Reaching our potential: a framework for making the most of microgeneration technologies

Victoria Willis
Energy Saving Trust
London
United Kingdom
victoria.willis@est.org.uk

Keywords
microgeneration, renewables, strategy, technology, policy, modelling, consumer behaviour

Abstract
The 'Potential for Microgeneration Study and Analysis' examines the uptake of heat and electricity microgeneration technologies to 2050. The study was undertaken by the Energy Saving Trust to inform the Government's grant programme (Low Carbon Buildings Programme)[1] and the Microgeneration Strategy (Department for Trade and Industry (DTI, 2005) for the UK Government. This paper examines the results of the modelling and makes policy recommendations to reach ambitious carbon reduction targets for 2050.

Microgeneration is the production of heat and/or electricity on a small-scale from a low carbon source and includes both renewable and energy efficiency technologies. The modelling shows that microgeneration has the potential to deliver between 30 to 40 % of the UK's electricity needs with microCHP (fuel cell and Stirling engines) leading the way in the early years, followed by microwind and solar PV in the longer term.

The model uses learning curves, which determine the rate of cost reductions of technologies, as well as user willingness to pay, building on experience from established energy efficiency technologies.

Recent consumer research on attitudes towards microgeneration technologies shows that more than half of the people in the UK would like to generate their own energy; it is critical that consumers embrace these technologies in order to reach carbon reduction targets.

Policy needs to provide sufficient support and a more favourable market framework to deliver the potential offered by microgeneration. Financial support in the early stages; building regulations (once measures are cost-effective); and ensuring a fair price for electricity exports are likely to be critical to their success.

Introduction
Microgeneration is defined as any technology, connected to the distribution network (if electric) and with a capacity below 50-100 kW. Most domestic installations will be below 3 kWe, though thermal systems could be larger. These technologies are vital to the future security of energy supply in the UK and, after energy efficiency measures have reduced demand, is considered the only realistic option for cutting CO_2 emissions from *mass market* energy generation (DTI, 2005). Microgeneration can also help diversify supply, reduce wasted energy from transmission and distribution losses and help tackle fuel poverty in hard to treat and off gas network properties.

The report 'Potential for microgeneration study and analysis'(Energy Saving Trust *et al*, 2005) concluded that microgeneration has the potential:

- to deliver between 30 to 40 % of the UK's electricity needs with microCHP (fuel cell and Stirling engine) leading the way, followed by microwind and solar PV by 2050; and
- to reduce domestic sector CO_2 emissions by 15 %, with a significant contribution from fuel cell CHP and microwind by 2050.

1. See www.lowcarbonbuildings.org.uk

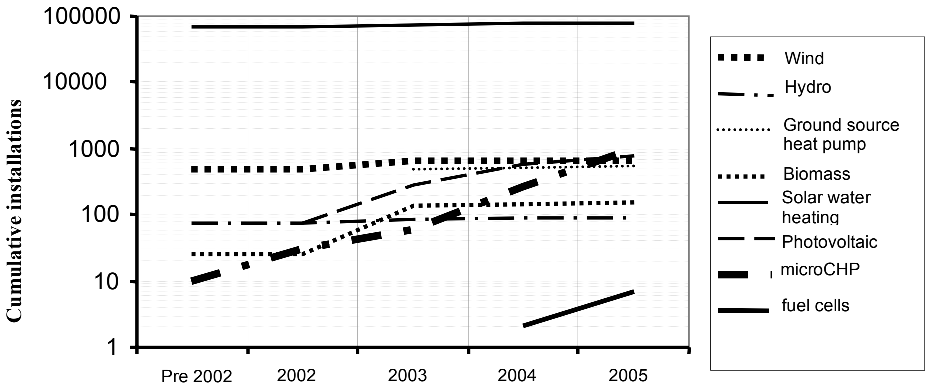

Figure 1. Cumulative installations of technologies in the UK, 2002-5. Graph adapted from (Energy Saving Trust, 2005)

The report concludes that many of the technologies needed to achieve this will be cost effective before 2020. It also concluded that substantial network reinforcement is unlikely to be required up to an installed capacity of approximately 500 W/household on a typical piece of network; it should not be a significant constraint on the timescales for mass rollout.

Recent consumer research conducted by the Energy Saving Trust on attitudes towards microgeneration technologies also shows that more than half of the people in the UK would like to generate their own energy (Allegra, 2006).

UK policy needs to provide sufficient support and a more favourable market framework to deliver the potential offered by microgeneration. The Renewables Obligation[2] (RO) is already delivering substantial growth in large scale renewable generation capacity. However, the RO does nothing to encourage renewable heat and provides very limited support in practice to renewable microgeneration technologies.

The 'Potential for Microgeneration' report showed that the financial support in early markets, building regulation requirements for microgeneration and a market that ensures a fair price for electricity exports are likely to be critical to the success of these technologies. Financial support options discussed here include capital grants, the Renewables Obligation, the inclusion of microgeneration technologies under the Energy Efficiency Commitment[3] (EEC) and a microgeneration commitment on energy suppliers. This paper also looks at the role of consumer awareness and provision of information and advice, as well as an accreditation and certification scheme, to instil confidence in consumers of these products.

A supportive policy framework will help unlock the potential of microgeneration. This paper explores what shape support for microgeneration should take in the UK, using lessons from other countries, as well as building on the results of the modelling undertaken in the production of the report 'Potential for Microgeneration'.

Current status of UK microgeneration

Underpinned by Government grant support, there are a growing number of microgeneration installations across the UK, with the largest markets being PV and solar water heating. Numbers of ground source heat pumps and wind turbines are also increasing rapidly, although from a much lower starting point. MicroCHP (both Stirling engines and fuel cells) is an important new entrant with significant technology investment, although the only units operating in a domestic setting are in trial installations; neither technologies are available commercially yet at this scale. There are currently around 100,000 installations across all the technologies, which is a small fraction of the market potential, and lower than many other European countries (European Solar Thermal Industry Federation, June 2006). The Environmental Change Institute (Environmental Change Institute, 2005), for example, estimates the potential at around 53.6 million installations by 2050 in the domestic sector alone, equating to 1.7 installations per dwelling.

