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A new approach to non-domestic energy efficiency policy

A report for the Committee on Climate Change

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1 Summary

Most organisations do not invest in energy efficiency even when it makes sense to do so. This is the “energy efficiency gap” that policymakers have struggled with for over 40 years. Current policy is based on overcoming the range of technical, economic and organisational barriers to energy efficiency that exist. However, governments are finding that energy efficiency policies are still not delivering their full potential.

Researchers now consider that policy should focus not simply on finding and overcoming barriers, but on how energy efficiency fits with the organisation’s wider investment decision-making processes. The evidence is that energy efficiency happens when it is strategically important, or “salient”, and that salience is strongly influenced by external drivers such as reputation and risk and also by the way different part of the organisation are connected and resourced.

These salience drivers are complex, but vary in a predictable way between organisations and sectors. This patterning could be used to open up new intervention points for policy to influence investment behaviours in businesses and the public sector. The experience of successful UK and overseas energy efficiency policies supports this conclusion:

- Building performance labels in Australia are used by tenants to enhance their reputation and by developers to increase rental income and asset value and reduce operating costs and void times.
- Networks of industrial SMEs in Germany are exploiting behavioural drivers where companies trust advice from local partners, prefer collective action and respond to pressure from supply chain companies.

More research is needed to understand how salience works in detail. But a number of important policy principles are emerging, of which the most important is that it is not so much what policies are used, but how they are used together. Also:

- The government has a key role in helping organisations recognise the salience of energy efficiency and supporting them as they seek to exploit it.
- To do this government needs to connect up existing policies more effectively to exploit the salience of energy efficiency as it passes through the investment process.
- Where salience drivers are strong there is a strong case for industry or the public sector to take the lead with the government in a facilitation and co-ordination role.
- However where salience drivers are weak government needs to step up to provide support and incentives, and where justified, set regulations and standards.
- Piloting – “learning by doing” – is important to build capacity and market expertise in government and to build confidence in the target organisations and sectors.
- Most governments work with a delivery agency to co-ordinate policy implementation. The UK chose not to, but should reconsider this position given the scale of the task.

2 The Energy Efficiency Gap

The central dilemma of non-domestic energy efficiency policy is that most companies and public bodies do not invest in it even when the investment is cost effective. This is the so-called “energy efficiency gap”: the wide disparity between what is apparently cost-effective and what is actually implemented in the real world (Hirst & Brown 1990). In the 40 years since energy efficiency policies were first developed, governments, including in the UK, have struggled with this dilemma (Mallaburn & Eyre 2014).

In the early 1980s the view was that companies, as rational economic players, were ignoring energy efficiency because “hidden costs”, such as lack of resources or management time, eroded the apparent profitability of the investment. The prevailing dogma was that government had no business intervening unless real market failures were involved, such as information asymmetries (Shove 1998). This “neoclassical” view formed the basis of information-based programmes such as the UK’s Energy Efficiency Best Practice Programme.

However, in the 1990s, a series of studies of the US Federal lighting retrofit programme “Green Lights” cast doubt on the profit-maximising model (DeCanio 1998). Lighting retrofit was a mature, well understood, risk free investment option. However many companies still applied discount rates to these investments far higher than comparable, non-energy efficiency investments. The conclusion was that the neoclassical economic model was at best, an incomplete description of reality (DECC 2012a).

Subsequent research revealed a range of organisational and behavioural barriers (DeCanio & Watkins 1998, DeCanio & Laitner 2003). Transaction cost barriers arise because organisations do not make rational decisions but instead display “bounded rationality” (Herbert 1955), relying on rules of thumbs and routines to makes sense of complex situations. Organisations can also show systematic biases against certain investment outcomes such as status quo bias (Samuelson & Zeckhauser 1988) and loss-aversion (Kahneman & Tversky 1992).

Taken together we now know of roughly 70 barriers and market failures affecting energy efficiency which are normally sorted into 7 main groups (Sorrell 2011):

- **Risk:** energy efficiency investments represent a higher, perceived technical or financial risk than other, competing investments. For example new technologies might not fit in the existing infrastructure, or the process might have to be disrupted to make the change.
- **Lack of information:** missing unintelligible or inappropriate information can lead to energy efficiency opportunities being overlooked. Information barriers operate on the organisation as a whole and within the organisation, e.g. between energy teams and senior managers.
- **Hidden Costs:** engineering-economics-based analyses may overestimate cost-saving potential by ignoring overhead and management costs, disruptions to

production, staff replacement and training, and the costs of gathering, analysing and applying information.

