

Industrial Energy Efficiency - Key Messages

Introduction

The world's energy systems are fundamentally inefficient – recent work suggests that only 11% of primary energy ends up in useful product, for example materials, heat, light and motion¹. Industry has a key role, not only to improve its own use of energy, but also deliver more efficient products and materials. The tendency has been to focus on de-carbonising energy supplies and CCS, due to climate concerns, whilst this report focuses intentionally on energy efficiency, not carbon efficiency. While it may appear that companies are economically rational, and hence that value adding actions to improve energy efficiency actions would already have been adopted; closer study reveals that this is often not the case.

Industry is responsible for 18% of final energy demand in the UK and about 32% of its total greenhouse gas emissions² and accounts for 22% of GDP, making the UK the 7th largest manufacturer in the world³. Since the oil shocks in the 1970's energy demand from industry has more than halved with a significant shift away from coal and oil to natural gas and electricity, the latter using about a third of the total UK generation (Figure ES1). Improvements in energy efficiency have delivered most of the energy savings. However, projections indicate that cutting carbon emissions from industry will be harder than in most other sectors leaving it as one of the biggest emitters in 2050.

Potential exists to increase energy efficiency across the whole of UK industry, delivering both cost savings to industry and a reduction in carbon emissions. Many of the energy efficiency technologies are already available and, unlike some other carbon reduction measures, can be implemented over the next 10-15 years, cost effectively. However, energy efficiency projects are not being implemented as fast as projected. Without energy efficiency measures industry will become increasingly dependent on a low carbon electricity infrastructure and on alternative carbon reduction measures such as biomass and CCS, which present uncertain costs and in the latter case reduce the efficient use of energy.

Energy efficiency is therefore important in determining the cost of achieving the UK's carbon targets. This report sets out what needs to be addressed to accelerate the deployment of energy efficiency projects and highlights the opportunities for a more system wide approach to efficiency to reduce energy demand.

¹ Cullen & Allwood 2010

² 2009 figures. Includes direct emissions and indirect emissions.

³ by nominal GDP, IMF 2010

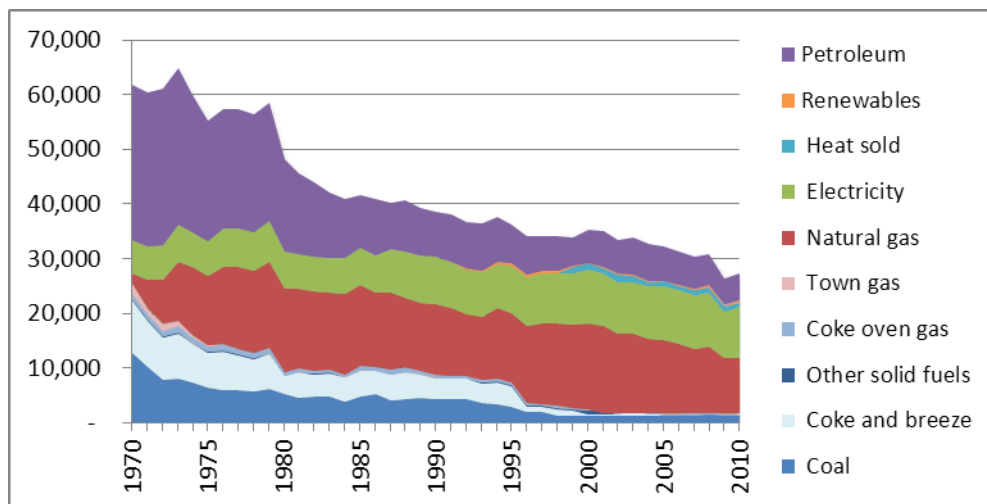


Figure ES1 Trend in UK Industrial Final Energy Consumption by Fuel 1970-2010 (Mtoe) (DUKES 2011)

Opportunities for industry

In 2010, industry consumed 27.5Mtoe of energy, of which 57% of demand came from five of the main energy intensive industries, iron and steel, chemicals, paper, metal products and food and drink. The remaining 43% was split across a diverse range of other industries including construction, plastics, extractive industries, textiles and furniture. The energy intensive users are generally more efficient and face a different set of challenges to the non-intensive users.

Within the two groups the level of energy efficiency is also affected by company size, with smaller enterprises tending to be less efficient primarily due to a lack of resources to address the issue. The options available within these various groups therefore differ.

Opportunities should not be restricted to what a company or sector can do, but should look at the wider energy system and how energy services are provided. For example, switching to decarbonised electricity may reduce carbon emissions but could be less energy efficient.