Figure 1 illustrates the impact of the government grant schemes[4] and cost reductions in the last 5 years. Solar heating remains the largest market by a significant margin, but growth is modest. PV installations have grown rapidly since grant programmes were launched in the UK. Ground source heat pumps, biomass and wind technologies have also grown substantially, from a low base.

Barriers to greater uptake of microgeneration

The Energy Saving Trust carried out an industry survey, as part of the research for the production of the report 'Potential for Microgeneration', to identify the key barriers to the introduction of these technologies. The main factors were found to be:

- Costs – many technologies require grant support to achieve viable markets;

2. The Renewables Obligation creates an Obligation on electricity suppliers to source a rising percentage of electricity from renewable sources. The level of the Obligation rises annually from 6.7 % in 2006/7 to 15.4 % in 2015/16. Suppliers can meet their Obligation by presenting Renewable Obligation Certificates (ROCs) as evidence of renewable generation or by paying the 'buyout' price, or a combination of the two. The buyout price caps the costs of the system to suppliers and thus ultimately to electricity consumers.

3. The Energy Efficiency Commitment 2005-8 sets targets on suppliers to achieve improvements in energy efficiency by providing energy efficiency measures to households across Britain.

4. PV grant scheme followed by Clear skies and Scottish Householder and Communities Renewables Inititiave, and then Low Carbon Buildings Programme.

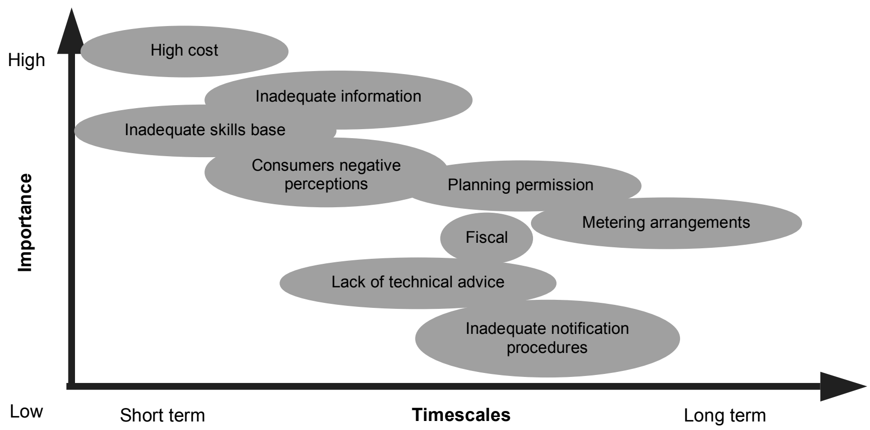

Figure 2. Barriers: importance plotted against timescale

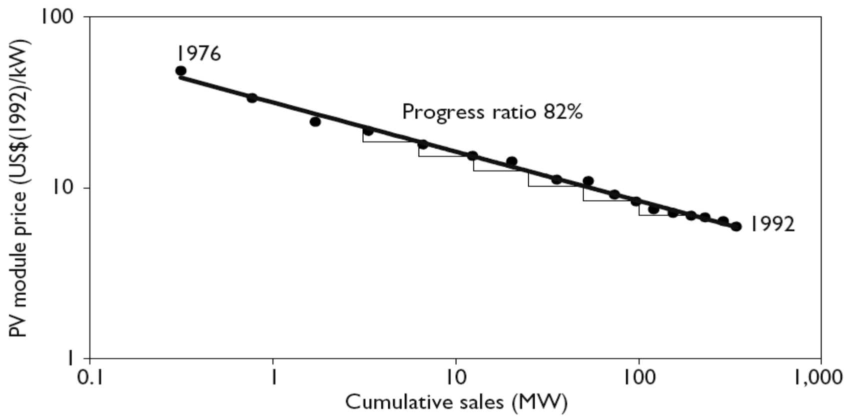

Figure 3: Experience curve for PV (IEA, 2000)

- Regulatory issues - planning, the value of exported electricity and lack of long term incentives for renewable heat; and
- Lack of awareness, independent information and advice.

The graph below summarises the results of the consultation by plotting importance of each issues versus the timescale for action.

The model

For the report 'Potential for Microgeneration', a model was constructed to allow analysis of the potential for different microgeneration technologies under a number of policy intervention scenarios.

The aim of the model was to look at the potential contribution that microgeneration could make to energy needs for the UK. It is not intended to be an accurate prediction of the future, more a tool to help analyse the likely impact of various policy measures on the markets for each technology.

COST CURVES

The model works by projecting future capital costs for each technology and then using these to calculate the future cost of energy, which is then compared to cost projections for grid gas and electricity.

The model uses learning rates, which relate costs to installed capacity. Historically, capital costs have been observed to decrease over time as a function of cumulative production levels, giving a learning rate. These learning rates are used to predict future equipment costs and can be used to provide effective energy costs to the consumer.

Learning curves demonstrate a linear proportionality between *log(cost)* and *log(cumulative capacity)*. This indirect relation can include the effects of economies of scale, technological improvements, and other cost cutting measures. A doubling of cumulative volume provides a cost reduction expressed as a percentage, known as the learning rate, with the inverse being the 'progress ratio'. *Figure 3* shows the example of PV, with a progress ratio of 82 %.

For each technology a similar curve has been constructed according to historical data.

Market growth is modelled, allowing for cost effectiveness, consumer behaviour and realistic annual growth rates of the industry and installer base. Total capacity of each technology, energy output and carbon savings are calculated as outputs of the model.

