

Industrial Audit

Industrial audits

A comprehensive and evidence-based primer for policy-makers and decision makers in the private and public sectors

Policy Guide No.1

This document is the first in a series of policy guides on topical energy efficiency issues, intended for policy-makers and decision makers in the public and private sectors.

Over the past 20 years, working with the energy efficiency community, eceee has built up a significant evidence base of practical energy efficiency policies and measures. This guide is the result of a “mining and refinement activity” in order to extract and synthesise the vast body of knowledge – from Summer Study papers and other reports – into practical, targeted information on how to implement energy savings.

The guide is intended as a primer for policy-makers and other decision makers thinking of developing energy efficiency policies and programmes and a signposting document for those wanting to dig deeper into the subject.

Acknowledgement

This policy guide was produced with support from Energifonden.

About the European Council for an Energy Efficient Economy

the European Council for an Energy Efficient Economy, is the largest non-profit, membership-based energy efficiency NGO in Europe. The goal of is to promote energy efficiency through co-operation and information exchange.

To facilitate this, provides evidence-based knowledge, analysis and information through its website, news service and seminars. arranges conferences and workshops and takes an active part in the key European energy efficiency policy discussions.

One of eceee’s principle events is the five-day Summer Study held in June every odd year. It typically attracts more than 450 participants from governments, industry, research institutes and citizen organisations. In 2012 started a specialist, three-day Industrial Summer Study series to be held every even year.

Contents

Preface.	2
Executive summary.	2
1.Introduction.	3
2.Industrial audits in context.	4
2.1 Background.	4
2.2 Rationale of energy audit programmes.	5
3.Programme design.	6
3.1 Market engagement.	6
3.2 Market segmentation.	6
3.3 Degree of subsidy.	7
3.4 Information and intellectual property.	7

4.	Programme delivery.	7
4.1	Appointing a delivery agent.	7
4.2	Recruiting the auditors.	8
4.3	Account management.	8
4.4	Developing programme collateral.	8
4.5	Monitoring and review.	9
5.	Impact and lessons learned.	9
5.1	The implementation gap.....	9
5.2	Lessons from the past.	10
6.	The state of the art.	10
6.1	Audits as programme delivery hubs.	10
6.2	What makes a good audit programme?.	11
6.2	A glimpse of the future.	11
	Bibliography.	12
1.	Introduction.	12
2.	Industrial audits in context.	12
3.	Programme design.	12
4.	Programme delivery.	13
	Standards, databases and other resources.	13
	Articles and papers.	13
5.	Impact and lessons learned.	14
6.	The future.	14

Preface

This document is the first in a series of ecee policy guides on topical energy efficiency issues, intended for policy-makers and decision makers in the public and private sectors. Industrial energy efficiency policy is at a crossroads. On the one hand it promises a win-win benefit for companies – both energy and cost savings. But on the other it is proving very difficult to deliver in real markets at the scale that we need to meet climate change targets. Governments across the world are reviewing their programmes to try to address this dilemma.

The ecee is an organisation focussed on delivering an energy efficiency economy. Over the past 20 years, working with the energy efficiency community, we have built up a significant evidence base of practical energy efficiency policies and measures. The time has come to put this resource to work to help policy-makers across the EU get to grips with energy efficiency.

Policy-makers require multidisciplinary skills to carry out their work. They need to know how to develop and implement credibly ambitious sustainable energy policies and plans – and how to secure scarce funding in governments with other priorities. So in 2014 ecee began a “mining and refinement activity” in order to extract and synthesise the vast body of knowledge into practical, targeted information on how to implement energy savings.

One of the key outcomes of this work is a series of energy efficiency “policy guides” to act as primers for policy-makers thinking of developing energy efficiency policies and programmes and a signposting document for those wanting to dig deeper into the subject.

The objectives of these guides are:

To allow policy-makers at national, regional and local level to access a wide body of evidence-based knowledge on effective policies and programmes.

To present this information in a way that is accessible and understandable to policy-makers and the actors that government programmes affect and influence.

To allow policy-makers to benchmark their policies and programmes against successful programmes operating in similar jurisdictions.

To provide the raw material for policy-makers starting from scratch to develop and implement their own programmes.

To provide source references that researchers and policy analysts can follow up with more detailed study or fact-checking.

We hope the guides will be useful. But it is important to point out that these guides are just that – guides. They are not instruction books or blueprints because each programme needs to fit with the circumstances of the relevant country or sector. Wherever possible we have tried to point the reader towards a richer literature to get them started on the nuts and bolts of programme development.

Executive summary

Industrial energy audits have been around since the first oil shock in 1973. They are still very popular and we understand how they work pretty well. They also have a lot to tell us as we struggle with energy efficiency policy. They get to the heart of the barriers to energy efficiency in industry and can offer clues on how policy-makers can reconfigure their programmes and regulations to accelerate implementation.

The eceee has 20 years of experience with the energy efficiency community and has assembled an unrivalled evidence base of programmes and policies in the EU and globally. This guide, the first in a series of policy guides for policy-makers, draws on recent material and influential papers and articles from the academic literature.