- **Access to capital:** even cost-effective investments will not go ahead if the organisation has insufficient internal up-front capital, or has difficulty raising additional funds. Investment could also be inhibited by internal budgeting procedures or investment appraisal rules.
- **Principal/agent:** energy efficiency opportunities are foregone if the investor cannot realise the benefits. For example, if individual departments within an organisation are not accountable for their energy use they will have no incentive to improve energy efficiency.
- **Bounded rationality:** opportunities can be ignored because individuals within organisations do not make rational economic decisions owing to pressures on their time or attention, or their ability to process complex technical information.
- **Biases:** such as status quo bias and loss-aversion affect the weight that people give to costs relative to benefits, and are different to bounded rationality, which affects the way people process information.

3 The Current Policy Landscape

Most of today's energy efficiency policies were conceived and developed in the late 1990s and early 2000s and draw heavily on this "barrier-based" research (Harmelink *et al* 2007), including the EU Energy Efficiency Directive (EU 2012). They generally fall into one of the following categories:

- **Performance labeling for electrical goods** allows customers to choose between efficient and inefficient goods based on the potential benefits. Schemes can be based on relative performance, such as the EU product labelling scheme, a binary pass/fail approach, such as the USA EPA Energy Star programme, or a "best practice" approach such as Japan's Top Runner programme.
- **Performance labelling for buildings** allows tenants and owners to choose efficient buildings. Well executed building labelling has created higher value for efficient buildings and attracted capital for low-carbon investment to go 'beyond code' e.g. the Australian NABERS and the US Energy Star Buildings programmes.
- **Regulation through technology standards** removes inefficient buildings, technologies and products from the market by mandating minimum performance standards for construction, manufacture and refurbishment. Building codes and technology standards are common to many countries.
- **Energy audits** are formal reviews of energy performance with recommendations for improvement. They are more common in industrial companies and especially SMEs. Audits force the organisation to measure energy consumption and set out options for reducing it. The best researched examples are in the US and Sweden.
- **Voluntary or Long Term Agreements** are formal sectoral agreements to reduce emissions over a time period. They can include incentives to help member companies and measures to offset competitive effects. The UK's Climate Change Agreements are

a good example of an energy efficiency agreement, with the Energy Agreements for Sustainable Growth in the Netherlands covering a wider section of the economy.

- **Energy management systems (EMS) and standards** set out a range of formal, integrated practices for measuring, reporting, managing and reducing energy use. EMS can be national, such as the US Portfolio Manager for commercial buildings or bespoke programmes for SMEs, or internationally certified such as ISO 50001.
- **Technical information and advice** provides independent information that the market will not provide, for example on technology performance, or by benchmarking an organisation's own performance. One of the best examples of an information programme was the UK's Energy Efficiency Best Practice Programme that ran from 1983 to 2002.
- **Standards of Performance schemes** collect a levy on energy bills to pay for energy efficiency programmes. The UK Energy Company Obligation covers households, but many countries also apply SOPs to businesses, such as the Energy Efficiency Portfolio Standard schemes in the US and the Danish Energy Efficiency Obligation.
- **Public procurement** exploits the buying power of public bodies by specifying efficient products or services. Many countries have procurement standards for office buildings and for products and services provided to the government. The Swedish Technology Procurement Groups programme is a good, well-established example.
- **Financial support** has been an important element to enable low carbon investment to occur where there are higher capital costs involved, specifically for SMEs that are more capital constrained. Financial support takes many forms, from grants and loans to tax breaks and depreciation allowances. Germany has many of the most innovative financial programmes managed by the German state bank KfW.

The UK has been an enthusiastic policy innovator (Mallaburn & Eyre 2014). It has also deliberately experimented so that the economy could build capacity and expertise, such as the 2005 Emissions Trading Scheme set up in advance of the EU ETS to give businesses early experience of allowance trading (Defra 2006). The Carbon Reduction Commitment (CRC, Carbon Trust 2005) took a similar approach for large organisations outside the EU ETS, a notoriously difficult market segment.

However, whatever their original intention, the impact of these early programmes was often not as great as expected. The Carbon Trust's audit programmes only implemented 30-40% of identified measures (Carbon Trust 2013), meaning that over half of the cost-effective measures were being ignored (NAO 2007). The CRC saved energy but met resistance from business for being too complex and expensive to implement, and as a result is now being abolished (HM Treasury 2016).