The cost and market uptake assessment calculations are repeated against various types of policy intervention including energy export (or feed-in) tariffs, capital subsidies, access

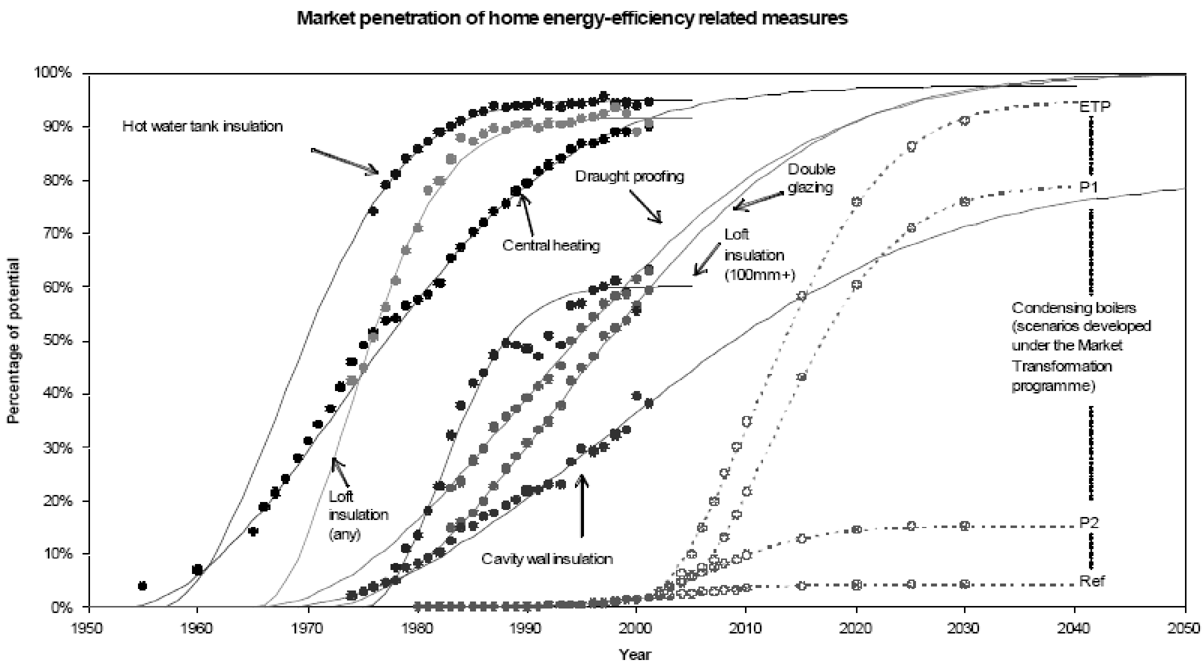

Figure 4. Market penetration of home energy-efficiency measures, showing existence of S curves. From (Energy Saving Trust, 2005)

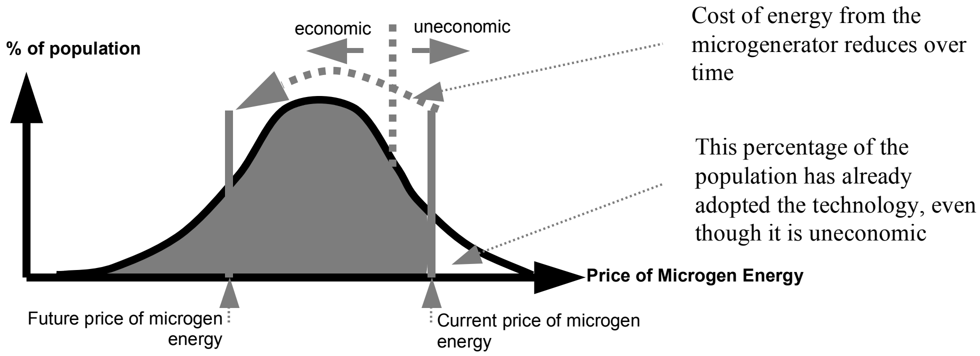

Figure 5. Willingness to pay

to Renewable Obligation Certificates (ROCs), support under the Energy Efficiency Commitment and regulatory intervention such as incorporation in building standards or planning conditions.

CONSUMER BEHAVIOUR

Historical evidence points to the existence of "S-shaped" curves of technology adoption. The figure below shows how various domestic energy efficiency and heating measures have been taken up in the UK. Certain measures can saturate the market within 20 years of introduction, others can take much longer (70 years for cavity wall insulation), but they generally follow the same pattern as seen in *Figure 4*.

The model works on the basis that traditional 'rational consumer' theory is inappropriate and accounts for the early adopters by incorporating a proportion of the population who invest before technologies are cost-effective, with the majority following as the measures become more cost-effective than the alternative (grid electricity and gas). The shapes of these curves are based on historical data of uptake of energy efficiency and microgeneration measures.

The approach used assumes that each consumer sets a cost-effectiveness test for the technology. If the technology passes the test, a purchase is made. For a typical commercial adopter, an investment would only occur if the technology is cost effective. However the population as a whole is more flexible with regards to investment decisions, and the 'willingness to pay' can vary through the population. Some of the population may be prepared to accept an on-cost (the reason may be an enthusiasm for the technology, or a higher than average valuation of the environmental benefit of the technology), while others may want an investment to be highly profitable before a purchase is made, see *Figure 5*. Although the 'irrational' decision makers may comprise a small percentage of the population, their role as innovators can be crucial in supporting a technology in its early phase, providing a bridge to commercialisation.

