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UK ENERGY RESEARCH CENTRE

UKERC response to the BERR consultation 'UK Renewable Energy Strategy'.

September 2008

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THE UK ENERGY RESEARCH CENTRE

The UK Energy Research Centre (UKERC) was established in 2004 following a recommendation from the 2002 review of energy initiated by Sir David King, the UK Government's Chief Scientific Advisor.

The UK Energy Research Centre's mission is to be the UK's pre-eminent centre of research, and source of authoritative information and leadership, on sustainable energy systems.

UKERC undertakes world-class research addressing the whole-systems aspects of energy supply and use while developing and maintaining the means to enable cohesive research in energy.

To achieve this we are establishing a comprehensive database of energy research, development and demonstration competences in the UK. We will also act as the portal for the UK energy research community to and from both UK stakeholders and the international energy research community.

We are funded by three research councils: the Engineering and Physical Sciences Research Council (EPSRC), the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC).

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Introduction

The UK Energy Research Centre welcomes this opportunity to provide input to the BERR Consultation on the UK Renewable Energy Strategy. We have addressed a number of the questions posed in the consultation document calling on all UKERC members for input.

Summary of key points:

- Approximately one fifth of the renewable energy target could be delivered through an aggressive policy of demand reduction in the UK housing, business and transport sector.
- UKERC believes that there is considerable uncertainty about the costs and feasibility of achieving a 15% market share of renewable heat by 2020 and that a failure to meet this target will require the electricity and/or transport sectors to take up the slack.
- UKERC suggests that the possibility of running a feed-in tariff (FiT) for all types and size of technologies alongside the RO should be considered.
- It is essential that Government takes urgent action on facilitative measures that dismantle barriers to renewable deployment. The obvious areas are: ensuring timely access to transmission capacity (including offshore) through regulatory procedures and investment in new capacity; reforming the planning regime to reduce investment delays; and sending clear signals to the market about the mechanisms for accelerating renewables deployment whatever form (obligation, feed-in tariff) these take.
- Incentives for biofuels should be based on greenhouse gas (GHG) savings. UKERC research has identified inadequacies in the systems to assess full life cycle GHG and recommends further research into developing methodologies to quantify the indirect impacts of biofuels on displaced land.
- A feed-in tariff for microgeneration electricity would not provide support across heating, electricity producing, and combined heat and power technologies. A suite of policy instruments is required that works across these energy vectors.

Chapter 1 - Renewables and the Energy and Climate Challenge

Q1: How might we design policies to meet the 2020 renewable energy target that give enough certainty to business but allow flexibility to change the level of ambition for a sector or the level of financial incentive as new information emerges?

We believe the responses to other specific questions address this point.

Q2: To what extent should we be open to the idea of meeting some of our renewable energy target through deployment in other countries?

We agree in principle with the BERR analysis that a limited proportion of the UK renewable energy target could met through credit for supporting renewable energy development in other countries. The mechanism through which credit claimed will need to be carefully designed to ensure that the projects are valid and are delivering what they promised. A robust and transparent scheme of certificates/guarantees of origin for the renewable energy projects will be critical evidence towards this.

Chapter 2 - Saving Energy

Q3: In the light of the EU renewable energy target, where should we focus further action on energy efficiency and what, if any, additional policies or measures would deliver the most cost-effective savings?

Energy demand reduction is a mechanism through which the overall size of the EU 15% renewable energy target can be reduced in absolute terms (i.e. you would simply need to install less renewable energy capacity to meet the target). The University of Oxford Environmental Change Institute[1] (ECI) in their report[2] to the Royal Commission on Environmental Pollution (The Urban Environment report) examined the potential for demand reduction from the UK housing sector in 2020 comparing the difference between a business as usual and aggressive policy scenarios with a focus on major carbon emissions reductions.

The findings of this report indicated that an aggressive policy scenario of demand reduction from the UK housing sector could reduce overall UK energy demand by approximately 5%[3]. In the context of the 15% renewable energy target this would reduce the absolute number by the equivalent of about 1%. The potential for demand reduction in the business and transport sectors is approximately the same. Therefore, if aggressive demand reduction policies were applied in the UK housing, business and transport sectors then approximately one fifth of the 15% target might be delivered through energy efficiency.

It is important to remember that rebound effects, where predicted energy savings falling short of expectations, are important when considering energy demand reduction. The UKERC Technology and Policy Assessment function has published an authoritative and high impact report on the "Rebound Effect[4]". Its main conclusion is that rebound effects are always important and can, in extreme circumstances, negate a significant proportion of the energy saved by the demand reduction measure.

[1] UKERC Demand Reduction theme is based at ECI - http://www.ukerc.ac.uk/ResearchProgrammes/DemandReduction/DemandReductionHomepage.aspx
[2] http://www.rcep.org.uk/urbanenvironment.htm#studies
[3] The difference in 2020 is 93 TWh (about 17%), with 20 TWh of electricity saved in appliances and 73 TWh saved in heat (mainly gas).
[4] http://www.ukerc.ac.uk/ResearchProgrammes/TechnologyandPolicyAssessment/ReboundEffect.aspx

Chapter 3 - Centralised electricity

Q4: Are our assessments of the potential of different renewable electricity technologies correct?

UKERC is in broad agreement with BERR about the scale of the potential for the main renewable electricity technology options. There is uncertainty about how each of the families of technologies will develop and particularly projections must include assumptions about renewables penetration into the heat and transport sectors which impacts electricity targets. The limitations to deployment are not typically physical nor technical but rather a factor of build rate, which in turn is a function of planning, grid connection and supply chain.

In the RES, it is suggested that renewable heat could gain a 14% share of the heat market in 2020. However, the real market and institutional potential for renewable heat is not well understood and uncertainty is high. If renewable heat fails to achieve a 14% market share then to meet the 2020 UK target of 15% renewable energy the market share of renewable energy in electricity and/or transport will have to increase to meet the shortfall. In the UKERC illustrative scenario it was proposed that renewable heat could contribute 10% towards the heat market. In carrying out sensitivity analysis UKERC found that if the contribution of renewable heat towards total heat is increased by 5% (e.g. to 15%) then the contribution of renewable electricity towards total electricity is decreased by approximately 10% and vice versa for a decrease in the contribution of renewable heat.

UKERC has performed its own analysis (presented to the House of Lords Select Committee enquiry on the European Union inquiry into the EU's 20% renewable energy target) and the details are summarised below.

The assumptions for the UKERC illustrative scenario (Table 1 below) were as follows. Demand for electricity and transport fuel in 2020 remains flat at 2006 levels and that demand for heat is reduced by 20% based on 2006 levels. 10% of the supply of transport fuels and heat is derived from renewable resources by 2020. The proportion of electricity required to meet the overall UK target for renewable energy of 15% was therefore estimated to be 41% (assuming no significant changes to conventional plant efficiency).

