of about 2 to 3%. Cost-effectiveness has been estimated to be high; for each euro of taxpayer money spent on LIEN, energy savings benefits of EUR 12 are attained in the productive business sector (SEAI, 2009).

Planning and design

In 2000, measures to decrease energy consumption and associated greenhouse-gas emissions were outlined in Ireland's National Climate Strategy. The

15 Includes some commercial, energy conversion and refinery companies.

16 Based on energy efficiency baseline of 1995, including all energy performance impacts.

proposed measures included a carbon/energy tax on all fossil fuels, as well as negotiated agreements with industry to maximise abatement and limit negative impacts on industrial competitiveness. In 2002, SEAI (then designated SEI – Sustainable Energy Ireland) launched a pilot programme to test three different types of agreements: i) a horizontal agreement that could be applied on an industry-wide basis; ii) a collective agreement with a grouping of enterprises from the same sector; and iii) a pilot agreement with a highly energy-intensive enterprise. The main objectives of the pilot programme were to assess the most suitable approach to Irish conditions and to work together with industry to develop an effective approach (SEI, 2003).

Before starting the project, SEAI consulted with industry and reached out to other stakeholders. To secure involvement and wide participation, SEAI published a call for interest for industries and consultants to participate in the pilot programme. This step was followed by one-on-one and group meetings. More than 20 sites signed up to participate, comprehensive audits were carried out and notional agreements were negotiated (no policy decisions were made at that time; instead SEAI developed a set of assumptions to test). The pilots did not involve an implementation phase; instead costs and benefits were estimated. The pilot project showed that all three types of agreements offered benefits and that negotiated agreements could be a viable and effective component of Irish climate change policy (SEI, 2003). The carbon/energy tax was not implemented at that time,[17] notwithstanding, SEAI established the Energy Agreements Programme in 2006.

The lessons learned from the LIEN programme, the pilot programme and the EAP, include the importance of determining how other interventions or initiatives (*e.g.* grant schemes and energy supplier obligations) can benefit the programme or can be channelled through the programme during the planning stage. Furthermore, the establishment of a business plan to guide the development of the programme is crucial. Such a plan should include consideration of the need for actions and support for enterprises when transitioning from a first energy agreement term to the next term, clear cost-benefit targets, a plan for how to reach out to enterprises and get them to want to participate, as well as consideration for retiring the programme once it has served its purpose. Similarly, multi-annual budgetary planning is important to keep programmes on track. A crucial part of this planning is to develop contingency plans for reduced (or increased) level of funding to support both fundamental and developmental programme elements (O'Sullivan, 2011b).[18]

A further issue that needs to be clarified at the outset is the role of the implementing agency in supporting the accreditation process for certification bodies. Appropriate measurement and verification protocol(s) for reporting of energy savings should also be developed. Energy service providers and consultants play crucial roles in the success of Programme. A mid-term plan or strategy on how to support and/or develop the energy service provider market should be part of the planning process (O'Sullivan, 2011b).[19]

Implementation and support

A range of approaches have been developed to support programme implementation. **Mentoring and technical expertise** are provided through Agreements Support Managers. The Support Managers conduct site visits, provide energy management advice, respond to queries, and can also assist with data collection and administration of funding. **Special Investigations**, which are a cornerstone of the EAP, take a step beyond routine assessments. SEAI continually develops processes, methodologies, or sector-specific approaches and projects to ensure continued effectiveness in

17 A carbon tax on fossil fuels was introduced in the Ireland 2010 budget or EUR 15/tonne; electricity is not covered.

18 These are recommendations from lessons learned that are under consideration.

19 These are recommendations from lessons learned that are under consideration.

uncovering new energy efficiency opportunities. Successful actions and approaches are then analysed, standardised and disseminated to the wider network, namely the LIEN. The Special Investigations thus not only identify opportunities in specific businesses but also contribute to wider knowledge creation and promote the replication of proven practices and successes (O'Sullivan, 2011a; SEAI, 2010). In some cases, funding support for special investigations is provided (SEAI, 2009).

Special project initiatives are planned each year to help enterprises undertake activities on significant energy end-uses. The scope of these projects extends beyond the EAP and LIEN to include also any relevant business or public sector entity. The aim of these projects varies; focus can be placed on a specific technology user, a new methodology or a specific sector. Efforts are made to ensure that all project activities contribute to the development of a body of knowledge that can be disseminated. The ultimate goal of these initiatives is to develop successful approaches that can be replicated and standardised. To make the initiatives more manageable, projects are divided into sub-projects called "Spins". This sub-division enables greater adaptability, and lessons learned from each Spin are integrated into the objectives and scope of work for the next project cycle (O'Sullivan, 2011a). A range of **methodologies** have been developed including, for example, the Energy-Efficient Design (EED) methodology, which addresses common barriers to achieving optimal energy-efficient design of facilities and processes. EED demonstration projects show savings of up to 50% compared to baseline design (SEAI, 2009). Other methodologies developed include Value Stream Mapping with Energy (VSMe), which integrates standard value stream mapping with energy analysis techniques (SEAI, 2009).

Networking and support activities embedded in the LIEN not only enable the dissemination of best practices and the benefits of energy management, but also provide a forum for enterprises to share experiences and knowledge. SEAI works closely with LIEN members to make sure that support activities reflect the needs of industries. Every year a number of workshops, site visits and conferences are organised. Many of the events are hosted by network members to increase their relevance and impact. SEAI also provides training courses (SEAI, 2009) 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 (O'Sullivan, 2011b).

To stimulate the development of energy awareness and energy management, SEAI provides EAP members with a range of **information support,** including statistics and reports, case studies, benchmarking data and special tools, *e.g.* the Energy MAP tool to facilitate energy assessments (SEAI, 2009).

Analysis of the Irish programme shows that, through structured energy management processes, participating companies are now probing deeper than previously and conducting critical assessments of energy service needs and process reconfiguration to reveal new opportunities.

Monitoring and evaluation

The certification process provides a structure that indirectly controls compliance to the EAP at no direct cost or additional management burden on SEAI. SEAI does not negotiate with each member a time schedule for certification (other than within the three-year time frame), nor are binding annual performance targets set. The decision on which energy efficiency opportunities to implement is also left up to the enterprise. It is assumed that continued compliance with the EnMS will cover these requirements by default.

The energy performance of the LIEN is reported on a yearly basis, using detailed energy data that is collected from members annually. Energy performance indicators are used to evaluate the performance of each enterprise. To assess energy savings or increases in energy use for LIEN as a whole, administrators use a method based on

relative change of energy intensity from one year to the next. Increases or decreases are calculated for each individual enterprise and then added together. Because this approach does not allow for differentiation between changes in intensity due to energy efficiency projects and changes spurred by other factors, complementary methods are used. Energy efficiency project data is collected, providing a "bottom-up" measurement of energy avoided due to the project. In 2009, EAP companies attributed 67% of energy savings to the EnMS process (SEAI, 2009). Although savings in absolute terms are of interest to gauge the impact of the programme, energy intensity is more understandable for businesses. Understanding, comparing and monitoring energy intensity over time stimulates enterprises to explore lost savings, hidden savings or offsetting of actual saving through inefficiencies elsewhere.

