The potential for energy savings from energy management in the EU – findings from a comprehensive assessment

Paul Waide
Waide Strategic Efficiency Ltd
4 Winster Avenue
Manchester M20 2YG
UK
paul@waide.co.uk

Hans de Keulenaer
European Copper Institute
Avenue de Tervueren 168, b-10
1150 Brussels
Belgium
hans.dekeulenaer@copperalliance.eu

Keywords

energy management, policies and measures, potential savings, Energy Efficiency Directive (EED), system analysis, barriers, EU policy portfolios

Abstract

Energy management is a structured process through which organisations seek to optimise their energy use and whose definition and practice is codified through standards such as EN ISO 50001. It is an essential tool to deliver systemic level savings in how energy using capital is chosen and deployed but also, and importantly, with respect to how that capital is actually operated and managed. Despite its importance to overcome some of the more intractable barriers to energy efficiency it has received relatively modest attention within EU policy portfolios.

This paper presents the key findings from a new (shortly to be published) study that provides a comprehensive assessment of the potential for savings from broader and more effective adoption of energy management across the EU. Degrees of energy management practice and effectiveness are outlined and the barriers which energy management helps to overcome are discussed. Current levels of adoption of energy management in European organisations and the associated trends are assessed and found to be quite low e.g. just 1.5 % of medium to large companies have adopted EN ISO 50001. In contrast, a detailed quantified analysis finds there is a techno-economic optimal savings potential from greater adoption of effective energy management in the EU's industrial and service sectors of 26 % of their combined energy consumption by 2035.

The paper concludes with an analysis of policies that could help to increase energy management adoption rates across the EU and positions them within the context of the existing EU policy portfolio for energy efficiency. This builds from an assessment of factors that influence (encourage or inhibit) the adoption of effective energy management for each end-user sector and of the degree to which targeted policies can help to influence this. The analysis considers where these measures fit within the broader portfolio of EU energy efficiency policy instruments and concludes with a set of policy recommendations pertinent to the ongoing reviews of the major EU Directives.

Introduction

Energy management has no single definition but can be said to entail the proactive, organised and systematic coordination of procurement, conversion, distribution and use of energy to meet an organisation's requirements, taking into account environmental and economic objectives. In the tertiary and industrial sectors its operation addresses facility management, logistics, procurement, production, planning and control, maintenance and IT. Its implementation requires an organisation to develop an energy management strategy.

This paper summarises the findings of a new study to assess the impact and issues associated with energy management in the European Union [1]. This study includes:

- an assessment of the current situation by sector – an analysis of levels of deployment of EM by depth of EM and includes an assessment of typical institutional frameworks for EM

- the typical savings potentials by sector (light industry, iron & steel, petro-chemicals, cement, glass etc. and the various tertiary sector building and organisational types)
- the typical cost/benefits of energy management by sector
- the effectiveness and teething issues with energy management and specifically ISO50001 – experience from the field
- an assessment of the barriers to greater application of EM by sector
- recommendations on how to strengthen good practice and the EU's policy portfolio.

This current brief paper presents a short summary of the parts of the report that address current practice, barriers to the adoption of energy management, existing policy frameworks, the energy savings potentials, economics and the opportunities to stimulate increased savings from energy management through more proactive policy measures.

Current energy management practice

CURRENT TRENDS

One way of classifying the implementation of energy management is to consider the nature of organisation EM strategies and practices which can be grouped into following cases ranked from least to most proactive strategies:

- no systematic planning; where an organisation only deals with the most essential issues and has no dedicated management process for energy
- short-term profit maximisation approach: where management is focused exclusively on measures that have a relatively short payback period and a high return
- longer-term profit maximisation: where measures with a longer term payback are also implemented
- realisation of all financially attractive energy measures: where all measures are implemented that have a positive return on investment
- climate optimisation strategy: where the organisation is willing to invest in all measures that meet their climate impact mitigation strategy and hence may go beyond purely cost-effective measures.