Table 1

	2006				2020			
Technology	**MW**	**GWh**	**LF %**	**% Elec**	**MW**	**GWh**	**LF %**	**% Elec**
Onshore wind	1,651	3,574	25%	0.9%	20,000	52,560	30%	13.1%
Offshore wind	304	651	24%	0.2%	20,000	61,320	35%	15.3%
Wave[5]	-	-	0%	0.0%	1,000	2,978	34%	0.7%
Tidal	-	-	0%	0.0%	1,000	3,679	42%	0.9%
PV[6]	10	7	8%	0.0%	571	1,000	20%	0.2%
Hydro[7]	1,522	4,605	35%	1.1%	1,522	4,606	35%	1.1%
Biomass[8]	1,837	9,946	62%	2.5%	5,350	28,119	60%	7.0%
Severn[9]	-	-	0%	0.0%	5,000	10,950	25%	2.7%
TOTAL	**5,324**	**18,783**	**40%**	**4.7%**	**54,443**	**165,213**	**35%**	**41.0%**

The breakdown of the contribution of renewable energy technologies towards the 41% electricity target was based on an assessment by UKERC experts of their development and deployment rates over the next 12 years. It was assumed that wind power would be required to "fill the gap" between the capability of other renewable technologies and the "renewable electricity target". The findings of the assessment are summarised below.

Wind energy is the most developed of the technologies. Given the excellent UK wind resource, installation rates have been disappointing with only 2 GW currently installed (including 0.3 GW offshore) – accounting for around 2% of UK electricity[10]. On a positive note there is currently around 8 GW of wind capacity in the planning system. Although unlikely, if all of this was consented, and built, it would be able to generate an additional 7% of UK electricity bringing the total to 9%, and in principle this could be achieved within a few years. This leaves around a decade to install an

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[5] UKERC Ocean Energy roadmap - http://ukerc.rl.ac.uk/ERR0303.html
[6] UKERC Solar Energy roadmap - http://ukerc.rl.ac.uk/ERR0301.html
[7] Assume 2020 hydro energy remains same as 2006
[8] Defra UK Biomass Strategy - http://www.defra.gov.uk/environment/climatechange/uk/energy/renewablefuel/index.htm
[9] 2020 figure based on estimate – not to be taken as UKERC policy
[10] http://stats.berr.gov.uk/energystats/dukes7_4.xls

additional 30 GW in total, including on and offshore, which is enough to generate, in total, 28.4% of UK electricity. At around 3 GW per annum this represents an order of magnitude increase on current UK installation rates (0.24 GW per year averaged over the last five years). Germany has achieved an installation rate of 2.5 GW per year averaged over 5 years between 2000 and 2005[11]. In 2007 3.5 GW was installed in Spain. Growth rates of around 2 GW are not confined to Europe: in 2007 around 5 GW was installed in the US, China installed around 3.4 GW[12]. Globally, over the same period around 7 GW of wind power was installed per year on average, possibly indicating global wind turbine production capacity. The level of installation continues to grow: In 2006 11.3GW of wind power was installed world wide, in 2007 this grew to 19.5 GW. Since the UK is not the only country with ambitious plans for wind energy deployment meeting its ambitions are contingent upon the capability of world companies to expand their wind turbine manufacturing capacity to meet this demand. Therefore, if the UK policy environment is more uncertain or less attractive than that elsewhere then it will be at a disadvantage in a supply constrained world market (this issue is further discussed in the answer to question 8).

Wave energy The UK has the best wave energy resource in the EU, with 50TWh/year offshore (equivalent to 15% of UK electricity demand), 7.8TWh/year in nearshore waters and 0.2TWh/year on the shoreline. There are only three examples of technologies supplying electricity to the grid. LIMPET, a shoreline device on Islay has been supplying electricity to the grid since 2000. Pelamis was connected and supplied the Orkney network at EMEC during prototype test. Open hydro and MCT have full-scale tidal current generators connected to the Scottish and Northern Irish networks.

There are a number of wave power projects under development. Pelamis Wave Power (PWP)[13] are currently installing 3 devices (2.25MW) off the coast of Portugal - the first offshore wave farm. PWP also have consents and funding for a farm off the coast of Orkney (3MW), and are planning a 5MW farm at in the South West of England in the WAVEHUB project[14]. Wavegen[15], the developers of LIMPET, are currently installing a harbour wall device at Mutriku in Spain. In addition there are a

[11] IEA data from Economic and Social data service
[12] Windpower Monthly News Magazine data, Sept 2008
[13] http://www.pelamiswave.com/
[14] http://www.wavehub.co.uk/
[15] http://www.wavegen.co.uk/

number of other developers with funding for sea trials in the next 12-18 months: Aquamarine[16], AWS Ocean[17], Ocean Power Technologies[18], and Wavedragon[19]. Wave energy is very much an emerging technology, with deployment at the MW level. Its development pathway is approximately 15 years behind that of wind power.

It is estimated that 1 GW each of both wave and tidal current energy could be installed by 2020 in UK waters (see UKERC's Ocean Technology Roadmap). This figure is significantly more ambitious that that of the RES. This would require a rapid increase in deployment from 2012 onwards. A deployment of 1GW of wave energy by 2020 in the UK would translate to 0.8% of the UK's total electricity. The Carbon Trust predicts that there could be between 1-2.5GW of wave energy in European waters by 2020, with comparable tidal opportunity. There is a lot of activity and planned deployments in the UK, but it will be challenging to meet the Carbon Trust/UKERC 2020 forecasts.

Tidal current The Carbon Trust estimate that the UK tidal current resource is 18TWh/year, equivalent to 5% of UK's electricity demand and about 10-15% of the total world tidal current resource. The technologies for tidal current generation show less variation than for wave energy generation, in which every device operates on very different principles. Hence, it could be argued that the technology is nearer to market. Marine Current Turbines (MCT)[20] is the only UK developer to have successfully demonstrated tidal current turbine technology and have been operating a 300kW device off the north coast of Devon since 2003. They have also recently installed the first commercial device (the Seagen project) in Northern Ireland which is rated at 1.2MW. MCT also plan a 10.5MW tidal current farm at the Skerries between the Welsh mainland and Anglesey, which could be installed as early as 2011. A full scale tidal current test site has been established at EMEC, with Open Hydro, an Irish developer, testing a 300kW grid connected device.

Like wave energy, tidal current energy is an emerging technology, with deployments at the MW level, but has the potential to make a significant contribution to the UK's renewable energy targets. It is estimated that 1GW of tidal current energy could be

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[16] http://www.aquamarinepower.com/
[17] http://www.awsocean.com/technology.html
[18] http://www.oceanpowertechnologies.com/index.htm
[19] http://www.wavedragon.net/
[20] http://www.marineturbines.com/

installed by 2020 in UK waters (see UKERC's Marine Technology Roadmap). A deployment of 1GW of wave energy by 2020 in the UK would translate to 0.9% of the UK's total electricity. The Carbon Trust has suggested that between 1-2.5GW of tidal current could be deployed in European waters by 2020.