The guide focuses on industry, commerce and the public sector, with a special emphasis on smaller companies. It starts by looking at the history of industrial energy efficiency over the past 40 years, and in particular how audit programmes were developed to address barriers to energy efficiency in companies. Their development from simple audit schemes to more sophisticated change management programmes is set out.

The guide then sets out basic design principles of an audit programme:

2 ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS

How to engage with the industry sector that the programme will be aimed at: what their needs are, how they address issues like climate change.

How to break the sector down to make it manageable to address: for example designing services to meet specific needs or operational types.

How much and what type of support the programme will provide, and, equally important, what type of subsidy would work best.

What information, advice and data is needed to underpin the design process and help with the implementation and management of the programme.

Then the detailed process of actually procuring and running the programme is reviewed, including:

Commissioning the agency or contractor who will deliver the programme, including the governance of the programme and the skills and capabilities needed.

Recruiting and managing the network of auditors.

Mechanisms needed for managing the client base of the programme, such as customer relationship management systems.

Requirements for the collateral that the programme will need, ranging from information and software for companies to training programmes for the auditors.

The basic features and requirements of independent programme monitoring and review, including key performance metrics.

The guide then reviews the impact of audit programmes and what our experience of audits tells us about how industrial companies work, the real-world barriers to energy efficiency and how policy-makers might overcome them.

The guide finishes by drawing on the lessons we have learned to describe the current “State of the art” – what makes a good audit programme, and how audits are beginning to evolve into energy efficiency delivery “hubs”, tying together a portfolio of modern energy efficiency policies and measures. Finally, there is a glimpse of how audits might develop in the future.

1. Introduction

Industrial energy efficiency audits were amongst the first programmes developed after the oil shocks in 1973. We’ve chosen them for the first guide for three reasons: our understanding of them is well developed, they are still very popular and emerging economies are beginning to implement them. In the EU interest in audits can only grow now that they are a requirement for larger companies under the new EU Energy Efficiency Directive.¹

Audits are important because they have to be at the centre of any effective industrial energy efficiency programme. Audits are essentially about information, and lack of information is a pivotal barrier to energy efficiency for businesses. Audits and auditors also form the main point of contact between governments and businesses, and the output of the audit can be used to measure success and deliver support and resources.

The ecee has long advocated audits as an instrument of policy and the ecee library of journal articles and Summer Study proceedings holds around 70 papers on the subject – more than any single programme. There have also been a few excellent academic reviews in recent years.² But, strangely, there are very few studies specifically aimed at policy-makers wanting to set up a programme trying to find their way through the technical literature.

This guide is meant to fill this gap by reviewing recent ecee archive material on audits, together with the author’s personal experience of setting up the early UK programmes.³ It sets out the background and basic principles of energy audits, identifies the key design and delivery features and puts them into the broader policy context of a modern climate change programme.

This guide is a primer on all kinds of audits, but it has a special emphasis on smaller companies and organisations. There are three reasons for this. First, SME energy use has

the biggest potential for savings. Second, they are usually a priority for governments of all political persuasions. But, thirdly, they have proved to be the hardest nut to crack despite libraries full of research papers. If we solve SMEs we will go a long way to solving the energy efficiency dilemma as a whole.

1. Commission Directive 2012/27/EU on energy efficiency.

2. See in particular the review of Price, Lynn, & Lu, Hongyou, “Industrial energy auditing and assessments: A survey of programs around the world” in *eccee 2011 Summer Study Proceedings*, *eccee 2011*, pp. 629–640, and Thollander, Patrik, & Palm, Jenny, *Improving Energy Efficiency in Industrial Energy Systems: An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs*, Springer, London 2013.

3. Mallaburn, Peter S., & Eyre, Nick, “Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013” in *Energy Efficiency 7: 1*, Springer 2014, pp. 23–41.

2. Industrial audits in context

2.1 BACKGROUND

Industry, commerce and the public sector typically account for 30 % of energy consumption in the West and significantly more in many developing economies.⁴ The large, highly cost-effective, untapped energy saving potential sector was attractive to policy-makers because, politically, industry is easier to regulate than households because fewer voters are affected.

So many of the first energy efficiency programmes focused on industry, primarily in the US, Japan and Europe. Initially they took the form of simple grant and loan schemes and tax breaks for efficient plant and machinery. But it quickly became clear that this funding was not utilised effectively because companies had no idea how much energy they were using in the first place.

The concept of energy audits took off in the US with the Industrial Assessment Centres in 1976. They quickly

4. IEA Key World Energy Statistics 2014, OECD/IEA, Paris 2014.

ly proved themselves as a highly effective way of engaging with industry and in the next decade or so they quickly spread to Europe⁵ and Japan. Now there are estimations that there are over 100 audit programmes operating around the world.

However energy efficiency programmes in general are under the microscope. Public funding is hard to come by in a time of austerity. But more importantly energy efficiency programmes are struggling to deliver the scale of the emission cuts needed to deliver climate change targets. So policy-makers are re-examining their programmes to focus on implementation.

The EU, for its part, has gone back to first principles. The Energy Efficiency Directive makes it mandatory for member states to implement a programme of ener

5. Finland was – and still is – an early pioneer of audits. See Kahn, Jamil, “Evaluation of the energy audit programme in Finland (within the framework of the AID-Energy Efficiency project)”, Ecofys, Intelligent Energy Europe contract number EIE-2003-114, [2006].

gy efficiency audits for large industrial companies and to make auditing easier for smaller ones. It is timely, therefore, to take a look at our experience of energy efficiency audits to see what lessons we have learned and how these can be applied today.