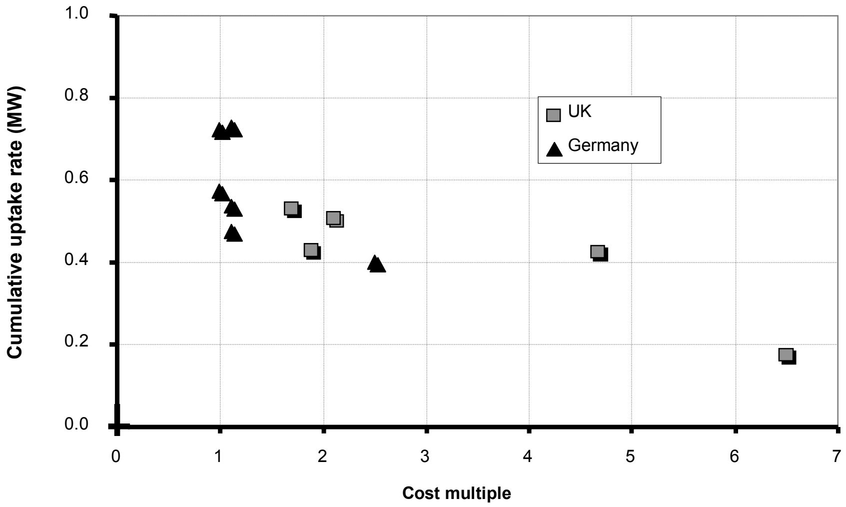

Figure 6. Cost multiple vs. uptake rates in UK and Germany

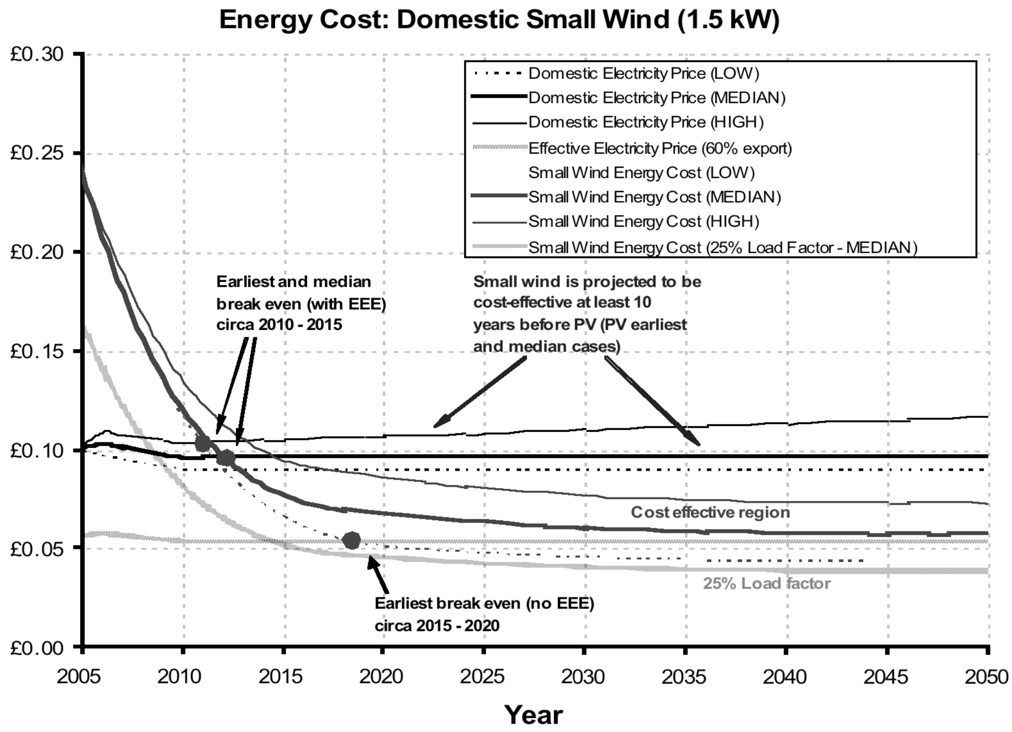

Figure 7. Energy cost curves for domestic wind

Empirical data suggests that this behaviour is indeed seen in reality. For example, Figure 6 shows growth rates in the UK and German PV markets over recent years. The graph clearly shows growth even when the technology is highly pre-commercial, but that uptake is higher once the cost of energy is economic.

The cost multiple in the diagram below is defined as the cost of energy from the technology under consideration divided by the cost of energy from the incumbent energy supply. If consumers were rational then purchase would only occur after the cost multiple reaches 1. In Germany, the feed-in tariff is designed to provide energy at a cost multiple close to 1.

RESULTS

For each technology analysed, a graph similar to *Figure 7* is produced. This one is for domestic small wind turbines and shows break-even points depending on the grid gas and electricity prices assumed, as well as high, median and low assumptions about the future cost of the technology. This graph shows that the earliest breakeven point for domestic small wind is around 2010 – 2015. Without energy export equivalance (achieving the same price for export as for import of electricity), this is delayed until circa 2015 – 2020. The graph below also superimposes two points from the PV analysis to compare the earliest and median cases of breakeven.