Photovoltaics remain expensive but policies in both Japan and Germany have demonstrated that with appropriate market support significant capacity can be installed relatively quickly. The global solar PV market has been booming recently and this trend is forecasted to continue. High cost reductions are foreseen for conventional crystalline silicon technologies (1st generation) and emerging thin film technologies (2nd generation)[21]. The EU PV Technology Platform estimates PV to become competitive with retail electricity prices by 2015/2020 and wholesale electricity prices by 2030 (in Southern Europe)[22]. Moreover, increased interest and efforts in novel PV devices (3rd generation) such as organic PV (both in the research and industry arenas) are likely to result in commercialisation for such technologies earlier than previously forecasted. The IEA ETP BLUE Scenario for PV forecasts niche deployment for 3rd generation technologies around 2020 and strong uptake (up to 50% market share) in 2050, the support necessary to move from lab to commercialisation is put in place[23].

Currently, PV technology development and cost reductions drivers are not UK based (in particular for 1st and 2nd generation technologies), as they are mainly dependent on research, market and policy developments in other countries such as Germany, Japan, USA as well as other emerging countries as China, India, Spain. However, UK is among world leaders for advanced 3rd generation PV technologies research. UK could potentially gain competitive advantage on 3rd generation technology deployment, provided UK world leading research harnessed to its potential (see UKERC's Solar Energy Road map[24]).

Analysis by the PV EU Platform estimates that 3% of EU electricity can be met in this way by 2030, which is considerably less than Germany has already achieved (see UKERC's Solar Energy Road map). More ambitiously, EPIA the European Photovoltaic

[21] http://www.eupvplatform.org/fileadmin/Documents/PVPT_SRA_Complete_070604.pdf
[22] http://www.eupvplatform.org/fileadmin/Documents/PVPT_SRA_Complete_070604.pdf
[23] http://www.iea.org/Textbase/techno/etp/ETP_2008_Exec_Sum_English.pdf
[24] http://ukerc.rl.ac.uk/ERR0301.html

Industry Association has recently announced a target to supply 12% of EU electricity demand by 2020[25]. In the UKERC scenario a 0.2% contribution (representing a 57 fold increase on current installed capacity) to UK electricity by 2020 has been estimated.

Hydro electricity currently accounts for 1.1% of UK electricity through large (1%) and small scale (0.1%) schemes. The scope for new hydro schemes in the UK is limited because the majority of the large-scale resource has already been successfully exploited. For example, the potential for new hydro electricity in Scotland has been estimated to be 657MW[26]. The Environment Agency and British Hydropower Association are currently undertaking opportunity mapping exercises for small scale devices. In the UKERC scenario it has been assumed that there is no increase in the contribution of hydro electricity from current levels.

Biomass electricity currently accounts for approximately 2%[27] of total UK electricity through a mixture of biomass co-firing at large coal power plants, combined heat and power plants and anaerobic digestion plants. Professor Gail Taylor (UKERC) has estimated that that biomass electricity could account for around 7% of UK electricity demand by 2020[28]. However, some of this potential could be diverted to biofuel generation for transport, especially if second generation techniques capable of utilising woody material become established; the EC Biofuels Directive is proposing bio-generated component of transport fuel to be raised to 10% by 2020[29].

The Severn estuary barrage is currently undergoing a two year feasibility study to assess the cost and environmental impact of the proposed scheme. It is uncertain whether the barrage will be completed by 2020 and what contribution it will make to UK electricity generation. In this response we have optimistically assumed that an 8 GW barrage will be partly completed by 2020 and at time able to generate up to 5GW, and thereby providing 2.8% of the UK's total electricity. Of course if the Severn barrage is not contributing, for whatever reason, then the onus will be on an

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[25] http://www.epia.org/fileadmin/EPIA_docs/documents/press/380904_PR_12_Electricity_EN_FINAL.pdf
[26] Scottish Hydropower Resource Study –http://cci.scot.nhs.uk/Topics/Business-industry/Energy/19185/FREDSHydroResStudy
[27] http://stats.berr.gov.uk/energystats/dukes7_4.xls
[28] Professor Gail Taylor, Bioenergy for heat and electricity in the UK - a paper for the Office of Science and Innovation (in preparation)
[29] http://ec.europa.eu/energy/energy_policy/doc/07_biofuels_progress_report_en.pdf

alternative renewable technology to take up the slack. Other British estuaries are also being investigated for energy capture using traditional barrage structures (e.g. Mersey where Peel Holdings are looking at proposals with a generating capacity of ~ 600 MW with installation expected by 2020) or tidal stream devices (e.g. Morecambe Bay's Bridge over the Bay 110MW).

The overall capacity to generate renewable electricity is usually calculated by summing the contributions from the different generating sources assuming that they are independent. Studies suggest that within some technologies (e.g. offshore) major developments such as the Severn Barrage would impact on other devices and other technologies (e.g. wind and biomass) may be competing for the same land area and may not be 100% compatible.

Q5: What more could the Government or other parties do to enable the planning system to facilitate renewable deployment?

The decision not to consult on the possibility of reducing the threshold for central consent is unfortunate since it appears to be the simplest way to reduce planning delay.

UKERC welcomes the proposal that targets be devolved to local authority level.

There is a risk that the detailed planning recommendations the Government proposes will not overcome the planning problem and will take time to implement. The recommendations do not overcome the risk of the planning process being captured by vociferous minorities, nor do they reduce the delays created for developers, even if they result in more positive outcomes.

Q6: What more could the Government or other parties do to ensure community support for new renewable generation?

The provision of information and incentives for communities could encourage public support for new renewable generation. Firstly, if information was available for communities to measure their energy use then this would enable them to plan strategies for reducing the community energy use. Secondly, grants could be made available that would enable communities to build up sustainable systems or projects. Thirdly, a mechanism such as FiT could further encourage the development of community level microgeneration. We would encourage that the Government consider extending the proposal for a microgeneration FiT to include community scale wind power projects.

Q7: What more could the Government or other parties do to reduce the constraints on renewable wind power development arising from:

Environmental legislation will need to be based on scientific evidence relating to the environmental impacts of renewable energy technologies. Currently, tools for assessing the environmental impact of renewable energy technologies vary in their scientific robustness. UKERC has identified a particular need for tools to assess the environmental impact of renewable energy technologies that are deployed in the marine environment and this will be a research priority in UKERC Phase II. The research will focus on several key aspects:

- Developing model systems working at a scale relevant to physical and biological processes affected by offshore windfarms and other energy activities such as CCS
- The potential of offshore windfarms to provide socio-economic benefits through multiple-use, added value and improved ecosystem service
- Use of an area within the east coast North Sea as a test bed to forecast the potential of offshore wind to provide ecosystem goods and services to society, taking into account downstream implications.