Irish experience highlights the importance of defining primary and secondary metrics to qualify the "additionality"[20] of the programme and overall energy performance improvements. Efforts should be made to establish a methodology to capture all savings that were enabled by the programme. This necessitates a quantification of: energy savings; energy losses due to energy and other business factors; operational savings through productivity improvements, including waste minimisation, water usage, quality and reliability improvements; and all associated monetary savings. SEAI use special project initiatives to explore and develop approaches that contribute to linking energy management practices with business improvement methodologies. Tools such as LEAN, Six Sigma, and Kaizen are promoted. Energy management can thereby become an important driver for business improvement in areas beyond the traditional scope of energy efficiency projects.

Some of the special initiatives are directed towards improving monitoring systems. For example, in the food and dairy sector, a gap analysis showed that few sites have established effective and transparent metering systems. This finding led to the initiation of a metering study to demonstrate the advantage of establishing management and operational key performance indicators (SEAI, 2009).

A recent initiative has generated an Energy Management Maturity Model. This model will help organisations to understand their level of maturity in EnMS development and efficacy. It will assist EnMS users to understand how the EnMS itself can be continually improved, which is a new requirement of ISO 50001. The model integrates a new body of knowledge, including the linkages to operational excellence and mainstream business improvement methodologies.

Sweden: a small incentive has led to big results

In 2004, in line with the EU tax directive (ETD), a minimum energy tax equal to EUR 0.5/MWh for industrial electricity use was established in Sweden. In 2005, to counteract negative impacts on the competitiveness of Swedish industry, and supported by article 17 of the ETD, the Swedish

20 Additionality is here used to denote the net results or impacts of a given policy measure. Calculating and estimating net results requires identification of what results stem from the policy measure and what results are caused by, for example, other policies, market development, or other factors.

Energy Agency (SEA) established a programme for improving energy efficiency in energy-intensive industries (PFE) (Stenqvist and Nilsson, 2011). More than 100 companies, with 240 separate production sites, participated in the first five-year programme period. Companies that join the programme are eligible for a tax rebate (*i.e.* EUR 0.5/MWh electricity use) during the five-year agreement. Companies are required to implement and attain certification for a standardised energy management system, conduct energy auditing and analysis, and adopt procedures for energy efficient procurement and project planning. The companies need also to document and report their identified electricity savings measures to SEA and are committed to implement those measures with a straight payback period of less than three years. The requirements are stipulated about implementation of electricity savings measures (*i.e.* not heat and fuel savings) as a response to the electricity tax rebate. Moreover, PFE should not interfere with potential fossil fuel savings due to the EU Emissions Trading Scheme (ETS). In cases where non-compliance results in termination of the agreement, the companies are required to refund the tax rebate.

During the first five years of the programme, results have surpassed expectations. Instead of the expected annual electricity savings of 0.5 TWh, participating enterprises have reported gross annual electricity savings of 1.45 TWh, and invested approximately EUR 70 million in more than 1 200 electricity efficiency measures. Savings for the enterprises from the tax exemption equals EUR 15 million per year, while the reported electricity savings have an annual value of around EUR 70 million (Petersson *et al.,* 2011). These aggregated results show that PFE is very attractive for participating companies. A second programme period was launched in 2009, and most of the initial participants have extended their agreements.

Planning and design

The planning and formulation process for a Swedish voluntary agreement targeting energy-intensive industry was initiated around 2000/01. Policy makers at the time were inspired by such agreements used in other countries. When the EU minimum tax on electricity had to be enforced in 2004, the exemption from the tax provided a suitable incentive to offer the participating companies in compensation for their compliance with the programme requirements (Stenqvist and Nilsson, 2011).

A PFE programme council was established in April 2005, consisting of representatives from industry organisations, relevant public authorities, and enterprises. The council meets four times per year to discuss issues that come up during implementation and the need to make adjustments to the programme. This arrangement ensures that different industry perspectives are present in the planning and implementation process (Swedish Energy Agency, 2007). No significant modifications were made when going from the first to the second five-year programme period.

Implementation and support

The Swedish programme utilises a phased approach and a range of supporting elements to ensure effective implementation. The SEA's website provides a wealth of information and guidance. A range of manuals have been developed to help implementation, including manuals on energy mapping and analysis, life-cycle costing, and procurement. To stimulate the inclusion of life-cycle cost considerations in procurement and investment decisions, during the first two years, participating enterprises have to introduce procurement routines for electrical equipment with high energy consumption and routines for energy efficiency project planning. Participating enterprises constitute a network, and meetings are held on a regular basis.

Key success factors of the Swedish programme have been the systematic approach provided by the EnMS, the programme'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 are important to ensure that energy efficiency is not put aside for other strategic or more acute issues. Through energy review and analysis, the EnMS creates the structure needed to plan, implement, follow-up and review the progress, as well as to secure continuous improvements with regards to energy-related issues.

Lack of time, slim organisations and poor access to capital are frequently mentioned barriers for energy efficiency, which have been remedied by the Swedish programme. Due to the fact that PFE involves tax money, energy issues have become a management task. In participating companies, energy-related issues now have a higher priority, both regarding access to capital and personnel. Several PFE companies have now educated all employees in energy issues, due to the EnMS. This extension of energy education has raised the awareness and technical skills of the personnel. By involving more people in energy management, organisations are benefitting from new ideas for savings. Although in other programmes investment risk is also claimed to be a key barrier for energy efficiency improvements, in PFE, working with the participants as a network and bringing forward good practices has substantially lowered the perceived risk to introduce new solutions.

Monitoring and evaluation

Participating enterprises are obliged to report results both after the second and after the fifth and final year of the programme period. Second-year reporting contains deemed savings from planned measures; the fifth-year reporting contains more reliable data based on measurements or engineering calculations of the actually implemented measures (Stenqvist and Nilsson, 2011). Hence, the programme result, *i.e.* the impact in terms of quantified electricity savings, is based on the bottom-up calculations performed and reported by the companies to SEA. In their communication of programme results, the SEA has compared the aggregate of reported electricity savings with the base year (*i.e.* 2004) electricity demand of participating companies.

The programme result of 1.45 TWh annual electricity savings should be regarded as a gross impact. In other words, this result does not reflect that other driving forces could also have played a role in determining reported outcomes. As an attempt to gather some knowledge about the net impact of PFE, the SEA requires the participants to report for each electricity savings measure whether it was identified through the energy audit or if it was known already prior to the start of programme. Moreover, the SEA receives voluntary company reporting on heat and fuel savings, indicating multiplier/spill-over savings (beyond electricity) as a result of the EnMS implementation (Stenqvist and Nilsson, 2011).