There is no systematic survey of current levels of EM adoption across EU organisations; however, a review of the literature, of case studies and a survey of experts in the field[1] suggest that:

- there is a broad spectrum of behaviours currently seen but on average EM adoption is well below economically rational levels
- (as one would expect), energy intensive and larger organisations are much more likely to have adopted proactive energy management strategies than less energy intensive or smaller organisations
- very few organisations adopt strategies to realise all financially attractive measures and even less to optimise their climate impact
- the case of no systematic planning predominates in SMEs
- short term profit maximisation is most common in other commercial enterprises such that measures with payback periods of beyond 2 years are seldom considered.

Overall it appears that while awareness of energy management and its significance is increasing most organisations are struggling to implement it effectively. They tend to operate conservative, risk-averse strategies that avoid deflecting time and effort from core business activities for measures that may be seen to be desirable in principle but are perceived to be outside core competences. Given this situation there remains a considerable scope to develop more sophisticated EM strategies that mine the cost effective savings potentials more fully.

Based on the study's findings of the trends in levels of EM adoption in the EU's businesses and public sectors a reference case scenario of energy consumption by end-use to 2035 was elaborated. This scenario is broadly in line with IEA projections [2] that assume current policies are implemented and somewhat strengthened over the time period; however, unlike these scenarios the Reference Case scenario disaggregates end-use by industrial and tertiary sector sub-sectors. The energy consumption projected for the industrial sector is shown in Figure 1.

BARRIERS TO GREATER SAVINGS THROUGH ENERGY MANAGEMENT

There are manifold barriers to the greater adoption of EM and to the adoption of more effective EM. For example, a good summary of barriers faced by industrial energy audits (one element within EM) is provided in [3]. While in the buildings sector the barriers that limit the better use of more effective automation and control strategies (a major EM opportunity) are documented in [4]. These have a substantial overlap with the broad generic barriers to energy efficiency documented in [2] in that they include: EE is not visible to end users & service procurers and is usually not measured; limited awareness of the value proposition and opportunity; energy expenditure is a low priority; split incentives e.g. competing account holders for capital and operational budgets; scarce investment capital or competing capital needs; unfavourable perception and treatment of risk; limited staff resources and know-how on implementing energy-saving measures; limited government resources to support implementation; fragmented and underdeveloped supply chains and services markets. All these factors apply and act to hinder adoption of cost-effective energy management and hence supporting measures are required to help overcome these constraints and enable good practice to flourish. Critically though there is a need to raise the prioritisation of energy management, and not just energy audits, as a strategic objective of organisations [5] and this has implications for the most appropriate focus of remedial policy measures.

1. A structured survey of 27 people involved in EM professionally across the six largest EU countries. Interviewees were mostly EM users/procurers but included some service providers. They covered a variety of industries and tertiary building sectors and ranged from heavy industry, through manufacturing, SMEs and service sector providers/facility managers. Additional informal interviews were conducted with a number of well respected sector analysts.