Other countries are also finding that policies were not delivering their full potential: voluntary agreements and energy audits in Sweden (Stenqvist & Nilsson 2012; Larsen *et al* 2006, Karlsson *et al* 2012) and policies at State and Federal level in the USA (Khanna *et al* 2007, Hayes *et al* 2013). A similar picture exists in the EU (Rezessy & Bertoldi 2011, ADEME 2012) and the IEA (IEA 2016). Clearly policies designed to overcome barriers are not enough on their own to close the energy efficiency gap.

4 Salience - the strategic value of energy efficiency

4.1 The investment process

Many authors now consider the barrier approach to be flawed because it retains the implicit assumption that organisations will behave rationally when barriers are removed (Jaffe & Stavins 1994, Shove, 1998, Biggart and Lutzenhiser 2007). Instead barriers are seen as operating in a “socio-technical” landscape (Guy 2006). Policies to overcome barriers are blind to this organisational context, and their shortcomings could be because they are perturbing a complex system in unpredictable ways (DECC 2012a).

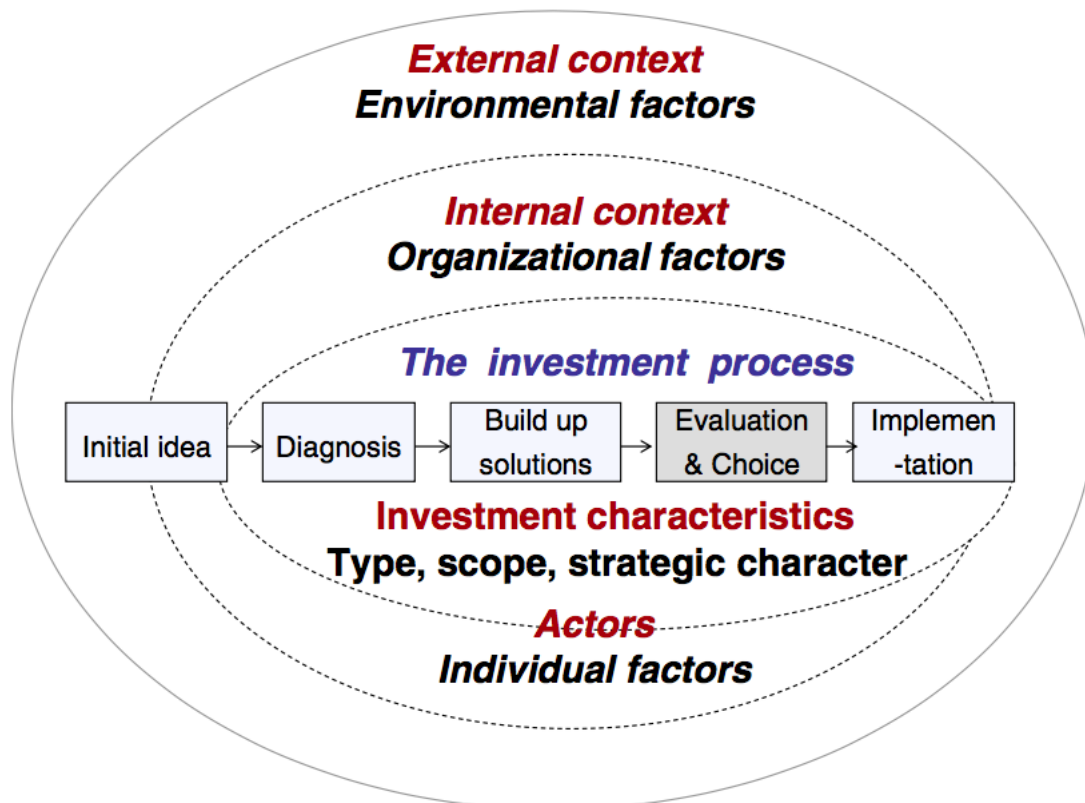
This approach is useful because it explains how energy efficiency is seen as part of the investment decision-making process (Cooremans 2011) and compared to other investment opportunities. For energy intensive companies energy is highly salient because it makes up a large proportion of their costs. But for other organisations, energy is a marginal, invisible non-core issue delegated down the corporate hierarchy to operational teams such as facilities or estate management.

