

Response to ECC Select Committee Call for Evidence on Heat

Summary

The Energy Technologies Institute (ETI), a public-private partnership between global energy and engineering firms and the UK Government, believes the UK can have an affordable, secure and sustainable energy system in the future. However, it is important that the right steps are taken to ensure the cost of carbon reductions are affordable in the context of sustaining UK economic growth and industrial development.

The ETI carries out two key activities – (1) modelling and analysis of the UK energy system to identify the key challenges and potential solutions to meeting the UK's 2020 and 2050 targets at the lowest cost to the UK, and (2) investing in major engineering and technology demonstration projects which address these challenges with the aim of de-risking solutions – both in technology and in supply-chain development – for subsequent commercial investors.

The ETI is investing more than £210m in projects across nine technology programme areas, including buildings, distributed energy and smart systems and heat.

The ETI believes that the future approach to practical, cost-effective and sustainable domestic heat supply will vary from location to location across the UK. For example, district heat networks in dense, urban areas and electric heating in rural areas.

Furthermore, we believe providing heat at least cost to the consumer, in any one area, should consider an optimum of both supply-side and demand-side measures (including building retrofits). The ETI's smart systems and heat (SSH) programme is developing a software tool that will allow the design of practical, cost-effective local energy systems (both heat and power). The SSH programme is working with a number of local authorities across the UK to develop the software tool and subsequently create and demonstrate the resulting practical, cost-effective local energy solutions for their areas. Importantly, the activity will prove that the capability and approach can be adopted nationally.

Detailed Responses to Questions 1 - 12

1. Is the government taking the right approach to reduce heat energy demand?

The Government has recently launched the Green Deal and Energy Company Obligation mechanisms to address energy efficiency in the building stock. We see the aim of the combination of these to stimulate innovation and capacity building in the supply chain for cost-effective building retrofits.

We made detailed comments in response to the pre-launch consultation. We reiterate three key points:

- Stimulating innovation inevitably takes a longer time to be effective but also produces greater benefits than short term schemes.
- The design of these policies will need to be reviewed in the light of sufficient early experience to understand the reality of their implementation.
- Whole house retrofits undertaken as part of wider general housing refurbishment will be more effective than an approach based on individual measures for efficiency only.

With these qualifications we believe that these policies have an important contribution to developing a better approach to energy efficiency in buildings.

2. What progress is the government making on reducing the demand for heat?

While the general demand trend for heat is downwards, we believe the relative importance of weather, the economic downturn, energy prices and improvements to the existing building stock is difficult to ascertain.

3. Biomass is deemed a key fuel for heat production from both the cost and GHG perspectives. What should be done to ensure methods of calculating biomass GHG balance represent an accurate picture?

Biomass is attractive for heat production from a cost, flexibility and GHG perspective. However for the latter to be truly optimised, good accounting methodology is required in order to facilitate informed choices about biomass feedstock type, agricultural practices, transportation choices, and conversion technologies. Increasing the amount of sustainably produced biomass removes carbon dioxide from the atmosphere. Incentivising the use of biomass for energy production does not necessarily lead to an overall increase in *sustainable* production.

Any methodology needs to strike an appropriate balance between robustness, tractability and auditability. The effects of direct land use change are not fully supported by sufficient scientific evidence and indirect land use change effects add further complexity. Current methodology for accounting for lifecycle GHGs does not take account of the length of time taken for carbon emissions released from biomass combustion to be removed from the atmosphere (carbon debt). It also allows generators to use default values instead of actual values for many of the GHG sustainability criteria calculations, without verification. Therefore these are natural improvements, which we understand are receiving attention.

The ETI Ecosystem Land Use Modelling (ELUM) project is collecting detailed experimental data on the changes to soil carbon and GHG emissions associated with land use transitions to bioenergy crops in the UK, and will generate significant evidence to inform the debate on carbon accounting of biomass production and associated land use change. For UK biomass production it is much easier to understand the counterfactual – what would have happened if biomass had not been grown and used for energy production. Nevertheless there may well be opportunities for GHG reduction by using imported bioenergy, provided confidence can be established in the counterfactual and the credit is not claimed under agriculture by the producer and under energy by the UK consumer.