The outputs of this research may be off interest to BERR and we would be happy to discuss the project in further detail.

For onshore wind, existing legislation such as the Habitats Directive need clear guidance as to its interpretation including a firm definition of Overriding Public Interest in the case of renewable energy schemes; the objectives of the Directive to protect and conserve must be upheld without providing either too general grounds for rejection or opportunity to delay development.

Q8: Taking into account decisions already taken on the offshore transmission regime and the measures set out in the Transmission Access Review, what more could the Government or other parties do to reduce the constraints on renewable development arising from grid issues?

Efforts to remove access to the transmission system as a barrier to the delivery of the UK's renewable obligations via the Transmission Access Review, are welcome. However, there is concern that the limited scope of the Review might hinder its ability to deliver the measures necessary to make real progress in this area. We need to ensure via the Transmission Access Review, Ofgem's RPI@20 initiative or via some other mechanism that electricity markets properly value transmission and that regulation encourages Transmission Owners and National Grid as GBSO to make objective decisions concerning transmission investment and operational alternatives.

Implementation of the new enduring regulatory regime being developed by OFGEM and BERR for offshore transmission is only beginning and there is, as yet, no experience of how effective it will be. The scale of offshore transmission required, and its technical complexity, for Round 3 projects is of a different magnitude to those of Round 2. This is supported by clause 3.2.25 discussing possible interconnections with other countries and the requirement for further work. Hence the critical area of offshore transmission development should be kept under close review to assess if the arrangements proposed are delivering suitable transmission infrastructure for both Round 2 and Round 3 projects.

There is concern that emerging offshore regulation will introduce unnecessary delays and add additional workload for equipment suppliers because of uncertainties over which bidder will be successful in the Offshore Transmission Operator (OFTO) tendering process and the possible need for suppliers to prepare multiple bids in a multi-bidder process. In the current situation where offshore projects are effectively competing for scarce equipment supplies, it maybe that that equipment is diverted to countries whose connection regimes are simpler and involve greater certainty for equipment manufactures.

The offshore regulation being developed also seems at odds with the need to develop a more strategic approach to developing an offshore network. The installed capacity envisaged for Round 3 suggests that an offshore cable network should be developed to support and add to the capacity of the onshore system, rather than the series of radial circuits connecting individual windfarms to shore that will result from the regulatory arrangements currently being developed.

Chapter 3 of the consultation focuses on transmission with limited discussion of renewable generation connected to distribution networks. It would be disappointing if the considerable progress made over recent years in facilitating the connection of renewable generation to medium and low voltage networks slowed and momentum was lost. Consideration should be given to the arrangements required for ensuring that connection of generation to distribution networks is facilitated and that the appropriate balance is struck between the interests of generators, load consumers and DNOs.

UKERC suggests that connect and manage could and should be adopted on a permanent not a temporary basis. It is imperative that the proposals to allow National Grid to invest in a pre-emptive not merely responsive way are taken forward rapidly and that they work.

Q9: What more could the Government or other parties do to reduce supply chain constraints on new renewables deployment?

There is perhaps a perceived wisdom that provided government puts in place a long term and stable policy, with appropriate incentives, the supply chain will fix itself. Given the scale of the challenge and the significance of the supply chain constraints in renewable energy this is almost certainly not sufficient. There is a need for research to understand the supply chain constraints much better, not just in terms of their size and nature, but also on the tools available to overcome them. Supply chains comprise numerous links and unless there is confidence across the entire chain the significant investments required at each step cannot be assured.

Q10: Do you agree with our analysis on the importance of retaining the Renewables Obligation as our prime support mechanism for centralised renewable electricity?

UKERC recognises that BERR are strongly minded to retain the RO as the main support mechanism for bulk electricity. It is obviously very much in the interests of incumbent market participants to keep the RO. However, that does not mean that the RO should not be changed. The merits of an FiT are clearly shown in a recent paper[30] which concludes that "a well-designed (dynamic) feed-in tariff system ensures the fastest deployment of power plants using Renewable Energy Sources (RES) at the lowest cost to society". It is not inevitable that a move to a FiT destroys investor confidence. UKERC suggests that the possibility of running a FiT for all types and size of technologies alongside the RO should be considered. The benefits of both schemes could be monitored and evidence could be gathered to examine the relative performance.

We understand in particular that the government would not wish to propose another wholesale review of the support for RE whilst the Energy Bill is still going through the legislative process. UKERC's report on investment in electricity generation[31] indicates that investors do value regulatory certainty and there is a strong argument that the banding proposals should at least be given time to prove their worth before they are changed again. Nevertheless UKERC's work in this area did not indicate that investors expect that policy can be cast in stone, and identified concerns related to the relative complexity of the RO (and other matters such as planning) at least as significant as any desire for policymakers to avoid revising policies. The performance of the RO should be reviewed when the banding arrangements are reviewed.

We welcome the recognition in the consultation document that FiTs have many advantages. Analysis by the EC[32] indicates that countries with FiTs have generally been more effective in deploying renewables and that FiTs offer a more cost effective form of support. In a sense, the case the government makes for the RO has shifted from economic principle[33] to pragmatic issues of policy continuity (this consultation).

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[30] Held, A., Haas, R., Ragwitz, M., On the success of policy strategies for the promotion of electricity from renewable energy sources in the EU, Energy & Environment, 17(6), (2006), 849-868.
[31] UKERC Investment in Electricity Generation report - http://www.ukerc.ac.uk/ResearchProgrammes/TechnologyandPolicyAssessment/TPAInvestingInPower.aspx
[32] COMMISSION STAFF WORKING DOCUMENT - The support of electricity from renewable energy sources. Accompanying document to the Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources {COM(2008) 19 final} http://register.consilium.europa.eu/pdf/en/08/st05/st05421-ad01.en08.pdf
[33] Energy White Paper 2003

In many respects this is a welcome shift, that aligns with UKERC's emphasis on evidence based policy and practice.

Q12: What (if any) changes are needed to the current electricity market regime to ensure that the proposed increase in renewables generation does not undermine security of electricity supplies, and how can greater flexibility and responsiveness be encouraged in the demand side?

UKERC stresses the need for further research into the variety of options for managing the network with large penetrations of renewable energy and nuclear, including much greater attention to both active demand side management and storage. There may well need to be further consideration of market support fo reserve capacity, possibly including investment support.

Chapter 4 – Heat

Q14: Are our assessments of the potential of renewable heat deployment correct?

To obtain 14% of UK heat from renewable sources is a very ambitious target. It is not clear to UKERC whether the UK has sufficient expertise and capability to deliver this target. Should renewable heat fail to deliver the target set then it is clear that transport and/or electricity will be required to take up the slack and therefore uncertainty in the heat target has significant knock on implications. There are several uncertainties relating to renewable heat that UKERC would like to draw attention to:

- Heat is a demand issue and thus differs from electricity
- The UK does not currently have a heat market
- Utility companies are not at all set up to think about an Obligation for heat.

