RENEWABLE ENERGY STRATEGY

1 The Royal Society of Edinburgh (RSE) is pleased to respond to the Department for Business, Enterprise & Regulatory Reform (DBERR) consultation on a *Renewable Energy Strategy*. We fully recognise that the Strategy is timely for the UK, and from our viewpoint as Scotland's National Academy, will have major implications for Scotland, particularly as the Strategy envisages, subject to planning permission, that a large proportion of onshore wind development will take place in Scotland. The current consultation is extremely important given the issues arising at the UK, European and global political levels, particularly given the climate change imperative. It also represents an important opportunity for government to engage with the public on an issue of the highest priority. Professor Geoffrey Boulton, RSE General Secretary, has approved the following response

2 Displacing or supplementing fossil derived energy with renewable derived energy is a truly formidable challenge because of the scale of the problem, the incompatibility of infrastructure required and the complex interactions between technical, policy and economic aspects.

3 With the need for large-scale replacement of electricity generating plant in Scotland and the UK within the next ten years, as well as the challenging targets that have been agreed by the EU on renewable energy, decisions on the viable options are urgently needed. Our overall targets should be to minimise emissions and cost, and to maximise energy security, sustainability and the economic benefit we might gain through exploitation of our R&D and manufacturing capacity irrespective of the ultimate source of energy. This response will focus on the key issues that will have to be considered in preparing an energy strategy for the future that will meet the challenges that already exist as well as those that will be encountered in tackling climate change and ensuing security of energy supply. In this context we would like to draw to the attention of DBERR the activities undertaken by the RSE on energy and the importance that it has attached to this area in its recent work, not least its wide-ranging major Inquiry Report into *Energy Issues for Scotland* (2006) and follow-on activities[1]. The RSE has also responded to a number of consultations[2] on renewable energy and wider energy policy, and these responses will also be relevant to the issues that DBERR is consulting on. We recommend that DBERR fully consider this body of work in order to develop the UK's energy policy and assist in formulating the structure of a renewable energy strategy.

4 Although we are acutely aware that electricity represents about one-fifth of energy use in the UK, and the renewable energy strategy contains a range of possible measures to encourage deployment of renewable energy – across electricity, heat and transport – by 2020; at this point we would also like to draw DBERR's attention to electricity generation statistics for Scotland. This is important given the statements in the document that a high proportion of renewable energy will be renewable electricity and a significant contribution is expected of Scotland in this regard. The RSE provided a briefing to the Scottish Parliament Economy, Energy and Tourism Committee earlier this year when that Committee was developing its remit for its Inquiry, *Determining and delivering Scotland's energy future*[3]. When we met with members of the Committee it was apparent that there is misunderstanding and sometimes misinformation in relation to the proportion of electricity delivered by Scottish generators, in particular the actual contribution in GWh delivered from renewable sources (especially sources of variable output such as wind) which must be considered in addition to the installed capacity for generation. In the light of the meeting the Committee indicated that it would be extremely useful if it could have access to robust data on electricity generation, particularly from renewable sources. Professor Jim Macdonald FRSE and the Institute for Energy and Environment at the University of Strathclyde collated such data on behalf of the RSE. It is included as an appendix to this paper.

1 RSE Inquiry into Energy Issues for Scotland; June 2006 RSE Energy for Scotland: A Call for Action; May 2007 http://www.royalsoced.org.uk/enquiries/energy/index.htm

2 Relevant consultation responses are referenced at the end of this response. Responses are available at RSE Consultation responses and Policy Statements: http://www.royalsoced.org.uk/govt_responses/2008_files.htm

3 http://www.scottish.parliament.uk/s3/committees/eet/inquiries/energyFuture/index.htm

ENERGY STRATEGY

5 The Scottish Government has substantial powers to determine energy strategy through its responsibility for promotion of renewable energy, encouragement of energy efficiency, and its powers to grant consent of new electricity generation and transmission infrastructure. With these responsibilities in mind, we understand that the Scottish Government intends to publish shortly its own draft Renewable Energy Framework for consultation. In these respects it is crucial that there are open lines of communication and wider connectivity at the Scottish and UK levels to ensure that there is a joined-up approach and alignment of energy policy.

