Enterprise and Culture Committee

6th Report 2004

Renewable Energy in Scotland

SP Paper 194 £11.20 Session 2 (2004)

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Remit and Membership

Remit:

To consider and report on matters relating to the Scottish economy, business and industry, energy, training, further and higher education, lifelong learning and such other matters as fall within the responsibility of the Minister for Enterprise and Lifelong Learning; and matters relating to tourism, culture and sport and such other matters as fall within the responsibility of the Minister for Tourism, Culture and Sport.

Membership:

Alasdair Morgan (Convener)

Brian Adam

Mr Richard Baker

Chris Ballance

Susan Deacon

Murdo Fraser

Christine May

Mr Jamie Stone

Mike Watson (Deputy Convener)

Committee Clerking Team:

Clerk to the Committee

Simon Watkins

Senior Assistant Clerk

Judith Evans

Assistant Clerk

Seán Wixted

1. The Committee reports to the Parliament as follows-

THE ARGUMENT

Introduction

2. The exploitation of Scotland's renewable energy resources is one of the biggest challenges facing the nation.

3. Scotland is uniquely positioned to exploit a range of renewable resources; a successful renewables policy can contribute as much to the nation's economic growth, particularly in more marginal areas, as it can to environmental policy.

4. The increasing evidence of global climate change and the damage caused by greenhouse gas emissions create an urgent stimulus for action. The UK is committed to meet the Kyoto targets for reducing these, and Scotland must play its part.

5. We also now live in a much less certain world in terms of geopolitics and energy supply. The UK, to give one example, will become a net importer of gas in 2005 and of oil in 2010, much of it from politically less stable parts of the world. There is now an imperative for an effective renewables policy, not just to be `green', but also to keep the lights on. This would have been unthinkable only 5 years ago.

6. The Enterprise and Culture Committee is wholly supportive of the Executive's ambitious renewable energy targets. Throughout its inquiry it has sought to examine whether the targets will be met and whether the Executive is effectively exploiting the potential for renewable energy to achieve them.

7. The inquiry has therefore focussed on electricity generation, to which the targets apply. The Committee has not examined energy conservation in any great depth, although some evidence was received on the issue and it is an essential component of a sustainable energy policy. Neither has the Committee taken substantial evidence on other aspects of renewable energy production for transport or space and water heating, although these are touched upon in the report.

8. Renewable energy is an issue that affects all of us. For this reason we have set out to present the core of our report in as coherent and readable way as possible.

THE CURRENT SITUATION: 2010 TARGETS

Meeting Targets

9. The Executive has set a target of 18% of electricity generated in Scotland to be from renewable sources by 2010, and an `aspirational' target of 40% by 2020. Current generation from renewable sources stands at around 12% of the total.

10. **It is clear from the evidence that the Committee has taken that the Executive will meet its short term target of 18% of electricity from renewable sources by 2010.**

11. **However, this increase will come almost entirely from onshore wind generation, which raises a number of major issues in relation to the future of renewable energy in Scotland.**

THE RELIANCE ON WIND

12. The construction of onshore wind farms is the easiest and cheapest way for the energy supply companies to meet their targets for renewable generation under the Renewable Obligations (Scotland) (ROS) scheme. It requires only existing, tried technology, and is technically straight-forward to construct.

13. As a result, there has been a rapid development of wind power by the generating companies over the last two years. Respondents to the Executive's consultation on renewable energy warned that this would happen - and it has. Today 255MW[1] is delivered to the grid by wind farms - by the end of 2005 this will be almost 700MW.

14. The live applications before planning authorities, if they were all built, could provide twice the energy required to meet the Executive's target in 2010. Progress in other forms of renewable energy generation has not kept pace.

15. **The Renewables Obligation (Scotland) scheme has been successful, but in a single direction - that of promoting onshore wind power. It has led to the invigoration of the market for wind power by energy companies, but without developing other sectors. Whilst this may be welcome in terms of meeting targets, it has raised concerns over the merits of wind power and has not stimulated other renewables generating technologies to a significant degree. By focussing power companies' attention on wind, it may even have hindered the commercialisation of other renewable technologies.**

16. This is a significant issue for a number of reasons which are outlined below.

Economic Impact

17. There are excellent examples of significant local economic benefit arising from

wind power development. Jobs that are created in rural areas, are often disproportionately important. As part of the inquiry, the Committee visited the Vestas wind turbine plant at Machrihanish, which now employs almost 300 people.

18. The Vestas development is a very welcome one, but there appears to be limited scope for increasing the economic benefit of wind power to Scotland. The dominant companies in this field are foreign, particularly Danish. So far most of the equipment bought has been `off the shelf' and this brings relatively little benefit to the Scottish economy. In particular, the increase in higher value jobs will not be as significant as it would otherwise be if the firms were domiciled in Scotland.

19. Electricity is of course a Scottish export, so there are benefits that accrue to Scotland in term of income and jobs, particularly as the major power companies are still significantly Scottish-domiciled. There are also of course indirect economic effects and benefits from a shift to renewables, such as reduction in the costs of dealing with pollution from fossil fuels or other conventional technologies. These are real benefits, although much harder to quantify.

Neglecting Other Renewables Technologies

20. The energy companies, operating under the quasi-market conditions created for them by the Executive, are putting very substantial investments into certain types of wind energy. It is the obvious, sensible, low-risk, smart commercial decision. But the effect is that other technologies are being starved of the level of investment which would allow them to develop and compete. Substantial sums of public money are being invested to manipulate the electricity generating market for public good; however at present that investment is going almost exclusively into onshore wind.

21. **The Executive's current renewables policy is unintentionally working against the development of renewable energy sources other than onshore wind.**

Creating Vulnerability

22. **This over-reliance on one source of renewable energy is not good energy policy.**

23. Energy policy should seek to develop a number of different sources of energy to protect security of supply and allow energy to be drawn from different sources under different conditions. An effective policy will also include efforts to reduce our demand for energy by incorporating energy efficiency measures.

24. In this respect the reliance on large onshore wind farms generates an additional problem due to its dependence on appropriate meteorological conditions and the potentially intermittent nature of wind energy generation.

25. Whilst it is unlikely that poor generating conditions will exist across the entire country at any one time, this is an issue that needs to be considered.

26. Whilst Scotland can draw on energy sources beyond its borders, this is limited by

the inter-connector (the main electricity grid link to England), and we should not therefore be in a situation where we rely too heavily on onshore wind power.

27. **The Executive's 40% renewables target for 2020 must not be met entirely from large onshore wind farms - at the moment we are unable to say with certainty that this will not be the case.**

Public Reaction to Wind Farms

28. There is significant opposition to onshore wind farm development in many areas in Scotland. However, it would be a mistake to assume that this opposition is universal, and the Committee has received equally persuasive evidence from voices supporting their development.

29. Some of the arguments put forward against wind farm developments carry more substance than others. There will be situations where individuals' concerns relate fundamentally to self-interest and where initial fears may not be borne out in practice. There will be other cases where wind farm developments will genuinely impact negatively on nationally or regionally important areas. There are good locations for wind farms, and there are poor ones.

30. The Committee firmly supports the Executive's commitment to increase renewable energy generation and believes that onshore wind must form an important part of that increased capacity. To achieve this there will need to be more onshore wind farms. However, there does currently appear to be a proliferation of large onshore wind farm proposals concentrated in sensitive geographical areas, with which the planning system is struggling to cope.