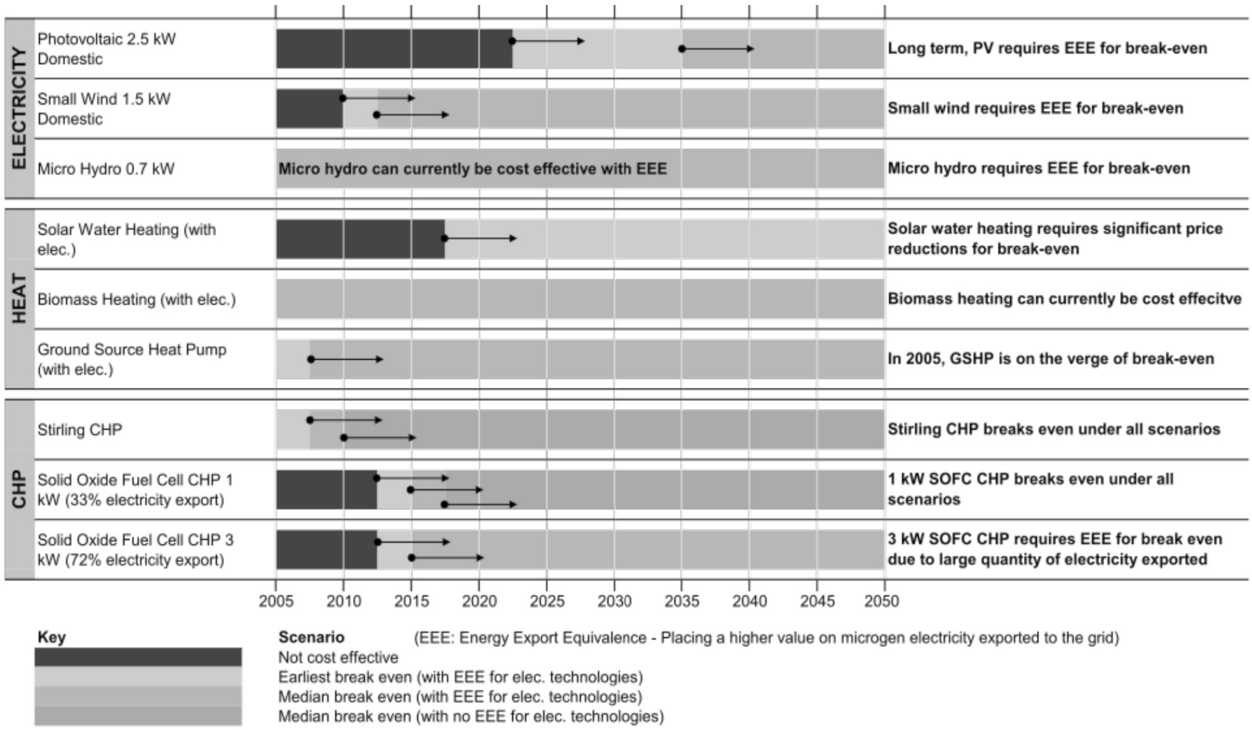

Figure 8. Breakeven points for technologies

These graphs can be produced for each scenario analysed – e.g. 25 % subsidy or various regulatory requirements.

This analysis is done for each technology and each scenario, resulting in a summary of breakeven points (*Figure 8*).

The model concludes that by 2020/2030 microgeneration will be able to make a significant contribution to energy needs. Solar water heating and photovoltaics are likely to be cost-effective on this timescale. By 2050 most technologies considered are likely to be cost effective. Microgeneration in households could contribute most heat demand and more than 100 % of electricity – i.e. they could be net exporters.

The results of the model show that for uptake in the medium term (up to 2020), regulation when technologies become cost-effective is the most effective policy intervention. For uptake in the longer term, capital grants at early stages in the market are effective, particularly for wind; along with regulation, particularly for micro-CHP options (Stirling and Fuel Cells). In the long term, valuing export energy more highly (energy export equivalence) is also vital to increased uptake.

SENSITIVITY ANALYSIS – CONSUMER BEHAVIOUR

The model looked at a variety of consumer attitudes to energy investments and simulated these to see what impact various consumer programmes would have. These are modelled simply by changing variables such as the consumer discount rate and the cost multiple at which a typical consumer will buy. Note that this is not to estimate exactly what these numbers should be (these numbers are extremely difficult to estimate), but to see what impact the change has on the uptake of microgeneration.

These scenarios had a profound effect on the model outputs, showing that national policy towards the 'soft barriers' (e.g. familiarity of technologies, attitude to the environment) are vital in order to reach the ambitions of achieving mass-markets in microgeneration. These will include, amongst other factors, education of consumers and suppliers about new products, as well as their pre-disposition to environmental issues.

Each consumer model affects the uptake of each technology in different ways. For capital-intensive technologies (specifically wind and PV), consumer attitude to capital has the greatest effect, as would be expected intuitively. Soft-loan schemes rapidly increase uptake, whilst high-interest loans and short loan repayment periods have a major adverse effect on these technologies.

The effect of capital-focused behaviour is less severe for technologies for which fuel (rather than initial capital investment) is a major component of annual costs (e.g. CHP, biomass, ground source heat pumps). Here the greatest effect is the consumer's attitude to the price of delivered energy. If consumers require a substantial price incentive to switch technologies, most microgeneration technologies struggle to achieve their maximum impact. In reality, the consumers' attitude to price can be affected by government actions, such as clarity regarding which technology is most appropriate for adoption.

What can be taken from this model is that consumers wary of high capital costs can be assisted through the provision of long term low cost loans. Alternatively, utilities or purpose-built energy service companies could bear the long term capital investment costs of the new technologies, as these private organisations can structure a business plan around access to loan finance.

It is clear is that consumers will require substantial education and awareness raising to ensure a shift to microgeneration technologies, even once cost equivalence is achieved. Economics only will not guarantee the future of these technologies.

CRITICISMS OF THE MODEL

The key drawback of this modelling approach is that it does not take capital cost into account. It therefore values two technologies equally, even if one has a capital cost twice as high as the other, as long as the payback times are the same. There is evidence (in current uptake figures) that consumers do not behave like this (solar water heating tends to be relatively popular (approx 90% of the market (Energy Saving Trust, 2005)) compared to the other technologies as it has a comparatively low capital cost, even if the longer term economics are less favourable). Also current planning policies in many local authorities in the UK are demanding a certain percentage of energy to be generated from renewables5. Since developers are not responsible for the ongoing fuel costs or the beneficiaries of the ongoing savings, this will generally be achieved by installing the technology with lower upfront capital cost.

A revised model currently being developed by the Energy Saving Trust tries to address this by taking the capital cost into account with a new approach which assesses consumer utility of each technology, partly based on a Department for Food and Rural Affairs sponsored study of consumer behaviour (Oxera, 2006). For the moment, it is likely that there is an under-estimate of some of the cheaper technologies such as solar water heating.

Policy Recommendations

The UK Department for Trade and Industry (DTI) has made it clear that they do not favour further grant support after the current support programmes finish in 2008. But the modelling work described above suggests that further financial support is essential in order to reach the potential for microgeneration and to access the kind of energy and carbon savings required to meet the 2050 target of 60 % saving. However, this support can take a form other than direct grant support, as outlined below. Indeed, anecdotal evidence exists for inflated prices for these technologies as result of grant aid.