6 In its Report of 2006 the RSE strongly recommended that there should be an energy strategy for Scotland, although this should be nested, for maximum impact and efficiency, within those aspects of energy responsibility shared between the UK and Scottish Governments, and bearing in mind that the European dimension is becoming increasingly important. We remain of the view that a comprehensive and integrated strategy for energy is an urgent priority and should be developed soon. Such a strategy should re-assure the public and industry that decisions on all aspects of energy are contained within a clearly articulated framework, rather than in an ad hoc and uncoordinated manner, as has been perceived to be the case in the past. In its Report the RSE proposed the strategic aim of – **a secure, competitive, socially equitable and low carbon emissions supply of energy for Scotland**, comprising policy objectives that embrace energy efficiency and energy savings, ensure energy availability, and capitalise on the natural energy resources of Scotland in an economically viable and environmentally sensitive way. The strategic aim is equally applicable to the UK.

7 The RSE wholeheartedly agrees with DBERR that a diversity of energy sources is absolutely essential and this was a key recommendation of the RSE's Report. There is no "silver bullet" and all available sources and technologies will need to be considered as part of the energy "mix", including renewables, clean technologies for fossil fuels and nuclear powered generation. We strongly emphasise that a diversity of supply is essential to achieve maximum security and flexibility. Partitioning of thinking with regard to technology options and choices should be avoided as there are interesting opportunities for making progress towards a much higher degree of sustainability. To prepare for the longer term, investment in the development of alternative sources and cleaner technologies is essential.

REDUCING DEMAND FOR ENERGY AND ENERGY EFFICIENCY

8 We also agree that a key strand of energy strategy must be reducing the demand for energy as well as increasing energy efficiency. In its Report the RSE identified the need for an improvement in the efficient use of energy in reducing the use of fossil fuels in space and water heating, and in transport. Reductions in total energy demand, both in terms of demand reduction and improved efficiency, will produce proportional reductions in the overall energy required. Demand-side reduction is an incredibly important but complex area and effective cross-cutting engagement and action across government departments is essential. The possibilities for energy savings are enormous but the primary obstacle is behavioural change. Behaviour change requires a package of education, information and financial incentive measures. Whilst energy efficiency is important, and can be stimulated through regulation, the focus must be on demand reduction, bearing in mind that there is frequently a rebound effect in domestic usage. An example of this would be the driver who replaces a car with a fuel-efficient model, only to take advantage of its cheaper running costs to drive further and more often. Rebound effects in commercial usage are not inevitable if the objective is to reduce cost. Therefore, it is important that rebound effects are factored into policy assessments.

RENEWABLE ENERGY

9 The majority of the UK's natural resources in wind, hydro, marine and biomass energy are found in the north of the UK. This is illustrated by the fact that 50% of the UK renewable energy production is sourced from Scotland[4]. The consultation correctly points out that renewable sources of energy are a key contributor to energy supply needs because they reduce "whole life" CO2 emissions from overall electricity production and also crucially, increase the diversity of fuel resources and hence security of supply. The Scottish Government has recently increased its challenging target for the proportion of Scotland's electricity to be generated from renewables from 40% to 50% by 2020. Furthermore, according to the current consultation on the Renewable Energy Strategy, subject to planning permission, there is an expectation that a large proportion of onshore wind development will take place in Scotland. Consequently, there are significant prospects as well as challenges for Scotland in utilising its natural resources as components of the energy mix. It must be recognised that abundance of resource does not necessarily result in its utilisation as that resource must be harnessed efficiently and at a competitive cost.

10 The exploitation of renewable energy offers significant opportunities for economic growth from manufacture and export, as well as providing employment in site development, management and maintenance. At present there is a realistic prospect for Scotland to develop a leading marine renewables industry, but this will only flourish if the right environment, including maximising bureaucratic efficiency, is provided: a substantial domestic market, with stable trading conditions to encourage steady growth. Initial costs will be high and technical risk significant. Both will reduce over time as the industry matures. The experiences of wind power exploitation are relevant here. A sizeable public investment is required in the early stages, with financial returns beginning to emerge after perhaps ten years. In the case of wave technology, devices that have been developed and demonstrated are highly subsidised. The *Pelamis* project in Portugal, which has just gone live, is subject to a guaranteed price for its electricity for 15 years.

11 Basic research, e.g. into wave behaviour, needs to be enlarged, while development and implementation costs are mostly prohibitive. Uncertainty about real future costs, particularly the installation, operating and maintenance costs is a major problem. Turbine prices are increasing as global demand expands, reliability is uncertain and raw material prices are high. It is important that work take place to establish whether some of the above risks can be mitigated, by a regime of capital grants and adjustments to economic instruments.

12 With regard to the deployment of offshore wind, wave and tidal technology, ultimately, the gap between capital costs, expected operational costs and revenue still remains too large for substantial industrial commitment, without improvements in the ROC system. The ROCs regime is designed to be technology neutral and encourage diversity of electricity generation. However, undifferentiated ROCs will always lead to industry employing the lowest cost option. As a result, onshore wind turbines have become commercially viable, but this mechanism has not stimulated development of other renewable sources other than for local use. The RSE has commented on the ROCs regime and "banding" of support levels in its Report of 2006 as well as in recent consultation responses[5].