But the evidence was clear that companies invest in energy efficiency despite all the barriers working against it. For example, utility companies were found to be more likely to install efficient lighting (DeCanio & Watkins 2008) and lease of efficient offices (Eicholtz *et al* 2010). Clearly something was happening in these companies that was raising energy from its lowly operational status to something more strategic, attracting the attention of senior managers and the Finance Director. This propensity of an issue to be noticed and acted upon is called “salience” (DECC 2012a).

Cooremans (2012) showed how salience works as part of the investment decision-making process (Figure 1 below). Investments are not simple yes/no decisions but follow a more nuanced process with a beginning, middle and end. Issues first become salient during an early identification phase, possibly amplified by a sensitising event that distracts the organisation from its core business and allows it to focus on new opportunities (Dieperink *et al* 2004). This is followed by a diagnosis phase where options are assembled and analysed and solutions are proposed and costed.

It is only during the final evaluation phase where the surviving investment options are compared using economic analysis tools such as NPV or payback before being presented to the Board for final decisions to be made. This is the stage where most research and policy attention has focussed. However, by this point, energy efficiency may have been filtered out at an earlier stage in the process and would no longer be an option for policy to work on (DECC 2012a).

Figure 1 – a model of energy efficiency decision-making (from Cooremans 2012)



4.2 Salience drivers

For non-energy intensive organisations, the salience of energy use, and the socio-technical landscape in which it operates, is highly complex. But there is a predictable pattern (DECC 2012a), for example the salience of energy efficiency is generally stronger in larger companies compared to smaller ones, and in the public sector compared to the private sector. Research into these variations have revealed three factors, or drivers of salience:

- **External drivers** such as reputation are strongly influential in organisations that deal directly with the public (Janda 2002), or in sensitive fields like forestry, oil and gas (Prindle & Fontaine 2009, Cox 2012, Bansal & Roth 2000). Other drivers include the need to attract and retain high quality staff (Mori & Welch 2008).
- **Internal drivers** influence how energy efficiency is noticed, perceived and acted upon (Pellegrini-Masini & Leishman 2011). Salience is more common in organisations where there are strong connections between energy teams and senior managers (Prindle & Fontaine 2009, Martin *et al* 2012).

The way energy efficiency is presented internally, or “framed” is also important, both in the terminology used (DECC 2012a) and by emphasising the wider benefits of energy efficiency where carbon savings have little recognition (Bicknell & Skumatz 2004, Jennings & Skumatz 2006).

- **Sectoral drivers** such as business-to-business (b2b) networks and supply chain partners can be strongly influential because local agents are more familiar and are seen as more knowledgeable and trustworthy than government (Dieperink *et al* 2004, Paramonova, S. *et al* 2014).

Also some sectors are more “cohesive” than others, for example those well organised sector associations and trade bodies (Bansal & Roth 2000). Good practice can also spread very quickly through informal networks (Cordano *et al* 2010).

5 “What Works” in energy efficiency policy

The attraction of salience to policymakers is that it places energy behaviours – and our attempt to influence them – in a broader and more realistic organisational context so that there is a clearer connection between the policy intervention and the eventual effect on the organisation and the market it operates within. Two international examples show how this works in practice.

5.1 Commercial and public buildings

UK non-domestic building emissions are broadly the same in 2016 as they were in 2002 (CCC 2016a) despite domestic building regulations and the EU Energy Performance of Buildings Directive (EU 2010). A number of market studies have found a “circle of blame” operating (Figure 2 below), with developers reluctant to build because they see no demand, and tenants unable to choose because they see no supply (Carbon Trust 2009, LCIG 2012, Cohen & Bordass 2015).

Figure 2 – the “Circle of Blame” in the non-domestic buildings market (from Carbon Trust 2009)



Recent industry research (Bordass *et al* 2016) suggests that the underlying cause is the use of predicted rather than the actual energy performance, with the result that tenants cannot easily choose an efficient building or see what the actual benefits to them would be. Overall the system also perpetuates a “design for compliance” culture that over-engineers the building fabric, adding to developer’s costs.

There is growing evidence from Australia (Bordass & Cohen 2015) and the US (Eicholtz 2010) that performance-based approaches are delivering significant emission reductions. The Australian National Australian Built Environment Rating System (NABERS) appears to be particularly effective. NABERS provides in-use energy performance ratings based on a 5-star system, with 2.5 stars the median and 4.5 stars representing best practice.