The proposal for a Renewable Heat Incentive could potentially oblige energy suppliers to take on considerable additional responsibilities in terms of delivering the Government's energy policy objectives. Their ability to do so effectively depends crucially on the extent to which they form relationships, and are trusted by, their customers. There are risks in a policy portfolio which places heavy reliance on this small group of actors. The Government should examine the possibility of other institutional arrangements and a wider range of organisations playing a role in delivering the heat strategy, It is possible that local authorities, NGOs etc could play a wider and constructive delivery role in this policy domain.

To date UKERC research has focused upon microgeneration technology for heat and some conclusions from this work have been stated in this response. Future UKERC research, from 2009 onwards, will focus on accelerating the deployment of renewable heat. This project will investigate the reasons for the lack of take-up in the UK of renewable heat, particularly for district heating and biomass CHP, and identify how deployment can be accelerated. Interconnected heat networks could allow a diversity of heat loads to be exploited. The UKERC Combined Gas and Electricity Network model will be developed to allow analysis and simulation of renewable heat systems including biomass CHP systems and larger solar thermal systems. Necessary changes to policy and regulatory mechanisms, including market rules and incentives, will be investigated.

UKERC would like to comment specifically on heat pumps and solar hot water. Heat pumps are unlikely to have a major penetration into the residential sector before 2020. The same is true for solar hot water in that uptake is too slow, even where grant support is available. Therefore the estimates of potential for renewable heat are possibly overstated. It should also be noted that heat pumps use electricity to produce heat. Whilst the thermal energy delivered is certainly "renewable", the carbon implications are not so positive where grid-average electricity is used (0.43 kg CO_2/KWh). In this case a heat pump provides only a small carbon saving in comparison to that of a modern boiler.

UKERC has conducted research into the CO_2 savings of micro-CHP vs grid electricity for domestic heat and power[34]. The conclusion is that carbon emission reductions are no longer achieved by any micro-CHP under the least-cost operating strategy when the grid CO_2 rate falls below 0.3 kg CO_2/kWh[35] (see Figure 1). This clearly has ramifications for micro-CHP policy given the intent to progressively decarbonise the grid electricity.

[34] Hawkes A.D. (2008) "Policy and Regulation for Microgeneration in the UK" in UKERC Annual Assembly, June 26th, London UK.
[35] Results are based on an optimisation approach, where operating cost in minimised. Critical assumptions are a) technology is gas fuelled, b) energy prices are marginal London residential tariffs of 10.25p/kWh elect and 2.48p/kWh gas, buyback rate is 4p/kWh for exported electricity, c) gas embodies 0.19 kg CO2/kWh, and the grid consumption and credit rates are equal (horizontal axis of the Figure). Results are for an average existing terraced house (i.e. the median UK household w.r.t. energy consumption) and results will varying according to dwelling energy demand.

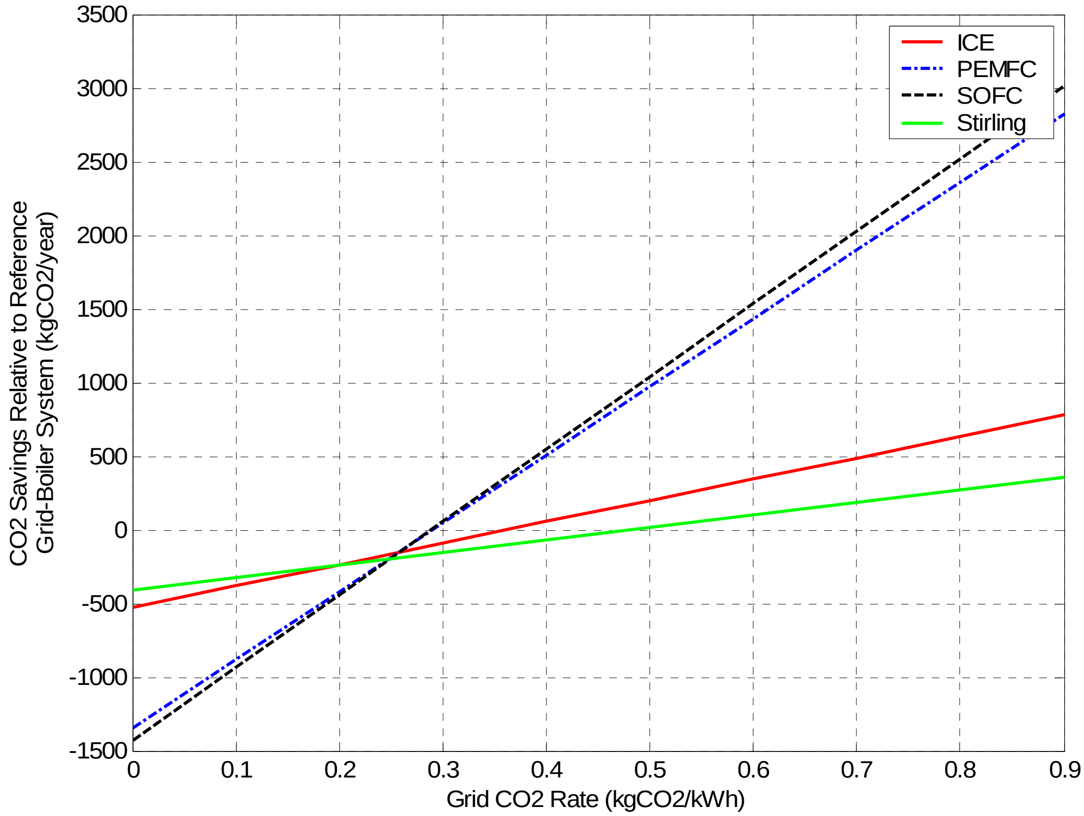

Figure 1: Sensitivity of Annual CO2 Emissions Reduction (kg CO2/year) to Emissions Credit Rate Granted for Onsite Generation (kg CO2/kWh) for 1kWe Micro-CHP Systems and Existing Terraced House Demand Scenario

Chapter 5 - Distributed Energy

Q19: Do you agree with our analysis of the mechanisms for support of small-scale renewable electricity?

UKERC is currently conducting a project into microgeneration for domestic use. The project has the following aims:

- To assess the suitability of various types of microgeneration technologies for application in domestic buildings.
- To examine the behavioural, regulatory and policy issues associated with introduction of microgeneration.
- To identify and address the research challenges that need to be overcome in order to promote microgeneration.

The project team is not due to report their findings until Spring 2009, however, they have raised some general points that are relevant to this consultation.

The conclusion of the RES consultation that that FiT gives more certainty to investors compared to RO is correct. It should be noted that "deemed" feed-in tariffs do not provide an incentive to operate equipment in a productive way, so reward should be based on metered output.