13 Most of this evidence is concerned with electricity supply. This is symptomatic of the history of energy policy in the UK, where the supply of heat is largely ignored. We agree with DBERR that a much more detailed consideration of heat supply, followed by innovation, is needed in Scotland and the UK. This could, for example, be 1) in the use of biofuels for heating in rural regions off the gas grid, 2) in the use of 'waste' heat to supply local industries within 30km of existing large power plants, 3) the design of integrated district heating as part of the planning process during re-developments such as east Glasgow. All of these aspects are well established in Scandinavian countries. As we understand it, renewable heat is a devolved matter for the Scottish Government and the Forum for Renewable Energy Development in Scotland (FREDS) Renewable Heat Group has recently reported[6] and identified recommendations

4 The Energy Technologies Partnership, Expression of Interest in Support of the UK Energy Technologies Institute; February 2007

5 Select Committee on Economic Affairs Inquiry into *The Economics of Renewable Energy*; June 2008; Scottish Government preliminary consultation on the *Introduction of Banding to the Renewables Obligation* (Scotland); July 2008

6 Renewable Heat Group Report (FREDS) 2008; *Scotland's Renewable Heat Strategy: Recommendations to Scottish Ministers*

for the key components of a Scottish renewable heat strategy, including the structure of the market, technologies review and mechanisms for supporting renewable heat. We recommend that DBERR and Scottish Ministers consider the findings of the Report with a view to bringing forward a renewable heat strategy.

14 As part of this there would also need to be greater use of local energy sources which are capable of reducing costs, reducing environmental impact and increasing security of supply, and resilience to fuel supply shortages or centralised supply and distribution outages. There is considerable opportunity for distributed energy systems in many parts of Scotland to create semi-autonomous networks. This could range from large-scale district heating or CHP in the major settlements to microgeneration facilities utilising renewable energy sources in the remoter areas of the mainland and on the islands. The statutory planning framework has not been effective in promoting the use of waste energy, or the development of district heating and CHP schemes. The utilisation of substantial waste heat from industrial processes or from power generation should be stimulated. We commend the innovative initiatives in Lerwick and Wick and new technologies available for obtaining energy from domestic and other waste.

PLANNING ISSUES

15 The planning system, public consultation and the democratic process generally, specifically in relation to onshore wind farms, form the greatest barriers to increased deployment of renewables. We recognise that DBERR is seeking to address some of the concerns that have arisen from the planning system through the Planning Bill, whereby onshore wind developments above 50MW in England and Wales will be considered by a new Infrastructure Planning Commission. However, it is still envisaged that there will be a large number of developments under 50MW and these should also be subject to a more efficient planning regime.

16 The locations of renewable energy devices, and in particular onshore wind turbine installations, are controversial because of their impact. We are particularly concerned that decisions on the location of renewable energy facilities are taken on an ad hoc basis using the town and country planning system which was not designed for this purpose. We agree that measures could be deployed to support onshore renewable developments within the context of a reformed planning regime and we strongly support the recommendation of the RSE Energy Inquiry on the need for a locational strategy for renewable energy and this argument is strengthened by the proposals from DBERR in relation to onshore wind development in Scotland. There are signs that this position may change with the advent of the draft National Planning Framework in Scotland but many applications have been through a planning system which was not designed to cope with the volume of applications and has not been updated to allow effective representation by objectors or speedier decision making which is in the interests of all parties. A strategy for the location of renewable energy installations is still urgently needed.

17 We are heartened that DBERR recognises that communities should see local benefits in renewables developments. In terms of developments impinging on communities, natural heritage and the environment, perhaps some form of compensation or reparation payment could be developed to ensure that the impact is kept to a minimum and those directly affected can derive direct benefit. As examples, the Shetland Islands receive income from the North Sea oil revenues that has contributed to an improved economic state and infrastructure, and in Denmark, local attitudes to onshore wind installations softened substantially when electricity costs were reduced to hosting communities.