2.2 RATIONALE OF ENERGY AUDIT PROGRAMMES

In a rational world energy costs should be controlled and optimised as part of normal business. In companies with large energy bills, such as metal refining, food and drink and paper, this is indeed what tends to happen because energy costs, as a proportion of turnover, can easily be as high as staff costs or raw materials – 10 % or even higher.

But for everyone else much less energy is saved than is both technically possible and cost effective. This so-called “energy efficiency gap”⁶ happens because, in the real world businesses, energy savings are not “rational” in the neo-classical economic sense. A wide variety of barriers conspire to prevent companies from doing the right thing.⁷ Energy efficiency is a bit like dieting: easy in principle, great if you can do it, but really, really hard to actually do.

Many of the barriers stopping energy efficiency are operational, caused by the way the company works. Energy is a highly technical field, so, unlike paperclips or petrol, energy is delegated to specialist facilities management (FM) teams. However, their job is typically not to worry about saving energy but to make sure that the product goes out of the door on time and the lights and air conditioning stays on in the CEO’s office.

Barriers can also be technical or knowledge-based. The FM team may not have the knowledge or skills to cope with installing or maintaining energy efficiency technologies. Will the new efficient technology fit in the old brackets? Will the new efficient lights need a new ballast? Does the new equipment need new wiring or a change in the supply voltage? What happens if it breaks?

Finally, there are organisational barriers that result from the way people interact within the company. The FM team are unlikely to have a strong working relationship with the senior managers who need to sanc

6. 20 years old, but still the best primer for the subject: Jaffe, Adam B. & Stavins, Robert N., “The energy-efficiency gap. What does it mean?” in *Energy Policy* 22: 10, Elsevier 1994, pp. 60–71.

7. For an industry-specific review of barriers see Vetromile, Julia, “It’s all about the margins: Where does energy efficiency fit for industrial segments?” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp. 429–436.

tion the investment. As a result, the Board might not be aware of the potential benefits of energy efficiency, or the risks in not anticipating consumer needs or tighter regulations.

Many of these barriers operate in both large and smaller businesses. But SMEs have their own problems, with the two most important being lack of money, and lack of senior manager time to organise everything. The priority for the CEO is simply to keep the company afloat until the next order comes in. Capital investment has to go on delivering the product to market and not on energy efficiency that might or might not pay back in the future.

Given this complex mix of barriers it is not surprising that energy efficiency is marginalised. But the flipside is that energy efficiency is just the same as other corporate things that should be done but aren’t, such as employee welfare or good management.

So energy efficiency audit programmes are best seen as change management programmes for energy. Audits didn’t start out like this: most were rooted in technology

policy. However, as climate change rose up the political agenda, energy use began to be managed more effectively, and the discipline of “energy management” emerged in its own right, eventually developing its own international management standards such as ISO 50001 and EN 16001.

Formal management standards like these are complex and expensive, and tend to be the domain of larger companies and public bodies. Fortunately there are a number of common features that can be applied when designing new schemes for companies of all sizes:

A strategic commitment to change, by senior management, to tackle the company’s energy and carbon emissions.

A company-wide review of both energy and carbon use and the workforce skills and capacity in place to manage energy.

Performance benchmarking to show how the company’s energy and carbon emissions compare to its peers and competitors.

Costed recommendations based on the best available efficient technologies and organisational processes.

An action plan: a structured programme of implementation, management and review, including investment and procurement advice.

6 ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS

All of these elements are found in all successful energy efficiency audit programmes.⁸ However different countries have a different balance between the various elements depending on a host of local variables, including the market involved, the local and national politics, the degree of funding and the type of delivery agencies in place. The next section picks out the most important parameters that a policy-maker needs to consider to meet their own needs.

3. Programme design

There are four crucial scoping decisions that need to be addressed early on:

How to engage with the industry sector that the programme will be aimed at: what their needs are, how they address issues like climate change.

How to break the sector down to make it manageable to address: for example designing services to meet specific needs or operational types.

How much and what type of support the programme will provide, and, equally important, what type of subsidy would work best.

What information, advice and data is needed: it’s an old dictum that you can’t manage what you don’t measure, but that doesn’t make it irrelevant.

3.1 MARKET ENGAGEMENT

Government cannot happen in a vacuum so the first step when considering a new programme is to establish relationships with key market actors, particularly trade bodies. These are generally taken to be those operating on the energy “demand side”, for example small business trade associations, or bodies representing energy professionals, energy intensive companies or specific sector interests.

Energy “supply-side” organisations can be helpful as well. The energy companies themselves are an obvious player and indeed are integral to a number of auditing

programmes, particularly in the domestic sector. Energy companies have also established a number of Energy Service Company (ESCO) finance schemes for small businesses.

8. See Thollander, Patrik, et al. "A standardized energy audit tool for improved energy efficiency in industrial SMEs" in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp. 659–667.

Technology companies are another key market player that is often overlooked. They hold comprehensive databases on technology performance and best practice and are generally willing partners because it is in their interest to work with companies because they are potential clients, and after all, the programme is effectively subsidising their marketing effort.