The key policy interventions highlighted by the model are early market financial support, a higher price for electricity exports, and regulation to require use of cost effective technology. These are covered in turn below, along with a number of other supporting interventions to complete the policy framework.

FINANCIAL SUPPORT

Options considered under financial support are measures for a contribution to capital costs – continued grant support, adaptation of the existing Renewables Obligation or Energy Efficiency Commitment, or a new Microgeneration Obligation; and subsidy of generated or exported electricity. Additionally, various fiscal incentives could help the market develop.

All these measures need to be reviewed together to determine which options could be structured to deliver the most appropriate and cost effective mechanism(s) for supporting all forms of microgeneration, both electricity producing technologies and heat technologies. It is not suggested that all of these measures are required or even desirable, as confusion amongst consumers of available support must be avoided.

A key test for any financial support or regulatory scheme should be that it ensures that energy efficiency is supported on an equivalent basis, in order to ensure the most cost-effective and highest carbon saving measures are done first, and that microgeneration systems are correctly sized.

CAN THE RENEWABLES OBLIGATION PROVIDE ADEQUATE FINANCIAL SUPPORT?

The Department for Trade and Industry, the UK regulator (Ofgem) and other key stakeholders helped develop a scheme to enable microgenerators to claim Renewable Obligation Certificates (ROCs) on the basis of demand profiling determined from known data, rather than metered data (DTI, 2005b). So, the reward would be a fixed amount per kW of installed capacity, rather than based on actual generation (as for a feed-in tariff) or export (as for the current ROC system). In reality this is unlikely to be any less accurate than the current ROC system where one ROC is awarded for an amount anywhere between 500 and 1,499 kWh. A similar scheme is already in operation in Australia for deemed renewable energy certificates (Office of the Renewable Energy Regulator (Australia), 2005). This approach would reduce the administrative burden on small generators/suppliers and would at least simplify the process for claiming ROCs.

However, the Renewables Obligation was not designed with microgeneration in mind and an alternative solution is suggested here. The RO does not serve individuals well as they are not used to dealing with such mechanisms and administrative requirements, which they find time-consuming and confusing and therefore a barrier to accessing the value of ROCs. The administrative overhead and transaction costs simply outweigh the potential benefit in most cases. As a general rule, individual consumers do not register to claim ROCs. If they did, it would provide a value over the product's lifetime roughly equivalent to the current government grant scheme (the Low Carbon Buildings Programme). Furthermore, we do not believe that allowing agents to act on behalf of small generators will add significantly to the value since they will need to take some of the value to cover their operating costs. We also note that if this did prove successful then it would place a significant additional burden of administration to the regulator (Ofgem) as the number of installations grows, which would also destroy the overall value of the scheme.

A re-appraisal of the options for microgeneration support mechanisms is required as part of the current reform of the Renewables Obligation. Options could include introducing a supplier obligation for a guaranteed tariff or subsidy. Either of these could be done by keeping the RO framework, but allowing suppliers, rather than customers, to retain the value of the ROCs in order to fund the subsidy or minimum tariff. Alternatively, the RO could just be abandoned for microgeneration installations and replaced with either a subsidy or a fixed or minimum tariff.

---

5. There is now a move towards changing these requirements to demand a carbon saving, rather than requiring a certain percentage of renewable energy. The recent consultation – Planning Policy Statement: Planning and Climate Change, Communities and Local Government, December 2006 – endorsed this view.

A MICROGENERATION OBLIGATION : A SUPPLIER OBLIGATION FOR SUBSIDY OR FIXED/MINIMUM TARIFF

Suppliers could be allowed to claim the value of ROCs for all microgeneration amongst their customers. In return, the supplier should be obligated to ensure a certain capacity of microgeneration is built within their customer base – a Microgeneration Obligation – and/or to provide a supplier subsidy on the export tariff offered to consumers. This would give suppliers the incentive to encourage consumers to install systems but would remove the choice of consumers having direct access to ROCs. Whilst this may seem counter-intuitive with the aim of increasing demand for microgeneration, we believe that it would be administratively easier for both the consumer and Ofgem, and result in an increase in value to the consumer and increased growth in renewable microgeneration.

The targets could be reached through any means desired by each supplier, as they are for the Energy Efficiency Commitment for energy efficiency measures. They could, for example, give grants as a contribution to upfront capital costs, or develop an energy service approach that could include energy efficiency measures as well as microgeneration, or offer a higher tariff on exported electricity. The important principle is that it would allow suppliers to differentiate their offerings and operate in a competitive market. If the Obligation includes heat as well as electricity-producing technologies, this would also allow heat and electricity technologies to compete on a level playing field; a supplier could offer grants for heat technologies and an ongoing reward for electricity export or generation, for example. Alternatively, heat technologies could be kept within EEC (as they are currently) and electricity producing technologies within this new Microgeneration Obligation.

This solution does not necessarily require a regulated minimum price (a 'feed in tariff'), but, as a minimum, there should be a requirement to publish tariffs, in order to allow consumers to make an informed choice. At the moment, it is difficult for consumers to establish which companies offer export tariffs or what those tariffs are.

In addition, the Electricity Network Strategy Group[6] has made suggestions to increase the value of exported electricity through changes in the regulation and metering charges. These changes are likely to add around 1-2 p/kWh (1.5 – 4 EURO cents/kWh) to the value of exported electricity (compared with import price of around 10 p/kWh) (14 EURO cents) (DTI, 2007).

The value of ROCs for microgenerators would be worth an average of around 4 p per kWh (5.5 EURO cents/kWh), based on current ROC prices. This is unlikely to be high enough to encourage significant renewable generation (very little impact is seen when this option is modelled), so the target should be set at a level which requires suppliers to make a higher investment to bring the value to at or near the import price. Thus suppliers would receive some compensation for the Obligation through the ROCs, but would be required to make investment over and above that value.

This Obligation would replace the need for long-term capital grants and would provide a strong signal and a stable, long-term initiative to help industry invest in these technologies.

