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Consultation on UK Renewable Energy Strategy

Response by Scientists for Global Responsibility

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About Scientists for Global Responsibility

- Scientists for Global Responsibility (SGR) is an independent UK-based membership organisation of approximately 1000 natural and social scientists, engineers, IT professionals and architects. We promote science, design and technology which contribute to peace, social justice, and environmental sustainability. As such, issues related to sustainable energy are of great concern to us.
- This response was compiled by members of SGR's National Co-ordinating Committee and staff with expertise in energy issues.
- For more information on SGR, see http://www.sgr.org.uk/

Key points of response

- We believe that the UK's renewable energy target for 2020 should be at least 15% and this should all come from sources deployed within the UK. The UK has a very large domestic potential for renewable energy and it will set a poor example if we opt to carry out part of our target abroad. We consider that the costs of meeting this target will be at the low end of the range discussed in the consultation document because: (a) fossil fuel prices (especially oil) are likely to be significantly higher than those projected; (b) major efforts to reduce demand will have had to be taken anyway if we are to achieve the necessary reduction in greenhouse gas emissions; and (c) the economic benefits to the UK of additional developments in the domestic renewable energy sector will be significant.
- Major improvements in energy efficiency are vital both in achieving the target proportion of renewable energy and in meeting greenhouse gas reduction targets. We welcome the recent government statement on support for domestic energy efficiency programmes, but believe even more is required, particularly on community based schemes.
- We believe that the 2020 target for renewable electricity should be at least 35%. This aim would be supported by wider adoption of efficient electrical heating and use of electric vehicles which can provide energy storage, easing the integration of a high proportion of intermittent renewables on the system. Thus, the renewable transport contribution needs to focus more on modal shift, energy-efficiency and electric/Plug-In-Hybrid vehicles rather than biofuels. Similarly, heat from efficient heat pump systems together with heat storage can reduce fossil fuel consumption with the present mix of energy sources and take power at times of surplus of supply on the grid.
- In mainland Europe, Feed In Tariffs (FITs) have been shown to be more effective in deploying renewable energy systems than the Renewables Obligation in the UK. We believe that all renewable generation should, in the medium term, come under a FIT regime with price profiles tailored to the state of development of the relevant energy source. In the immediate future, we believe FITs should be implemented for "on-site"

generation (including, but not restricted to, microgeneration) and for less fully developed technologies to improve their economic viability.
- As well as the renewable energy technologies currently being deployed, there are technologies under development, such as tidal flow devices and floating wind turbines which could have a large potential. The UK should take a major role in such developments, as well as in manufacturing of components and systems, particularly for wind power where there are supply chain constraints.
- Ambitious targets on renewable energy – if combined with strong energy efficiency measures – should not undermine attempts to tackle fuel poverty. It is unfortunate that we are only now starting to see the scale of action on energy efficiency needed to tackle both climate change and fuel poverty. Had these measures been brought in sooner, many of the current financial problems facing householders could have been avoided.
- We believe that the energy security benefits of more indigenous renewable energy are significantly greater than implied by the consultation document. The UK's foreign and military policies include major efforts to ensure continued access to energy sources abroad – a situation which has considerable financial, as well as ethical, costs. A greater reliance on indigenous renewables will have compensatory benefits, which could be realised in terms of lower spending on military technologies and deployment of military forces. Such resources (especially those in engineering) could be redeployed to assist the development and deployment of renewable energy technologies.
- Although renewable energy technologies and energy efficiency measures can achieve major reductions in CO_2 emissions, to meet the very large reductions required to minimise the risk of dangerous climate change, changes in lifestyle will also be needed.

Responses to Questions

Q 2 Meeting our RE target domestically or by deployment in other countries

We believe that the requirement should be for us to meet the 15% renewable energy target only from sources deployed within the UK. The UK has a very large domestic potential for renewable energy and it will set a poor example if we opt to carry out part of our target abroad.

In addition, we believe the UK should support proposals for a super-grid linking European countries (and possibly North Africa and the Middle East) to make optimum use of renewable energy sources (1).

We are disturbed by reports (BBC Today, 18.9.08) that the UK government is seeking within the EU to increase the proportion of its greenhouse gas emission reduction commitments that can be met by buying credits under schemes such as the Clean Development Mechanism to 50%. We believe that such a move would undermine our efforts in other areas, due to loopholes in such schemes. However, the UK should support, financially and technically, appropriate development of renewable energy in the least developed countries, over and above meeting our national targets. The UK should work to ensure that such technologies are widely available to these countries.