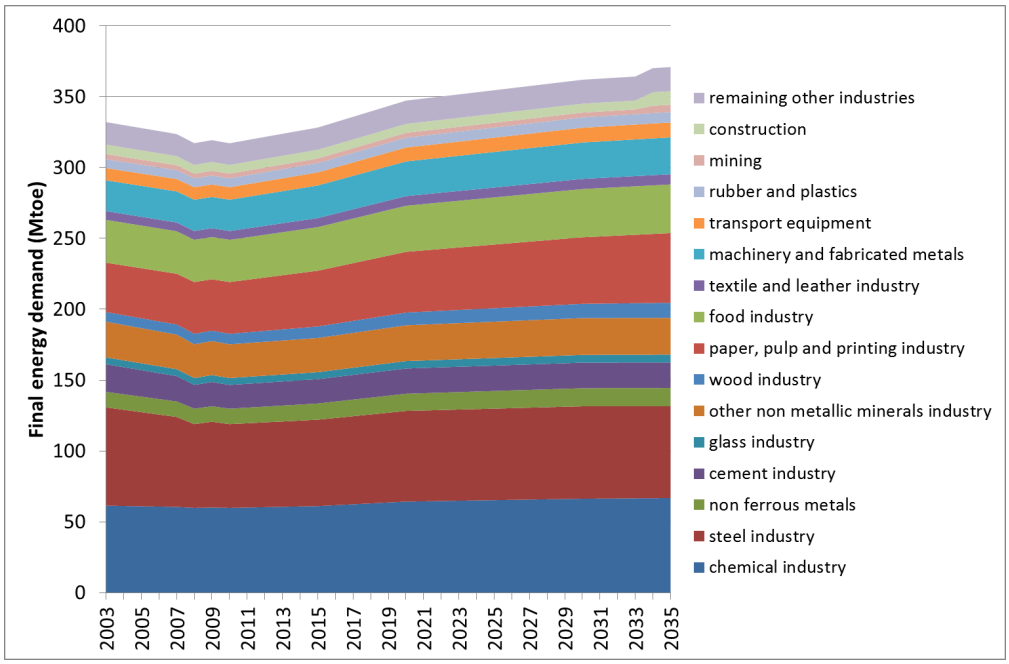

Figure 1. Final energy consumption for industry in the EU under the Reference Scenario (RS).

Existing policy frameworks

In recent years there have been a number of technical and policy developments in the EU that are providing some support to higher and more effective EM adoption. On the technical level the ISO 50001 series of energy management standards has been issued and revised [6] and serves to provide a consistent platform for energy management. While the use of this standard is steadily growing its level of adoption is still quite low[2] and much remains to disseminate its (or equivalent standards) use.

Public policies to promote energy management can broadly be divided into those that target the tertiary buildings sector and those that apply to industrial enterprises and SMEs; however, the measures adopted at the EU level leave some very significant gaps.

In the buildings sector the EPBD [8] includes some measures and encouragement for EM, however, this is essentially limited to energy performance certificates that can be based on either operational energy consumption or asset energy ratings and hence either give modest or no encouragement to savings through energy management in the operational sense. The majority of the other measures within the EPBD apply to whole building energy performance when assessed as an asset and hence only encourage improvement through new build or major renovation interventions i.e. do not address improvements through improved operation of existing buildings. The exception to this are Articles 14 and 15 which addresses heating and AC system inspections respectively; however, while these could be applied to promote some improvements in energy management it is not well targeted in this respect and so its expected impact will be weak.

The EED [9] currently requires EU member states to make energy audits mandatory for large enterprises and gives the possibility for such enterprise that have implemented broader energy management schemes such as ISO 50001 to be exempt from the requirement provided the energy management scheme includes audits of a recognised quality. While this is welcome progress compared with previous policy frameworks it leaves several important gaps:

a. it does not oblige affected enterprises to implement an energy management system (just to conduct audits; although this does give mild encouragement to EM adoption) nor does it create an incentive for organisations to adopt EM other than through the findings of the audits

b. it does not oblige or encourage affected enterprises to implement cost effective measures identified in the audits

c. it does not create a system to support the adoption and implementation of energy management systems

d. it only applies to large enterprises.

With respect to point b) the EED falls short of the requirements already imposed for example in Japan [10] and Denmark [11]. In the former the strength of obligations on companies to conduct energy audits and implement the measures is related to the companies energy use; however, a large proportion of tertiary sector enterprise and almost all industrial enterprise are required to undertake energy audits and to implement measures with a sufficiently short payback time. Furthermore, the quality of the audits has to be approved by the relevant line ministry. Danish regulations impose similar requirements on the more significant energy using sectors of industry. Nonetheless, while audits are an important technical input and stimulus to action to address energy savings they are one element within energy management and the main deficiency within the EED measures is that they do not address the organisational and institutional

2. Just under 4,000 enterprises in the EU had ISO 50001 certification in 2013, which amounts to 1.5 % of large and medium sized businesses [7]. It is not known what share of companies make use of ISO 50001 without being certified.

policy issues that are also a part of energy management. Nor do they adequately address other barriers, such as competition for investment finance.

The EED also has several measures that are intended to support energy savings in SMEs.[3] These include requiring Member States to:

- develop programmes to encourage SMEs to undergo energy audits and the subsequent implementation of the recommendations from these audits
- set up support schemes for SMEs, including if they have concluded voluntary agreements, to cover costs of an energy audit and of the implementation of highly cost-effective recommendations from the energy audits, if the proposed measures are implemented.
- bring to the attention of SMEs, including through their respective representative intermediary organisations, concrete examples of how energy management systems could help their businesses.
- encourage training programmes for the qualification of energy auditors in order to facilitate sufficient availability of experts.