To reduce reporting requirements for enterprises, the SEA uses a data-based system. For analysis and evaluation, the system can be used by the Agency to automatically generate and aggregate results from enterprise reports. The SEA follows up with participant surveys and interviews stakeholders (*e.g.* certification and accreditation bodies, sector organisations). Independent academic studies and evaluations have also proven to be a valuable source of information.

Denmark: almost two decades of experience

In 1992, CO_2 taxes were introduced for all fossil energy sources in Denmark, and concerns for the competitiveness of Danish industry led to the development a system of voluntary energy management agreements for industry. In 1993, the voluntary agreement programme for energy-intensive industry in Denmark was introduced, and it has been modified a number of times since. The voluntary agreement scheme in the present form

was launched in 2002, but was changed to cover only electricity in 2008 due to the implementation of the EU Emissions Trading Scheme (ETS). The programme was further revised in 2010. The agreement scheme is administered by the Danish Energy Agency and is financed through the national budget with about EUR 5.4 million each year.

Companies joining the programme get a rebate on the energy tax.[21] The voluntary agreements are made between enterprises and the Danish Energy Agency and run for a period of three years. To participate in the programme, enterprises must obtain an energy management certification (EN16001 standard), make a number of special investigations that include an evaluation of the profitability of energy efficiency projects, and implement all projects with a simple payback horizon of less than four years. If the company does not comply with these requirements, the agreement is cancelled, and the company must pay back the tax rebate. Currently 106 enterprises are participating in the programme.

Planning and design

Agreements need to be renewed after three years, which gives the Danish Energy Agency the flexibility to make frequent revisions. Evaluations and systematic monitoring of the agreements provide the Agency with a firm basis for making adjustments in the programme. Although some of the adjustments provide clearer guidance to enterprises or demand more stringent monitoring efforts, others are more far-reaching. For instance, as a consequence of large energy savings from equipment replacement having been exploited, increasing focus was put on energy efficiency in core production processes (Johansen, 2002).

Implementation and support

Thorough guidance for companies wishing to join the programme is available on the Danish Energy Agency's website. The Danish Energy Agency also provides contact information for consultancy agencies that offer services to help the involved companies comply with programme requirements. At the outset of the programme, and up to 2001, enterprises planning to adopt EnMSs could receive subsidies in the implementation phase. In addition, specific energy efficiency measures in individual industries were subsidised. These subsidies have since been discontinued.

A special feature of the Danish programme involves collective agreements that are specially designed for companies with similar processes, products or energy consumption patterns. The collective agreements were introduced to reduce the administrative costs of entering an agreement. Prior to entering an agreement, enterprises negotiate with the Danish Energy Agency regarding the timetable, special investigations (comprehensive analysis of energy consumption of a process, plant, or overall production and energy system), and improvements in energy measuring/accounting systems. The basis for these negotiations is a proposal made by the enterprise specifying energy policy and targets, and how the company intends to reach these targets. The agreement lists all the enterprise's obligations and is signed by the firm manager and the Danish Energy Agency. Industrial organisations co-ordinate the collective agreements and negotiate with the Danish Energy Agency. The role of the industrial organisation varies, and can include co-ordinating annual reporting to the Danish Energy Agency. However, the actual agreement is signed by each individual enterprise, and the agreement lists the obligations of each individual enterprise (Krarup and Ramesohl, 2000).

Monitoring and evaluation

The Danish programme is built on self-reporting, with external verification and special investigations. Each enterprise submits data to the Danish Energy

21 In 2010, the energy tax was DKK 0.062/ 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 and rebates are adjusted annually in the period 2010/15 by 1.8%. (Danish Energy Agency, 2010).

Agency on energy consumption and a number of other key performance indicators, either manually or through an online system. The annual reporting and follow-up on the agreements and interim targets ensure close monitoring of the progress in each individual firm. In the initial phases of the programme, the Agency spent considerable time reviewing submitted reports, but increased reliance is now placed on self-reporting and the monitoring and verification processes that are embedded in the implemented energy management systems. This approach is complemented by detailed random sample checks of the enterprises' EnMSs and compliance with the agreement that are made by independent verification agents (Danish Energy Agency, 2005).

The whole programme has been evaluated several times, typically on a three- to five- year basis. Independent consultants are contracted to carry out the evaluations. The evaluation of the programme period 1998-2003 showed some interesting findings. The initial analysis identified a range of improvement opportunities in regard to data collection and the design of the Danish Energy Agency's database. For example, key data such as production and turnover was missing in some of the reported data-sets; also some errors in the entered data were uncovered. As a result, only a limited number of data-sets could be fully analysed, which in turn limited the types of analysis methods that could be used. For instance, it was not possible to make a statistical analysis. The evaluation process also highlighted the difficulties in isolating the effect of the programme from the influence of other factors such as the introduction of new products or new production processes, and changes in the composition of raw materials and climatic variations (Danish Energy Agency, 2005).

Taking these issues into consideration, the evaluation team decided to shift the focus on the evaluation from a quantitative analysis toward a more qualitative evaluation based on in-depth interviews with programme participants (Danish Energy Agency, 2005). The in-depth interviews with 28 enterprises and successive analysis uncovered interesting trends and provided insights into areas that could be improved. The evaluation indicated that approximately 40% of the savings can be attributed to the implementation of the EnMS, while the rest can be ascribed to developments such as changes in energy pricing and technological development.

Conclusions

Voluntary agreements between governments and companies can provide the extra incentive that makes enterprises start to realise energy efficiency potentials. Experiences show that the three programmes have been effective at addressing numerous barriers to improved industrial energy efficiency. The programmes have different formats and support systems but have attained similar results. The programmes have all succeeded because the local energy agencies have set up supporting policy measures, *i.e.* a combination of measures such as tax relief, assistance to join the programmes, grants, effective reporting systems and networking activities. One of the key identified success factors is the creation of a culture with real interest from top management, sufficient time allocated to work with the EnMSs, help from external consultants, networking and the promotion of concrete results on a national level. The three cases clearly show that the structured approach embedded in EnMSs enables enterprises to successively work toward deeper energy service and process changes.

Although the Irish programme has neither incentives in the form of tax rebates nor targets for enterprises, SEAI has achieved excellent results through the provision of a strong and varied package of support instruments. The Irish experience indicates, however, that continuous improvement and energy savings will not just emerge with maturing systems; they must be uncovered with effort and commitment. As programmes mature and good practices become embedded, the SEAI takes a proactive role in stimulating further activities. These activities include developing innovative approaches to encourage

enterprises to identify and implement additional energy efficiency opportunities, and taking measures to promote the replication and standardisation of solutions. To capture large potentials, programmes need to progress beyond conventional technical projects toward projects that more fundamentally address how energy is used in enterprises. To achieve this, programmes need to stimulate methodology development and support, and develop the energy service provider market. The Irish programme also shows that experiences gained at the enterprise and programme level can be pivotal in identifying new projects and pinpointing opportunities across the business sector as a whole.

The Swedish programme illustrates how a relatively small incentive can fundamentally change how energy management is perceived even in energy-intensive industry. Swedish experience shows not only that networks are valuable forums to share experiences, but also that the sharing of best practices can have a direct impact on how investment risks are perceived.