Q 3 Energy efficiency – most cost effective measures

A massive programme of home energy efficiency is needed, like the one in Germany where every home built before more stringent efficiency rules were imposed will be upgraded by a given date. To date, home energy efficiency programmes have been fragmented. We welcome the recent government statement on increased funding for domestic energy efficiency, but believe more needs to be done. The funding for the proposed Community

Energy Saving Programme (including Warm Zone schemes) where large numbers of homes in a given area are upgraded as a single project (thus reducing the cost compared with treating individual homes) should be increased. These schemes could be partly funded by an up-front grant to the householder, to be repaid over a number of years with the money saved on heating. Priority should be given to hard-to-heat homes (e.g. with non-cavity walls or off-gas-grid).

We believe there is a large potential for energy reduction in the transport sector, both by improved facilities for cycling and walking, integrated public transport as well as improved efficiency in conventionally powered vehicles and downsizing of cars in face of increased fuel costs. A system of transport nodes (served by rail or high-speed coach) near to but outside urban areas, with low cost electric cars available for hire would allow convenient and energy efficient travel for many journeys.

Q 4 Potential for different renewables technologies

The technologies most likely to make the major contribution to meeting the renewable energy target are on-shore and off-shore wind (as indicated in fig 2 of the consultation document). On-shore wind generation costs are broadly comparable with conventional generation at its current prices (2), although there are some current cost increases due to supply chain shortages: these are likely to be overcome as production capacity grows. Off-shore wind, for which the UK has a huge potential, has higher costs at present. However, these should reduce due to advances in technology and decreasing connection costs due to increases in the size of clusters of turbines. Floating wind turbines are being developed by a number of companies. These turbines can be sited in much deeper water where the wind is stronger and more consistent, and would have reduced installation costs. This concept is being tested by StatoilHydro in Norway and others, who believe that the costs will be significantly lower than sea-bed mounted wind turbines (3), particularly if installed in large clusters to minimise the connection costs. The UK should support further development of this technology. Given the greater depth at which these devices could be installed, the total energy potential is very large in relation to current UK energy demand – larger than assumed in the government assessment.

Tidal stream devices have advantages over a fixed barrier (such as the Severn barrage) in having less environmental impact, and they can be installed incrementally. Also, if installed at a number of locations round the UK coast, the overall output would be less variable than with a single barrage. Some assessments of tidal stream devices indicate that the energy extracted using a high density of these devices could be significantly more than generally assumed, up to 20GW (4). This is because high density deployment leads to a small reduction in the speed of the tidal current, significantly reducing the energy dissipated by friction on the bed of the flow channel. This is a technology whose development the UK should continue to fully support. Other tidal energy devices which should be rapidly assessed and deployed where appropriate include lagoons and tidal fences (5).

Q 7 Reduction of constraints on renewable energy

Other countries such as Germany do not have such strict limits for radar interference caused by wind farms. We suggest that the demands made by the Ministry of Defence are not justified in security terms and the limits should be relaxed.

Q 9 Reducing supply chain constraints

We welcome the increased commitment to supporting and building the skills base in the low carbon manufacturing sector outlined in the newly published BERR strategy document, "Manufacturing: New challenges, new opportunities". We hope this will be carried through to maximise the deployment of UK renewable energy technologies and energy efficiency technologies.

Q 10 The Renewables Obligation

Feed-in tariffs (FITs) in mainland Europe have been shown (6) to be more effective than the Renewables Obligation in the UK in supporting the deployment of renewables. For example, by 2004, Germany had installed 12,000MW of wind power under a FIT type of regime compared with 600MW in the UK under our Renewables Obligation, and the delivered price of renewable electricity in Germany was 6.6 to 8.8 Euro cents compared with 9.6 Euro cents in the UK. Other mainland European countries also had significantly lower costs under FIT regimes.

We believe that FITs should be introduced for all generation in the medium to longer term. Hence we support a phased move to the use of FITs across the sector. However, in the short term, for reasons of practicality, we accept the continued use of the Renewables Obligation for large generators and for well developed renewable energy technologies. Nevertheless FITs should be implemented as soon as possible for "on-site" generation (including, but not restricted to, microgeneration) and for less fully developed technologies such as wave power to improve their economic viability. (FITs lead to less uncertainty in the economic return thus reducing the return required on capital, a crucial factor in the cost of renewables). We believe such a move would lead to a rapid expansion in this area – well beyond that envisaged in the consultation document.