All these measures are laudable but they are mostly quite open-ended with respect to how they are defined, implemented and with respect to their scale of implementation. As the nature and scale of requirements is left unspecified Member States have considerable freedom to do rather little in this domain while still technically meeting the legal obligations i.e. of having done something, no matter how modest. Inspection of the activities mentioned in national energy efficiency action plans reveals that many are exercising this freedom.

Critically none of the provisions in the EED require Member States to develop dedicated finance mechanisms or subsidies to support savings through energy management measures. Rather the Directive simply states:

> Without prejudice to Union State aid law, Member States may implement incentive and support schemes for the implementation of recommendations from energy audits and similar measures.

The EU emissions trading scheme (EU ETS) and the integrated pollution prevention and control (IPPC)[4] Directives also provide some indirect encouragement to greater adoption of effective energy management within major industries but these are poorly focused as far as energy management is concerned and hence will only weakly stimulate greater levels of adoption.

Thus in summary, the existing EU policy frameworks are helpful but insufficient to stimulate more than a part of the full economically ration savings potential from energy management.

Savings potentials

In order to clarify the value proposition from broader adoption of effective energy management a series of scenarios were developed and modelled using specifically designed energy capital stock models which treat each energy use sector individually. For each tertiary and industrial sector three scenarios were developed:

- A *Reference Scenario* that considers the energy use by sector that is anticipated with a continuation of current trends.
- A techno-economic *Optimum Scenario* that considers the energy use by sector that would be expected were all cost-effective energy management options to be adopted as rapidly as is technically feasible.
- A *Recommended Actions Scenario* that explores what savings might be achieved through energy management were the specific recommendations in the study to be implemented across the EU.

These scenarios are informed by the findings from the detailed literature review, numerous case studies and interviews with specialists in the field. They are also based on a thorough evaluation of the likely costs and benefits of broader adoption of specific energy management measures and the expected uptake in response to a more proactive policy portfolio. The results are presented separately in the report for the industrial and tertiary sectors[5] and also for each of the sub sectors within these e.g. the industry sectors presented in Figure 1 and the following tertiary sectors: retail, education, health, office, hotel/restaurant, other.

The analysis finds the potential energy savings from greater and more effective use and deployment of energy management are vast. The total techno-economic optimal savings potential as expressed through the Optimal Scenario is estimated to reach 26 % of combined tertiary and industrial sector energy consumption by 2025 and to maintain that level thereafter; however, this is predicated on a rational and perfectly functioning market without serious constraints to effective service delivery. A more realistic depiction of the potential to deliver additional savings beyond the Reference Scenario (business-as-usual case) is offered by the Recommended Action Scenario. In this case, savings ramp up progressively over the scenario period to reach 19 % of the Reference Scenario energy consumption by 2031 and remain relatively constant thereafter (Figure 2).

The Optimal Scenario leads to some 1,728 Mtoe of cumulative energy savings from 2015 to 2035 compared to the Reference Scenario for industrial and service sectors combined (Figure 2), of which 807 MToe of savings are in industry and 931 Mtoe of savings are in the tertiary sector. This equates to estimated cumulative CO_2 savings of 4.8 gigatonnes over the same period, with annual savings of 124 million tonnes of CO_2 in 2020 and 383 million tonnes in 2035.

By contrast, the Recommended Action Scenario leads to some 1,184 Mtoe of cumulative energy savings from 2015 to 2035 compared to the Reference Scenario for the industrial and service sector combined (Figure 2), of which 560 MToe of savings

3. The category of micro, small and medium-sized enterprises is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding €50 million, and/or an annual balance sheet total not exceeding €43 million.

4. Pollution from larger industrial installations is regulated under the Pollution Prevention and Control regime. This regime implements the EU Directive on Integrated Pollution Prevention and Control (IPPC) (2008/1/EC).

5. This principally concerns the energy use in tertiary sector buildings.

are in industry and 624 Mtoe of savings are in the tertiary sector. This equates to estimated cumulative CO_2 savings of 3.3 gigatonnes over the same period, with annual savings of 76 million tonnes of CO_2 in 2020 and 295 million tonnes in 2035.