Of course the best form of engagement for a company, particularly a smaller one, is with its peers. It is human nature to follow what others like you have done, so programmes that exploit this are generally successful. The trick in programme development terms is to facilitate the right support networks. This might, or might not, involve the trade bodies that see themselves as the representatives of the target companies.

3.2 MARKET SEGMENTATION

Resources are always limited, so an early decision is how to ration the service fairly but keep it as effective as possible. It wouldn't be a good use of resources to offer the same level of effort to an aluminium smelting plant and the shop where the plant workers buy their morning newspapers. Politically, the programme manager might have no choice, but, in an ideal world, even political judgements always have to be made on the basis of good market information.

So the target audience has to be broken down so that the programme can implement a limited number of offerings – "market segmentation" in the jargon. To do this there are four company characteristics that need to be considered:

Degree of commitment. Obviously it is important that a company wants to save energy. But many don't, or more accurately, they might want to but have concerns over the risk this entails. More reluctant companies will be more expensive to engage and need to be handled differently.

Type of energy use. In heavy industry most energy is used to drive process technology and supporting systems like HVAC and compressed air. But in commerce and the public sector office energy use dominates. Both types of companies need markedly different types of audit.

Size of businesses. Smaller companies are generally more expensive simply because of the transaction costs. But SMEs might be politically important, or have very effective local support networks. Different approaches are needed to keep the costs manageable.

ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS 7

Size of energy bill. If the energy bill is more than 5 % of the turnover, efficiency should be part of standard management practice. But simple experience shows that this isn't always the case. Energy intensive companies can focus on the process they employ and often miss simple, generic opportunities.

The outcome of the market segmentation and the relationships established with the key market players and support networks should now allow the specification of the programme to be drafted and the delivery agent to be procured.

3.3 DEGREE OF SUBSIDY

It is tempting to offer service free to companies, particularly SMEs, on the basis that they are generally capital constrained. If the availability of capital is a problem, then the audit should be free. But the findings of numerous studies has shown that, for companies above a certain size threshold, cost-shared programmes are significantly more effective.

This seems to be for two reasons. First a contribution from the company lowers the programme cost and reduces the “free rider” effect where companies that would have paid for an audit get one for free. But possibly more importantly the process of making the contribution requires commitment from the organisation, which then tries harder to extract value from the process because it has a stake in the process.

3.4 INFORMATION AND INTELLECTUAL PROPERTY

The value of data cannot be overemphasised. Before the programme is set up it is vitally important to research what data is – and is not – available. This applies to relatively simple data on market structure to complex technology best practice and performance benchmarking information.

As an example most business databases available to government are not designed with energy efficiency in mind. Energy use according to company size and process is available, but it can be too highly aggregated to be useful, for example energy end-use by type of fuel or sector, but not by company or site.

Technology best practice data is more complex, but there are a number of repositories around the world assembled by other programmes and industry bodies. But these might not be directly applicable in another country (for example if technology standards are different) so they will need to be adapted.

IP is another important consideration. The technical data that is used to set the programme up will need to be acquired. As the programme develops the new data that is generated will assume a significant value which will need to be protected. It is very easy to allow this IP to dissipate in a complex network of subcontractors that can evolve and change over time.

4. Programme delivery⁹

4.1 APPOINTING A DELIVERY AGENT

Most audit programmes are run by governments, either on their own, or in partnership with industry, consultancies and intermediaries like local and regional government. However the delivery is usually delegated to an energy agency that subcontracts the various programme elements. But how the various actors are deployed is dependent on country circumstances.

Whether the programme is run and managed in house or contracted out to an agency or private contractor, the delivery agent needs to have three important characteristics:

Experience. The delivery agent must have managed audit programmes before and have the right balance between client management and technical knowledge. In a mature market there are a large number of organisations with the right mix of skills and experience. They might not be based in the same country though.

Authority. Companies and individuals prefer to work with people that they trust especially when advice will be given that could involve significant investment decisions. The

delivery agent needs to be able to show that the advice delivered on their behalf is both accurate and relevant, but also not coloured by vested interests.

Flexibility. The delivery agency or the government also needs to ensure that the portfolio of contractors under their control is configured to be able to meet expected demand and be able to react to change without incurring too much additional expense. Target setting, stage reviews and performance incentives or penalties are particularly important.

9. For a review of practical experience across the EU see: The guidebook for energy audits, programme schemes and administrative procedures, Motiva, IFE and CRES, Save Project Final Report, 2000.⁸ ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS

Some programmes have found that some degree of independence is also important for the delivery agent. Programmes managed from within government have the benefit of being controllable, but they can be subject to government procurement rules, which can affect flexibility and cost.

However a more important benefit of a delivery agent free of government is the ability to make decisions based on merit. Government will often be required to be even-handed or respond to political instruction, but audit programmes have to allocate resources based on energy efficiency potential and cost-effectiveness. Independent agents are better placed to do this.

4.2 RECRUITING THE AUDITORS

One of the first jobs of the delivery agent is to assemble and manage the auditor network. This will be by some distance the most expensive element of the new programme, so it is important to get it right. A typical country-wide programme can have over 500 individuals on its books.