Q 12 Maintaining security of electricity supply and demand side management

There should be no significant problems in managing the proportion of intermittent renewables likely to be installed before 2020. The UK Energy Research Centre (7) following an analysis of a large number of international studies showed that the costs of coping with 20% of electricity from intermittent renewables would be 0.5 to 0.8p/kWh, i.e. less than 1% on customers' electricity costs. National Grid (8) indicated the balancing cost for 40% supplied by wind would be £6 to £12 per customer per year, equivalent to ~1.5 to 3%. It should be noted that the seasonal variations in average wind energy match the seasonal variations in demand. Wide geographical dispersion of wind generation (and indeed of tidal stream systems) would reduce the variations in total power output. The small individual units and this spread of output variations would not need additional spinning reserve (with its parasitic energy losses) to take up a sudden loss of generating capacity. (Such capacity is currently sized to cope with the loss of 1,200MW, i.e. the Sizewell B nuclear reactor, the largest single unit on the grid).

The output of tidal power systems is variable but fully predictable, thus the need for any standing reserve can be planned for in advance. If required, pumped storage capability can be incorporated into tidal barrier schemes such as lagoons. In addition to the Dinorwig pumped storage scheme in North Wales, hydro-electric systems such as those in Scotland, with some modifications, could provide pumped storage capability. The price paid for electricity supplied to the grid varies hugely between different times, so having more control over when power can be dispatched is very valuable.

There are a number of demand side management (DSM) methods to enhance stability of the grid. The use of interruptible tariffs (already widely used in industry) could be increased to include domestic customers. Such tariffs with pricing structures to discourage electricity use at times of stress on the grid would ease the integration of intermittent renewables. Many appliances (fridges, freezers, washing machines, tumble dryers, immersion heaters) can be timed for off-peak use, or fitted with "dynamic demand" devices sensitive to small reductions in grid frequency. Although significant standby reserve capacity would need to be maintained if we had a very high proportion of variable or intermittent renewables, much standby capacity already exists in many organisations, e.g. diesel generators which can be started remotely. However, the number of hours per year this standby capacity would be needed to operate has been shown to be low. Thus the objectives of reducing reliance on scarce fossil fuels and reducing CO_2 emissions are not seriously compromised.

In addition, electrical heating and electric vehicles, which are becoming more attractive due to recent advances in technology and increases in energy costs, can be used in ways to balance demand against supply in a situation with a high proportion of intermittent renewables on the grid (see responses to Q 14 and Q 25). Although at present, the problem is more one of installing enough renewable electricity generation, such technologies for electrically powered heat and transport could give more confidence that renewables will not be squeezed out if further nuclear power stations were to compete for space on the system at periods of low demand.

Q 13 Realising the potential for CHP

The large potential of Combined Heat and Power (CHP) has not been fully exploited in the UK. The current and likely future high cost of fuel will make the economics of CHP more favourable, as the additional capital costs will be offset by larger fuel cost savings. Pipework for district heating should be incorporated into all new housing schemes, to allow a variety of efficient energy sources (eg from CHP, biomass or heat-pumps) to be used. The cost of doing this at the time of initial construction, as opposed to retrofit, is low. To encourage community and district heating, legislation should be put in place enabling an energy supplier to have a monopoly for a given period to supply heat, at prices no greater than the average from alternative heat sources. As local networks develop, they can be linked to larger CHP plants.

Q 14 Renewable heat

New buildings should be designed to make maximum use of passive solar energy by favourable orientation of windows, combined with variable shading to limit solar gain in hot weather: this represents an optimal use of renewable energy at minimal cost. All new homes should be provided with solar water heating – large scale of production and installation at the time of building would radically reduce costs.

Given the present high cost of gas, the economics of electrical heating using heat pumps are improved, with the greater capital costs being offset by the greater efficiency in the use of primary energy. In a building with a high area of heating surface relative to the heat load so that the heating water temperature can be quite low, ground source heat pumps can have a coefficient of performance of up to four. Given that modern combined cycle gas turbine power plants have an efficiency of ~55%, the overall effectiveness of using energy from this source would be ~2.5 times that of direct use of gas with typical domestic boiler efficiency. Thermal storage can provide flexibility in when energy is needed, increasing the proportion of intermittent renewables that can be accommodated. Heat pumps and heat stores are cheaper for community heating schemes than for individual dwellings. Their greatest benefit would be in buildings off the gas grid or high rise apartments where gas cannot be used.