GRID ISSUES

18 Grid access, connections and transmission infrastructure, and the technical difficulties in maintaining quality of supply in remote areas, are very prominent barriers, particularly to realising Scotland's renewable potential. Wherever and by whatever means electricity is generated, it must be delivered to the market. The greater the diversity and distribution of generating plant the greater the need for investment in grid development and increased in-grid management costs. The significant sources of renewable energy tend to be remote from major demand centres and grid access points, thus requiring heavy investment in EHV grid extensions and consequential delays to connection. In terms of the 'GB Queue', which mainly exists in Scotland, there are approximately 9.3 GW of wind energy applications awaiting connection[7]. Commitment and investment to fund network development is necessary to unlock generation projects. In the longer-term, in remote areas where the transmission capacity is constrained there may need to be a review of security standards in some cases if renewable resources are to be fully exploited. In the immediate term, the Transmission Access Review (TAR) should to result in better access and operation arrangements in practice and provide greater certainty and incentivisation to all those involved. Government, Ofgem, National Grid Company and industry need to take this work forward and review progress against the objectives. New technology and adaptation will be required for multi-directional flows of power in HV distribution systems where renewables are closer to load centres.

19 However, Scotland as a whole and the remoter areas in particular, are additionally disadvantaged by the locational charging scheme operated by the National Grid Company with the agreement of Ofgem. This could act as a disincentive to increasing renewable energy developments in Scotland. Previous attempts to have this modified to equalise costs have failed and it is essential that this situation is reconsidered. We recommend that the DBERR and the National Grid Company reduce the disadvantage of remote locations to supply electricity from renewable sources to UK consumers.

20 The two large Grid infrastructure projects with major implications for Scotland are the proposed transmission line upgrade between Beauly and Denny, and the North-South transmission system upgrade. Currently the flow from Scotland to England is limited to 2.2 GW. We are pleased that DBERR is working on a new Offshore Transmission Regime as this will increasingly become important if the UK is to make inroads into meeting the EU target. It is important that careful consideration is given now as to how we want the offshore grid structure to develop to ensure offshore resources are harnessed efficiently.

21 Ultimately, it is crucial that decisions for investment in the grid infrastructure are made timeously by the industry, regulators and government to lead the connection of renewable generation technologies and ensure coordination of construction activities to avoid stranded assets. Without major changes to the Grid system renewable energy will be unable to make the contribution necessary to meet the UK and Scotland's long-term aspirations.

ENERGY STORAGE

22 Major research, development and demonstration in energy storage technologies is needed to meet the needs of increasing intermittent renewables in the system and to balance supply and demand. Pumped storage hydroelectricity is the only proven large scale energy storage mechanism and has been operating for decades. Pumped storage offers a crucial back-up facility at periods of high demand due to its flexibility and could be used to store power from intermittent generators at periods of low demand. If renewable electricity from wind, wave and tidal power continues to develop, as envisaged by the consultation, there is the possibility of large over production at off-peak periods. This must either be stored, sold or dumped. There is scope for integration into the overall supply strategy – for example cheap off-peak electric heating for fuel-poverty households, or recharge of batteries for electric and hybrid vehicles to displace transport emissions.

7 *Renewable electricity – generation technologies*; Innovation, Universities, Science and Skills Committee; Fifth Report of Session 2007-08; June 2008

23 Electrochemical technologies provide some of the most practical solutions. For larger scales, redox flow fuel cells have particular potential and are being developed by Plurion in Scotland with support from ITI Energy. For smaller stationary applications and mobile applications in particular, modern battery technology, based on either lithium or on nickel-metal-hydride is being considered. There is considerable expertise in this field in Scotland in St Andrew's University.

TRANSPORT

24 Transport fuel is primarily oil based and in its Report of 2006 the RSE indicated that most commentators consider that oil-based resources will remain the main fuel source for the next 25 years, with gradual market penetration of biofuels, hybrid engines, and hydrogen. Any energy strategy for the transport sector should focus primarily on the reduction in carbon and other greenhouse gases, and in higher fuel efficiency; these two components should go hand-in-hand. In its Report the RSE considered that a range of incentives and restrictions are needed to stimulate the market for hybrid engines, technologies to capture energy from otherwise wasted sources such as braking, incentives for higher car occupancy, and measures to reduce speed in order to reduce consumption. In terms of public transport, there is also a need for more flexible fleets capable of adjusting to variable levels of passenger use, especially at off-peak periods. We recognise it will take time for new vehicles and new fuels to become commonplace and the need for joint working with the motor industry and other relevant stakeholders.