Q20: Given the analysis on the benefits, costs and potential, in what way and to what extent should we direct support to microgeneration electricity?

Renewable microgeneration electricity is likely to form only a small proportion of the 2020 energy mix. However, if decarbonisation of the residential sector is the goal (as opposed to meeting our 2020 renewables target), then microgeneration will be an important class of technologies. Therefore a mechanism to support renewable microgeneration electricity, in line with support for large scale renewables, is appropriate. However, it should be recognised that broader support for low carbon technologies in the residential sector will be required and it is important to understand how other policy instruments would fit with the proposed feed-in tariff.

A feed-in tariff for microgeneration electricity would not provide support across heating, electricity producing, and combined heat and power technologies. A suite of policy instruments is required that works across these energy vectors.

Q22: Do you agree with the Government's current position that it should not introduce statutory targets for microgeneration at this stage in its development?

Further research is required regarding transformational pathways for the residential sector as a whole, creating better understanding of the potential of microgeneration before targets defining targets.

Q23: What more could the Government do to incentivise retrofit of distributed energy technologies?

A feed-in tariff could provide a financial incentive for retrofit of electricity producing microgeneration technologies. Other options include low interest loans, or enabling ESCo-type arrangements between supplier and customer. In the near future, smart metering arrangements should be developed that specifically caters to the needs of stakeholders involved with microgeneration, as this could lead to better access to potential.

Chapter 6 – Transport

Q24: How can we best incentivise renewable and low-carbon transport in a sustainable and cost-effective way?

Liquid biofuels are a mature technology that has the potential to partially de-carbonise transport. In the UK the RTFO has been a success in that it has incentivised the delivery of nearly 3% biofuels (into the road transport fuels market). The RTFO data collected by the Renewable Fuels Association shows that 90% of biofuels used in the UK are imported from overseas and that the origin of around 32% of the fuels is unknown[36]. Only 30% of the biofuels currently used in the UK are known to meet the sustainability standards. The future of the RTFO is unclear as, the pull-back from the 2020 10% target, proposed in the UK and European Parliament, may act to slow development.

UKERC has completed a study[37] to assess the life cycle GHG costs of different biofuel chains ranging from first generation (based on food crops such as maize and soy) to that of second generation lignocellulosic resources for ethanol and other biologically based transport fuels. This research has revealed inadequacies in the systems developed to assess full life cycle GHG costs. UKERC makes three recommendations on the basis of this research:

- That sustainable transport fuels should be supplied on the basis of their whole life cycle energy costs (GHG).
- Further research should be carried out into developing methodologies to quantify the indirect impacts of biofuels on displaced land, as identified in the Gallagher review. International coordination is required in this area. The UK is leading on some of this thinking but better underpinning research is required particularly on GHG costs related to soils.
- Incentives for biofuels should rapidly move away from being volume supplied based towards being based on GHG savings. UKERC suggests that the European Parliament target of 45 % GHG reduction should be taken as standard. We agree with the option in Table 6.3 therefore, to amend the RTFO in line to use a GHG savings target, alongside a pull-back from the 2020 target of 10% to ensure sustainability criteria are met.

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36 http://www.dft.gov.uk/rfa/_db/_downloads/RFA_monthly_report_May_Jun_2008.xls

37 http://www.ukerc.ac.uk/Downloads/PDF/L/LifecycleAssesmentwp0408.pdf

Q25: What potential is there for the introduction of vehicles powered through the electricity grid in the UK? What impact would the widespread introduction of these kinds of vehicles have on:

energy demand and carbon emissions;

providing distributed storage capacity;

smoothing levels of electricity demand on the grid?

What factors would affect the scale and timing of these impacts?

The potential for electric vehicles to reduce carbon emissions, provide distributed storage capacity and smooth levels of electricity demand are widely discussed and generally agreed to be substantial. However, there has yet to be an effective trial to explore either the technical and social questions raised, or to support calculations of the potential benefits. The present Smart Metering trials appear to be focused on energy demand reduction with involvement of Electricity Suppliers but not Network or System Operators. The increased interest in electrical vehicles emphasises the importance of ensuring Smart Metering and Demand Side Participation contributes to energy use reduction directly but also to reducing the demand for T&D assets and reducing the carbon emissions of generating plant. An extended trial to gather data on the benefits of electric vehicles to the power system would be very useful.

In 2009 UKERC will start a project focussing on electric vehicles. This will investigate the likely deployment of electric vehicles including plug-in hybrids and how they can be integrated into a decarbonised energy supply system. We would be happy to discuss the scope and ambitions of this project with BERR.

Chapter 7 – Bioenergy

Q27: How can we best ensure that our use of biomass is sustainable?

The use of current standards such as the Forest Stewardship Council (FSC) standards for forestry should be discouraged and is not supported by UKERC. These standards exclude the use of GM trees for example, but such genetic resources may provide sustainable options for future food, fuel and ecosystem service provision as identified in the Millennium Development Goals[38]. Similarly the Roundtable for Sustainable Palm Oil has a focus on non-fuel use of oil palm. New and directed standards are required such as those being develop in the EU and across the Round Table for Biofuels and GBEP partnership. These will emerge and should underpin changes to the RTFO which in future should be focussed on GHG savings. The Government should be cautious in deploying stringent sustainability criteria for bioenergy that are currently not apparent for other agricultural outputs including food production, which is energy intensive.

Q28: How do you see the market for biomass developing to 2020? What are the implications for:

Imports

Imports will be central to the UK use of bioenergy, given the constraints imposed by land availability. Approximately half of UK bioenergy supply[39] (and 90% of the biofuels supply) is currently imported and this figure is likely to grow. Sustainability criteria in a global context present unique challenges that are not readily addressed by UK legislation and there is limited confidence that global standards can be achieved in the long-term given current world trade. Learning from the development of other international standards such as the Kyoto protocol and CDM gives us little hope for optimism. The UK is active and leading in many of these initiatives but their delivery remains problematic[40]. The UK must accept that this is a long and complex

[38] http://www.un.org/millenniumgoals/pdf/The%20Millennium%20Development%20Goals%20Report%202008.pdf

[39] http://www.defra.gov.uk/Environment/climatechange/uk/energy/renewablefuel/pdf/ukbiomassstrategy-0507.pdf

[40] http://www.globalbioenergy.org/

process and be prepared to commit considerable resource in this area over the coming decade.

Longer-term prices and costs

Long term predictions from climate change, food insecurity and land impoverishment suggest that biomass prices are likely to continue to rise in the future. Technology acceleration may to some extent balance this by reducing the cost of bioenergy production. It has been suggested that bioenergy crop yield should double in the next twenty years and this will reduce the cost of feedstock supply which will encourage continued deployment. Despite the central importance technology advance, limited research funding has been targeted in this area in the UK. Even with the recent £18M BBSRC initiative, the UK has committed little more than £50-70M in this area. This is a pressing issue for the immediate future if UK competitiveness is to be maintained.