31. **All those affected - developers, local authorities, objectors - believe that there are major weaknesses in the current planning system and a lack of clear guidance from the Executive.**

32. The system simply cannot cope with the scale of applications or the pace of change - there will be a 40% increase in the total number of wind farms this year alone. It is time for a new approach.

33. **The Executive must take an active lead and develop a national strategic framework for wind farm applications, and engage with local authorities on how to deliver this within their areas. This could include arriving at agreements with local authorities as to their contribution to meeting the energy targets, and extending guidance.**

34. There are a number of advantages to this approach. It should lead to a reduction in the level of speculative applications, and could allow more local discretion and decision-making, resulting in speedier and more sensitive decisions. The current review of the planning process provides an ideal opportunity to achieve this. All planning fees, even those currently paid to the Scottish Executive, should be paid to local authorities.

35. Crucially, if more effort and investment were to be devoted to other renewables

technologies, the requirement for the growth in the number of large onshore wind farms would reduce and their siting could be more selective and considerate of the views of local communities.

THE NEED FOR A SCOTTISH ENERGY POLICY: 2020 TARGETS

Meeting Targets

36. The Scottish Executive's current renewables policy is working in the narrow sense that it is promoting the rapid expansion of renewable energy in the form of onshore wind farms. The 2010 target will be met. However, in the medium term the policy is unsustainable and will not capitalise on the enormous economic opportunities that are presented by renewable energy.

37. **As things stand, if the Executive's 40% renewables target for 2020 is to be met, it will be almost entirely through onshore wind power. This is neither sustainable nor sensible.**

The Need for a Policy

38. Energy policy overall is of course a reserved issue, and the energy market is essentially a UK one, with some energy being bought and sold across borders. However, the Executive has responsibility for renewable energy policy, and therefore, in effect has already created a de facto Scottish energy policy through the introduction of the Renewables Obligation (Scotland) scheme. Energy sectors are inter-dependent, and the introduction of the ROS has already had a profound impact on the Scottish energy market. This is clear from all the evidence received in the inquiry.

39. The energy market in Scotland and our needs are profoundly different from those of England. The energy mix, the scale and location of demand, the siting of power plants, topography - all are different. This is already evident from renewables policies north and south of the border. The UK renewables target for 2010 was 10%, compared to 18% in Scotland, and is 20% for 2020, compared to 40% for Scotland. A different, explicit yet complementary and co-ordinated energy policy is required in Scotland.

40. **The Executive should therefore accept the reality of the situation and create a comprehensive Scottish energy policy, which would take account of the UK context and the areas in which it operates in co-operation with Westminster.**

41. The policy should identify the most appropriate and balanced mix of energy supply technologies as well as comprehensive energy efficiency and demand reduction measures.

ELEMENTS OF THE POLICY

A New Renewables Obligation (Scotland)

42. The first element of an energy policy should be a revised Renewables Obligation. The Executive is currently planning to review the ROS in 2005-6. This is too late - it needs to be done now. There has been rapid change since the system was introduced in April 2002, and it is already out of date.

43. The initial ROS has already had an enormous impact on the Scottish energy market, but almost solely in promoting onshore wind power. The situation needs to be rectified now to avoid further damage being done by, for instance, squeezing out other new renewables technologies such as wave and tidal power, biomass and biofuel, offshore wind, etc.

44. **The ROS needs to be refined into a more sophisticated policy tool that allows other types of renewable energy to be incentivised, not just onshore wind.**

45. This requires careful manipulation of the market and close co-operation with the UK Government, the power companies, technology suppliers, developers and financiers. However, there are a number of pressing reasons why it must be done.

Green Jobs

46. **Scotland is in a unique position to be able to create significant numbers of green jobs through encouraging and investing in leading edge renewables technologies.**

47. Scotland has natural resources unrivalled in Europe for the generation of energy from marine sources. This is new technology with several countries vying for control of the market. Portugal, for instance, is making a determined attempt to become the leader in the marine sector.

48. Whoever wins this competition will enjoy major economic benefits, as the technology spreads around the world. We can lead the world and reap the benefits if we invest now. There are potentially jobs in research and development, design, manufacturing, export, licensing, consultancy, in fact in almost every area of the economy. The Executive estimates that the total number of jobs in renewables will increase at least 10-fold over the next 15 years. The number of jobs created will vary according to how successful we are in promoting the technology - in the marine sector for instance estimates of the number of jobs vary from a few hundred to 24,000 by 2015, depending on the level of investment.

49. **The Committee believes that the opportunities and potential benefits presented by the renewables energy sector are so great that the Executive should be prepared to invest significantly in the sector. It should be treated as a priority sector by the enterprise networks and the full range of business support mechanisms should be brought to bear on its development. In circumstances where the private sector is risk averse the Scottish Executive should take the lead.**

50. Scottish Enterprise has of course created the Intermediate Technology Institutes, one of which is for energy and has an annual budget of £15m. This is welcome, but it is not enough. The £15m is spread across the whole of the energy sector, which is of course substantial in Scotland, and there will be potential draws on it from many other technologies in the oil and gas industries.

51. Developing the sector is not just about throwing money at it, and a refinement of the ROS should have a major impact in encouraging private investment. But the Executive must prioritise the renewables sector, and use all the tools at its disposal to ensure that it succeeds, from proof of concept funding to assisting the commercialisation of technology. This should include looking at the skills aspects of developing the sector, since concerns were raised in evidence that the supply of skilled workers could be a constraint on its expansion. There is also a need to maximise the match-funding available from the European Union in its various research and technological development programmes.

52. **This is one of the big opportunities facing the Scottish economy, and one of the major challenges facing the Scottish Executive as a whole. Great rewards can be reaped through a more effective linkage of economic and energy policy. A Scottish energy policy could help to achieve this.**

Alternatives to Onshore Wind Power

53. **The energy policy should seek to shift the focus from large onshore wind farms to other forms of renewable power.**

54. If it is successful in this, it will create jobs, since there is more scope for `home-grown' jobs within these others sectors.

55. **Marine** renewables energy generation appears to offer the greatest potential for further development. Scotland has a leading competitive position in this sector and can become to wave and tidal power what Denmark is to wind power. Impressive steps have already been taken, such as the establishment of the European Marine Energy Centre in Orkney, but more needs to be done to reinforce Scotland's position.

56. Through its extensive commercial forests and coal deposits Scotland is also well resourced with the raw materials for the exploitation of energy production from **biomass,** both on a small and a large scale. There is significant scope for increasing the number of `co-firing' biomass plants and for much greater use of carbon sequestration technology[2]. Scotland could realistically aim to promote these to the level of importance these technologies enjoy in Denmark or Germany. In addition, co-firing has significant potential as a technology for use with other forms of waste, for instance oil. Biofuels can also be used in combination with waste to generate power.

57. The drawback of intermittency which affects wind power also means that effective renewable energy storage mechanisms must be developed or renewables will never be able to reach their full potential. Scotland has already developed a unique cluster of companies and academics in the field of **hydrogen fuel cell technology** which does exactly this. The commercialisation of this technology

should be a focus for investment by the Executive and a part of the energy policy.

58. **Offshore wind** farms, depending on their location, do not suffer from many of the drawbacks attributed to some of those onshore. However, there do appear to be some barriers to further development around Scotland under current and foreseeable technologies. There are of course also barriers to the linkage of offshore sites to the national grid in some areas, but these problems affect many renewables sources and a fundamental rethinking of the grid strategy may be necessary in any case. It would probably be unrealistic to expect offshore wind to contribute much further to the achievement of the Executive's 2010 target, although a contribution could be made by 2020.