25 There is potential in hydrogen as an energy vector for transport applications in the longer term provided that it is produced from low carbon emissions sources. Widespread applications of hydrogen technology require major investment in production, transport and storage infrastructure, and stimulation of demand. More medium term use of hydrogen for transport includes using it in a normal combustion engine. Public transport is particularly amenable to hydrogen fuel cell implementation as there is much less need for a distribution network and storage in buses is easier to implement. The major European HyFLEET:CUTE[8] project involves the operation of hydrogen fuel cell powered buses as well as hydrogen powered internal combustion engine buses in cities around the world and also focuses on the development and testing of hydrogen refuelling infrastructure. Also, despite its relatively small scale, the PURE Energy Centre on Unst is involved in the research and development of hydrogen technologies, and has utilised wind power to extract hydrogen from sea water and use it in conjunction with a fuel cell. However, the problem of hydrogen storage is the primary issue and work on identifying hydrogen storage materials continues worldwide, including here in Scotland. The Hydrogen Energy Group established by FREDS reported[9] on opportunities for Scotland in this area.

26 In terms of the potential from biofuel, current biofuel (biodiesel, bioethanol) production is proven technology and therefore provides a basis for production of non-fossil transport fuels. The Royal Society of London recently published a comprehensive report[10] on the science and technology prospects of delivering efficient biofuels for transport in the broader context of environmental protection and sustainability. That Report shows that biofuels are potentially an important part of the future although the existing policy frameworks and targets may not result in greenhouse gas reductions and wider environmental and social benefits. It is a very complex picture as different biofuels have widely different environmental, social and economic impacts. Whole cycle analysis is required for the different biofuels to assist in determining these impacts. Future biofuels are likely to be produced from a much broader range of feedstocks, including agricultural by-products and domestic vegetable waste. Advances in the conversion process will improve the efficiency of producing biofuels. We urge DBERR to fully consider the Royal Society of London's Report.

8 http://www.global-hydrogen-bus-platform.com/Home

9 Hydrogen and Fuel Cell Opportunities for Scotland; Hydrogen Energy Group (FREDS); 2006

10 Sustainable Biofuels: Prospects and Challenges; January 2008

INNOVATION AND SKILLS

27 In terms of the average annual per capita R&D spending on renewables 1990-2005, it was a little over 0.3 Euros in the UK while in Spain it was about 0.5 Euros, Japan about 0.9 Euros and Germany almost 1 Euro[11]. More publicly funded UK R&D could improve matters if carefully expended. Ironically, the rising price of oil and other commodities could alleviate the uncompetitiveness of renewables. Research, development and demonstration of projects are paramount and these aspects should be built-in to a programme and not treated in isolation to one another. The real benefit of full scale demonstrators is their potential to provide confidence in a technology.

28 A major hindrance and threat to the development and commercialisation of energy technologies in the UK is the lack of technically-skilled people. There is a deficit below requirements in those studying and graduating in engineering as they once did. This is equally true for energy engineering, and must be addressed if the UK is to meet its challenging targets for renewable energy. As part of this, the government must investigate the skills crisis and introduce initiatives to act as a catalyst to introduce new students to energy-related discipline areas. The Innovation, Universities, Science and Skills Committee has been undertaking a wide-ranging inquiry into engineering and the findings are eagerly awaited. In Scotland, some effort has also been made by the Scottish Enterprise, High Technology Talent Strategy Board. The government's Knowledge Transfer Partnership programme is a most effective enabler for knowledge transfer and a flagship programme could usefully be established in the area of new and renewable energy systems. Such an initiative would both bridge the industry/academia gap and help with the training of new graduates.

11 IEA energy R&D database (Euros based on 2005 prices)

ADDITIONAL INFORMATION AND REFERENCES

This submission does not necessarily represent the views of all of the Fellowship.

In responding to this consultation the Society would like to draw attention to the following Royal Society of Edinburgh responses which are of relevance to this subject:

- The Royal Society of Edinburgh's *Inquiry into Energy Issues for Scotland* (June 2006)
- The Royal Society of Edinburgh's *Energy for Scotland: A Call for Action* (May 2007)
- The Royal Society of Edinburgh's submission to the Select Committee on Science and Technology Inquiry into *Renewable Energy-Generation Technologies* (July 2007)
- The Royal Society of Edinburgh's submission to the Select Committee on Economic Affairs Inquiry into *The Economics of Renewable Energy* (June 2008)
- The Royal Society of Edinburgh's submission to the Scottish Government *Introduction of Banding to the Renewables Obligation* (Scotland) – Preliminary Consultation (July 2008)
- The Royal Society of Edinburgh's submission to the Scottish Parliament Economy, Energy and Tourism Committee Inquiry, *Determining and delivering Scotland's energy future* (August 2008)
- The Royal Society of Edinburgh's Inquiry into *the Future of Scotland's Hills and Islands* (September 2008)

Any enquiries about this submission and others should be addressed to the RSE's Consultations Officer, Mr William Hardie (email: evidenceadvice@royalsoced.org.uk).

Responses are published on the RSE website (www.royalsoced.org.uk).

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