Q32: What barriers exist to the cost-effective deployment of anaerobic digestion, biogas and the use of biomethane injected directly into the gas grid, and what are the options to address them?

Sweden and Finland provide a model for effective capture of biomethane with small farm digesters used to power farm vehicles and with feed-in as appropriate. The technology is mature but not deployed widely in the UK, but current Defra incentives and demonstration should provide some kick-start to the industry. This should be reviewed in 2-3 years to ensure that commercial developments have followed from these actions. Currently a lack of commercial investment acts as a bottle neck, but this may be overcome with these new incentives.

Q34: Are there issues constraining biomass supply and use other than sustainability, supply chain and information issues? How should these be tackled?

The use of biomass for heat and CHP was identified by the Biomass Task Force report as highly effective for GHG savings and so the comments on the development of decentralised CHP and support for heat through either incentive or obligation are welcome and critical to the industry and for capturing GHG savings. A timely decision with full stakeholder view is urgently required in this area.

Land use in the UK is a pressing issue that will be addressed in the Foresight Activity now underway. Land is a limited resource that has traditionally had a single focus. Green plants provide food, fuel and fibre as well as a number of ecosystem services such as water and soil carbon conservation. It is suggested that our future economy could be based on better, multi-purpose use of these resources in the face of climate change. Agencies involved in land curation, management and use could be better coordinated – Natural England, Forestry Commission, National Farmers Union and Environment Agency are major players here but still appear to have conflicting remits and targets at the very highest strategic level. Given that much of the biomass resource in the UK is within their domain, this should be addressed with some urgency. A suggestion would be the development of a cross cutting targeted 'biomass for bioenergy UK' group with a remit to include bringing policy together for multi-purpose land use alongside the realisation of the biorefinery concept.

Paragraph 7.5.14. suggests that the deployment of new bioenergy crops including non-native forest trees for short rotation intensive forestry is being considered. This recommendation should be viewed with caution. The evidence base provided by research in the 1980s and 1990s under the leadership of ETSU (Energy Technology Support Unit) and EU networks for energy crops should be examined. Several grass and tree crops were considered by these groups and this evidence should be re-assessed particularly if trees from non-native genera are being considered for planting since their impact on natural ecosystems can be extensive.

Chapter 8 – Innovation

Q35: How can we adapt the Renewables Obligation to ensure that it effectively supports emerging as well as existing renewable technologies? Are there more effective ways of achieving this?
Q36: Is there evidence that specific emerging renewable and associated technologies are not receiving an appropriate form of support?

The maturation and deployment of emerging renewable technologies such as wave and tidal-current generation would certainly benefit by their eligibility for multiple ROCs or through financial support in the form of a Feed-in Tariff. Whichever instrument is pursued or ultimately operates would be best to do so across all of the UK, and should provide the most stable and enduring support for the contracted plant. Variability in the future regional and time-value of ROCs and the wholesale price of electricity introduce uncertainty into the effectiveness or uptake of the measure.

Chapter 9 - Business Benefits

Q38: What more could the Government or other parties do to ensure that the UK secures the maximum business and employment benefits from the EU renewable energy target?

We believe that there are three ways in which Government can act to secure business and employment benefits:

1) the renewables targets across Europe are demanding. Supply chain constraints could have a significant impact on the speed of deployment. To ensure that investment comes to the UK (and to maximise the chance of meeting the targets in the first place), it is essential that Government takes urgent action on facilitative measures that dismantle barriers to renewables deployment. The obvious areas are: ensuring timely access to transmission capacity (including offshore) through regulatory procedures and investment in new capacity; reforming the planning regime to reduce investment delays; and sending clear signals to the market about the mechanisms for accelerating renewables deployment whatever form (obligation, feed-in tariff) these take.

2) by providing specific encouragement for those technologies where the UK enjoys comparative advantage in relation to other Member States. As a result of competences established through development of North Sea oil, these are mainly in the marine renewables (offshore wind, wave, tidal). Early action could place give the UK a “first mover advantage”.

3) To date, renewables deployment in the UK has focused on relatively large scale electricity generation options. The ambition of the EU targets suggest that a wider range of renewable technologies will need to be developed, including renewable heat and community–scale projects. There is considerable potential for local employment creation with technologies of this type. Exploiting the potential is perhaps more analogous to energy efficiency projects than to large-scale power generation. It is imperative that the Government works with the devolved administrations and the regions to build

up the skills and competences required to deliver on renewable heat and community–scale projects.

Chapter 10 - Wider impacts

Q39: Do you agree with our analysis of the likely impacts of the proposed increase in renewable deployment on:

Carbon dioxide emissions

We agree that the ambitious targets set for heat and transport, if achieved, will induce additional CO_2 savings of the magnitude set out in the consultation document. We believe however that the situation in the electricity sector is more complex than the consultation document suggests. First, at the micro level, it is clear that every kWh of electricity generated from renewables will result in lower carbon emissions than if the same kWh had been generated from fossil fuels, even after allowing for a small 'take back' in the form of emissions associated with fossil plant providing additional balancing services (typically of the order of 1% of emissions saved[41]). Second, it is correct to point out the importance of interactions with other policy instruments, particularly the EU ETS. If renewables deployment is increased while the ETS cap remains the same, then inevitably other measures will be displaced. However, these other measures might include the purchase of CDM credits so that actual European emissions might fall while emissions outside Europe would be higher than they would otherwise have been. To 'lock in' emissions savings from renewables, ETS caps should be tightened in the context of accelerated renewables deployment so that other cost-effective measures are not displaced. Third, it is important to point out longer-term dynamic effects. One of the purposes of a renewables deployment strategy is to accelerate innovation and drive down costs through learning by experience. Accelerating deployment should result in lower renewable costs in the future and hence open up the opportunity for more ambitious CO2 policies than might otherwise have been the case. The size of these dynamic effects is hard to assess because they result from the interaction of technology, economics and the policy-making process. Nevertheless, they should not be ignored. There is a reference to UKERC's work on technology acceleration in Chapter 8 of this response.

[41] UKERC report "The Costs and Impacts of Intermittency" - http://www.ukerc.ac.uk/ResearchProgrammes/TechnologyandPolicyAssessment/TPAProjectIntermittency.aspx

Security of supply

"Security of supply" has many interpretations. It is helpful to distinguish between the short-term reliability of electricity and gas networks and broader geo-political concerns arising from dependence on energy supplies from potentially unreliable sources. The Renewables Energy Strategy will diversify UK energy supply, reduce import dependence and hence enhance the geo-political dimensions of supply security. We do not share the view expressed in 10.4.11 that the RES by itself will create the certainty that will induce investment in wind, as well as the additional conventional plant needed to ensure an adequate capacity margin. The incentives for such conventional plant will come in the form of highly volatile "spiky" price signals sustained for short periods of time. It is not at all clear that business models supporting this type of investment will develop. We recommend investigation of different options for supporting the necessary investment including, possibly, capacity payments and further consultation with the utility companies (see also the UKERC answer to question 12). We are not aware of evidence relating to the resilience of bio-energy supply chains and suggest this is also an area for further investigation.