59. **Community-developed wind farms -** There are a growing number of developments which have been brought forward in co-operation with local communities, or whose genesis lies with the local community itself. The Committee has been impressed by a number of these schemes and by agency work in support of them, and by how successful this approach has been abroad. In many ways this may represent the future for onshore wind generation. It is another area which could benefit from the concentration of further resources and expertise.

60. **Other renewables -** The potential of micro renewables, such as solar panels and small wind turbines, should also not be over-looked. Micro wind turbines now have the capability to supply SMEs as well as domestic demand, and solar panels for water and space heating are becoming much more widespread. The scale of these technologies means that they will currently have a limited impact on meeting the renewables targets, but there is the potential for a significant culture change in this area as they become more commonly adopted by individuals. By contrast the potential for major hydro developments has largely been exploited, although a limited number of smaller schemes and efficiency upgrades can contribute to the growth of renewable energy production.

Security of Supply Issues

61. If the Executive's current policy continues for much longer there is a real risk that, within the renewables sector, there will be an over-reliance on wind energy which will threaten the security of supply. A wind energy component of 20% of electricity generation has been reached in Denmark, for instance, but no country has gone beyond this to date.

62. At present there is no preferred mix of renewable energy sources specified by the Executive. Rather the market has been left, with the incentives created by the ROS scheme, to find its own solutions. This is seen as a technology neutral strategy, but it is not - it favours onshore wind, because it is cheaper and relatively risk free. This situation cannot be allowed to continue unchecked. The Executive must establish what is the reasonable upper limit for wind as part of the energy mix, beyond which security of supply is threatened. It must begin to give indications within a coherent energy policy of how it sees the contribution of each source and also of energy efficiency measures.

Energy Conservation

63. **Energy conservation must be a key part of a Scottish energy policy, and the policy should include targets for conservation.**

64. Scotland is again different from the rest of the UK in that our climate means that there are greater benefits to be had from, for instance, building insulation. Scotland's model for energy conservation should be the Scandinavian states, who are many years ahead of us in this area.

Sustainable Energy

65. **The Scottish Executive should consider ways of incorporating sustainable energy in all public procurement. The need for the use of sustainable energy should be reflected in all arrangements for Best Value and Public Private Partnerships.**

The Grid

66. **A new energy policy must also include a view on the future of the national grid in Scotland.**

67. The current grid was created under a twentieth century model of energy generation linking it to a relatively small number of big power plants, predominantly located on the coast. That model is having to be rethought as the pattern of generation changes with the advent of renewables. The grid is being turned on its head. Currently it is a major barrier to the long-term development of renewables.

68. As with various other elements of energy policy, the Executive does not have control of the grid. Nevertheless, it must set out its vision, to assist in creating a policy framework for the power companies, the owners of the grid and generators. That vision must include Executive support for sensitive infrastructure projects to open up access to renewables generating sites, and the encouragement of a similar view from Ofgem, for instance regarding the Beauly-Denny transmission line upgrading.

69. There may be significant environmental impacts from these kinds of upgrades and a significant body of objections, similar to those for wind farms, both of which must be carefully handled. However, it is also important, given its importance to the future of renewables, that the Executive takes a lead on the issue and ensures that local and national interests are considered in planning decisions on grid upgrades.

70. The Executive should also challenge the orthodoxy of grid management and prompt its operators to manage the grid in new ways. There may be solutions other than heavy engineering ones that can increase its capacity. We can learn from others who are developing this philosophy in North America and elsewhere.

Non-Renewables

71. However successful the renewables policy is in the coming years, at least 60% of Scotland's energy will still need to be generated from non-renewable sources. It has not been the purpose of this inquiry to examine this or to speculate on an appropriate overall energy mix.

72. There are very difficult decisions to be taken on the future of energy generation from nuclear and fossil fuel sources and some of them will have to be taken quite soon. It is important that Governments face up to their responsibilities in this regard and do not delay decisions which could undermine future energy supply. Under any scenario, advantage should be taken of the major opportunities that exist to produce cleaner and more efficient energy within conventional thermal generation.

CONCLUSION

73. Potentially, renewable energy has a very bright future in Scotland. It can be a major contributor to our energy supplies and it can help tackle global environmental problems. It can deliver some security for the future and it can deliver huge economic benefits, including jobs and exports. However, if it is to do this it will require a more concerted effort by the Scottish Executive and the creation of a coherent Scottish energy policy.

SUMMARY OF EVIDENCE

INTRODUCTION

Remit and definitions

74. The remit agreed by the Committee for the inquiry was:

"To inquire into the development of renewable energy in Scotland. Specifically, the Committee will wish to ask the following questions, which are intended to be illustrative rather than prescriptive:

· Will the Executive targets be met, under current circumstances, and are they appropriate?

- how were they arrived at by the Executive?

- what is the relationship with UK targets?

- have assumptions been made about the contributions of different sectors?

- what are the opportunities and implications for the economy in achieving the targets?

- what are the implications if the Executive's targets are not met?

· If not, why not? (What are the current barriers, and what action needs to be

taken to ensure that the targets are met?)

- global issues

- the Renewables Obligation (Scotland) and the UK energy legislative framework

- the electricity market

- the transmission network (inc. the Scottish national grid)

- local issues

- What opportunities are there/should there be for local community involvement in, and economic benefit from, renewable energy schemes?

- examination by sector

- onshore wind (inc. planning issues, community development)

- offshore wind (inc. UK strategy, role for energy ITI?)

- wave/tidal (inc. technology issues, job potential)

- hydroelectric

- biomass

- other/longer-term (e.g. emerging technology, non-electricity)

· Are there implications for the reliability of supply if the Executive's aspirational target is met?'

75. The UK statutory definitions of fossil fuels and renewable energy are as follows:[3]

"fossil fuel means coal, substances produced directly or indirectly from coal, lignite, natural gas, crude liquid petroleum, or petroleum products"

"renewable sources means sources of energy other than fossil fuel or nuclear fuel, but includes waste of which not more than a specified proportion is waste which is, or is derived from, fossil fuel."

76. At the beginning of this inquiry the Committee agreed that it wanted to hear from as wide a selection of witnesses and organisations as possible. While this included groups which are most active in the debate on renewable energy, such as the power generators, environment and energy interest groups and the Scottish Executive, the Committee also wished to take evidence from other groups whose voice may be heard less often, such as small scale private developers, public petitioners and community representative organisations. The initial basis for the inquiry was set out in the remit. The Committee was particularly keen to examine the social and

economic potential for Scotland to benefit from the development of the renewable energy sector.

77. As well as taking oral and written evidence the Committee was anxious to see practical examples of renewable energy at work in Scotland and to examine the roles it plays in local communities. Members of the Committee undertook three case study visits to Aberdeen, Kintyre and Orkney and one overseas visit to Denmark. The Committee also held a formal meeting and a public participation event in Campbeltown on the Kintyre peninsula in January 2004.

78. Given the huge interest amongst the Scottish public on the subject of renewable energy the Committee has received a very large volume of evidence. It would be impossible for this report to refer to all submissions received. The summary of evidence seeks to highlight the major themes and messages which have emerged from this inquiry. A complete copy of all of the evidence received is available on the Enterprise and Culture Committee's website at:

http://www.scottish.parliament.uk/enterprise/index.htm

Collection of evidence

79. The Committee issued its call for written evidence on this inquiry on 13 November 2003 and began taking oral evidence from witnesses on 6 January 2004. As part of its evidence gathering for the inquiry the Committee was anxious to hear from as wide a field of witnesses as possible. By the end of the oral evidence taking session on 30 March 2004, the Committee had received 144 written submissions and taken oral evidence from 50 witnesses representing 34 different organisations and groups.