NABERS began as a voluntary scheme in New South Wales in 1998. Initially it only covered the “base building”: the parts of the building controlled by the owner or developer. In 2004, Federal and State governments and the property investment industry began to specify minimum NABERS standards. Take-up accelerated significantly, allowing the Federal government to mandate the possession and disclosure of NABERS ratings for large buildings from 2011.

Official government and investment reports (Commonwealth of Australia 2016, IPD/Commonwealth of Australia 2013) are showing that NABERS has transformed the market. 80% of base buildings are now rated and the average has risen from 2.9 stars in 2000 to 4.2 in 2014. CO₂ emissions have been cut by 32% since 2005. Investors are reporting significant improvements in key asset value indicators such as lease length and vacancy rates. Average rents are 9% higher and operating costs 8% lower.

NABERS works because performance-based labels allows tenants to choose efficient buildings in response to salience drivers such as reputation. The demand created by tenants increases the asset value for developers, and a “virtuous circle” is set up with supply and demand feeding from each other.

In addition, NABERS is built on a number of crucial policy and market interventions that, over time, have maximised the effectiveness of the scheme:

- The scheme was voluntary with the industry closely involved in the development and roll-out to secure their support and to help to build capacity.
- Flexibility was built in from the start so that the scheme could learn from its mistakes, for example to identify and shake out glitches in the software and benchmarking tools.
- The 5-star system rewards success, which allowed “quick wins” to accumulate, reinforcing industry credibility and support and setting benchmarks for others to meet.
- This positive culture made it a lot easier for government to introduce procurement standards in 2004 and eventually to mandate NABERS in 2011.

Could a NABERS-style approach work in the UK? Two industry-led initiatives are attempting to find out. The “Soft Landings” approach (BSRIA 2014) is addressing the performance gap in general. The Better Buildings Partnership, a collaboration of the leading UK property owners, has commissioned a series of pilots to test how NABERS could be adapted to fit within the UK policy and market landscape. The findings of both initiatives will emerge in the next 18 months.

5.2 Industrial companies and SMEs

Industrial energy efficiency networks in Germany (Koewener *et al* 2011) and Sweden (Paramonova 2014) are designed to accelerate the take-up of energy management systems in industrial companies. They are distinctive because their management and delivery is highly devolved. Networks are managed by local agents, such as business groups, trade bodies and banks, with central government playing a back seat role.

The German programme began in 2009 and is run by LEEN GmbH, a subsidiary of the Fraunhofer Institute, the state innovation and research agency. 366 companies are involved, of which 30% were SMEs. Each network comprises 10-15 companies, with each paying 10% of network costs (typically €6000-8000 pa). SMEs receive 60-80% grants, but they are still expected to make a contribution. Capital investment finance is provided by a combination of local banks and loans from the state bank KfW.

Networks are commissioned by a local initiator who is responsible for developing and steering the network and for measuring and reporting the results. The initiator usually devolves the day-to-day operation to a network coordinator who recruits the participants and ties together the various elements and partners, and often also an engineering consultant who provides the energy audits and technical advice. The networks are implemented in three stages:

1. The acquisition phase, lasting 3-9 months, when the network initiator selects the network manager and the consultant recruits the member companies.
2. The review phase, lasting 5-10 months, where each company is audited and a target set for energy intensity and carbon savings each year.
3. The network phase, lasting 2-4 years with 2-4 meetings a year. The way the network meetings operate varies considerably, but typically there are five activities:
 - Capacity building – education and training from the network team and experts.
 - Tools and software – tailored support for auditing, monitoring and implementation.
 - Peer-to-Peer support – exchanging ideas and experiences with network members.
 - Reporting and feedback – case studies and problem solving sessions.
 - Mentoring – support from local businesses, often through the supply chain.

The pilot phase of the network ended in 2014, and results from the first 6 networks showed energy intensity savings of 2.2% pa, which was twice the national average for

industrial companies. This compares very favourably to the UK energy audit programme, with each company saving twice as much carbon (Carbon Trust 2013, Koewener 2014).

From a salience perspective, the value of the network approach is that they are exploiting the sectoral drivers operating between companies and local business groups (DECC 2012a). For example:

- The pooling of management resources, coupled to federal incentives and KfW loans, overcomes organisational and financial barriers and keeps costs under control.
- The involvement of local support groups means that the advice and support is seen as more trustworthy and relevant compared to utility or government programmes.
- The involvement of external managing agents (coordinator, consultant, engineer) forces the company to take the process seriously.
- The peer-pressure effect of a collective target has a significant reputational effect because it encourages member companies to try to outdo each other.