In the medium to long term there could be a high proportion of intermittent low carbon power generation capacity with near zero marginal costs, such as wind and tidal systems. A significant capacity of efficient heat pump systems with controllable heat storage capacity, by its flexibility and ability to take power at periods of surplus supply over demand, could ease the integration of intermittent renewables into the electricity supply system (see appendix).

Q 18 Renewables for off-gas-grid buildings

Off-gas-grid buildings, where heating costs tend to be high, should be a priority for energy efficiency improvements and biomass or heat-pump heating, as outlined above.

Q 24 Incentives for renewable and low-carbon energy sources for transport

Serious questions have been raised over whether current use of transport biofuels can be considered sustainable, given evidence of their contribution to deforestation and food insecurity and a lack of clarity over their savings in greenhouse gas emissions over their full lifecycle. We believe that biofuels should only be used when they have met clear standards in these three areas. However, monitoring to ensure this is the case may be difficult. The first report from the Renewable Fuels Agency stated that the country of origin and feedstock of only 57% of biofuels is known, and only 19% met environmental standards (9). The report also said the 42% greenhouse gas savings achieved did not account for indirect effects of land use changes, as recommended by the recent Gallagher review (10). Clearly there are needs for much improvement in this area before positive incentives for first generation biofuels are considered. We agree with the need to assess the developments in second generation biofuels, which, in principle could be more acceptable than first generation biofuels. The proportion of transport energy that can be provided by biofuels will depend upon the outcome of such assessments.

To encourage the development of renewable and low carbon energy use for transport, the government should indicate that a favourable tax and duty regime will be maintained for electrical powered transport for a sufficient period to ensure take up of the technology and development of the charging infrastructure. At current petrol or diesel prices (before tax), the much greater energy efficiency of electrically driven vehicles compared with internal combustion engines would make their operating costs significantly less than petrol or diesel vehicles even on the basis of relatively expensive renewable input to the system (see appendix). The effects of a large deployment of electrically powered transport on energy demand, distribution and storage capacity and demand smoothing are discussed in response Q 25 below.

Q 25 Potential for deployment of electrically powered vehicles

In a situation where oil prices are likely to be high, and where a relatively high proportion of electricity will come from low carbon sources, electrical power could have a greater role in transport, both directly for rail, trams and trolleybuses, and for battery powered vehicles. The latter are now becoming more practical with the development of advanced batteries. A particular development is the plug-in hybrid (PIH) vehicle, whose power source is a mains-chargeable battery combined with a downsized internal combustion (IC) engine. The battery supplies the energy for journeys up to a few tens of kilometres, while the IC engine is used to extend the range when required. Several manufacturers are intending to market these in the next few years (11). There would be an important advantage in having a relatively large fleet of battery electric vehicles and PIHs in a situation with a high proportion of intermittent renewables supplying the grid. This would be that the vehicles can be charged at times of surplus power available on the grid, and feed power back into the grid when connected to a charging point and when the vehicle use cycle allows this. In the case of a long period of power deficit, PIHs could run on their IC engines.

Even during the winter period of maximum demand on the electricity grid, in the night hours when most charging of electrical vehicles would take place, there is a surplus capacity in the electrical supply system of several tens of GW. Thus a large fleet of electric vehicle vehicles would not require strengthening of the supply network (see appendix).

Q 26 Timescale for deployment of electric vehicles

The government could accelerate the introduction of electric vehicles as outlined in response Q 24 above. The technology for electric vehicles and PIHs is likely to be available for widespread roll out within a few years (see response Q 25 above).

Q 32 Anaerobic digestion, biogas and biomethane

Bio-gas can be produced by anaerobic digestion from biomass or municipal waste, and this can be used for heating – either locally or when processed to produce bio-methane, distributed via the gas mains. Biogas from municipal waste is being used in Lille to power a high proportion of the city's buses (12). The UK seems to be far behind some other countries in exploiting this technology, and efforts are needed to remedy this.