Danish experience shows the value of having flexible programmes that can be adjusted in line with changes in policy frameworks and industry needs. The lack of an associated network can be seen as a weakness of the Danish programme, and a lost opportunity to stimulate communication and diffusion of knowledge between enterprises. Collective agreements, developed under the Danish programme, are, however, an effective approach that can lead to the development and diffusion of sectoral energy efficiency solutions.

In all three countries, the monitoring process and evaluations have played an important role in identifying areas for improvement and for getting insight into the needs and perceptions of enterprises. Both targeted surveys or interviews and continual dialogue with industry are crucial to ensure that Programme evolve in line with technological changes and the needs and abilities of industries. Assessing the added-value or additionality of programmes over a "business-as-usual" case is challenging and needs to be considered during the planning phase so that baselines and methods can be established. To assess the effectiveness of programmes and identify areas for improvement, policy makers must evaluate programmes in terms of quality, delivery, cost and customer service, *i.e.* analogous to normal operational metrics.

The Australian Energy Efficiency Opportunities (EEO) Programme: demonstrating the importance of industry consultation, collaboration and continuous learning

Overview of the programme and results to date

The EEO programme requires large energy-using businesses in Australia (those that use more than 0.5 petajoules (PJ) of energy annually) to assess their energy use in detail every five years and identify cost-effective ways to reduce it. The results of the assessment and the business response are then reported annually to the programme's board and the public. Companies are not required to implement the findings of the assessment. Rather, they can decide which savings to pursue based on their own business priorities and resources. The programme is administered by the Department of Resources, Energy and Tourism (referred to as DRET).

At the time of writing (September 2011), 283 companies, responsible for 30% of Australia's energy use, were registered under the EEO programme.

Analysis of public reports from 207 corporations that were required to report on their energy efficiency assessments by the end of December 2010 shows that individual companies have identified opportunities that have the potential to reduce their energy use by an average of 9.8%. Collectively, companies have identified opportunities with the potential to save 141.9 PJ of energy per year, which is equivalent to 2.5% of Australia's total energy use. These savings are equivalent to greenhouse-gas emission reduction of 11.2 Mt/year, or 2% of Australia's total greenhouse-gas emissions. The total financial benefit for EEO participants is estimated to be AUD 1.2 billion per year.

More than half (*i.e.* 53%) of the energy savings identified by companies are in the process of being implemented or have already been implemented (DRET, 2011).

This case study highlights some of the key lessons learned in the process of planning, implementing, monitoring and evaluating the EEO programme.

Planning EEO

The EEO policy announcement in 2004 noted that programme details would be developed through close consultation with industry participants and would build on the experience of previous industrial energy efficiency programmes.

Companies were invited to provide submissions in response to discussion papers and to share their perspectives through workshops and programme trials. The industry responses provided the EEO team with practical input that was used to help design the programme.

The EEO team had learned from previous industrial EE Programme that the effectiveness of consultation depends on asking the right questions at the right stages of the process. Rather than presenting a detailed draft of the EEO programme design at the start of the consultation process, the team asked open questions such as: *What would an effective assessment involve? What should be included in public reports? How could the programme be designed to achieve the government's objectives while minimising administration costs and maximising business benefits?*

This consultation provided companies with an opportunity to share their practical experience and expertise. As the programme design progressed and the design features became more detailed, the team felt that it was important to explain how the industry feedback had informed particular design features. This perspective helped to give industry participants greater confidence in the programme design, because it was seen to be based on practical experience rather than bureaucratic decisions.

An additional benefit of the collaborative planning process was that the businesses involved in the consultation and programme trials have become advocates for the programme. Their experiences have been communicated through published case studies, public workshops and other learning events. Peer-to-peer communication such as this is a very powerful way for industry personnel to promote the programme, because they are able to use industry rather than bureaucratic language and normally have a high degree of credibility with other businesses.

During the consultation process, companies suggested that the programme should be structured as a business improvement model rather than an audit "check-up". They argued that the design should allow companies to have some flexibility in its application so that existing data management, business improvement and reporting systems could be modified rather than new ones created. The companies also suggested that the structure should clearly communicate the intent behind the assessment components and provide detail on what is required without being too prescriptive.

The consultation process also highlighted the importance of both technical rigor and a focus on management initiatives to build organisational support for energy efficiency. Companies with experience in energy efficiency suggested that senior management support was essential to obtain the financial and other resources required to conduct assessments effectively. This suggestion informed the requirement that managers set and communicate energy use objectives prior to the commencement of assessments. By requiring the board to sign off on annual public reports that describe the progressive outcomes from the assessments, the EEO programme helps to build senior-level support throughout the assessment process as well.

The DRET's experience with previous energy efficiency programmes had demonstrated the importance of detailed energy data and analysis, and this was reinforced during the consultation process. Attempts to benchmark energy performance across organisations, technologies and processes in the past had been severely limited by a lack of quality energy data at both facility and sub-system levels within firms. This past experience led to the development of specific EEO programme requirements including:

- The accuracy of facility-level data must be within ±5% for each fuel type.
- Energy analysis tools such as energy mass balances or equivalent techniques must be applied.
- Energy analysis must be undertaken at various levels, including individual equipment, processes or subsystems and whole systems or entire facilities.

Further information about the programme and the assessment requirements is available in the EEO Industry Guidelines.[22]

Implementing EEO

Three aspects of the programme's implementation that have been critical to its success are Industry Support Officers, annual capacity-building workshops, and the on-going development of case studies and guidance materials.

The DRET has found that these aspects have supported industry participation by ensuring that: companies have a clear understanding of programme requirements; leading practices and learning are shared among participating companies; and the achievements of the programme and the companies involved are effectively recognised.

22 Available from www.energyefficiencyopportunities.gov.au.

Industry Support Officers

Each company is assigned an Industry Support Officer (ISO) when they register for the programme. The role of the ISO is to provide a single point of contact between each company and the DRET. ISOs review documentation from companies including assessment plans and reports; inform them of any programme changes or new resources; and respond to any questions or concerns.

A few years after the programme commenced, ISOs were allocated to companies in the same industry sector. This arrangement has helped the ISOs to better understand the specific needs of a sector and to share leading practices and lessons learned across the companies involved.

Annual workshops

Two-day workshops have been conducted in five state capital cities every year since the programme began. Typically about 600 people attend each year.

The workshops provide an opportunity for the DRET to update participants on any new developments, to communicate programme achievements, and to encourage networking and peer-to-peer learning among participants. Company representatives make presentations on their approach to implementing EEO, their achievements and any challenges they have faced along the way.

The workshop topics have changed over time in response to the changing needs of EEO participants. The first workshops explained the programme requirements in considerable detail. The most recent workshops (September 2011), which coincided with the end of the first five-year assessment cycle, focused on some of the areas that participants have found most challenging, such as detailed data analysis and evaluating opportunities.