The early programmes had to recruit auditors from other professions, principally facilities managers and retired engineers. Fortunately, as energy management has evolved as a discrete engineering discipline, the profession of energy auditors is now pretty well established and a number of trade bodies have been set up that can offer guidance and provide accreditation services. There are also auditing standards such as ISO 50002 and others in the Energy Management series.

The balance of skills and experiences amongst the auditors will be informed by the market segmentation process. Energy intensive SMEs will tend to need more sector specialists and engineers, whereas an accountancy firm will need experts in building services and energy management.

One important element to include in the specification for the auditors is performance management and professional development. The programme will need to evolve, and the best auditors will push at the boundaries and need to be encouraged. Conversely the poorer performers need to be weeded out before they can do too much damage.

4.3 ACCOUNT MANAGEMENT

The delivery agent will also need to put in place a number of client management processes to generate and manage demand from companies and to provide advice and support. These include:

A dedicated customer acquisition call centre with specially trained staff capable of handling enquiries and simple technical questions.

A specialist auditor management unit responsible for recruiting, training, deploying and assessing the auditor network.

Fit-for-purpose Customer Relationship Management (CRM) tools for recording and archiving all aspects of the service and its outcome.

Marketing and outreach tools including a dedicated website and other on-line resources.

Compared to when the first auditor networks were set up in the late 1990s client management is now pretty well established in energy efficiency circles, but the programme manager and his or her lead contractor or agency still needs to be able specify the requirements properly.

4.4 DEVELOPING PROGRAMME COLLATERAL

Last but not least there are a number of specialist items of collateral that will need to be assembled for the auditors. The most common are:

Information and advice. This is usually in the form of general guidance on energy management and best practice technical publications.

Software and other assessment tools. There is a range of proprietary and off-the-shelf tools available for analysing energy use data.

Benchmarking. Benchmarking data shows how well the company is doing compared to its competitors. This can be one of the strongest drivers of change.

Case studies. Another strong driver is precedent. If a company can see that similar companies can do something safely, then it is more likely that they will.

Training and professional development. Key staff, particularly the energy manager, may need specialist coaching in key techniques.

Obviously this task is highly specific to the programme involved. But a number of governments have established libraries of support material either directly themselves (e.g. the UK's industrial energy efficiency library) or through professional and industry bodies (e.g. the US ASHRAE standards and guidelines). ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS 9

4.5 MONITORING AND REVIEW

Reviewing the impact of the programme is obviously important, but it is very difficult to be specific about the way the review should be carried out because there are so many variables. The "impact" that needs to be reviewed changes according to the type of programme, the target sector and the reason why the programme was set up in the first place. So for example a common metric such as carbon saved per Euro is important to the Treasury, but less so to a trade body interested in how the market is changing.

However it is possible to list several important factors to bear in mind when designing the review methodology:

Agreeing the metrics up front is absolutely essential. Confusion is surprisingly common between absolute measures and measures related to output, and between the various carbon metrics themselves (e.g. annual and lifetime tonnes of carbon saved).

The process of review is best carried out by the government itself or by a third party contractor independent of the delivery agent or government. If the process of review is still outsourced to the delivery agent then the methodology and the final sign-off still needs to rest with the government.

Empirical measures like tonnes of carbon tend to be easier than subjective ones such as market transformation, but this doesn't mean the latter are less important; they just require a more complex methodology.

Output measures (e.g. energy cost saved) are almost always better than input measures (e.g. number of audits carried out or leaflets sent out). In reality a programme will produce both, but the final decision should relate to outcomes generated and not processes initiated.

5. Impact and lessons learned

5.1 THE IMPLEMENTATION GAP

Audit programmes can be one of the most cost-effective ways of changing company behaviour. But they don't work for everyone. Across industry as a whole the percentage of audit recommendations that are actually implemented can be as low as 20 % for some sectors or

company types. Even the most advanced programmes generally only manage a 50 % implementation rate.¹⁰

Why is this? As any advertiser will tell you, simply providing information doesn't always lead to change, or if it does, it only lasts for a short time before the company lapses back to the old, more comfortable way of doing things. Once again, the dieting analogy is very relevant here.

This is today's critical challenge for industrial energy efficiency policy. Programmes of all types are coming up against this implementation barrier and governments of all colours are struggling with the solution. Those favouring market intervention have run out of money. Those favouring market forces are loath to regulate. Energy efficiency, caught in the middle, risks losing credibility and funding.

5.2 LESSONS FROM THE PAST

So what is the answer to this "implementation gap"? At the moment, we don't have all the answers. But we can draw a number of lessons from our experience of audit programmes so far, and in particular, how industrial energy efficiency programmes operate at the company, and indeed, the individual manager level.

Information and organisational barriers don't operate in isolation. In most companies the crucial barrier is money. This can simply be a lack of up-front capital, which is particularly common amongst smaller companies, where the bottom line rules everything they do. Finding capital for non-core investments, especially outside the normal capital replacement cycle, is next to impossible.

In larger organisations lack of capital is compounded by intransigent accounting rules. Cost-effective energy efficiency tends to pay back inside 2 years, but internal rules may impose a one-year limit. To make matters worse it may also be impossible to link capital expenditure to revenue budgets, all but ruling out projects that pay back over time. This "capex/opex" barrier is a particular problem for public bodies and central government departments.