80. On 6 January 2004 the Committee took evidence from Dr Robin Wallace of the Institute of Energy Systems and Mr Blair Armstrong and Mr Brian Nixon of Scottish Enterprise.

81. On 13 January 2004 the Committee heard from five public petitioners on the subject of proposed onshore wind farm developments in various areas of Scotland. They were: Mrs Marylin Henderson, Mr WR Graham; Christine Grahame MSP; and Mr Peter Hodgson, John BP Hodgson and Ben Palmer of the Skye Wind Farm Action Group. The Committee also took evidence on that day from Councillor Alison Hay, Mr Derek McKim and Mr James Fowlie of COSLA.

82. On 20 January 2004 the Committee held a meeting in the Victoria Hall, Campbeltown in Argyll and Bute. At this meeting the Committee took evidence from: George Harper and Angus Gilmour of Argyll and Bute Council; Mr Steven Watson ALIEnergy; Alan Mortimer and Susan Reilly of Scottish Power; David Sigsworth and Dr Brian Smith of Scottish & Southern Energy; and Robert Forest and Maf Smith from the Scottish Renewables Forum.

83. On 3 February 2004 the Committee took oral evidence from: Mr Adrian Bull of British Nuclear Fuels Ltd; Mr John Thomson and Mr Bill Band from Scottish Natural Heritage; and Dr Dan Barlow (Friends of the Earth Scotland); Anne McCall (RSPB

Scotland) and Ian McCall (Ramblers' Association Scotland), all representing the Scottish Environment Link.

84. On 10 February 2004 the Committee heard from: Dr Chris Anastasi of British Energy and on 2 March 2004 the Committee took evidence from Mr Alistair Buchanan, Mr David Halldearn and Mr Charles Gallacher from Ofgem. The Committee also heard from: Iain Todd from the UK Department of Trade and Industry; Dr Jim Hunter and Elaine Hanton of Highlands & Islands Enterprise: and Dr Richard Yemm, Fergus Tickell and Professor Ian Bryden, representing the Scottish Renewables Forum.

85. On 10 March 2004 the Committee took evidence from Charles Davies and Dr Lewis Dale of National Grid Transco. The Committee also took evidence from Angela Duignan of the Baywind Renewable Energy Co-operative in Cumbria and Mr David Gordon from the Glasgow based company Windsave Ltd.

86. On 23 March 2004 the Committee heard from: Mr Andy Knill of the Civil Aviation Authority; Mr Allan Baillie and Air Commodore Simon Bryant of the Ministry of Defence; and David G Hilton from National Air Traffic Services Ltd. The Committee also heard from Mr Chris Bronsdon and Dr Gary Connor of the Scottish Energy Environment Foundation.

87. Finally, on 30 March 2004, the Committee heard from Mr William Gillett from the Directorate of Transport and Energy of the European Commission. The Committee completed its formal oral evidence taking sessions by hearing from the Deputy Minister for Enterprise and Lifelong Learning Lewis Macdonald, accompanied by Mr Robin Naysmith and Mr Neil Stewart from the Scottish Executive Enterprise Transport and Lifelong Learning Department.

88. As well as taking oral and written evidence the Committee also undertook four fact finding visits to a variety of renewable energy locations in Scotland and abroad.

89. On 19 January 2004 the Committee visited one of Scotland's largest onshore wind farms at Beinn an Tuirc on the Kintyre peninsula. The Committee also visited the Vestas Celtic Wind Technologies plant at Machrihanish in Kintyre. On 16 and 17 February 2004 three members of the Committee travelled to Denmark to examine the development of the renewables sector in that country and see what environmental and economic lessons Scotland could learn from the Danish experience.

90. On 6 and 7 May 2004, three members of the Committee undertook a visit to Orkney to examine the development of various renewable initiatives in rural Scotland. Finally on 10 May 2004, four members of the Committee visited sites in Aberdeen and Fife to examine the research and development aspects of the renewables sector in Scotland.

Major Themes

91. The Committee has received written and oral evidence on a wide range of topics relating to the renewable sector in Scotland. These have ranged from issues of

climate change and wildlife protection to jobs, workforce skills and the future of Scotland's economy. Several major themes have developed during the course of the inquiry, namely:

· the current public debate over the development of onshore wind farms;

· progress in developing other renewables technologies;

· potential for capturing the emerging marine renewable market;

· potential economic benefits for local communities and the overall Scottish economy;

· the structure of the electricity market and the transmission grid;

· reduction in energy consumption;

· estimating Scotland's future energy needs and how to meet them; and

· the role of public participation in the renewables debate.

WIND FARM DEVELOPMENT IN SCOTLAND

92. One of the first themes to emerge from the evidence is the public debate on the issue of onshore wind farm development. This issue, more than any other, is driving the current public debate on the renewables sector. Indeed, the Committee has noted that since the start of this inquiry hardly a week has gone by without reference to the subject in the Scottish broadcast or print media.

Onshore Wind - the Current Debate

93. Early in the inquiry the Committee took evidence from five public petitioners on the subject of onshore wind farms[4]. While each of these petitions was specific in nature to a particular geographical part of Scotland, all were objecting to the proposed levels of development of onshore wind farms. All of the petitioners expressed concerns about the number of planning applications for onshore wind farms and all outlined almost identical objections to the potential consequences if these proposed developments were to proceed.

94. It is clear from the evidence taken that the substantial increase in the proposals for new onshore wind farms in Scotland is being driven by the way in which the electricity market is currently structured and the mechanisms put in place for that market to deliver the UK's renewables targets.

95. Under current targets the UK government is committed to generating 15.4% of the country's electricity from renewable sources by 2015 and an `aspirational' 20% by 2020[5]. These targets form the Government's commitment, as set out in its Energy White Paper of 2003, to reduce the UK's carbon emissions to 60% of current levels by 2050.

96. Scotland already generates approximately 11% of electricity from renewable sources, mostly due to the level of installed hydroelectric capacity. In light of this fact the Scottish Executive is committed to generating 18% of Scotland's electricity from renewable sources by 2010 and an `aspirational' 40% by 2020. To date, the Executive has not set any specific Scottish targets in relation to carbon emission reductions.

97. In order to achieve its renewable targets, the UK Government has established the Renewable Obligation (RO). This is an obligation on licensed electricity suppliers in England and Wales to supply a specified percentage of their electricity from renewable sources. In Scotland the Renewable Obligation (Scotland) (ROS) applies a similar obligation for licensed electricity generators in Scotland. The RO and ROS are designed to be `technology neutral'. In essence this means that, while the system specifies the various types of renewable technologies which are eligible for use under the Obligation, the system does not favour any one technology over another. So, in theory, the market should bring forward a `mix' of renewable technologies. While a detailed list of the eligible technologies can be viewed on the Department of Trade and Industry website at http://www.scottish.parliament.uk/enterprise/reports/www.dti.gov.uk, the main eligible technologies are:

· Landfill and Sewage Gas

· New hydroelectric exceeding 20MW (after 1 April 2002);

· Onshore and Offshore wind power;

· Co-firing of biomass and other biomass;

· Tidal and Tidal stream power;

· Wave power;

· Photovoltaic; and

· Energy crops.