Development of case studies and guidance material

The annual workshops and discussions between the ISOs and companies have helped to target the development of capacity building and support materials including case studies and guidelines. These materials are all publicly available from www.energyefficiencyopportunities.gov.au.

Monitoring EEO

A continuous approach to programme monitoring

During the planning phase, a monitoring and reporting framework was developed. Box 18 lists some of the key indicators that were established. Companies are required to report detailed data three times during the assessment cycle: at the time they submit their Assessment Plan (to establish baseline data), in their report to the DRET halfway through the cycle, and in their report at the end of the cycle. These data are aggregated and analysed, enabling the DRET to monitor changes made to company energy management systems and energy efficiency outcomes.

Companies are also required to publish a brief summary each year of their assessed energy use, the number of opportunities identified and their status (*e.g.* the number implemented, under investigation or "to be implemented"). Public reporting has provided a particularly useful way of monitoring programme outcomes, because it provides information on how companies are progressing with their assessments and the outcomes of these assessments on an annual basis. The data provided by companies are used by the DRET to develop summaries of progress on an annual basis, for the programme as a whole and at a sectoral level. This type of feedback is important, because it allows the DRET to monitor compliance and to demonstrate to industry and government stakeholders that significant progress is being achieved.

Companies are required to provide additional information in their reports to the DRET at the middle and end of each five-year assessment cycle. This additional material includes information on the specific opportunities identified, the costs of implementing the programme, and the financial savings and other business benefits that have been achieved. Additional information such as this, which is too detailed and confidential to include in public reports, allows for more detailed analysis of the benefits being achieved by companies.

Assessing company compliance with EEO through verification

Verification is an important component of the EEO programme. It provides an opportunity for the DRET to assess whether businesses have met the key requirements of the Assessment Framework and reported accurately on their findings and business response.

Two types of verification are undertaken. Desktop verification, which requires companies to complete a questionnaire on the key requirements of the Assessment Framework, is undertaken by all companies in each five-year assessment cycle. A smaller number of companies are then selected for a full verification process, which involves site visits, interviews and a review of documentary evidence.

The DRET has found that by managing the verification process themselves rather than outsourcing it, they can learn more about compliance levels and areas of implementation that are weakest. This information is used to provide specific feedback to companies and also to identify aspects of the programme that are commonly misunderstood or that are difficult for companies to implement. These findings then inform the capacity building and communication Programme.

Evaluating EEO

As outlined above, data collection was built into the milestones that companies must adhere to over the programme's five-year cycle to support compliance assessments and to identify gaps in programme implementation. These data are also used to evaluate the programme in the middle and at the end of each assessment cycle.

The first mid-cycle evaluation, which was completed in 2010, included interviews with personnel responsible for the implementation of EEO in their companies. The evaluation found that many companies have improved their energy management systems and processes as a result of their involvement in the programme. The companies noted that system and process improvements have contributed to an increase in the number and quality of opportunities identified, which many participants have reported to be far greater than was expected prior to the beginning of their assessments.

The most important changes identified by companies were improvements to their data and analysis systems. They also reported that the requirement to report to the board has helped to build greater awareness at senior management and board levels, and this has resulted in more support for initiatives throughout the organisation (DRET, 2010b).

Assessments had also brought about behavioural changes, with a greater appreciation within companies of their energy use and the benefits of implementing identified opportunities.

The evaluation also highlighted continuing barriers to energy efficiency, particularly in implementation. For example, most companies focus resources and capital on growing their core business, which means that they may not have resources available for energy efficiency projects. This barrier suggests that complementary government policies that facilitate access to capital may be required.

Conclusion

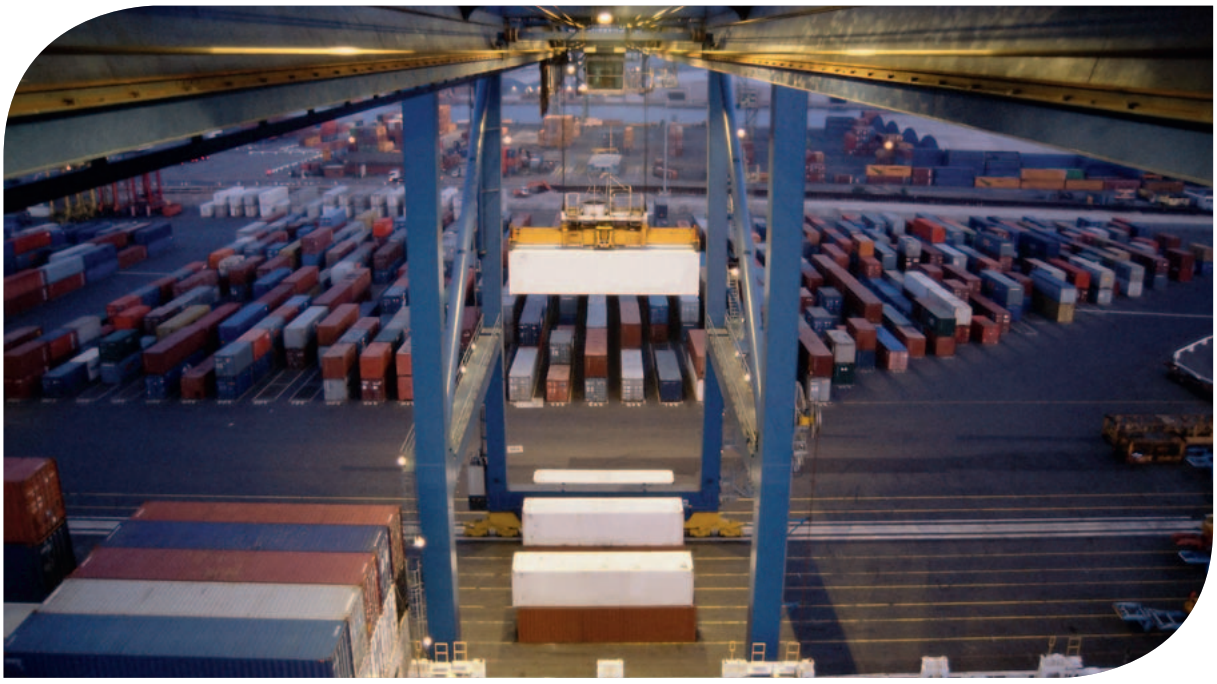
Analysis of public reports, together with the findings of the mid-cycle evaluation, demonstrates that the EEO programme has been successful in reducing energy use, improving EnMSs and changing the way in which energy efficiency is viewed within participating organisations. This case study has highlighted some of the key lessons learned in the process of planning, implementing, monitoring and evaluating the EEO programme.

With regard to planning, industry consultation, combined with the experience from past EnMPs, prompted EEO to include a number of elements that have had a high degree of impact. For example, board reporting has significantly raised the profile of energy efficiency in companies and has led to greater support for both assessment of opportunities and implementation. Requirements to conduct rigorous data and analysis have increased the number of identified opportunities and provided the data that are required to support investment decisions.