Q 35 The Renewables Obligation and support mechanisms for emerging technologies

We favour a Feed-in Tariff for emerging renewable energy technologies to provide greater financial certainty to technology developers (see Q 10). Our discussions with professionals in this area indicate such an option is preferred.

Q 37 Barriers to the development of renewable technologies

We believe that the funding for renewable energy R&D in the UK should be markedly increased. We note that no figures were given in the consultation document for the total annual amount of this funding (e.g. in Table 8.1). The latest figures available in the International Energy Agency's R&D database – for 2005 – put this amount at £37 million (13). This is far too small and a strong case can be made for it to be an order of magnitude higher. While we acknowledge that there have been significant increases since 2005, we are very concerned that current funding for R&D in low carbon energy is too focussed on improved fossil fuel use and nuclear fission and fusion. In addition to a major increase in R&D funding for renewable energy, we also urge transparent and up-to-date funding figures to be published so progress can be monitored.

In this context, we note also that the Ministry of Defence's annual R&D budget is around £2.5 billion (14). Given the security benefits of renewable energy (see Q 39 below), we believe a strong case can be made for some of the MoD's finance (and the associated skills) to be redirected to renewable energy.

Q 39 CO_2 emissions, local environment, energy security, prices the economy, and fuel poverty

CO_2 emissions. The consultation is primarily about meeting a given proportion of renewables by a given date. This could be achieved with some increase in overall energy demand and a high installation of renewable energy capacity, or a smaller energy demand and a proportionate renewables capacity. However, the latter situation would emit less CO_2, and in practice, would make it easier to increase the proportion of renewables. Thus, energy efficiency and conservation are vital in overall energy policy.

Local environmental effects. The main local environmental impact of wind turbines (the leading near-term renewable energy source) is principally its visual impact. While wind farm location must be chosen with sensitivity, we believe that in principle, the long term and probably irreversible environmental damage due to climate change which renewable energy can help mitigate, must take priority. This view is also held by the Royal Society for the Protection of Birds and other conservation bodies.

Energy security (and related economics). We believe that the government is too optimistic in its estimates of the future costs of fossil fuels, especially oil and gas. For example, the oil price used to produce the mid-range cost estimate for the renewable energy expansion is only $70/bbl in 2020. We believe this to be far too low, given the rapidly increasing demand from the countries such as China and India, and the apparent difficulty or unwillingness of many oil and gas producing countries to increase their exports due to technical constraints or bigger domestic demand (15).

The CEO of leading oil corporation, Total, has recently stated that oil supplies are likely to peak sooner than previous predictions (16). In addition, many of the major suppliers of oil and gas are countries which are not especially well disposed to the West or are subject to political instability (such as Russia and some Middle Eastern countries). China is buying oil rights in a number of African countries and elsewhere. These factors lead us to believe that the aims of the UK's policy for secure and affordable energy are highly unlikely to be met with the present strategy of reliance on a global supply of fossil fuels being consistently available at reasonable prices. This means that the economic benefits of a move towards much greater levels of renewable energy deployment are likely to be more positive than outlined in the consultation document, especially if greater priority is put on developing the indigenous renewables industry.

Conflicts over oil and gas seem increasingly likely unless energy importing countries can greatly reduce their dependence on supplies from unstable or potentially unfriendly countries. The UK's foreign and military policies include significant efforts to ensure continued access to energy sources abroad – a situation which has considerable financial, as well as ethical, costs. A greater reliance on indigenous renewables will have compensatory benefits, which could be realised in terms of lower spending on military technologies and deployment of military forces. Such resources (especially those in engineering) could be redeployed to assist the development and deployment of renewable energy technologies. Potentially, several billion pounds per year could be made available this way (17).

Most renewable energy sources are dispersed and do not provide an attractive target for terrorist action – unlike for example, nuclear or LNG installations. The need for energy security in the widest sense gives a further powerful reason for developing as quickly as possible the UK and EU renewable energy resources.

Fuel Poverty. Energy prices to consumers are likely to continue to rise, so fuel poverty should be addressed in two main ways. Firstly, there needs to be greater urgency in providing energy efficiency measures to lower income households. Secondly, pensions and benefits should be linked to a prices index which better reflects the high proportion of income which people on low incomes spend on essentials including fuel.