98. To achieve these targets the Government has established a market support system called Renewable Obligation Certificates (ROCs). This system is based on the principle of ensuring the electricity market delivers the required levels of renewables generation by providing a financial support system which allows generating companies to produce electricity at a cost per kWh[6] which can compete with the cost of producing electricity from cheaper fossil fuel sources.

99. The effect of these targets and the statutory obligations placed on the major electricity generators has been the rapid development of the onshore wind power sector. This situation is magnified by the fact that Scotland, because of its geographical position and meteorological conditions, has the largest proportion of the UK's wind resource. Indeed Scotland's wind resources are among the best in Europe. As a result developers have looked to site the major proportion of onshore

wind farm development in Scotland. Some of the public perception of onshore wind farms in Scotland has also been influenced by the practise of developers who submit multiple applications for wind farm developments in various parts of the country. This practice seems to be driven by the `hit and miss' philosophy of developers maximising their chances of success by lodging numerous planning application.

100. Public concern over this situation is reflected in the evidence received by the Committee from the petitioners. Mr William R Graham for instance stated that at the time he submitted his petition (PE564) to the Parliament in October 2002 there were five wind farm proposals in the Moray area. By January 2004 that number had increased to 13.[7] This is a reflection of the pace of growth of the onshore wind sector in Scotland and the fact that developers make multiple applications for wind farms in order to increase their chances of success.

101. Much of the concern expressed by the petitioners related to the potential cumulative impact of wind farm development on areas of rural Scotland. There was a generally held concern amongst the petitioners that wide scale development of wind farms could be detrimental to the scenic quality of the landscape and so have an adverse impact on the Scottish tourism industry[8]. While concerns have been expressed about the tourism industry, there is no reliable data on the cumulative visual effect of wind farms on tourism available. Those who support the development of wind power challenge assertions about potential negative impacts of wind farms on the tourism sector.

102. Concern was also expressed in relation to the potential impact on wildlife, particularly the possible danger to protected bird species from turbine blades[9]. Possible health risks to local residents from issues such as low frequency sound and shadow flicker has also been expressed, though no reliable data on this appears to be available.[10]

103. In its evidence to the Committee, Scottish Natural Heritage (SNH) stated that Scotland already had a network of forestry access road and that further damage to the natural habitat could be reduced by utilising this network in the development of the onshore wind farm sector[11]. On the issue of danger to bird species SNH stated that, while there was some evidence to suggest that a small number of birds have been killed as a result of wind farms, there was not a large enough body of research to demonstrate a firm conclusion on the subject either way. However SNH believes that there is a need to collate reliable data on the issue of bird deaths in relation to wind farms in Scotland[12].

104. In evidence to the Committee, Ann McCall of the Royal Society for the Protection of Birds (RSPB) stated that, to date, wind farm development in Scotland had not caused a major problem for most bird species. However, as the volume of wind farm developments increases throughout the country there could be a cumulative impact on more sensitive bird areas[13].

105. Many of these concerns are reflected in the current public debate on the issue of wind farm development. While the Committee does not consider that it is in a position to adjudicate on these arguments based on the evidence taken to date, it is clear that public support will be vital for the successful development of the Scottish

renewables sector.

106. Another issue that has been raised is the potential impact of wind farms on civil and military aviation. Concerns have been expressed in relation to the operation of radar for air traffic control. The Ministry of Defence (MoD) has also objected to planning applications for the development of onshore wind farms in tactical training areas used by the Royal Air Force. [14]

107. On 23 March the Committee took evidence from the MoD as well as the Civil Aviation Authority (CAA) and National Air Traffic Services (NATS) on the implications of wind farms for radar operation and tactical training areas in Scotland. The Committee welcomes the co-operation it received from the MoD, the CAA and NATS. The Committee believes that the ability of Scottish Parliament committees to take evidence from UK Government departments is an important element of their scrutiny process.

108. In evidence to the Committee, Alan Baillie of the MoD stated that much progress had been made to date with wind farm developers and environmental consultants to reduce the number of wind farm proposals which may draw planning objections from the MoD. The MoD is seeking to establish a concordat with the Scottish Executive to set a framework for working relationships in relation to planning applications for onshore wind farm and the needs of the MoD in Scotland.[15] As the renewable sector expands in Scotland such a concordat could also assist in resolving other planning issues between the MoD, developers and planning authorities.

109. The Committee notes the work of the Wind Energy, Defence and Civil Aviation Working Group on radar operations for air traffic control, which is led by the Department of Trade and Industry and on which the Scottish Executive is represented. This group has produced guidelines on the development of onshore wind farms in relation to air traffic control services and other civil and military aviation issues.[16]

110. Progress requires society to balance the need to change with the need to protect the physical and social environment for future generations. The major elements of this debate are ably reflected in a submission from Mr John Macdonald on the arguments of protecting the nature and culture of an area like the Highlands with the equally important need to ensure a successful local economy. He states:

"....the most striking impression is the incredible grandeur of what lies before you in every direction. I have always thought that the second most striking aspect of such scenes is the ever-present evidence of man's impact on this landscape throughout the generations. Tracks, waymarking, dykes, ditches, enclosures, fields, plantations, boundaries, dwellings, settlement. These are everywhere. Man is still here and there are roads and fences and forests and pylons and communication masts and villages and a town or two and a hydro-dam. This visual vastness can absorb them all."[17]

111. Further on in his submission Mr Macdonald states:

"It is imperative for all who live here from choice to realise that community is what

makes this wilderness special, and that every development which offers short-term or long-term employment (and you cannot know in advance what will succeed or fail) should be given the chance unless there are compelling reasons to oppose them.

The prevailing determination to do it the other way round has come to be a millstone which threatens us all. We cannot go on like this."[18]

The Role of Onshore Wind Farms in Meeting the 2010 and 2020 Targets

112. The practice of harnessing the power of the wind is not a new one. Throughout history, wind power has been used by human society for a variety for purposes from the development of ocean going transportation and trade, to land irrigation, drainage and food production. The modern development of wind turbine technology for electricity generation from wind power has been ongoing since the 1950s. While the technology was slow to develop at first, the energy crises of the 1970s led to an upsurge in the research and development of alternative forms of energy which were not dependent on fossil fuels.

113. The development of wind technology was further boosted by the growing environmental movement of the 1970s and 1980s. This added to the impetus for the development of clean sources of energy. In Scotland, trials of wind turbines for generating electricity were underway by the late 1950s. However, the discovery and exploration of North Sea oil and gas reserves in the 1970s meant that the development of wind technology in Scotland and the UK abated.

114. The cause of wind power development was taken up by other countries anxious to establish energy independence from fossil fuel sources. By the late 1980s several European countries, led by Denmark, had moved forward significantly in developing and producing wind turbine technology.

115. One of the important questions raised during the inquiry has been in relation to the development of onshore wind in Scotland and its potential role in meeting the targets set by the Scottish Executive. The answer to this question depends, in large part, on the current market support system for the development of onshore wind.

116. Scotland is already starting from a high level in the development of renewable electricity generation thanks to the hydro-electric projects in Galloway in the 1930s and the Highlands in the 1940s, 1950s and 1960s. Scotland currently derives about 2000MW or 11% of its installed capacity from hydro-electricity[19]. Given this position the potential for further large scale development of hydro-electricity in Scotland is limited. Scottish and Southern Energy stated in evidence to the Committee that "with the exception of the proposed 100MW hydro-electric scheme at Glendoe, the potential for large-scale hydro generation in Scotland has largely been exhausted"[20].

