Mark Fessey
Energy Resources
Advisor: Andrew Lovett
March 2005

Projecting Domestic Energy Use into the Future

Putting changes in the demand for energy services and in energy efficiency together, total domestic energy use could either rise or fall in the future. According to government projections domestic energy demand by 2050 could increase slightly, stay at a similar level or decrease by as much as 30 – 40%, depending on what future scenario is used. There is certainly less tendency for growth than in the services or transport sectors. The projected future energy demand falls only in scenarios where policy and social changes give substantial weight to environmental goals. Predictions for future domestic energy demand from my own analysis of demand for energy services and improvements in efficiency can be seen in Chart 1.

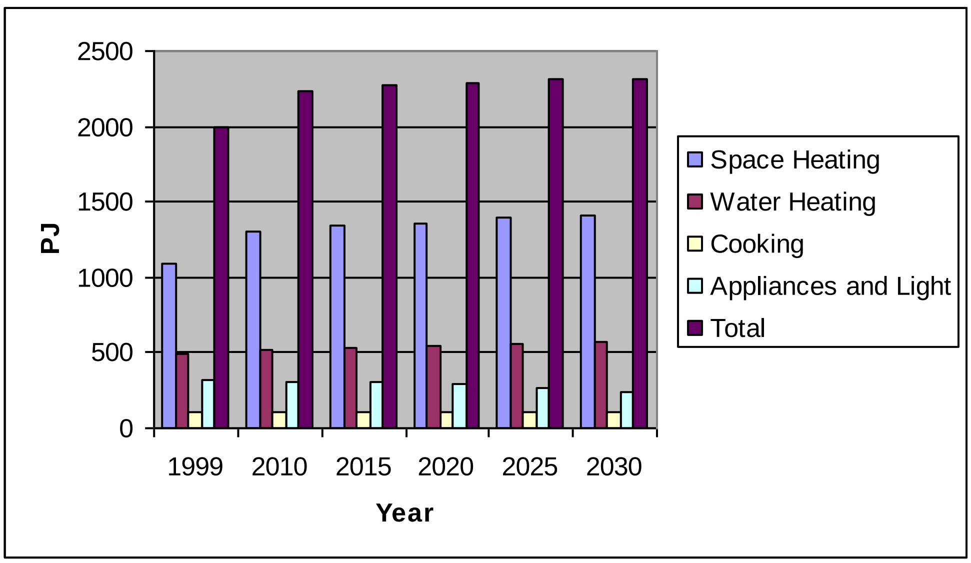

Chart 1. Predicted Domestic Energy Consumption

85% of domestic energy use is for space and water heating and I have made some confident assumptions about future demand for these energy services, mainly regarding thermal comfort levels reaching saturation in the near future and also an increase in the housing stock. There is little that can be done in the future to influence the demand for these energy services and also the domestic demand for electrical appliances and consumer goods. However, with regard energy efficiency in the domestic sector the future could take several different paths depending on the future economic and policy situation. This is what I will be focussing on in this report.

Energy Efficiency

In the past two decades domestic energy efficiency has improved at about 1% pa, which is better than in any other sector. Energy efficiency will certainly continue to improve as it has done historically. The rate of improvement will depend on:

- Innovation
- Reaction to energy prices
- Policy interventions to improve efficiency

Britain is committed to a low carbon future, with a goal of cutting CO2 emissions 60% by 2050, and efficiency improvements are seen as vital to achieving these goals. The Energy Review (2002) found that energy efficiency improvements can assist the economy as well as achieve social, such as energy security, and environmental goals, all of which are major goals of sustainable development.

There is huge technical potential for improved energy efficiency. However, only the proportion of this potential that can show itself to yield energy savings which more than pay for the extra investment cost will have any chance of implementation.

In order to assess which energy saving technologies represent economically efficient options it is useful to compare the cost per tonne of carbon saved. Future changes are difficult to predict, but what is certain is that relative merits of the different technologies change over time, with costs falling with technological progress and market growth. Any analysis of this type will use 2 broad approaches:

1. Engineers must place technologies on a spectrum from infant, through emerging to mature. The main problem of looking at the future technologies in this way is that is that these engineering assessments rely on expert judgements, which may differ.

2. Historic relationships between cost reductions and cumulative production can be extrapolated. These ‘learning curves’ have been seen across a wide range of technologies. Although there are many drivers of cost reduction, the ‘learning curve’ shows that by far most cost reduction comes through production and market experience. The curve tends to be steeper in the early stages of technology development. More established products with a large market share will find the potential for cost reductions more difficult than newly emerged technologies. A further important thing to remember is that the market for some of these technologies will be global, and so the learning curve will be as a result of global production levels.

There are many energy technologies that, after analysis of their economic potential, may be employed in the future, such as renewable energy, carbon sequestration and fuel switching in transport. Potential improvements in end use energy efficiency represent only one area of energy technology. For all sectors of end use, studies have shown that there is a very significant economic potential for energy efficiency technologies to be employed. This potential energy saving amounts to approximately 30% of final energy demand, and a potential annual savings to the consumer of £12 billion. Domestic energy savings could be as much as 37%, which is a greater percentage saving than any other sector (although transport could potentially see a greater absolute saving as it currently has a higher energy demand).