Q 41 Overall approach to renewable energy strategy

Technology can deliver large reductions in CO_2 emissions and reduced dependence on scarce imported fuels. We have discussed above the ways in which renewable energy sources can contribute to achieving such benefits. However, significant changes in lifestyle will also be needed to obtain the order of CO_2 emission reductions (~80% or more) that will be required by industrialised countries like the UK, if they are to contribute an equitable share of the global action required to avoid dangerous climate change. The government should be preparing the public for a future without unlimited supplies of low cost energy, so that people's long term decisions on what products to buy and where to live in relation to travel requirements are made in this context. The emphasis in government policies should be to achieving a high quality of life rather than excessive focus on increasing GDP.

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Appendix - Potential for electric vehicle and electric heating market penetration

This note provides scoping calculations to indicate the scale of market penetration of electric vehicle and electric heating by high efficiency heat pumps with heat storage that is possible technically without increasing the capacity of the electricity generating, transmission and distribution systems. In the context of renewable energy strategy, this would be of interest in providing a load profile which could accept a high proportion of intermittent renewables in the generating system.

Electric vehicles

There is a strong case for more electrification of the rail network and ultra-light urban transport systems, on grounds of efficiency and diversity of primary energy sources. However, this note concentrates on electric vehicles using batteries, as being most relevant to making use of electricity at times when there is a surplus of supply on the grid. These vehicles are pure electric vehicles, with present technology likely to be most suited for use cycles of limited range (city cars, delivery vehicles), and plug-in hybrids (PIHs) where the range possible on batteries alone between charges is typically a few tens of km and an internal combustion engine can extend the range when required.

Average fuel consumption of vehicles with most vehicles complying with the EU CO_2 emissions regime is taken as ~5litres/100km.
1 litre petrol = 35MJ. Thermal energy consumption = 35x5 = 175MJ/100km

Average vehicle use ~18000km/year = 50km/day: energy use per day = 175/2 = 87MJ

Assuming efficiency of Internal Combustion Engine drive train is ~30% and electric drive (including losses in battery charging) ~75%, the average electricity demand per 24 hours is 87x30/75 = 35MJ
If this is taken over an 8 hour charging period, i.e. 8x3600 = 28800seconds, the power demand is 35x1000/28800 = 1.2kW

In the season of peak electrical demand (i.e. winter months) during the night hours the demand is ~30GW below the system's capacity. Take this to be ~20GW average available over 8 hours, this power could supply ~ 20,000,000/1.2 =17M vehicles.

In practice, pure electric vehicles are likely to be somewhat smaller than average car, and PIHs might use electricity for, say 2/3 of their mileage. Thus the total number of vehicles could be greater. PIHs are likely to be more efficient than conventional vehicles even when running on petroleum fuels, because of the potential for radically downsizing the engine, energy recuperation from braking etc.

This indicates that capacity of "off peak" electricity is not a constraint on the large scale deployment of electric vehicles, and leaves room for some electric heating (See below).
Relative vehicle operating costs, on present fuel and energy prices

Petrol at £1.15 per litre, cost is £1.15x5 = £5.75 per 100km

Electricity use (taking account of efficiency of ICE and electric drive trains, see above) is 175x30/75 = 70MJ/100km
Off peak, typical cost is 5.5p/kWh = £0.055x1000/3600 per MJ = £0.015/MJ
Cost per 100km = £70x0.015 = £1.07 per 100km.

Unless some means of taxing electricity used for transport were introduced, this cost difference provides a good incentive for electric vehicle and PIH use. This off-peak electricity price would cover the average generating cost of wind generation plus small marginal cost for transmission and distribution.

Heating

In the season of peak electrical demand (ie winter months) during the night hours the demand is ~30GW below the system's capacity. In terms of energy per 24 hours, take this to be 20GWx8 hours = 160GWh = 160,000,000kWh

Assuming new homes to be highly efficient and energy efficiency measures have been applied to a high proportion of existing homes, for average size house, heating demand is taken as 120kWh (thermal) per day.

If efficient heat pump/heating systems are used, a coefficient of performance up to 4 possible. With a margin, assume 3.5 is achieved on average. Thus electricity requirement is 120/3.5 kWh/day = 34kWh/day

In principle, the "off-peak" capacity could supply 160,000,000/34 = 4.7M homes.

In practice, the economics to the consumer are likely to be attractive mainly in dwellings not supplied by gas – e.g. off gas grid homes and high rise apartments, which currently have high energy costs.