Different types of companies require different types of support. This is not simply a company size and sector issue, although these variables are important,

10. For an example see Karlsson, Magnus, et al., “Impact and process evaluation of the Swedish national energy audit program for small and medium-sized industries” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp. 73–80. as described above. But similar-sized companies in the same sector, but in different stages of maturity, can also need different services and different types of support.

Subsidy, and especially financial subsidy, is a good example of this, and the debate is particularly rich on loans versus grants. Grants are best suited to smaller companies with no cash. Loans are better for larger companies with a healthy balance sheet where the energy savings accrued can be offset against the original capital cost. Larger companies also tend to implement more if they make a contribution to the audit programme.

The needs of the same company also change as it moves along the change management process. Technical changes should be embedded into the facilities management team’s maintenance processes. But behavioural change is much harder to “maintain” because it depends on staff outside FM, or even subcontractors, who may not be adequately trained or resourced to keep a behavioural change programme going.

Behavioural change is much harder to implement and maintain than technical change.

Even though the barriers to technical change in an organisation can be significant, once the new equipment is in place it tends to continue saving energy for years because it will be included in normal operation and service protocols. However behavioural changes such as employee awareness schemes and training programmes can lose impact very quickly.

This is because the drivers of behavioural change are much more ephemeral. The enthusiastic individuals leading awareness programmes can move jobs. Senior directors, who are important to lend authority (and resources) to a scheme, will have other priorities which will tend to dominate after the novelty of the new programme has worn off. All this means that whilst technical measures can easily last for 10 years, behavioural schemes on average last only 10 weeks.

6. The state of the art

6.1 AUDITS AS PROGRAMME DELIVERY HUBS

The impact of these and other insights on audit programmes is that they are evolving to work alongside other measures designed to address the barriers that audits cannot address on their own. A new breed of ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS

11

“integrated” audit programmes have emerged, where the audits are a part of a more sophisticated mix of programmes and policies, for example:

Long Term Agreements, which involve formal agreements with an industry sector to deliver savings in exchange for incentives such as audits or grants.

Fiscal measures such as tax breaks for energy efficient technology or taxes on energy use or carbon emissions.

Regulatory or other mandatory measures such as cap-and-trade schemes, management standards or public procurement programmes.

Reputational and exhortation measures aimed at the customers of a company or at its shareholders and institutional investors.

Audit programmes themselves, either stand-alone or as part of other programmes, have become far more sophisticated. Indeed the study of audits is beginning to be a research discipline in its own right, and our understanding of how companies work makes it possible to describe the various elements that make up an ideal audit programme and how to make them work most effectively together.

6.2 WHAT MAKES A GOOD AUDIT PROGRAMME?

These new, integrated audit programmes are designed to fit a particular need and circumstance. But it is possible to distil some of the main elements that make up the successful programmes:

Flexibility is critical. Markets evolve, finance comes and goes and politics intervenes. So a programme needs to be built on a framework that can adapt to meet these challenges. Fortunately there are many energy efficiency measures to choose from and usually there are several alternatives that can tackle a particular problem.

The managing agency, or the part of it that engages with the sector, needs to be separate from government to allow it to act as a trusted “market catalyst” as well as to understand how business responds to climate drivers. The agency doesn’t have to run the programme, but they do have to be seen by industry to be an influential player free of government influence.

Local “networks” of actors are critical – particularly for SMEs – to encourage peer-to-peer exchange of experience and to impart local knowledge and credibility. Precisely who these actors are depends on what works best: local and regional government, NGOs and trade bodies are all used. But they have to be both authoritative and independent and trusted by business, which is often quite a hard combination to get right.

The quality and experience of the auditors and the responsiveness of process by which they are managed are very important. Auditors need to be trusted because they will get to see quite sensitive company information, and have a wide range of knowledge to be able to deal with different circumstances. The process needs to be robust and flexible so that the auditors are deployed effectively. Twin-track audits, where an initial scoping study precedes a more thorough investigation, are becoming very common.

Some degree of compulsion is necessary. No matter how tempting it is to “leave it to the market” the basic economics of energy efficiency mean that if left to themselves, companies do not do the right thing even if it makes them money. How this compulsion is presented and configured depends on the politics and the market, but it has shown to be essential if the programme is to deliver at scale.

What is interesting here is that it is possible to compile a “best practice” list like this. Ten years ago the academic literature was not mature enough to allow us to do this. But the evidence base has developed significantly and now, armed with the design principles set out in this guide and a decent analytical team, policy-makers have access to the tools they need to design a programme that fits their own circumstances.

6.2 A GLIMPSE OF THE FUTURE

The most recent research on audits and the programmes they operate within is giving us glimpses of how climate programmes might operate in the future. More and more the phrases “business model” and “framing” are

appearing in the research,¹¹ shorthand for the need to align support programmes with how markets actually operate in the real world, rather than imposing services top-down.

This is an area fraught with risk for civil servants, both fiscal and political: too much intervention can alienate business and impose unnecessary costs, but

11. Nilsson, Hans, & Ruhbaum, Charlotte, “Understanding and addressing the client’s needs: how can we frame energy efficiency?” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp. 703–710.¹² ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS

12.