It is important to note that PV may require additional support over and above that which other technologies require. The modelling showed that PV will require financial support for the medium to long-term as it is currently an order of magnitude more expensive than the other technologies; But it has great potential and to reach the carbon reduction goals envisaged, it is a vital part of the mix, particularly with the Government's new commitment to build net zero-carbon homes by 2016 (Communities and Local Government, 2006). Therefore, an ongoing grant scheme, or a separate PV obligation within the overall microgeneration obligation, would be an important part of any financial support.

ENERGY EFFICIENCY COMMITMENT (EEC)

EEC is likely to become more important in the medium term as these technologies become more cost-effecitive, but in the short term higher levels of financial support are required. EEC works on the basis that energy efficiency measures compete on a level playing field and suppliers make decisions based on cost of delivery per tonne of carbon saved. Support under EEC should not be seen as an alternative to the provision of continued funding for those technologies that are not yet cost effective.

A Renewables Heat Obligation (RHO) would be more complicated than the existing RO (for electricity). The GB electricity market is governed by the British Electricity Technical and Trading Arrangements (BETTA) with electricity suppliers, generators, distributors and the transmission company being regulated by Ofgem through their licenses and it was possible to introduce new powers under the Utilities Act for the RO. It does not appear to be feasible to impose an obligation on 'heat suppliers' in the way that an obligation has been placed on electricity suppliers as the generation of heat is far more decentralised than for electricity. Further, even if an RHO is deemed to be workable, renewable heat microgenerators may encounter the same administrative problems under an RHO as experienced by renewable electricity microgenerators under the RO.

As such, all heat microgeneration technologies should be eligible to receive for the 50% extra support available to innovative technologies under EEC, or they should be included within a microgeneration obligation as described earlier in this paper.

There is currently provision within EEC to do this; under EEC2, which runs from 2005-8, microCHP, solar water and heat pump (space and water) technologies are eligible to receive a 50 % uplift under the Energy Efficiency Commitment (EEC). However, it is worth noting that very few measures have been installed under this arrangement to date[7].

REWARDING EXPORT

The modelling described above showed that obligating electricity suppliers to purchase microgeneration export is vital to transformation of the market and achievement of the car-

6. The Electricity Networks Strategy Group has been charged with the duty under the Climate Change and Sustainable Energy Act to establish a scheme which fairly rewards electricity exports, else Government will intervene. Government has confirmed that it will enforce this duty if the industry does not come forward with a scheme.

7. See updates on measures installed on Ofgem's website: www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/energyefficiency

bon savings envisaged. There is provision within the Climate Change and Sustainable Energy Act 2006[8], which allows for Government to impose a scheme to reward exporters 'fairly' if industry does not come up with such a scheme itself. Reaching the full potential for micro wind, PV and fuel cell CHP depend heavily on such a policy being in place. Research by the British Electrotechnical and Allied Manufacturers Associations (BEAMA)[9] has shown that 50-60 % of electricity produced by these technologies is typically exported to the grid because of the profile of generation versus consumption, i.e. the technologies are generally generating electricity in the daytime – and in summer in many cases – whereas peaks of consumption occur in winter heating periods and in morning and evenings for domestic consumers. Therefore giving the export a higher value than currently available is essential in order to transform the economics of these investment decisions.

ADOPTING FISCAL INCENTIVES

A number of fiscal incentives could be introduced which would incentivise developers to build to higher energy performance standards and encourage customers to buy sustainable properties. The Energy Saving Trust recommend these two measures as the most effective[10] :

- Introducing Stamp Duty Land Tax rebate of 1,400 EURO for the first sale of new properties built to a high energy performance standard.
- Modifying the proposed tax on 'planning gain' to reward developers who build to a high performance standard by an average of 1,400 EURO per property.

REGULATION

Results from the model support the view that regulation (once cost-effectiveness is reached) is essential for the development of the microgeneration market; Stirling engine CHP, fuel cell CHP and biomass are the key technologies depending on this policy measure.

Regulatory measures suitable for this market would include *product standards*: Government could support the development of a set of robust product standards for all microgeneration technologies is to work with industry and learn lessons from other sectors such as the gas boiler industry (CORGI's codes of practice).

Granting *permitted development status* for microgeneration technologies would reduce the overall cost of installation and the delays associated with seeking planning permission. Currently, householders would need to spend an average of approximately 350 EURO to gain planning permission for a microgeneration technology. This measure will be consulted on in the UK in 2007 (DTI, 2006).

A new *Code for Sustainable Homes* is currently being implemented by Government. For maximum effectiveness in mass market transformation, the Code should be made a requirement wherever possible. The Government has already announced that all publicly funded homes must be compliant with the Code. Likewise, regional and local planning bodies should be encouraged to adopt the Code and make it a requirement. This should be backed by a consumer awareness campaign, linking in with the A-G Energy Label to be introduced for new homes.

The key to long term cost reduction is mass production and deployment, as there is a well established link between production volume and cost. To give industry confidence that such market transformation will occur, it is likely that long term *targets* for microgeneration will help, in order to give industry confidence that market transformation will occur.

OTHER MEASURES

The modelling shows that one of the key variables in the potential for microgeneration is how much consumers are willing to pay compared to the alternative (grid electricity or gas). Sensitivity analysis shows that variation of this variable has a major impact on the results. Furthermore, it is the variable that is hardest to estimate. Consumer willingness to pay can be affected with a change in attitudes through information and advice, and promotion of the idea that microgeneration technologies are something to aspire to. For example, nearly seven out of ten Britons now believe that homes boasting energy saving features are worth paying more money for, according to research by Ipsos Mori[11]. This kind of attitude can be strongly affected by messages from government and estate agents, to give two examples.

Consumer information

Economic incentives will play their part in the establishment of microgeneration markets, but widespread dissemination of information about products and services will be vital.