117. For Scotland to meet the target of 18% renewable electricity generation by 2010 it will require approximately an additional 1300MW of installed capacity from renewable sources. In its evidence to the inquiry the Scottish Renewable Forum[21] (SRF) stated that most of this balance will be met by the development of onshore wind farms. This is a view supported by the Scottish Energy Environment Foundation (SEEF)[22]. Indeed SEEF went further by suggesting that the `aspirational' 40% target

by 2020 could be met and that the largest proportion of it (possibly up to 85%), will be met by onshore wind development. This equates approximately to 4890MW of installed capacity, which does not take into account any potential gain from demand reduction[23].

118. According to SEEF this is mostly due to the fact that Scottish and UK energy policy has "placed the development of renewable energy sources firmly in the hands of the market with no strategic overview of what the market will deliver in terms of build-rate, capacity or technology mix"[24].

119. The Scottish Energy Environment Foundation (SEEF) describes itself as "an independent organisation set up to create an internationally significant centre of excellence in energy and related environmental policy. Its aim is to provide authoritative advice on energy and the environment for demand and supply issues, as well as contributing to the development of a balanced energy policy within the UK"[25].

120. Scottish Power stated in written evidence to the inquiry that a large proportion of the energy mix required to meet the 40% target will need to come from other renewable sources besides onshore wind[26]. The submission goes on to state that the potential for offshore wind development in Scotland is low due to a lack of appropriate offshore sites close to areas where grid access is, or is likely to become, available. This will require the development of market ready levels of other renewable sources such as wave, tidal and biomass. However, Scottish Power suggests that this is, at the moment, an unlikely prospect. It submits that there "does not yet exist a coherent and functioning mechanism to ensure that the most promising technologies...can move through the development cycle to full commercialisation"[27].

121. As previously stated in paragraph 97 the Renewables Obligation should, in theory, bring forward a mix of renewable generating sources as it is intended to be technology neutral. In practice, however, this seems far from the case. The evidence received by the Committee suggests that, under the present market system, onshore wind will play the major part in meeting the renewables targets over the next decade. This is due to the fact that wind technology is a mature technology with off the shelf wind turbines providing an affordable, low-risk and easily designed option to allow the generating companies to meet their targets under the RO and ROS[28]. Also, the dedicated market support structure provided by ROCs[29] ensures that onshore wind is commercially viable within the UK energy market.

122. The public debate over the use of onshore wind technology is set to continue for the foreseeable future with strongly held views - both for and against - regularly being expressed through the media. This has led to a general concern, expressed by several witnesses to the inquiry, that the small but vocal opposition to onshore wind farm development may have a wider negative impact on the general public's opinion of the renewable energy sector as a whole.

123. **It is clear from the evidence taken that the Scottish Executive will meet its short term target of 18% of electricity from renewable sources by 2010. However, this increase will come almost entirely from onshore wind**

generation, which raises a number of major issues in relation to the future of renewable energy in Scotland.

124. **As things stand, if the Executive's `aspirational' target of 40% by 2020 is to be met, it will be almost entirely through onshore wind power. This is neither sustainable nor sensible**.

Offshore Wind Farm Development

125. The development of wind farms in relatively shallow costal waters is another potential source of renewable electricity generation. Throughout Europe, offshore wind farms form a major part of the generation capacity from wind sources.[30] The main advantage of offshore wind over onshore wind farms is that, given the right coastal conditions, it is possible to construct much larger farms than are normally found on land.

126. Scotland's first offshore wind farm, Robin Rigg, is currently under construction in the Solway Firth. Once operational this wind farm will produce approximately 180MW of electricity[31]. The potential for offshore wind to contribute to the UK's emission reduction targets is considerable. However, the Committee has heard in the evidence that, currently, the bulk of the UK's usable offshore wind resource lies in England and Wales[32]. There are two main reasons for this.

127. Firstly, the coastal shelf around England and Wales is better suited to the construction of offshore wind farms as shallow waters extend for several miles off the coast[33]. In Scotland, for the most part, the coastal shelf drops away into deeper waters closer to the coast. This makes the economic development of offshore wind more difficult. It has, however, been pointed out by several witnesses that given Scotland's long experience with the construction and development of the North Sea oil and gas infrastructure, the development of offshore wind farms in deeper waters should not present an insurmountable problem.

128. Secondly, the development of offshore wind in Scotland is likely to be hampered by the weakness of the transmission grid. Regardless of the amount of suitable development sites off the coast of Scotland, the vital issue for the development of large scale offshore wind is ready connection to the grid. Part of the problem for offshore wind development is that, like onshore wind, many of the best offshore sites in Scotland occur at points where the Scottish grid is weakest. In order for Scotland to harness its offshore wind potential, upgrading and strengthening the transmission grid will be essential. Issues of grid capability and maintenance are discussed in detail later in this report.

129. Offshore wind may also have the advantage of being relatively visually unobtrusive. Many witnesses opposed to the development of onshore wind farms cited the potential for the development of offshore wind farms as an alternative. Several submissions to the inquiry suggested that the present North Sea oil and gas infrastructure could be adapted for use by the offshore wind farm sector. Much of the support expressed for offshore wind was based on the fact that it would not be as visually obtrusive as onshore wind farms and so would be less likely to have the allegedly negative impact on the rural economy. This argument is not necessarily

borne out by experience to date. It should be noted that, as part of the consent process for the Robin Rigg project mentioned above, the Scottish Ministers received 491 representations from organisations and the public[34]. Of these 436 cited the potential impact on visual amenity and 237 cited the potential impact on tourism as objections to the project. As part of the granting of consent for the development the Scottish Ministers established the Robin Rigg Monitoring Group (RRMG) whose role is "providing a schedule of potential impacts to be monitored for the approval of Scottish Ministers"[35].

130. The development of large scale offshore wind farms would also have to consider the potential impact on industries such as fishing and maritime shipping. Navigational routes and marine habitat issues would also need to be considered carefully. Scotland's planning laws have not been tested in this regard; the Robin Rigg development was granted permission by the Scottish Ministers under section 36 of the Electricity Act 1989. As all of the relevant cabling and substation development of the Robin Rigg project will occur in Cumbria, it was dealt with under English planning regulations. No Scottish local authority was formally involved in the granting of approval for this project.

131. Despite the problems of finding suitable marine sites for the construction of offshore wind farms, coupled with problems in connection to the national grid, it is clear from the evidence that under the right conditions offshore wind could contribute to meeting Scotland's renewable targets. In some locations this would have the added benefit of overcoming many of the public objections encountered by onshore wind farms. The development of offshore sites in Scotland would not only add to the mix of renewable sources of installed generating capacity, it would also be a positive sign that all of Scotland's various renewable energy resources were being exploited.

Intermittency and Security of Supply

132. One of the major concerns expressed in the role of large scale wind farm development in Scotland is the issue of intermittency of supply. In order to maintain a stable electricity supply the transmission network (the national grid) must remain balanced. Put simply, the levels of electricity being put onto the grid must be balanced with the amount of consumption taking electricity off the grid. The grid operators (Scottish Power & Scottish and Southern Energy in Scotland and National Grid Transco in England and Wales) have a statutory duty to ensure the transmission grid remains balanced and operational in order to secure supply[36]. This is achieved by managing the amounts coming on to and off the grid at any one time.