4. There are sustainability guidelines for biomass, do these go far enough?

We understand that these guidelines are currently under review. Current criteria cover land use change and GHG emissions. We note:

- None of the voluntary schemes (particularly forestry) cover all aspects of the land sustainability criteria. It is therefore possible to ‘pick and choose’ different schemes to produce the most positive report. It would be prudent to develop a single comprehensive scheme for each main biomass group.
- Any such scheme needs to recognise the uniqueness of biomass and be appropriate to the application. For example, the “Central Point of Expertise on Timber Procurement (CPET) scheme” consolidates advice on Government’s Timber Procurement Policy, EU Timber Regulation and the Forest Law Enforcement Governance and Trade (FLEGT) Regulation. If this is to be used, then due consideration needs to be given to the practicalities of application to wood fuel production, often a by-product of wider sustainable forest management regimes.

5. What will the local environmental impact (for example air pollution) be from the use of heat generation in urban areas, for example CHP units?

Heat is currently generated mainly by the combustion of gas, oil, wood and coal. All of these generate nitrogen oxides (Nox) and all but gas generate some level of particulates. Large central generation plant addresses these emissions more effectively than smaller CHP generators. Road traffic is a very significant source of these emissions, especially in terms of individual exposure.

Typically we would expect well-designed biomass CHP schemes to produce lower levels of emissions than existing oil-fired or coal heating systems. The overall production of Nox from a CHP scheme compared to domestic boilers and central generation is unlikely to be problematic in terms of air quality in urban areas, although this should be considered in planning and siting.

Advanced technology for gasification of biomass and wastes enables clean-up of emissions and may be attractive for this reason in addition to its likely cost and efficiency benefits. The ETI Waste Gasification project is currently investigating the overall efficiency and carbon balance of three technologies, at a scale suitable for deployment at the ‘town’ level. The evidence generated from this project will accelerate the ability to provide very clean CHP in more challenging air quality locations.

6. What are the relative merits of using gas to directly provide space heating compared to centralised electricity production plus domestic heat pumps?

We have estimated the costs of providing comfort and cleanliness in a typical dwelling using either a modern condensing combi-boiler or a very high efficiency air-source heat pump, such as those now being launched in the UK market.

The annualised cost of the combi-boiler is £930, of which £645 is gas costs at retail prices and the rest is maintenance and boiler capital charges. The annualised cost of the heat pump is £1265, of which £205 is fuel cost at wholesale prices and the rest is the capital and operating costs, including the heat-pump, but also electricity generation by a modern Combined Cycle Gas-Turbine (CCGT) and other supply costs. This calculation includes an allowance for upgrading the electricity distribution system.

The combi-boiler produces 2.9 Tt CO₂/year and the heat-pump 1.8. Whereas the heat-pump can be made nearly zero-carbon by using a low carbon source, the gas-boiler emissions can only be reduced by some combination of increased insulation, reduced comfort and cleanliness and reduced wastage (eg avoiding over-heating unoccupied dwellings).

7. Why is community heating/CHP not more common in the UK?

Our response recently to the Energy and Climate Change Committee's consultation on Local Energy described several barriers.

Community heating via CHP has to compete with domestic gas. Community heating via CHP can achieve a 30% primary fuel use reduction. However the lower operating costs are offset by higher capital costs. The technology is generally well known and well established, with some potential for improvements, but the main barriers are mostly financial and commercial:

- High upfront capital costs associated with building the distribution infrastructure. Very little investment track record for this type of technology within the UK's market place reducing confidence.
- The difficulty of raising capital funding due to the very long term returns on investment.
- The risk associated with consumer take-up, creating uncertainty of heat loads for developers and investors – whilst having to compete with retail gas prices.
- The risk and reliability associated with using new technologies such as biomass CHP to drive the heat and electricity outputs.
- The uncertainty of whether future heat networks will be regulated.

We note that there is no framework currently to support integrated local future planning to utilise waste heat from existing industrial plants and large thermal generating stations for community heat.

Typically infrastructure projects of a similar nature (such as water supply, waste treatment and electricity) have been originally developed by governments at very low

costs of capital and or discount rates, making these projects more attractive. This is also comparable to other infrastructure projects such as railways, roads and airports.

8. What are the lock-in, costs and GHG savings from the promotion of different forms of domestic heating solution?

The only heating solution which has strategic flexibility is District Heating, which ETI analysis suggests could apply to up to 40% of buildings in the UK, although dense inner city areas would be the best location for initial investment.

Until we are confident of the timing of decarbonisation of electricity generation in the UK, the high cost of heat-pumps makes them a problematic investment at a mass-scale.