Energy intensive industries

Energy intensive industries⁴ in the UK have already made significant advances in improving energy efficiency and are generally above global averages for efficiency. Across the energy intensive industries sector in the UK it is estimated that energy efficiency could be improved, cost effectively, by between 10% and 20% over the next 20 years⁵, with some industries providing greater opportunities than others.

Some of this can be achieved by incremental improvements in efficiency by implementing plant upgrades, while in others the processes are nearing their theoretical maximum efficiency and will require a change in process to realise further gains. Assessing the potential can be difficult due to the commercial sensitivities on data reporting. However, analysis suggests the improvement in energy intensity has been slowing down over the last 20 years. The scale of investment means that

⁴ Refers to (with SIC code) Iron & Steel (27), Chemicals (24), Food & Drink (15,16), Paper & Printing (21, 22) and Metals (28, 29).

⁵ AEA 2010, Allwood 2011, Carbon Trust 2010

opportunities to replace or upgrade plant are limited by plant lifetimes and maintenance cycles. In the UK steel industry the blast furnaces are nearing replacement within the next 5 years.

Process heat accounts for about half of the 15.7Mtoe used by this group, of which 40% is high grade heat. Such energy service is hard to provide with decarbonised electricity, but some efficiency improvements could be made through the capture of 'waste' heat, such as from blast furnaces. The remaining 60% is low grade heat, used mainly in the chemical, paper and food industries, where wider deployment of CHP will provide efficiency improvements. The utilisation of waste heat could offer further efficiencies, with use either within the sector or more widely in the energy system to other businesses or for domestic use.

Energy efficiencies can be achieved through recycling, although there can be constraints on how recycled products can be used. Substantial energy savings opportunities have also been identified from product design and downstream material management.

Non-intensive energy using industries

Overall the non-intensive sectors are less efficient than the energy intensive users, driven less by energy costs, which are a much smaller proportion of overall costs. Assessing the potential for energy efficiency improvements is difficult due to the diversity of industries and applications. However, they share several common activities, such as heating, cooling and compression, often using common technologies particularly electric motors. Opportunities also exist for technologies to be transferred from one industry to another.

Estimates for the potential savings are harder to make because of the diverse nature and limited data. However, it is estimated that cost effective savings of 10-20% could be made over the next 10-15 years⁶. However, few projects are implemented even after the benefits have been identified by an energy audit.

Apart from the capital required for projects and any supporting R&D, a major barrier is the high cost of information about projects. Not directly exposed to the carbon price through the EU ETS, energy costs for these companies are rising for example related to the Carbon Reduction Commitment. However, several of the companies spoken to did not see this as significant enough to stimulate energy efficiency investments.

Barriers to deployment

Understanding the barriers to deployment is vital if energy efficiency is to have a significant impact and avoid the need for other more costly measures being required to manage energy supply and reduce emissions.

Projects fail to be implemented for several reasons, even when they give a good return on investment and a short payback period. This is primarily due to perceived risks, a lack of information and limited resource to implement. Furthermore few companies regard it as a strategic issue, with growth projects receiving more attention than cost-saving measures.

⁶ Carbon Trust 2010

Perceived risk

One of the most significant barriers is perceived technical and operational risk. Energy efficiency projects can deliver predictable returns with good confidence, thereby giving good returns with none of the risk of market volatility found in growth projects. An additional benefit is to reduce the company's exposure to future energy price changes, a factor that continues beyond the project payback period but is rarely recognised by external investors. Such benefits reduce the risk of investment and would expect to be recognised by applying a lower discount rate or longer payback period. However, this is rarely done as the benefits are often not recognised by companies in their financial assessments. This can be due to a lack of experience and knowledge of energy efficient technologies and a greater emphasis on short-term returns.

Information needs

Information is required at a number of levels: Awareness of overall potential for energy savings, identifying available technologies and providing more specific details about how a technology performs. Energy intensive and larger companies tend to have a better awareness of the overall potential than smaller companies, although both are dependent on detailed information about performance of technologies, particularly new ones.

Addressing the need for information is important to give confidence to energy efficiency investment. Companies can address this by building it into the management structure by appointing an energy manager. Larger companies tend to give it more resource, but the energy manager does not always have a sufficiently senior profile and the strategic benefits of projects are often overlooked. For smaller companies, where energy is less important and receives less attention, the cost of gathering the information outweighs the benefits.

In addition, a lack of monitoring of energy use can make it difficult to demonstrate the specific impact of the project particularly where the technology delivers additional benefits. This can add to scepticism about future proposals.

Pilot and demonstration projects, such as those delivered by the Carbon Trust's Industrial Efficiency Accelerator, are necessary to provide detailed data about the performance of new technologies, so as to help de-risk investments. Collaboration within sectors, such as through trade associations, can also provide information, help disseminate ideas and develop markets for new technology solutions.