Over the Recommended Action Scenario period (2015–2035), some €91 billion of extra investments in equipment and related services are needed to deliver these savings, at an average of €4.6 billion per year. Large as these incremental investments are, they are over twelve times less than the value of the resulting savings in energy bills, which total €1,154 billion over the period, at an average of €58 billion per year.

The details of the analysis behind these figures including the breakdown of savings estimates by sector and fuel type as a function of current levels of EM adoption are discussed in depth in the full report [1]. In general though savings potentials are slightly higher for electrical end-uses than thermal end-uses and tend to be higher in percentage terms for less energy intensive sectors and for smaller enterprises. This is logical as it reflects the relative importance of managing energy savings and the capacity to do so by economic sector. Nonetheless substantial savings opportunities from EM exist in all sectors, regardless of their energy intensity.

Recommendations

Given the pressing need for the EU to improve its energy security (especially with respect to natural gas imports) and make deep cuts in the carbon intensity of its economy it is appropriate to countenance more proactive stimuli to promote systematic energy savings than have hitherto been adopted. This is especially the case for the savings that require systemic and organisational level savings such as are accessed through energy management. The report this paper summarises includes an extensive set of recommendations supported with a carefully articulated rationale. The principal recommendations are summarised below.

Following review of the EED the Commission and MS should consider amending the provisions which currently exclusively concern energy audits to:

- impose energy management implementation requirements on enterprises using more than a minimum prescribed energy consumption or energy intensity level
- complete the development and promote benchmarks of energy performance in the industrial and tertiary sectors that are tailored for relevance to each specified industrial or tertiary sector activity (including SMEs) and require companies and organisations to benchmark their energy use and share the results in an anonymous format with public authorities
- develop and provide free energy management support services to SMEs targeted at those with poor benchmarked efficiency levels (note this would include but not be limited to energy audits) – consider obligating the poorer performers to implement highly-cost effective measures
- provide incentives on energy efficiency capital expenditures for those organisations that adopt relatively advanced EM, wherein the total scale of the incentives provided by each Member State is commensurate to a proportion (say a quarter) of the value of expected energy savings to be achieved over the lifetime of the investment. Financing of these incentives could be integrated within national energy efficiency obligation schemes imposed on energy utilities under the provisions of Article 7 of the EED
- develop extensive capacity building programmes to train organisations in the development and implementation of EM policies and to build and support the energy services sector.

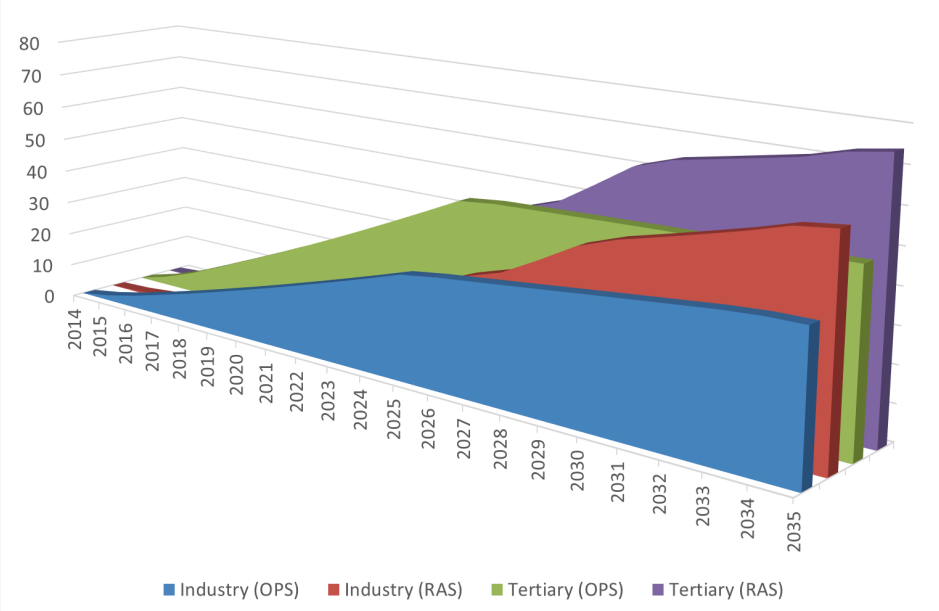

Figure 2. Energy savings from Energy Management under the Recommended Action Scenario (RAS) and Optimal Scenario (OS) for European tertiary and industry sectors compared with the Reference Scenario.