The combination of a small heat-pump with a gas boiler is potentially attractive in terms of maximising the return on the system efficiency benefits of the heat-pump and the ability of the gas boiler to meet the relatively infrequent peak heat loading requirements at low capital cost. Units designed for this application are starting to be launched in the UK. We note these hybrids are not supported by the domestic RHI.

Until Smart Meters are widespread and we can see how variable electricity pricing works in practice, there are significant risks in projecting demand and supply side responses to this new relationship. While consumers are used to complex tariffs for wholly private services such as hotel rooms and air travel, there is a tendency to simplify the tariffs for regulated services. Clearly this can drive very significant cost increases through under-use of the expensive assets involved. These will be borne ultimately by consumers.

Heating systems design and control will have to develop significantly in the UK if the benefits of new technologies are to be exploited. Bad publicity stories attached to new heating technologies provide evidence of the risks.

9. Should the government take any further any specific actions in relation to cooling?

This is a very important question in terms of longer term strategy. We are not aware of any authoritative analysis for the UK that covers the complex social, technological, economic and climate change issues involved. We anticipate that activities already planned by the Research Councils UK Energy Programme will provide better evidence for policy development over the next few years.

10. Why does the RHI not seem to promote heat pumps successfully?

n/a

11. How successful will the RHI be when rolled out to households?

The answer to this depends on many factors which are beyond the remit of the ETI and we therefore cannot answer the question directly. We note however that:

- The structure and targeting of the scheme is clear and well thought-through;
- DECC has undertaken very thorough consultation and market testing exercises and addressed the feedback effectively; and

- The objective is to create a more dynamic market for renewable heating in the UK and drive innovation and supply side improvements focussed on UK needs.

We also note that DECC has included detailed monitoring within the implementation which will enable the scheme performance to be accurately assessed. We understand the initial objectives of this scheme are to drive supply-side innovation and capacity building and gain valuable learning as a basis for future policy development. We cannot see any significant opportunities for improvement.

No doubt the level of tariffs will be much debated. In our view it is difficult to discover the appropriate market level of tariffs prior to launching a scheme and prudent use of social resources would argue for a moderate but realistic start point.

12. Thermal storage is a potential useful method of balancing electricity/energy demand both diurnally and annually. What is government policy doing to promote thermal storage, and should it do more/different?

We assume this question refers to thermal storage within buildings, since there are already market mechanisms to reward thermal storage in commercial settings, such as heating networks. Where district heating is likely to be the long-term best heating option for a group of dwellings, then providing financial support for retaining or installing storage in individual buildings would be an unproductive use of social resources, with distribution-scale storage more appropriate. Given the current limited coverage of domestic heating networks, we will not make further comments, although large-scale geological heat storage has been the subject of preliminary ETI research, along with geological storage of hydrogen as the lowest cost seasonal low carbon energy store.

There is limited value in thermal storage for buildings heated by gas or oil and much of this is being removed because of the very high utility of space in the UK, modest efficiency gains and industry practise (wall mounted combi-boilers). Electrically heated buildings typically include significant storage in the form of storage radiators or large structural thermal mass (such as underfloor heating). There are already tariff structures, such as Economy 7 that reward storage associated with electrical heating, either resistive or heat-pump based.

This question is really about preparing for the future in buildings where heat-pumps are likely to be the best solution. Current key government actions in this area include:

- Major investments by the Research Councils UK Energy Programme in the tools, capabilities and technologies to develop the evidence base on which sound policy can be based, most recently the six End-Use Energy Demand Centres, but also ongoing tool development by UKERC and the WholeSEM project.
- The Smart Meters Programme, which will enable investments in storage to be rewarded by effective tariff design.
- The Low Carbon Networks Fund which enables supply companies to test various grid technologies which are part of the solution, such as local voltage control.
- Various innovation support mechanisms, such as the recent DECC storage competition.

Under our SSH Programme we are launching a wide range of projects which examine the role of storage technologies as part of an integrated systems solution for different types of location across the UK, working closely with selected local authorities.

Until there is a compelling evidence base to support policy development and an overall strategy for the development of the UK energy system the only area of additional activity we would recommend is to ensure that new build properties include sufficient hot water storage to avoid demand peaking for domestic water heating. This is on the grounds that it will be hard to retrofit these properties with heat stores later, once the requirements are clear. New build properties should have relatively low space heating demands and good design practise would include sufficient thermal mass to avoid temperature swings.