133. On the consumption side there are two main sectors: commercial, and domestic customers. Most large scale commercial consumers of electricity have agreements with the grid operators in relation to their consumption levels at any given time. This allows the grid operator to vary the power they consume and so help balance the grid. On the domestic side the grid operators have very little control over how much electricity is consumed. However, the domestic market is relatively predictable in its consumption given the time of day and year and the weather conditions. The grid operators therefore have a very good idea of when `peak' levels of domestic consumption will occur and can respond accordingly by ensuring that sufficient levels

of electricity are generated when needed.

134. On the generation side, the grid operators have the ability to vary the level of electricity being generated by bringing more generating plants onto or off the grid. The speed with which this response can be activated depends on factors such as the consumption demand at the time and the types of generating plant available to step up production. Some forms of generation such as hydro-electric can react very quickly from a `standby' position. Other forms of generators, such as coal and gas plants, can only react more slowly , while nuclear has no short-term reactive capability. The normal method of managing this process is by having a certain amount of `spinning reserve' generation on standby for when it is needed. Spinning generation is the process of running a power plant to generate electricity but not having it connected on to the grid. The benefit of this system is that, at peak times, such spinning reserve can be connected to the grid quickly without any long start up time, so allowing peak demand to be met.

135. The drawback of spinning reserve is that generating plants need to be operating on the basis that they may be needed at short notice but for most of the time are generating power for no other purpose. For the most part these are the stations which consume fossil fuels such as coal and oil. Therefore, the practice of having stand-by spinning reserve increases the emissions of carbon dioxide and other gases.

136. Currently Scotland is a net exporter of electricity, mainly to England and Wales. As of 2001, 37% of Scotland's electricity was generated by nuclear power, 53.3% generated from conventional fossil fuels (coal 32.3%, oil and gas 21%), 8.7% from hydro-electric and 1% from other sources such as wind power and landfill gas[37].

137. One of the arguments put forward by those opposed to the wide scale use of wind power is that, as a generating source, it is an intermittent supply and so is far less reliable and predictable. Wind turbines can operate only within a certain wind speed range (between 4 m/s[38] and 25 m/s)[39]. If the wind speed is too low the blades will not be turned and the turbine will not generate electricity. If wind speeds are too high the turbine will shut down automatically to prevent damage being caused. If wind farms were supplying a large percentage of the power to the grid at any one time, and weather conditions suddenly became unfavourable, a situation could arise where several large generating farms go `offline' in a relatively short period of time. This in turn would lead to a sudden fall off of power across the transmission grid.

138. It is worth noting however that a situation where wind speeds across the entire land mass of Scotland would suddenly and dramatically fall, from a level where all onshore wind farms are generating electricity to a level where they are not, would be very rare indeed. Any such scenario would also be predictable using modern methods of meteorology.

139. In such circumstances, to keep the grid balanced and maintain supply, the grid operators would have to either try to reduce consumption by getting commercial customers to reduce their demand levels, or compensate for the power loss by bringing additional spinning reserve on to the grid. The latter is the more likely option in this scenario as it can be difficult and expensive for commercial customers to react

quickly to the minute-by-minute needs of the grid.

140. The greater the percentage of electricity generated from an intermittent source, the greater the amount of spinning reserve plant required to be on standby for back-up purposes. Most spinning reserve in the UK is generated from fossil fuel sources. Over-reliance on wind could lead to the ironic situation that the greater the proportion of Scotland's electricity generated from intermittent sources, the greater the need for carbon-producing spinning reserve to back it up. The ultimate result of this situation is that carbon emissions from fossil fuels would increase rather than decrease. Those opposed to the generation of electricity from large scale wind farm development cite this as the major reason against the use of onshore wind farms. They argue that the requirement for spinning reserve means that, in practice, wind power is not necessarily a `carbon neutral' power source since, while wind powered generation itself does not emit carbon dioxide (CO_2), the standby generation needed to back it up does produce emissions, using current equipment.

141. As things stand, if the current 2020 target is achieved, taking for example the energy modelling system put forward by SEEF as a guide, anything up to 34% of Scotland's installed generating capacity could be provided by onshore wind farms (i.e. 85% of the `aspirational' 40% target = 34%). In a situation where up to a third of Scotland's installed capacity is expected to come from intermittent renewable sources such as onshore wind, the need for the development of a large scale storage system for electricity is vital for grid stability and security of supply. This percentage increases even further depending on how other intermittent renewable sources, such as wave generation, contribute to Scotland's overall generating capacity.

Accommodating Intermittency

142. If wind were to supply more than 20% of electricity generation, methods of dealing with intermittency would have to be developed. The Committee received evidence that there are two main ways in which this can be achieved. One is to upgrade and reinforce the national grid to protect it from sudden changes in power level which may unbalance the system. The second method is to develop a means of storing electricity produced at times of peak generation, which can then be distributed at times of peak demand. This would ease the strain on the grid network and thereby improve stability and guarantee security of supply.

143. This report deals with upgrading the Grid at paragraphs 253 to 269 below.

Storing electricity

144. The practical methods of achieving an electricity storage system fall into two categories, namely:

· hydro-electric pump storage; and

· hydrogen cell technology.

145. Scotland's extensive network of hydro-electric plants provides an opportunity to

deliver a stabilising system for the grid network through the use of pump storage. Pump storage operates on the principle of pumping water uphill into mountain reservoirs during the periods of minimum demand when costs are lowest, releasing it downhill to generating stations at peak periods. Electricity generated from wind farms at times of low demand across the grid could be saved via pump storage, and could then be used to provide a reserve to the grid at peak demand times. This would be very beneficial if it coincided with a period of intermittent supply caused by a fall in generation from wind farms at times of peak demand.

146. In the debate over the intermittency issue of wind farms, the example most often quoted is that of the cold, windless winter day with high pressure sitting over Scotland. This would result in a high demand for electricity for lighting and space heating at a time when the wind resource is at its lowest and onshore wind farms are not generating enough electricity. Utilising the existing pump storage system would help to ease the intermittency issue in the short term.

147. Witnesses who gave evidence to the Committee in support of wind farms refuted the argument that such a situation would develop. They argued that while some parts of Scotland may have little or no wind at peak demand times, it would be almost impossible for all the wind farms across the country to stop generating because of calm conditions. In fact, witnesses in favour of onshore wind stated that the greater the number of wind farms spread throughout the country, the smaller the potential impact from still wind conditions.

148. However, given Scotland's electricity needs, it is clear that pump storage would not be capable of acting as a reliable grid stabilising system on its own. Expansion of pump storage facilities would also have environmental consideration. For example in areas where no suitable natural geographical conditions exist, man-made dams required to be constructed. To ensure the long term stability of the grid it will be necessary to develop wide scale hydrogen storage systems in Scotland.

149. Hydrogen storage works on the principle of storing electricity generated by intermittent renewable sources (e.g. onshore wind) at times of low demand, through the capture of hydrogen. This hydrogen can then be used in a chemical reaction to generate electricity for supply onto the grid at times of peak demand. The storage capability of such a system would only be limited by engineering and design issues.

150. Hydrogen is a highly volatile element which must be used in a safe manner. The primary issue in relation to the development of a hydrogen storage system relates to the infrastructural and commercial viability of the required technology. The Committee has heard that several other countries such as Iceland and Singapore are active in the development of hydrogen technology[40]. The development of hydrogen storage systems also holds great potential in relation to the main energy consuming sectors, namely transport and space heating. Electricity generation only accounts for 20% of all energy consumption in the UK. The vast bulk of energy consumed in the UK is used in the non-electricity generating sector. Consequently this is also the major contributor of climate changing gas emissions.