Conclusions

Strengthening the practice of energy management is a key need if public and private sector organisations are to access the large reserve of energy savings that are not directly addressed through other instruments. In the tertiary sector while measures addressing the energy performance of buildings are partially captured through the provisions of the Energy Performance in Buildings Directive and to a lesser extent the Energy Efficiency Directive these measures leave a substantial proportion of the systems- and operational-level savings potential untouched. This is the domain where energy management can make a significant difference. Similarly, in the industrial sector existing European policy instruments such as the EU ETS and the IPPC directive only provide weak stimuli to encourage the savings that are only accessible through energy management. Not least because the value of carbon credits has plummeted while the energy efficiency specifications within the IPPC are rather loose and have considerable freedom in their interpretation leading to diluted implementation. This leaves a policy vacuum that measures which promote stronger energy management could help to fill.

In this context the development of effective energy management across EU organisations should be viewed as a strategic opportunity and priority. About 11 % of all EU energy consumption can be economised cost-effectively through the adoption of more effective energy management and most likely this potential will be "renewable" as more sophisticated technologies and techniques are developed in the future.

A variety of policy and programmatic recommendations have been proposed which can help to realise a large part of this savings potential. These build principally on strengthening the design of the Energy Efficiency Directive and its implementation at the Member State level. Critically realisation of these savings will require efforts at a major scale supported by very substantial financial resources and incentives; however, as the value of the benefits outweigh the costs by an average of twelve to one over the lifetime of the measures this constitutes a highly cost-effective investment and one that merits greater policy attention than it has received thus far.

References

[1] Waide, P. *The potential for energy savings from energy management in the EU*, draft report, pending release on Leonardo Energy, http://www.leonardo-energy.org/, 2015.

[2] *World Energy Outlook 2012*, OECD/IEA, 2012; IEA 2012 (Chapter 9, p. 280).

[3] eceee Policy Guide No. 1 *Industrial audits: A comprehensive and evidence-based primer for policy-makers and decision makers in the private and public sectors*, The European Council for an Energy Efficient Economy, 4 December 2014, http://www.eceee.org/all-news/news/news_2014/2014-12-04.

[4] Waide P., Ure, J., Simth, G., Bordass, B. & Karagianni, N. *The scope for energy and CO_2 savings in the EU through the use of building automation technology*, Waide Strategic Efficiency for European Copper Institute, 2013. http://www.leonardo-energy.org/sites/leonardo-energy/files/documents-and-links/Scope%20for%20energy%20and%20CO2%20savings%20in%20EU%20through%20BA_2013-09.pdf.

[5] Corremans, C. Les déterminants des investissement en efficacité énergétique des entreprises: dimensions stratégique et culturelle de la décision d'investir, PhD Thesis, University of Geneva, 2010.

[6] ISO Energy Management Standards series ISO/TC 242: ISO 50001:2011 – Energy management systems. ISO 50002:2014 – Energy audits . ISO/DIS 50003 – Certification of energy management systems . ISO/DIS 50004 – Implementation of energy management systems. ISO/DIS 50006 – Energy performance measurement and verification. ISO/FDIS 50015 – Measurement and verification of organisations.

[7] ISO survey at http://www.iso.org/iso/home/standards/certification/iso-survey.htm?certificate=ISO%209001&countrycode=AF.

[8] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast), European Commission, 2010, OJEU.

[9] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

[10] Kimura O., & Noda F., "Does regulation of energy management systems work? A case study of the Energy Conservation Law in Japan" in eceee Industrial Summer Study proceedings, eceee 2014, pp. 647–657.

[11] Togeby M. *et al.* "A Danish case: portfolio evaluation and its impact on energy efficiency policy" in Energy Efficiency 5:1, Springer 2012, pp. 37–49.

Acknowledgements

The authors would like to thank the European Copper Institute who funded the work presented in this paper.