In order to maximise uptake of microgeneration technologies, consumers should be able to easily find reliable sources of information regarding microgeneration technologies and the process of installation. The rules and rewards for microgeneration are daunting and guidance is needed on technical, commercial and regulatory issues. Non-technical audiences (such as householders and new industry players) would benefit enormously from the production of a simple guide to the practical requirements of microgeneration. In addition, customers would benefit from an export price comparison sheet to be consistent with import price comparisons. These actions should be taken as a matter of priority as demand for information amongst consumers is increasing rapidly as evidenced

8. Climate Change and Sustainable Energy Act 2006, available at www.opsi.gov.uk/ACTS/acts2006/20060019.htm

9. Until recently all exports from microgeneration had to be recorded with half hourly metering. The cost of the meter, data communication and processing could easily exceed the value of the exports. This meant that this value was lost, even though it could make all the difference to the economics of the generator. A modification to the regulations that permits small generators to record only a single kWh figure for their exports and have the value of their electricity worked out by relating it to an assumed profile. To work though, this scheme needs accurate profiles and this project has been established to provide them. The project covers microCHP, PV, microwind and micro-hydro. 144 sites have been monitored for 2 years to produce import / export and generation profiles. This data will be used to define representative export profiles for each of the technologies. This data will be provided to the Profile Administrator for their use as they define profiles to be used in the settlements process.

10. These are the conclusions from the Energy Saving Trust in-depth study into the likely impact of introducing change to existing fiscal mechanisms in order to encourage energy efficiency (EST, 2005): www.est.org.uk/uploads/documents/aboutest/fiscalupdate.pdf

11. www.ipsos-mori.com/polls

by the growing proportion of enquiries now received by the Energy Saving Trust and the local Energy Efficiency Advice Centres[12] on microgeneration.

Improving skills

Building partnerships, training and accreditation of products and installers are essential drivers for mass market transformation. Approved training courses should be developed for each of the microgeneration technologies. The Energy Saving Trust's Energy Efficiency Partnership for Homes has facilitated development with relevant sector skills councils and trade bodies and has developed a qualification regarding energy efficient central heating boilers and control systems (which is now offered as standard training for gas installers)[13]. A similar approach could be used for developing the required skills and training for the microgeneration sector.

It is of primary importance in a nascent market to instil confidence amongst consumers, particularly with the background of reports on the existence of rogue traders within the solar thermal industry, for example. Customer confidence of installers is paramount and attracting companies with good trading reputations is essential to the development of the industry.

Research investment

Over the period 2005-2008, 450 million EURO is available to businesses in the form of grants to support research and development in new and emerging technologies, however less than 3 % of the total funds available supported various microgeneration projects under the April 2004 call. This is insufficient support for microgeneration technologies in comparison to large scale technologies. The recently announced Energy Technologies Institute is potentially an opportunity to address the lack of support for domestic scale technologies as is the proposed Environmental Transformation Fund (details to be announced as part of the Comprehensive Spending Review 2007).

In Conclusion

The Energy Review (DTI, 2006) states that 'Cost-effective ways of using less energy will help move us towards our carbon reduction goal. But on their own they will not provide the solution to the challenges we face. We also need to make the energy we use cleaner.' An increase in microgeneration is a vital contribution to cut CO_2 emissions, diversify supply and help tackle fuel poverty.

The modelling completed by the Energy Saving Trust and partners (Energy Saving Trust *et al*, 2005) shows that microgeneration has the potential to meet between 30 to 40 % of the UK's electricity needs by 2050; and to reduce CO_2 emissions by 15 % by 2050. UK policy needs to provide sufficient support and a more favourable market framework to deliver this enormous potential.

The modelling and research carried out shows that continued financial support, building regulation requirements for microgeneration and a market that ensures a fair price for electricity exports are likely to be critical to their success.

The model has potential for use in other countries. It has been adapted to model Scotland and Wales separately, using the same base data but changing data such as housing type and fuel cost and availability. Further changes to data such as the cost curves could enable its use in other countries. It is a useful tool for analysing the likely impact of a variety of policies and testing which policies have a greater impact on individual technologies. As with all models, the key lies in interpretation of the results to analyse the impact of various policy mechanisms.

References

Allegra, 2006, Project Renew: UK consumers perspectives on renewable energy: Strategic Analysis

Communities and Local Government, 2006, Building a greener future: Towards zero carbon development (Consultation)

DTI, 2005, Microgeneration Strategy: Our Energy Challenge - Power from the People

DTI, 2005b, Accrual of ROCs LECs and REGOs, Phase 3a: Pre-determined Entitlements to ROCs for Small Microgenerators: www.distributed-generation.gov.uk/documents/23_08_2005_dgdti000390102.pdf

DTI, 2006, Energy Review: The Energy Challenge

DTI, 2007, Scheme to reward microgenerators exporting excess electricity

Energy Saving Trust, 2005, Changing Climate, Changing Behaviour: Delivering household energy saving through fiscal incentives

Energy Saving Trust, E-Connect and Element Energy, 2005, Potential for Microgeneration Study and Analysis: www.dti.gov.uk/files/file27558.pdf

Environmental Change Institute, University of Oxford, 2005, 40% house

European Solar Thermal Industry Federation, June 2006, Solar Thermal markets in Europe - Trends and market statistics 2005

IEA, 2000, Experience Curves for Energy Technology Policy

Office of the Renewable Energy Regulator (Australia), 2005, Australia's Renewable Energy Certificate Scheme

Oxera, 2006, Policies for Energy Efficiency in the Household Sector (report prepared for the Department for Food and Rural Affairs)

Glossary

DTI	Department for Trade and Industry
EEC	Energy Efficiency Commitment
Ofgem	Office for gas and electricity markets
RHO	Renewables Heat Obligation
RO	Renewables Obligation
ROC	Renewable Obligation Certificate
PV	Photovoltaics

12. www.est.org.uk/myhome/localadvice

13. Certificate in Energy Efficiency for Domestic Heating: www.est.org.uk/housingtrade/installers/heating