The key factors are considered to be focus and trust (Koewener 2011). Companies with many competing priorities and a profit line to worry about are unlikely to focus for too long on a distant, centrally managed programme, especially when the funding dries up. Advice given by such programmes, especially if they involve energy utilities, is not seen as authoritative or relevant, and may not be trusted.

But when local actors are involved the situation changes. SMEs will already be involved in and trust many of the support groups exploited by the networks. Sharing your problems with your peers is usually very effective. The involvement of larger companies as mentors adds credibility especially if the SME is in the supply chain. But often the most compelling reason for joining a network is because your competitors are in it.

6 A new policy approach

6.1 Policy design

Salience offers a useful conceptual model that is both well founded in the literature and describes the energy efficiency behaviours of real organisations. This is reinforced by practical experience that shows that successful energy efficiency policies, such as in Australia and Germany, exploit and enhance the specific salience drivers acting on a particular organisation or sector. In summary:

- Organisations rank investment opportunities according to their salience. For most, energy costs are not material so investing to save energy is not a strategic priority.
- Investment decisions are also not binary but more nuanced, with at least three distinct stages. Currently policy tends to only focus on the last, economic appraisal stage, which may be too late.
- As a result, energy efficiency policy should focus not on energy costs, but on salience drivers such as risk, value, reputation, productivity, competitiveness and peer reward.

- Salience is also strongly influenced by organisational factors such as management structure and expertise, availability of resources and capital and accounting issues.
- These internal and external salience drivers vary in complex ways both within and between organisations but patterns are emerging that are beginning to be mapped.
- These maps show how policy needs to differentiate both between organisations and sectors and to support investments as the move along the decision-making process.

From this we can start to sketch out some policy design principles:

- The government has a clear, active role by developing policies that influence salience drivers, and support and incentivise organisations as they respond.
- To do this, the government needs to understand how salience drivers vary between target organisations and sectors and to segment policies accordingly.
- In many cases, where the salience drivers are strong, the government's role can be limited, leaving the organisations themselves to do the "heavy lifting".
- The most effective policy will often be some degree of regulation, especially if it carefully planned and has the support of the industry.
- Piloting – "learning by doing" – is important to build capacity and market expertise in government and to build confidence in the target organisations and sectors.

6.2 Policy implementation

The lesson from the literature is that effective policy depends not just on which policies are used, but how they are used together (Sovacool 2009). But the case studies described above show that, from a salience and investment perspective, there are two distinct types of policy integration needed. The first is making policies work together. The second is managing policy interventions over time so that they adjust, and are eventually withdrawn, as the organisation responds and ultimately as the market transforms.

This is a significant challenge for government because it means balancing public accountability with market intervention. Most governments address this by working in partnership with a delivery agency. However the UK government withdrew programme funding from the Carbon Trust and Energy Saving Trust in 2012 mainly because it felt that both were outside its control (Mallaburn & Eyre 2014). The government will have to resolve this dilemma if it is to make significant progress.

The German government uses an approach that would merit further study for use in the UK. The Federal energy agency (DENA) does not directly provide advice, deliver or fund projects or provide finance. Instead DENA sets standards, provides information to businesses, supports KfW and passes on market expertise and intelligence to local traders and professionals. DENA's activities fall into four categories:

- Researching and developing information tools that the market cannot provide, such as benchmarking and best practice standards.

- Support for professionals and traders using evidence reviews, developing new techniques and researching new markets and professional practices.
- Increasing transparency and impact of energy standards and certification (e.g. kite marks, energy labels, performance standards).
- Developing and promoting model projects to demonstrate quality standards, implement best practice, and develop regional knowhow.

This hands-off implementation model is used by other governments in different forms, for example by the US State-level Energy Efficiency Portfolio Standard programmes (ACEEE 2015). It is an approach which merits further study to see if it could be adapted for use in the UK.