Just through engineering assessments, and without the need to employ the use of learning curves, studies such as the one above show with a high degree of confidence that end use efficiency technologies, such as for domestic, will decrease in cost through to at least 2020. The situation by 2050 is predicted to be similar, but with cost effectiveness more variable, as for individual technologies the lowest cost potential will progressively be deployed.

These sort of bottom-up assessments of suggest that there is substantial scope for greater energy efficiency, and that a great deal is cost effective in its own right (before any thought is given to adding the value of emissions saved). There are two competing explanations as to why this potential is not being taken up:

1. That a variety of market failures or barriers mean that when making investment decisions economic agents (households in the case of domestic) are not operating rationally. Economic agents may be acting with imperfect knowledge, for example, they may be better informed on the capital costs of the technology than in the running costs. Also, tenancy agreements provide no incentive for the land lord, and very little incentive for the tenants, to invest in domestic energy efficient technology. The fact that the price of energy does not take into account the costs to the environment, i.e. externalities, can also be considered a market failure. Increased prices by means of a tax could correct this. Increased price of energy could also increase the demand for information.

2. That these economic agents are making entirely rational decisions, and the reason that they choose not to invest in energy efficiency is because there are hidden costs in doing so that have not been picked up by the bottom up assessments as described above. Some of these unforeseen costs may be to GDP, for example the opportunity cost of the time taken to acquire information, though this is less an issue to domestic households than it is to business. Other hidden costs may be to welfare, such as the inconvenience of having builders in you home.

The extent to which either of these options is true is import as they have very different implications for policy. If the first view is accepted then policy interventions may be necessary to correct the market failures. If these interventions in the market, do not correct the problem of a lack of energy efficiency uptake by the consumers then it can be argued that government should act to regulate energy efficiency, and so enforce the uptake of technologies, which after all are cost effective. Policy interventions can also tackle to some degree the problem of hidden costs, for example if consumers are directed to investments that represent best practice.

In reality both of views will have some validity. The evidence suggests that the reasons for the non-uptake of energy efficient technologies may be more to do with 1 than 2. Many of the hidden costs appear relatively insignificant when compared to the potential financial returns of energy efficiency investments. A study by the National Audit Office (1998, cited in the Energy Review 2002) found domestic energy efficiency improvements to be cost-effective even taking into account some possible "hidden" costs such as implementation and management costs. Even if hidden costs do exist then studies show that the costs of carbon reduction by energy efficiency measures are still lower than the costs of saving carbon at the supply end.

As shown above there is a great deal of technological potential that is cost effective and will become more so in the future. Furthermore, this potential is not fixed. In the past 30 years innovation has increased the potential at about the same rate that cost effective measures have been adopted. As a result the 'current cost effective potential' has remained largely unchanged. As we move further into a knowledge economy the pace of innovation may increase to a rate faster than experienced over the past 30 years, and as a result the cost effective potential may actually increase (assuming the rate of uptake of cost effective measures remains the same). In the domestic sector the slow turnover of buildings will mean that there is a relatively slow uptake of cost effective energy efficiency measures, and as a result the cost effective potential should grow larger in the future. Most of the future innovations in energy efficiency technology in the domestic end-use sector, will rely on improvements in materials technology, design and control. These will include new construction techniques, micro-CHP, heat pumps, super-insulating windows, high efficiency appliances, smart systems for lighting, as well as design improvements to make better use of passive solar energy.

There may also be social and institutional changes in the future that affect the uptake of energy efficiency measures. The current regulatory arrangements by which energy is supplied discourage potentially beneficial long-term contracts between energy suppliers and domestic customers. This current inertia can be seen as a market failure that prevents the customer from making the most rational economic decision. In the future liberalised energy markets may be a driver of innovation. The potential for further cutting supply costs will diminish (especially if the government intervenes to internalise environmental externalities), and so suppliers may compete, not on who can supply energy at the lowest price, but on commercial innovations and who can supply the wider package of products. The result may be that commercial energy suppliers see the benefits in technological energy saving innovations and so actively encourage it. For example there may be important potential linkages between micro CHP, new metering technology and energy services marketing. Micro-CHP, which involves a gas powered household CHP unit, is an example of an energy saving technology, which is close to reaching technological maturity, and due to economic and environmental drivers, may become widespread in the future. It may appear cost effective, but like with many technologies it will find it hard to break into the current energy market, which can be described as an uneven playing field. This is where government agencies may need to intervene with economic instruments to tackle market failures and also policies to reduce hidden costs, although in a more liberalised energy market as described above this would not be necessary.

There are inherent uncertainties surrounding future innovation and increased cost effectiveness of technology. In these circumstances it is vital that government policy does not attempt to 'pick winners', but instead creates a framework where the market provides the appropriate incentives for innovation and development, and so allocates resources efficiently. The use of price signals must always remain of foremost importance (and they should be improved to reflect cost of carbon), but other government policy action such as information campaigns, target setting and minimum standards will also be necessary.

Bibliography

- **Performance and Innovation Unit (PIU), 2002. The Energy Review**
- **Energy Efficiency Office, 1990. Energy Use and Energy Efficiency in the UK Domestic Sector up to the year 2000.**
- **Future CHP Technology and Economic Review, 2003. www.microchap.info**
- **DTI, 2002. Energy Consumption in the UK**
- **DTI.gov.uk**
- **DTI, 2003. Our Energy- Creating a Low Carbon Future.**