Strategic role

Some projects are pushed through to meet regulatory requirements and mandatory performance standards can provide a valuable role to improve efficiency. Other projects are agreed as a strategic decision to give a company competitive advantage and to support the corporate image. Some companies show commitment by setting internal targets, which helps raise its profile and focus attention across the company. This can be further enhanced by providing ring-fenced capital removing the need to compete with other projects. International comparisons indicate that Japanese and German companies recognise this strategic benefit much more than UK companies.

Policy intervention

Addressing the barriers and incentivising energy efficient investments requires both policy intervention and action within companies, particularly in the evaluation of projects. A package of policy measures is required to incentivise and de-risk investment and to address information needs (see Figure ES2). Interventions need to respond to the needs of the different groups within industry, recognising the various needs of large and small companies within the energy intensive and non-intensive groups. A stable and robust, long-term price signal can help justify investments, but this needs to be supported by regulatory measures and technology demonstration.

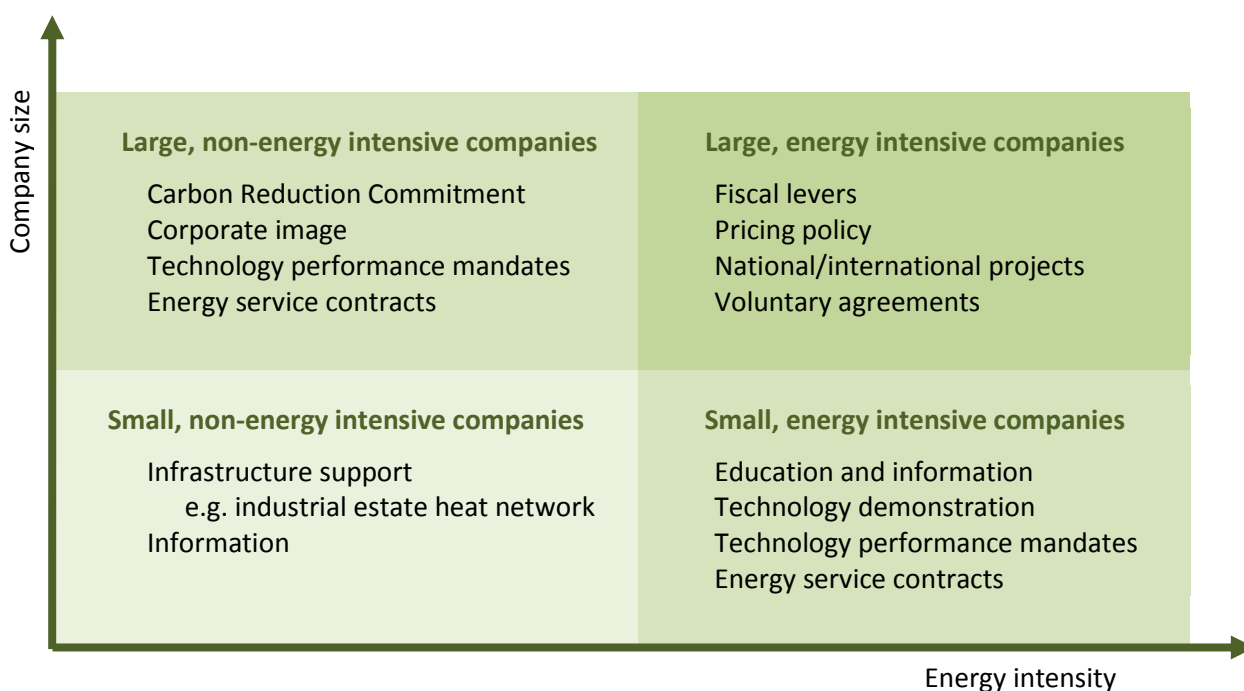


Figure ES2: Measures to stimulate energy efficiency depend on company size and energy intensity.

At the EU level the EU ETS raises the carbon cost for energy intensive users, but allows some flexibility for investments. The draft EU Directive on Energy Efficiency proposes to make the 20% reduction in energy demand across the EU mandatory. While specific targets are not set for industry, recommendations are proposed around the utilisation of waste heat and provisions to address information needs. It also proposes putting the onus on the energy suppliers to reduce the energy they supply by 1.5% per year to 2020, which would mean working with users to increase their efficiency. Additional EU Directives set mandates for the performance standards of specific technologies, such as electric motors. Such measures will be effective across all sectors.

Intensive energy users are already highly efficient as part of reducing costs. Further improvements, either incremental or from large-scale upgrading, will continue to require R&D to develop and demonstrate the technologies and processes in order to inform project decisions. Most will be industry driven, but some of the more substantial developments will require some intervention to de-risk the R&D investment. Investment decisions require a stable, long-term policy environment to reduce investment risk with a firm commitment to energy efficiency. Additional provisions are needed to shelter companies from rising costs to reduce the risks of carbon leakage.