13. too little can let business off the hook and encourage free-riding. Getting this balance right is very hard.

But it can be done. In the UK, in 2003, the government’s then delivery body, the Carbon Trust, realised that energy efficiency had little relevance to companies as a selling point. But “Carbon Management” had much more traction because it linked the CSR agenda, the climate change debate more generally, and crucially, the fact that consumers were demanding proof that companies took climate mitigation seriously.

In short energy efficiency was simply an answer to a much more important question: how can I improve my carbon management and grow my company?

This approach is gaining ground and a number of recent papers are beginning to work out what a “business model” approach means and to set out the ground rules for others to follow. And, interestingly, audits are once again taking centre stage because they are the point of engagement and interaction between the government and the private sector.

And, in the end, getting this right is all that matters.

Bibliography

These references are additional to those footnoted in the main text.

References are listed against the section of this guide for which their content is most appropriate. However, they could apply more widely.

Membership of the eceee may be needed to view the full articles from the eceee Summer Study proceedings. The abstracts are always open for all.

An academic subscription will be needed to view full articles in the Energy Efficiency Journal and other peer-reviewed publications. eceee members can access the Energy Efficiency Journal through eceee’s web site.

1. INTRODUCTION

Harmelink, Mirjam, et al., “Theory-based policy evaluation of 20 energy efficiency instruments” in *Energy Efficiency* 1: 2, Springer 2008, pp.131–148.

2. INDUSTRIAL AUDITS IN CONTEXT

Backlund, Sandra, & Thollander, Patrik, “The energy-service gap. What does it mean?” in *eceee 2011 Summer Study proceedings*, eceee 2011, pp.649–656.

Backlund, Sandra, et al., “Energy efficiency potentials and energy management practices in Swedish firms” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.669–677.

Brown, Marilyn A., et al., “Evaluating the risks of alternative energy policies: a case study of industrial energy efficiency” in *Energy Efficiency* 7: 1, Springer 2014, pp.1–22.

Dahlgren, Maja, et al., “Models for driving energy efficiency nationally using energy management” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.101–112.

Fouquet, Dörte, & Nysten, Jana, “The European Energy Efficiency Directive and its implementation in the German industrial sector” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.847–854.

Hasanbeigi, Ali, et al., “Barriers to energy efficiency improvement and decision-making behaviour in Thai industry” in *Energy Efficiency* 3: 1, Springer 2010, 33–52.

Trombley, Daniel, & Taylor, Robert, “Foundations for efficiency: How industrial energy efficiency programs are built and structured in the U.S. and Canada” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.171–178.

Zhisheng, Li, et al., “A study of energy performance and audit of commercial mall in hot-summer/warm winter climate zone in China” in *Energy Efficiency* 6: 3, Springer 2013, pp.459–473.

3. PROGRAMME DESIGN

Aste, Niccolò, & Del Pero, Claudio, “Energy retrofit of commercial buildings: case study and applied methodology” in *Energy Efficiency* 6: 2, Springer 2013, pp.407–423.

Backlund, Sandra, et al., “A regional method for increased resource-efficiency in industrial energy systems” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.55–58.

Berg, Martina, “The Swedish Environmental Code – one legislation, several ways of enforcement” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.143–148.

Bernardo, Hermano, et al., “Energy management in municipal solid waste treatment: a case study of a mechanical biological treatment facility” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.555–560.

ECEEE POLICY GUIDE NO. 1:

INDUSTRIAL AUDITS 13

Bleyl, Jan, et al., “Simplified measurement & verification + quality assurance instruments for energy, water and CO₂ savings – methodologies and examples” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.133–142.

Crittenden, Patrick, & Lewis, Helen, “Accelerating the uptake of energy efficiency in industry – a case study of the Australian energy efficiency opportunities program” in *eceee 2011 Summer Study proceedings*, eceee 2011, pp.795–805.

Dinkel, Henrik, & Hallström, Eva, “Energy efficiency in industry – aimed actions leading to extended awareness all through the corporation: energy project for increased energy efficiency in small and medium sized enterprises” in *eceee 2011 Summer Study proceedings*, eceee 2011, pp.675–684.

Dirckinck-Holmfeld, Kasper, “Can energy utilities play a role in local political energy savings programs?” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.11–19.

Harrington, John, et al., “A strategic review of energy management systems in significant industrial sites in Ireland” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.601–611.

Mahmood, Abbas, & Meyhoefer, Bernhard, “Introduction of management system approach in implementing energy efficiency improvement in the textile industry: experience from Pakistan” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.647–657.

Plötz, Patrick, & Fleiter, Tobias, “Energy efficiency policies for different firm sizes: challenging current policies with empirical data” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.347–354.

Vermeeren, Ronald, et al., “Implementation of ISO 50001 in industry in the Netherlands” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.679–688.

Vetromile, Julia, “It’s all about the margins: Where does energy efficiency fit for industrial segments?” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.429–436.

Vine, Edward, et al., “Training the next generation of energy efficiency evaluators” in *Energy Efficiency 6: 2*, Springer 2013, pp.293–303.

4. PROGRAMME DELIVERY

Standards, databases and other resources

ASHRAE Standards and Guidelines database, ASHRAE, US, 2014.