Throughout implementation of the programme, Industry Support Officers, annual workshops and the development of guidance material have enhanced outcomes by ensuring that companies have a clear understanding of programme requirements and can see them demonstrated through the practices of other participants.

Continuous monitoring, combined with formal evaluation processes, has built on consultation and collaboration with industry by providing useful insights into the effectiveness and how it can be improved. This approach has led to minor administrative programme changes that are intended to further enhance programme outcomes as companies prepare for the second five-year cycle.

Further information on the EEO programme can be found at:
www.energyefficiencyopportunities.gov.au.



The European Bank for Reconstruction and Development (EBRD) promotes energy management systems in industry

The industries in Central and Eastern Europe, as well as the Commonwealth of Independent States, include many highly energy-intensive industrial processes such as steel manufacturing, aluminium smelting, cement and glass production. The economic market potential for energy efficiency in this region ranges between 20% and 40% at current energy prices (EBRD, 2010). Despite this economic potential, a range of barriers including information gaps, market failures, lack of financing and enabling policy frameworks, are inhibiting investments in energy efficiency. Most of the production facilities in the region lack data on internal energy use and operational parameters of their systems and processes.

While governments have an important role to play in the creation of enabling conditions and programmes to accelerate the uptake of energy management systems in industry, other actors, such as international financial institutions, can effectively contribute to this process. One such player is the European Bank for Reconstruction and Development (EBRD), which operates in this region and has developed an approach that blends financing with technical assistance for projects also focusing on energy management systems capacity building.

This approach has been developed into a series of complementary programmes under the Bank's Sustainable Energy Initiative. The EBRD Energy Audit Technical Assistance Programme, which has been ongoing since 2002, has been designed to provide its clients with dedicated international expertise to help them implement energy efficiency through energy audits and targeted training. This programme constitutes a core element of the Bank's other initiatives to promote the uptake of energy efficiency investments in industry. During the second phase of the EBRD Sustainable Energy Initiative 2009-11 industrial energy efficiency investments grew by 22% per annum from EUR 317 million in 2009 to EUR 578 million in 2011. Cumulative investments during this period in industrial energy efficiency reached EUR 1.34 billion (EBRD, 2012). Increasing attention is being placed on energy management systems which are considered by the Bank to be essential to accelerate such investments. In this context EBRD launched in 2009a dedicated Programme for Energy Efficiency Management Systems.

Introducing Energy Management Systems in GHG-intensive Industries in Russia

International financial institutions have been active in helping identify energy efficiency opportunities and addressing the lack of availability of finance for energy efficiency investments in industry. The EBRD has developed a two-pronged approach:

- Building the capacity of local lenders, including financial intermediaries such as energy service companies (ESCOs), to access risks and returns associated with energy efficiency projects.
- Increasing the capacity of industries to develop bankable energy efficiency projects according to a defined methodology based on EnMS.

EBRD, together with the United Nations Industrial Development Organization (UNIDO) with funding from the Global Environment Facility (GEF), launched a market transformation project[23] in Russia in August 2010. It will run until 2015 and provides companies with continuous and tailored technical assistance and project implementation support on energy efficiency.

The EBRD provides support larger enterprises, while UNIDO focuses on small and medium sized enterprises and on the policy support component of the project. The project aims to improve industrial energy efficiency by building the capacity of the

23 Russian Federation: RUS Market Transformation Programme on Energy Efficiency in Russia (www.thegef.org/gef/node/3333).

government to develop effective industrial energy efficiency policies and by enhancing the capacity of industry to engage in energy management and identify energy efficiency projects. Ultimately, the project also aims to develop effective business models for energy efficiency finance.

Expected results include:

- Improved industrial energy efficiency in heavy industries leading to a total CO_{2eq} emission reductions of 3.8 million tonnes over 10 years and total energy savings of 1.4 TWh per year by 2015.
- Improved commercial prospects of industrial borrowers that will lead to an estimated USD 300 million investment in industrial energy efficiency.

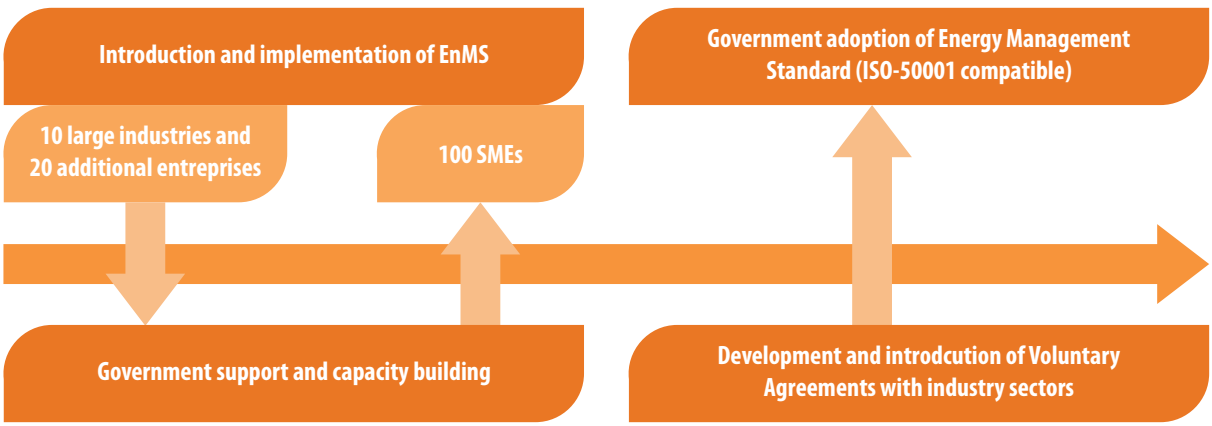
Planning the project

To develop the project, numerous meetings were held with stakeholders dealing with industrial energy efficiency in Russia. Stakeholders included industry, policy makers at the federal and regional level, banks, utilities, project developers, investors, and companies that provide products and services related to energy efficiency. In terms of engagement with policy makers, dialogue was established with all relevant ministries and agencies including the Ministry of Economic Development, Ministry of Energy, Ministry of Regional Development, Ministry of Industry and Trade, Ministry of Finance and the Federal Tariff Service of Russia.

The project planning phase also included close dialogue with institutions and organisations in other countries. This enabled building on experiences and lessons learned from earlier energy management capacity building initiatives and other programmes, for instance, long-term agreements in the Netherlands and the BESS programme for SMEs. The dialogue also helped to ensure coordination between on-going initiatives such as the European Union Technical Assistance for the Commonwealth of Independent States (EU TACIS) programme and the International Finance Corporation - GEF project on sustainable efficiency financing in Russia.

These discussions, together with a comprehensive analysis of barriers to enhancing energy efficiency in Russian industry, indicated the need for a combined approach consisting of technical assistance around EnMS and lending to accelerate the implementation of energy efficiency projects.