For the less energy intensive sectors, addressing information needs is an important part of a package of measures to stimulate investment in energy efficiency. Current measures are focussed on indirectly increasing the cost of energy through the carbon price. While this can influence investments, the barriers are more related to availability of capital and lack of prioritisation; larger companies are often already using much higher costs for energy and carbon in their decision making. The Carbon Reduction Commitment may be helpful in raising awareness through its requirement to report energy use, but the financial incentive may be insufficient to stimulate significant activity.

Energy service contracts can also shift the onus for improving efficiency to equipment and energy suppliers, such as for refrigeration.

Smaller, non-energy intensive companies require a different approach. Information may help, but for many they have limited resources to invest in energy efficiency. Support could be provided at an industrial estate level, for example through the provision of a heat network or centralised CHP.

Broader approach to efficiency

The current approach for delivering carbon emission reductions from industry by 2050 faces a number of uncertainties. Even with accelerated improvement in energy efficiency the sector will be reliant on decarbonised energy supplies. However, there are risks and uncertainties over the cost of these technologies and it may be some years before they are understood and can be deployed. A wider system level approach is needed, focussed on the downstream management of products and material in the economy. This will deliver greater energy efficiency and reduce dependence on potentially less efficient technologies.

Based on managing the embedded energy, this approach goes beyond recycling to look for more efficient alternatives to simply recovering materials and the returning them for energy intensive recycling. It includes light-weighting materials, reusing components and extending product lifespan, such as by replacing only the necessary components. The impact of this will be to reduce the load on the most energy intensive parts of the supply chain, which is usually primary production. Emphasis will be put on design and reprocessing techniques, with new business models being needed, as the value moves down the product chain away from primary production.

Delivering energy savings from material management will require aligning policies and incentives that are not normally associated with the energy system. Waste management policies, product standards and building regulations will need to be assessed to incentivise material management. Account will be needed of embedded energy in materials and products, raising awareness to consumers, as is increasingly seen in the building industry. This is not only in imported products and materials, but also where energy savings and carbon reductions can be achieved by developing product management and material efficiency measures. Consideration is also needed on international agreements for embedded emissions, as a more efficient low carbon industry or an increase in recycling in the UK could lead to an increase in industrial activity and more energy use, while replacing imported products (and carbon).

Consideration should also be given to the impact that increased energy and material efficiency has on the upstream demand for resources, such as water and minerals. Scarce resources could present

constraints on how the energy system develops. Improvements in energy and material efficiency could therefore prove beneficial.

R&D needs

Modelling is needed to understand the different outcomes for the energy system in meeting long term climate change targets, between policies that are aimed at reducing carbon emissions and those that are specifically targeted at increasing efficiency and reducing energy demand. However, a lack of accurate data of how efficient processes are in the UK makes it difficult to model the impact that energy efficiency measures will have on reducing energy demand.

The majority of losses in energy systems take the form of waste heat. The technologies associated with heat networks are fairly mature and the challenges associated with deployment relate to legacy infrastructure and structural barriers. However technologies associated with the efficient conversion of low grade heat to electricity are in their infancy and warrant more research.

With increasing recognition of the potential to reduce energy demand through product and material management, more detailed assessments are needed of product recovery, reuse and transformation opportunities, together with the policies and business models needed to capture these.

Much of the R&D needed to implement energy efficiency technologies will be industry led. However, part funding for projects with public money can de-risk investments, incentivise companies to invest in developing new technologies.

Key Messages and Recommendations

Improving energy efficiency is not only good for industry but also addressing climate change targets. Despite delivering emission reductions at low cost, energy efficiency projects are less tractable than other low-carbon options. Greater emphasis is needed on energy efficiency not only in industry but how it interacts with the wider energy system and economy. To deliver this requires:

- 1 Levelling the playing field between low carbon energy supply and energy use by introducing a package of policy measures that incentivise energy efficiency projects. These should take account of the differing needs of industry sectors factoring in size and energy intensity.
- 2 The UK working with manufacturing industries to reduce the risks of manufacturing off-shoring and increasing global emissions through carbon leakage.
- 3 Encouraging companies to share and adopt best practice, through measures such as:
 - a Setting Board level targets.
 - b Appointing a senior manager with accountability for energy efficiency.
 - c Changing the hurdle rate of return for energy efficiency projects to fully account for the benefits from energy efficiency projects.
 - d Monitoring energy use to ensure benefits of energy efficiency projects are recognised.
- 4 Further research is required to understand how energy moves through the entire system and where losses occur, particularly heat and energy embodied in materials.