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References

- ACEEE 2015. The State Energy Efficiency Scorecard. American Council for an Energy Efficiency Economy.
- ADEME (2012). Energy efficiency policies in industry: lessons learned from the ODYSSEE-MURE project. Agence de L'Environnement et de la Matrisse de L'Energie (ADEME).
- Bansal, P. & Roth, K. (2000). Why companies go green: a model of ecological responsiveness. *Academy of Management Journal*, 43 (4), 717–736.
- Biggart, N. W. & Lutzenhiser, L. (2007). Economic sociology and the social problem of energy inefficiency. *The American Behavioural Scientist*, 50 (8), 1070–1087.
- Bordass, B., Cohen, R. & Bannister, P. (2016). UK Commitment Agreements: feasibility study final report. Better Buildings Partnership.
- Carbon Trust (2005). The UK Climate Change Programme: potential evolution for business and the public sector.
- Carbon Trust (2009). Building the future, today. Transforming the economic and carbon performance of the buildings we work in.
- Carbon Trust (2013). Energy savings from audits. Analysis of the Carbon Trust's close-out database.
- Cohen, R & Bordass, B. (2015). Mandating transparency about building energy performance in use. *Buildings Research and Information* 43 (4), 534-552.
- Committee on Climate Change (2016a). Meeting Carbon Budgets – 2016 progress Report to Parliament.
- Committee on Climate Change (2016b). The Fifth Carbon Budget – the next step to a low carbon economy.
- Commonwealth of Australia (2016). NABERS Annual Report 2014/15. Office of Environment and Heritage.
- Cooremans, C. (2007). Strategic fit of energy efficiency. European Council for an Energy Efficient Economy (ECEEE) Summer Study Proceedings 2007.
- Cooremans, C. (2011). Make it strategic! Financial investment logic is not enough. *Energy Efficiency*, 4 (4), 473–492.
- Cooremans, E. (2012). Investment in energy efficiency: do the characteristics of investments matter? *Energy Efficiency*, 5, 497-518.
- Cordano, M., Marshall, R. S. & Silverman, M. (2010). How do small and medium enterprises go “green”? A study of environmental management programs in the U.S. wine industry. *Journal of Business Ethics*, 92 (3). 463–478.
- Cox, A. et al (2012). The Impact of Workplace Initiatives on Low Carbon Behaviours. Scottish Government Social Research.
- DeCanio, S. J. (1998). The efficiency paradox: bureaucratic and organizational barriers to profitable energy-saving investments. *Energy Policy*, 26 (5), 441–454.
- DECC (2012a). Factors influencing energy behaviours and decision-making in the non-domestic sector.
- DECC (2012b). Exploring the design of policies to increase efficiency of electricity use within the industrial and commercial sectors.
- DECC (2015). CRC Energy Efficiency Scheme evaluation: final synthesis report.

DECC (2015). CRC Energy Efficiency Scheme evaluation.

Defra (2006). Appraisal of years 1-4 of the UK Emissions Trading Scheme.

DETR (2000). Climate Change: the UK Programme.

Dieperink, C., Brand, I. & Vermeulen, W. (2004). Diffusion of energy-saving innovations in industry and the built environment. *Energy Policy*, 32 (6), 773-784.

Eichholtz, P., Kok, N. & Quigley, J. (2010). Doing Well by Doing Good? Green Office Buildings. *The American Economic Review*, 100, 2492–2509.

Eichholtz, P., Kok, N. & Quigley, J. (2010). Doing Well by Doing Good? Green Office Buildings. *The American Economic Review*, 100: 2492–2509.

EU (2010). EU Directive 2010/31/EU on the energy performance of buildings.

EU (2012). EU Directive 2012/27/EU on energy efficiency.

Guy, S. (2006). Designing urban knowledge: competing perspectives on energy and buildings. *Environment and Planning C: Government & Policy*, 24 (5), 645–659.

Harmelink, M., Harmsen, R & Nilsson, L. (2008). From theory based policy evaluation to SMART policy design: lessons learned from 20 ex-post evaluations of energy efficiency instruments. *ECEEE Summer Study Proceedings 2007*.

Hayes, S., Baum, N. & Herndon, G. (2013). Energy efficiency: is the United States improving? American Council for an Energy Efficient Economy, Washington DC.

Hirst, E. & Brown, M. (1990). Closing the efficiency gap: barriers to the efficient use of energy. *Resources, Conservation and Recycling*, 3 (4) 267-281.

HM Treasury (2016). Reforming the business energy efficiency tax landscape: response to the consultation.

HM Treasury (2016). Reforming the business energy efficiency tax landscape: response to the consultation.

IEA (2016). Tracking Clean Energy Progress 2016.