Decisions pertaining to the scope and focus of the project were based on an extensive analysis of the industrial sector in Russia and potentials for energy savings. This included the use of process-based benchmarking *i.e.* comparing the average energy intensity of specific processes in specific industries (ferrous materials, pulp and paper, cement, chemicals,



Source: EBRD, 2012.

non-ferrous metals and non-energy intensive industries) in Russia with typical international values, as well as a comparison of technologies and practices utilised in Russian industry with best available technologies. Assessment of industry composition, energy consumption and savings potentials indicated that primary focus for the programme should be placed on metals, chemicals and pulp and paper and light industry.

The various forms of implementation support (training materials, capacity building etc.) were prepared in this early phase of the project.

Implementation

The project includes many of the components that form the basis of successful government-led energy management programmes. Implementation of specific elements of the programme is shared between the EBRD and UNIDO. These include:

- **Institutional assistance.** Government capacity building and support programme including training on policy development to promote the establishment of an energy management programme, and the development of a road map for the introduction of market mechanisms for energy efficiency certificate trading.
- **Support systems to help companies implement the programme.** The implementation support follows two tracks to tailor support to large companies and SMEs:
  - Implementation support of energy management systems compatible with the ISO-50001 within ten large industrial companies. This includes intensive on-site training, energy audits, system assessments and the development of energy efficiency investment plans.
  - Specific approach to introduce energy management systems in SMEs Including system assessments, benchmarking, energy audits and energy efficiency investment plans.
- **Training and capacity building of national experts.** Training and capacity building for industrial enterprises, equipment manufacturers and vendors, loan officers in banks and government officials. As part of the project 120 experts are to be trained in energy management and in systems optimisation. These experts are then involved in the provision of further training and workshops.
- **Networking opportunities.** Website with discussion forums that could potentially form the basis of a peer-to-peer network and the development of knowledge networks, including specially designed web-based tools for energy management in SMEs.
- **Tools.** Technology database with accessible information on energy efficient equipment and technologies targeted to SMEs.
- **Programme promotion.** Information campaign on the project to raise awareness and interest.
- The project implementation arrangement places special focus on effective oversight and management, establishing successful liaison with government and good cooperation with the management of participating enterprises and business associations.

Monitoring and evaluation

Monitoring and verification of results is essential in determining the success of projects. Prior to implementation, the project team considered various approaches for developing a baseline to track progress and measure impacts of the project. The considered approaches included base year efficiencies, historical annual efficiency gain trends, and a projected baseline for business as usual (BAU). The BAU baseline is estimated on comparison of samples of companies within and outside the project or extrapolated historical gain trends for participating companies with and without the support provided by the project. Rather than to rely on one approach, the different approaches will be applied in order to get a better understanding of the range of impacts of the project.

The project also tracks progress, outputs, outcomes and impacts on the basis of a wide range of indicators. These include quantitative indicators such as total CO_2eq. emission reductions, volume of investment, total energy savings, number of persons trained, number of audits carried out, number of system assessments performed, number of investment plants developed. Other qualitative indicators are also used such as government capacity to design and implement effective policies.

Conclusions

Initial results already indicate the level of potential impact on Russian industry. For instance, the EBRD provided a EUR 125 million loan to finance energy efficiency measures in the steel production company NLMK. The implementation of these measures will cut the company's energy consumption by over 15% by 2015 with cutting edge technologies to be used in Russian iron and steelmaking for the first time (*e.g.* pulverised coal injection). Once implemented, the project will cut NLMK's GHG emissions by 1.5 million tonnes CO_2 per year. This demonstration project can form the basis for further replication within the industry, which could have a significant impact as the iron and steel industry is estimated to be responsible for almost 7% of GHG emissions in Russia. Furthermore, NLMK plans to certify its energy management system under ISO 50001, which is a pioneering move with far-reaching implications for the rest of the industry in Russia.

Success factors of the project include an early and extensive engagement by the EBRD with the industrial clients that can benefit from the programme. It is essential to maintain a tight fit between the assistance provided and the needs of the participating companies. In order to develop effective projects and programmes, it is important to ensure that government, industry and other stakeholders have access to relevant and reliable information.

In addition, capacity-building among all stakeholders forms a key part of the programme. The EBRD is organizing a number of seminars in various Russian regions aiming at building capacity among industrial companies on Energy Management Systems and System Optimisation. On-site training is provided to participating companies to assist them in the implementation phase. Finally, a dedicated programme website and a peer-to-peer network are being developed. All these elements are pivotal to the support of the programme activities.

Further information can be found at: www.ebrd.com/sei.

Annex 2. Tools for tracking energy use and identifying savings opportunities

EnMS standards require companies to undertake an energy review (also known as an energy assessment). An energy review aims to analyse energy data, identify high-energy consumption areas within a company and highlight energy efficiency opportunities. EnMS standards do not, however, typically describe *how* companies can or should undertake an effective review to enable them to maximise the identification of opportunities.

Nonetheless, because EnMS implementation hinges on an effective energy review, EnMPs can play a significant role and provide further guidance about how reviews can be conducted within the company.

An in-depth understanding of energy consumption and the factors that influence energy performance is a prerequisite for identifying and pursuing energy efficiency improvements. Comprehensive data and rigorous analysis are required. Establishing robust systems for data collection and analysis is essential to quantify the full benefits of energy project and supply decision makers with information to support investment decisions. Data collection and analysis are also instrumental in providing the leverage to challenge entrenched operational practices.

Effective data gathering and analysis involve an iterative process of investigation. Experiences indicate that, as the quality and detail of energy data improve, more comprehensive analysis can be undertaken, which enables the identification of new savings opportunities. Data gathering and analysis should be done at various levels. Focus can be placed on individual equipment, processes or subsystems, and whole systems or entire facilities.

What method to promote? Several tools and approaches can be used to measure and monitor energy use and identify energy efficiency opportunities (Box A2). The use of these tools and approaches can be promoted through several support measure:, *e.g.* by developing specifically designed technical primers; by supplying databases of benchmarks; by helping to locate source expertise; or by providing subsidised or free access to technical experts. The cost in terms of time and money varies considerably for the different approaches, as does the level of detailed data and complexity of analysis provided. Experience shows that providing guidance on the techniques that can be used to gather and analyse data increases the number and quality of savings opportunities identified. Ideally, energy reviews should move beyond analysing equipment or sub-systems in isolation. Whole system reviews are more efficient in uncovering the full range of opportunities. More comprehensive and advanced approaches can uncover more savings, provide companies with new information, and increase the likelihood of finding and capturing co-benefits (which may have a greater value than the actual energy savings).