Energy prices and fuel poverty

We do not disagree with the analysis of impacts on energy prices, but note that there is considerably greater uncertainty about the costs of achieving the renewable heat targets than there is for renewable electricity. We believe there is an issue about the presentation of the impact on prices. The percentage increases appear to be presented relative to a counterfactual projection (the "status quo") rather than current prices (say for 2007). It is this that allows the case to be made that higher fossil fuel prices will lead to lower increases in bills. It is possible to be misled by this as, in the case of higher fossil fuel prices, the price of electricity in the counterfactual is likely also to be higher. Consumers are still likely to pay more for their electricity under a high fossil fuel price scenario. We believe it would be more transparent to measure price increases using the current year as the baseline or, alternatively, present details of the counterfactual cases. This would also be the relevant approach in estimating the (undoubtedly negative) impacts on fuel poverty.

Energy markets and investment

We believe that the ambitious nature of the renewable energy targets could inhibit or delay investment in other low-carbon electricity options such as nuclear or coal with carbon capture and storage (CCS). There are two reasons for this. One is the fact that the RES will depress the carbon price which is one of the mechanisms for incentivising low carbon generation. The other is that more volatile electricity markets will make it harder to justify investment in capital intensive options such as nuclear or CCS. We note that wind and nuclear are both “non-dispatchable” plant. It may be that with high levels of wind investment, the system will need to spill power on occasions when available generating capacity exceeds demand, thus effecting prices. This will weaken the financial case for investment in nuclear or CCS. In the longer term, the development of demand response (plug-in hybrid vehicles, electric space heating) and intelligent networks may square the circle in terms of having large investments in non-dispatchable plant, but this is unlikely to emerge to significant degree before 2020.

Annex 2: Feed-in tariffs for small-scale electricity generation

QA1: Do you agree with our assessment of the basic starting principles that feed-in tariffs for small-scale electricity generation should adhere to? Are there other principles you think we should consider?

UKERC feels that the basic principles are good, but that there are a number of questions that should be considered including;

- Is the instrument effective?
- Is the instrument cost-effective (in terms of CO_2 savings, diversification, and/or uptake of renewables)?
- Is the instrument easy to implement and administer?
- Does the instrument provide certainty to investors?
- Will the instrument stand up to the introduction of other production or performance-based incentives in the residential sector?
- Are there negative distributional consequences of a feed-in tariff?
- Is the instrument consistent with free market principles?
- Does the instrument engage consumers with their energy provision, giving the possibility of knock-on benefits?

QA2: What are your views on the option we have described? Factors we would like you to consider in your response include:

- **if there are problems with the option described or improvements you could suggest;**
- **if you can envisage a more effective way of implementing feed-in tariffs for small-scale electricity generation.**

The option described would probably be effective, although administration costs are a concern where each supplier must meter and report generation output, and the administrator must collate and settle amongst suppliers. Metering costs alone could be excessive. Also note that “deemed” output from microgenerators (which would avoid need for metering) would not provide incentive to maximise output from equipment.

QA3: Are there any other bodies or organisations that would be impacted by feed-in tariffs for small-scale electricity generation that we have not considered?

Construction and retrofit industries

These stakeholders will have less direct access to benefits (i.e. moving from grants to feed-in tariffs), because it is likely that there will be no support available up front.

Local councils and registered social landlords

These groups may encounter a split incentive if they do not have access to revenue from the feed-in tariff where they have installed microgeneration (e.g. through the Merton Rule).

Generators

In extreme cases substantial penetration of microgeneration could result in stranded assets.

QA4: Who do you think should have access to feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:

Different generation technologies

Renewable intermittent electric microgeneration. Care must be taken if dispatchable renewable generators are supported because there is potential for perverse incentives

Size of generation station

The rules that currently apply for connection and metering of microgeneration in dwellings should be used – up to 16Amps per phase (i.e. just less than 4kWe for a single phase connection).

Whether generation is primarily for own use, supply locally or for export

Generator should be connected to residential-level voltages (i.e. generation is for own use, and local distribution).

Whether generation is on or off-grid

Generation should be metered and serve a productive purpose.

QA5: Do you think it is reasonable to put in safeguards to limit the potential cost of feed-in tariffs for small-scale electricity generation, and if so how could those safeguards be set, and what would the access criteria be? Possible factors and criteria we would like you to consider include:

A limit on overall number of new installations in a given period

Possibly effective, but could cause the instrument to fail in a similar way to problems with LCBP support.

A limit on new installed capacity in a given period

Possibly effective, but could cause the instrument to fail in a similar way to problems with LCBP support.

Whether priority should be given to particular groups; for example, people in fuel poverty

This is unlikely to be effective as these groups probably won't adopt microgeneration. This is a challenging problem. The best approach would be to learn from other European examples and set the tariff appropriately.

QA6: How would we set the feed-in tariffs for small-scale electricity generation? Factors that we would like you to consider in your response include:

e.g. a building with wind turbines and solar panels

Initial cost and electricity production potential are the most important metrics to consider. If carbon savings are the aim of the instrument then there are better options than feed-in tariffs, particularly for the residential sector. Tariffs should vary by technology, and possibly by location (i.e. country, development agency, or local government differentiation).

QA7: What arrangements should apply to:

Currently existing small-scale renewable electricity installations

These installations should be supported (with possible exception of those that benefitted from other government support such as LCBP or CERT) because a powerful motivator for uptake in this sector is word-of-mouth. Therefore existing installations need to be able to report positive outcomes.

Installations which enter into operation before feed-in tariffs come into effect?

As above.

QA8: Do you think that financial markets will move to assist potential small-scale electricity generators with financing of the initial capital cost of renewable installations, or should we seek to introduce policies that will guarantee frontloaded support?

Investment support is a strong motivator, but production-based support may be a better tool to achieve policy aims. Therefore both are required, and front loading of support could be justified. A workable compromise is that a feed-in tariff is applied, but some output is "deemed" up front to provide capital cost support. Cost of deemed generation could be recovered progressively over the life of the unit by the supplier. Another possibly complimentary alternative is to continue CERT support for microgeneration, which may provide some capital cost support proportional to expected CO_2 reduction. The CERT and feed-in tariff combination could provide a powerful incentive, with supplier as one-stop-shop provider able to formulate business offerings as appropriate. Furthermore, it may be useful for the supplier to be able to decide how much of the expected generation is deemed up front, enabling them to tailor business offerings.