The Carbon Trust Industrial Energy Efficiency Accelerator (IEEA), Carbon Trust, UK, 2014.

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.

Articles and papers

Brunner, Christoph, et al., “GREENFOODS branch concept for enhancing energy efficiency in the food and drink industry” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.233–238.

Brunner, Conrad U., et al., “How to achieve efficiency through the right mix of policies? Guidelines for electric motor policy implementation” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.289–300.

Khan, Jamil, “Evaluation of the energy audit programme in Finland (within the framework of the AID-Energy Efficiency project)”, Ecofys, Intelligent Energy Europe contract number EIE-2003-114, [2006].

Kimura, Osamu, & Noda, Fuyuhiko, “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.

Johnson, Katherine, et al., “Lessons learned from the field: key strategies for implementing successful on-the-bill financing programmes” in *Energy Efficiency 5: 1*, Springer 2012, pp.109–119.

Sommarin, Per, et al., “A method for bottom-up energy end-use data collection – results and experience” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.435–439. **14 ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS**

5. IMPACT AND LESSONS LEARNED

“The Carbon Trust. Accelerating the move to a low carbon economy”, National Audit Office report, House of Commons, London, November 2007.

Carl, Klaus, et al., “Continuous improvement of energy performance: How policy makers can support ISO 50001 implementation for industry” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.715–722.

Cornelis, Erwin, “Lessons learnt from two long-term agreements on energy-efficiency in industry in Flanders, Belgium” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.3–17.

Fleiter, Tobias, et al., “Adoption of energy-efficiency measures in SMEs – an empirical analysis based on energy audit data” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.723–732.

Fleiter, Tobias, et al., “The German energy audit programme for firms – a cost-effective way to improve energy efficiency?” in *Energy Efficiency* 5: 4, Springer 2012, pp.447–469.

Gruber, Edelgard, et al., “Efficiency of an energy audit programme for SMEs in Germany – results of an evaluation study” in *eceee 2011 Summer Study proceedings*, eceee 2011, pp.663–673.

Napp, Tamaryn Ann, et al., “Is UK policy making industries more energy efficient? – A discussion of existing evidence and industry comments” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.381–390.

Paramonova, Svetlana, et al., “Swedish energy networks among industrial SMEs” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.619–628.

Perkins, Jeffrey N., & Maxwell, Jonathan B., “Energy audit impacts delivering sustained savings” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.59–66.

Schlomann, Barbara, et al., “Evaluation of different policy instruments to promote industrial energy efficiency in a national context” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.311–323.

Tolvanen, Jukka, et al., “System optimization through co-operation” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.611–616.

Trygg, Louise, & Karlsson, Björn, “A system perspective on industrial energy efficiency” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.405–410.

Werle, Rita, et al., “Financial incentive program for efficient motors in Switzerland: lessons learned” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.67–73.

Vine, Edward, et al., “Emerging evaluation issues: persistence, behaviour, rebound, and policy” in *Energy Efficiency* 6: 2, Springer 2013, pp.329–339.

6. THE FUTURE

Crittenden, Patrick, “Integrating energy efficiency into core business practices – an institutional work perspective on the implementation of energy management systems” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.697–706.

Drivsholm, Thomas, & Maagøe Petersen, Peter, “A network initiative to promote energy efficiency in SMEs” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.21–30.

Goldberg, Amelie, et al., “Promoting energy savings and GHG mitigation through industrial supply chain initiatives” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.227–236.

Heffner, Grayson, et al., “Energy provider-delivered energy efficiency: an international review” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.369–379.

Hendrix, David, & Cheung, Ray, “Case Study: tools to finance industrial energy efficiency projects for Chinese SMEs” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.795–804.

Mourik, Ruth, et al., “Energy consumption feedback and management: Best practices and the role for DSOs” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.751–758.

O’Sullivan, John, “Energy efficiency in industry, a holistic and integrated strategy from policy to results” in *eceee 2011 Summer Study proceedings*, eceee 2011, pp.745–757.

Reinaud, Julia, & Goldberg, Amelie, “The more the merrier: leveraging diverse players to deploy energy management systems in industry” in *eceee ECEEE POLICY GUIDE NO. 1: INDUSTRIAL AUDITS 15*

Industrial Summer Study proceedings, eceee 2014, pp.689–697.

Reinaud, Julia, et al., “Pathways to effective energy management programs” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.81–91.

Rochas, Claudio, et al., “New energy efficiency services in the industrial sector. A case study from an ESCO operating in the bio-ethanol industry. Analysis of experience” in *eceee 2012 Summer Study on energy efficiency in industry proceedings*, eceee 2012, pp.825–832.

Thollander, Patrik, et al., “The design and structure of effective energy end-use policies and programs towards industrial SMEs” in *eceee Industrial Summer Study proceedings*, eceee 2014, pp.75–81.

Togebj, Mikael, et al., “A Danish case: portfolio evaluation and its impact on energy efficiency policy” in *Energy Efficiency 5: 1*, Springer 2012, pp.37–49.

Vine, Edward, “Breaking down the silos: the integration of energy efficiency, renewable energy, demand response and climate change” in *Energy Efficiency 1: 1*, Springer 2008, pp.49–63.