IPD/Commonwealth of Australia (2013). NABERS Impact Analysis. September 2013. Department of Industry.

Jaffe, A. B. & Stavins, R. N. (1994). The energy efficiency gap: what does it mean? *Energy Policy* 22 (10) 804-810.

Janda, K., Payne, C., Kunkle, R. & Lutzenhiser, L. (2002). What organizations did (and didn't) do: three factors that shaped conservation responses to California's 2001 "crisis." *ACEEE Summer Study on Energy Efficiency in Buildings*, pp. 117–128.

Kahneman, D. & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47 (2) 263-292.

Karlsson, M. et al (2012). Impact and process evaluation of the Swedish national energy audit programme for small and medium-sized industries. *ECEEE Summer Study Proceedings 2012*.

Khanna, M., Koss, P., Jones, C. & Ervin, D. (2007). Motivations for Voluntary Environmental Management. *Policy Studies Journal*, 35 (4) 751–772.

Koewener, D., Jochem, I. & Mielicke, U. (2011). Energy efficiency networks for companies – concept, achievements and prospects. *ECEEE Summer Study Proceedings 2011*.

Koewener, D., Nabitz, L., Mielicke, U. & Idrissova, F. (2014). Learning energy efficiency networks for companies – saving potentials, realization and dissemination. *ECEEE Summer Study Proceedings 2014*.

- Larsen, A., Leth-Petersen, S., Kjaerbye, V. H. & Rieper, O. (2006). The Effect of Energy Audits in Danish Industry--Evaluation of a DSM Programme. *Energy Studies Review*, 14: 30–41.
- Low Carbon Innovation Group (2012). Technology Innovation Needs Assessment (TINA): non-domestic buildings summary report.
- Mallaburn, P. S. & Eyre, N. (2014). Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013. *Energy Efficiency* 7, 24-41.
- Martin, R., Muûls, M., De Preux, L. B. & Wagner, U. J. (2012). Anatomy of a paradox: Management practices, organizational structure and energy efficiency. *Journal of Environmental Economics and Management*, 63 (2). 208–223.
- Mazhar, M. U. et al (2014). The current state of strategic carbon management within the UK higher education sector: Leading the way forward? Proceedings of the 9th International Symposium on Sustainable Leadership, 3-6 June 2014, Salzburg, Austria.
- Mori, Y. & Welch, E. (2008). The ISO 14001 environmental management standard in Japan: results from a national survey of facilities in four industries. *Journal of Environmental Planning and Management*, 51: 421–445.
- National Audit Office (2007). The Carbon Trust: accelerating the move to a low carbon economy.
- Paramonova, S. *et al* (2014). Swedish energy networks among industrial SMEs. ECEEE Summer Study Proceedings 2014.
- Pellegrini-Masini, G. & Leishman, C. (2011). The role of corporate reputation and employees' values in the uptake of energy efficiency in office buildings. *Energy Policy*, 39 (9), 5409–5419.
- Prindle, W. & Fontaine, A. de. (2009). A Survey of Corporate Energy Efficiency Strategies. ACEEE Summer Study on Energy Efficiency in Industry (pp. 77–89).
- Rezessy, S. & Bertoldi, P. (2011). Voluntary Agreements in the Field of Energy Efficiency and Emission Reduction: Review and Analysis of Experiences in the European Union. *Energy Policy*, 39: 7121–7129.
- Russell, C. (2005). Energy management pathfinding: Understanding manufacturers' ability and desire to implement energy efficiency. *Strategic Planning for Energy and the Environment*, 25 (3), 20–54.
- Samuelson, W & Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty* 1, 7-59.
- Shove, E. (1998). Gaps, barriers and conceptual chasms: theories of technology transfer and energy in buildings. *Energy Policy* 26 (16) 1105-1112.
- Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 69 (1), 99-118.
- Sorrell, S. (2011). Barriers to industrial energy efficiency: a literature review. UNIDO Working Paper 10.
- Sovacool, B. (2009). The importance of comprehensiveness in renewable electricity and energy efficiency policy. *Energy Policy* 37, 1529-1541.
- Stenqvist, C. & Nilsson, L. J. (2012). Energy efficiency in energy-intensive industries-an evaluation of the Swedish voluntary agreement PFE. *Energy Efficiency*, 5: 225–241.
- UK Parliament (2016a). The Carbon Budget Order 2016.
- UK Parliament (2016b). Hansard 14 March 2016 Column 725.