Box A.1

Energy review and assessment methodologies

***Audits** are is an inspections, surveys and analysis of energy flows. They can be instrumental in identifying energy efficiency opportunities but may fully capture systems improvement potentials. Energy audits can range from cursory to in-depth and comprehensive. A **walk-through energy audit** is typically a quick and relatively inexpensive approach that provides a qualitative examination of facilities to identify basic opportunities for savings as well as areas that need further examination. A **detailed energy audit, which requires more time and expertise,** may cover equipment or processes for which energy-savings opportunities were identified during a walk-through audit or where a benchmarking process has identified savings potentials. Detailed audits can be carried out at various levels,* e.g. *at the equipment, system, or process level.*

***Benchmarking** involves identifying an aspect or process to examine and a suitable benchmark, or reference point, against which performance can be compared. Benchmarking can be done on various levels and can be conducted internally within a company (comparing with past performance), externally by comparing with other companies, or theoretically (comparing performance with what is theoretically or technically feasible). Benchmarking can also involve simulating different configurations or operating modes.*

***Energy performance benchmarking** is the comparative analysis of energy use per unit of physical production. This analysis involves the calculation of energy intensity by different fuel types or activities, and comparison with intensities achieved in the sector via reference to appropriate benchmarking guides. Similarly, **energy best practices benchmarking** involves comparing processes, operations and systems to sectoral best-in-class operations.*

***Key performance indicators** are measures that can be used to track energy system behaviour over time. Although **absolute indicators**,* e.g. *energy consumption, provide insights into changes in absolute terms, measuring energy performance requires the use of **relative indicators**, e.g. energy use per unit of product. Establishing an indicator system requires setting system boundaries, putting in place a framework for measurement, establishing a baseline, and conducting regular measurement and analysis. Benefits include improved understanding of energy use, identification of trends, finding energy losses and waste, as well the ability to track progress and report results to stakeholders.*

***Trend analysis** involves the identification of trends and correlation of these trends to factors that affect energy use. This analysis is useful in cases where variations occur in energy use. Trend analysis may identify, for example, that energy use of a certain process fluctuates during the week; further investigation could lead to the discovery that the fluctuation is caused by differences in operating practices by different operators.*

***Energy-mass balances** are analysis technique to systematically understand where and how energy is used throughout a system. The technique involves analysis of energy inputs and energy outputs, tracking of energy and material flows, and identification of losses and waste. The use of balances typically leads to enhanced understanding of processes and systems and the identification of a range of improvement opportunities.*

Box A.1

Energy review and assessment methodologies (continued)

Theoretical analysis *can be used in cases where it is not possible to make direct measurements or estimates. It can also be used to stimulate creative solutions or set ambitious goals. Focus is placed on estimating theoretical ideal energy requirements for a given function,* e.g. *the delivery of a service or task, and exploring how this can be achieved through changing operation, processes, products, etc.*

Regression analysis *is a statistical technique for modelling and analysing multiple variables by exploring the relationship between one dependent and one or more independent variables. This approach can be used to quantify the factors that influence energy use and can be particularly useful in conjunction with other methods to establish causality.*

Other types of detailed analysis *include engineering, logistical and even experimental diagnostic techniques such as thermographic imaging, experiments or trials. These techniques may be warranted when detailed energy flows cannot be directly measured, to test the viability of new solutions or to comprehensively address energy performance in complex environments.*

Process integration studies *involve a comprehensive analysis of industrial processes or sites, taking into account all key elements of a process or facility and their interactions* e.g. *consumption of energy, water, and materials; operating costs; and environmental impacts. Process integration is a structured approach that involves data collection and process simulation, energy and mass balance analysis, application of process integration techniques, and technical and economic evaluation of projects.*

Source: adapted from Crittenden, 2011; Vickery, 2011; DRET, 2011.

Glossary

Note that these are definitions used in this Policy Pathway.

Baseline: measurement or calculation of the situation prior to changes being made, used as point of reference for tracking changes and improvements over time.

Benchmarking: comparison of performance internally within a company or programme, externally with the performance of others, or theoretically with what is theoretically or technically feasible.

Co-benefit: see non-energy benefit.

Energy assessment: see energy review.

Energy efficiency: delivery of more services for the same energy inputs or the same level of services for less energy input.

Energy indicator: see indicator.

Energy intensity: ratio of energy consumption per unit of production or per unit of value added.

Energy management: measuring, monitoring and managing energy use; it does not necessarily follow a set of predefined practices and actions.

Energy management components: various energy management activities (*e.g.* energy audits, designating energy managers, establishing an energy management policy) that together constitute an energy management system.

Energy Management Maturity Model: Tool developed by SEAI to help organisations to understand their level of maturity in EnMS development and efficacy.

Energy Management Programme (EnMP): government-led initiatives to promote the uptake of energy management systems.

Energy management programme elements: different initiatives, drivers and support systems developed by the government that make up the energy management programme and serve to encourage enterprise adoption of effective energy management systems.

Energy management standard: standard developed by international or national standardisation bodies.

Energy Management System (EnMS): means by which organisations establish the systems and processes necessary to achieve operational control and continual improvement of energy performance. It includes a set of defined practices and actions.

Energy management system specification: specification typically formulated by a governmental policy agency as part of the development of a particular policy, for example, third-party certification of proper implementation of energy management standards.

Energy mass balance: a technique at the "whole system" level that measures and evaluates energy and material flows. For more information, see Annex 2.

Energy performance indicator: see indicator.

Energy review: collection and analysis of energy data, and identification of high-energy consumption areas and resulting energy efficiency opportunities. A variety of methods can be used to collect and analyse data. See Annex 2 for more information.

Energy savings: amount of energy saved by implemented measures compared to a baseline.

Indicator: defined metric used to monitor changes. Indicators can be absolute (*e.g.* energy use in kWh) or relative (*e.g.* energy use per unit of product output). Various types of energy efficiency indicators are available, with different levels of aggregation, covering different sectors and using different activity or service measurements or reference values. Key performance indicators (KPIs) are used to track progress towards objectives. Energy performance indicators are used to track progress in how well an organisation is managing its energy use.

Kaizen: approach aimed at eliminating waste and encouraging continuous improvement.

Key performance indicator: see indicator.

LEAN manufacturing: business model and collection of tactical methods that focus on driving rapid, continual improvement in cost, quality, service, and delivery, and usually generates significant environmental benefits.
For more information,
see www.epa.gov/lean/environment/index.htm.

MUDAe: MUDA means wasteful, non-productive activity in Japanese. MUDA is a concept used by businesses to systematically target unproductive activities over a range of areas. MUDAe targets practices that lead to energy waste.

Non-Energy Benefit (NEB): in an energy efficiency context, typically synonymous with the term co-benefit, meaning benefits that are the result of energy efficiency measures, *e.g.* product quality improvements, improved work conditions, enhanced energy security or other improvements other than energy savings. NEBs can be quantified on an enterprise level or a programme level.

Six Sigma: business management strategy to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimising variability in manufacturing and business processes.

Theoretical minimum or theoretical benchmarking: method whereby the minimum possible energy use for a given process is determined, this is used as an ambitious benchmark or goal to work towards.

Value Stream Mapping with Energy (VSMe): tool for the strategic development of a production system. Used to track activities (value-adding and non-value-adding) required to bring a product or service from source/raw material to the customer. ACEEE (American Council for an Energy Efficiency Economy) (2011), *Energy Management,* Retrieved September 25, 2011 from www.aceee.org/topics/energy-management.

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