151. **The potential to tackle the problem of reducing the UK's climate changing emissions by adopting integrated policy development in the areas of hydrogen**

storage, public/private transport and domestic/commercial space heating is substantial[41]. The UK Government must address these important areas if meaningful progress is to be made in arresting the causes of climate change.

152. Hydrogen storage development is, however, a leading edge technology and the feasibility of developing a large scale storage system in the short to medium term must be explored.

153. During the Committee's case study visits to both Aberdeen and Denmark, members heard evidence about the potential for hydrogen development. While visiting the Aberdeen-based offices of the commercial fuel cell company SiGEN on 10 May 2004, members heard of the need to develop a dedicated hydrogen strategy for Scotland which would create a focused timeline and context within which the hydrogen development industry could operate. SiGEN believes this will be vital for the development of hydrogen as an integral part of the development of the Scottish renewable sector.

154. During the Committee's case study visit to Denmark on 16 February, members met with Mr Hugh Sharman from the international energy consulting company Incoteco AsP[42]. Mr Sharman informed members of Incoteco's work on proposals for the development of a wide scale hydrogen storage system to act as a balancing system for the electricity transmission grid in the western Jutland area of Denmark. This work is being carried out because ELTRA[43], the transmission operator in the Jutland area, is seeking to develop a system to store surplus electricity production as a way of balancing its transmission grid. Incoteco is now working in partnership with other companies to develop its proposals for the construction of a mass hydrogen storage system for western Jutland.

155. **Clearly, the development of hydrogen technology has major potential for the growth of the renewables sector as a way of countering intermittency. This potential must be explored and exploited to the full to underpin the development of Scotland's renewable economy.**

RENEWABLES AND THE PLANNING PROCESS

156. The ability of the planning process in Scotland to cope with the growing renewables sector has been one of the recurring themes of this inquiry. The current debate on the subject of planning has been driven by the recent increase in the number of applications for the constructions of onshore wind farms in Scotland. However, there is a difference between the public perception about the level of wind farm development due to the increase in the number of applications and the actual number of projects that receive approval. Scottish and Southern Energy estimates that, under the present planning system in Scotland, for every eight applications which are submitted for the development of a wind farm, only one is successful[44].

157. However, Scottish Power sounded a note of caution in its evidence to the Committee on the estimate of a 1 in 8 success rate for onshore wind farm applications. Alan Mortimer of Scottish Power said: `the figure of one in eight relates

to the early development stages. Projects drop out of development for all sorts of reasons, which do not only involve planning. I am sure that the success rate from planning application to planning approval is an awful lot better than one in eight. Projects drop out even before they reach the application stage, as developers investigate and find an environmental or technical issue or fail to sign up the landowner, for example'[45].

158. In its submission to the inquiry the Scottish Executive indicated that there are about 16 onshore wind farm developments which have received planning approval and should come on stream over the next 12 to 18 months in Scotland. These projects total some 692MW of installed capacity[46]. According to the British Wind Energy Association (BWEA) there are currently 21 wind farm projects (over 1MW) with grid connection in Scotland, with a combined installed capacity of about 255MW [47]. The BWEA estimates a further nine wind farms, with an installed capacity of about 230MW, are expected to become operational in Scotland by the end of 2004[48]. These figures would suggest a near three fold increase in the installed capacity of onshore wind farms in Scotland by late 2005. All the evidence received by the inquiry would suggest that, if the current market system remains unchanged, this growth rate will continue over the next decade as power generating companies seek to achieve the targets set by the Executive.

159. On 13 January 2004 the Committee took evidence from COSLA. During its evidence COSLA called for the development of a national strategic planning framework for Scotland to oversee the strategic development of renewable energy[49]. While the bulk of applications to date have related to the development of onshore wind farms, COSLA argued for a strategy which could encompass the development of all renewables energy sites in Scotland[50].

160. The Deputy Minister for Enterprise and Lifelong Learning, Lewis Macdonald, stated in evidence that while the planning system is kept under review, the current planning guidelines are robust enough to deal with the expansion of the renewables sector. This view is not shared by many of the local authorities from which the Committee has taken evidence.

161. Planning is a matter devolved to the Scottish Executive. From the evidence taken to date it would appear that much of the experience of members of the public and local authorities in dealing with the developers of the renewable sector comes by way of the public planning system. Planning policy in Scotland is set out in the Executive's most recent guidance document for planning, NPPG6[51]. This guidance is further supplemented by the publication of a planning advice notice on renewable energy technology, PAN45[52]. In April of 2004 the Executive published the first National Planning Framework for Scotland. This framework is intended to "guide the spatial development of Scotland to 2025"[53]. These documents form the core of the Scottish Executive's planning policy in relation to the development of the renewable sector in Scotland.

162. In addition to evidence from COSLA, the Committee received both written and oral evidence from Argyll and Bute Council and written submissions from Aberdeenshire Council and Fife Council. Members of the Committee also met with representatives of both Orkney Islands Council and Highland Council during case

study visits. It is clear from the evidence received that many Councils are dealing with the same problems in relation to the renewable energy sector. For most, the current issue is the development of onshore wind farms and the burden this is placing on their planning systems.

163. All the Councils expressed the opinion that planning guidance in Scotland was not sufficiently robust to allow them to deal with the volume of planning applications they currently face in relation to onshore wind farms. One commonly expressed view was that Councils have no clear guidance as to what proportion of the Scottish national renewable targets their area should seek to deliver. This has led to a concern that some local authorities are bearing a disproportionately large amount of the development of renewables by virtue of the volume of proposed onshore wind farms in their authority area. This can have a negative impact on the planning resources of the council in question as the time to process an application for an onshore wind farm can increase, depending on the size and location of the proposed farm and the number of objections received from the public.

164. During the Committee's case study visit to Orkney, representatives from Highland Council told members of the Committee that the Council now regularly received upwards of 1000 public objections to the erection of anemometer masts in the Highland area. An anemometer is a device used to record the average speed and prevailing direction of the wind at any given site. These masts are erected to determine whether a site possesses suitable conditions for the construction of a wind farm.

165. Concern has also been expressed about the capacity of local authorities to deal adequately with the volume of planning applications for onshore wind farms. The Committee heard evidence that planning departments are finding it difficult to cope with the increase in the volume of wind farm applications and the lack of a coherent national strategy was leading to concerns such as the cumulative impact of wind farm development in areas where two or more local authority boundaries meet.

166. The Committee has noted that the Executive's newly published National Planning Framework for Scotland states that "...landscapes evolve continuously in response to climatic, economic, social and technological change. The effect on landscape character will be an important consideration in decision-making on renewable energy developments"[54].

167. Delays in the planning process also lead to constraints on new renewable developments. Currently, any developer wishing to seek access to the grid for the development of a wind farm, or any other renewable resource, can seek to secure access to the grid before being granted planning permission for the development. Given the limited space currently available on the transmission network in Scotland, this is normally the first priority for a developer. However, as delays in the planning system mount, this can give rise to a situation where grid access is restricted by developers who have secured access from the grid operator but, because their planning applications are delayed in the system, are not yet supplying electricity to the grid but have effectively sterilised the capacity they have been allocated. This logjam can, in turn, slow the development of both wind and other renewable projects as it becomes difficult to secure financial backing for a project unless the developer

has secured the necessary grid access.

168. This point was highlighted during the Committee's visit to the newly established European Marine Energy Centre in Orkney. The Centre has secured up to 7MW of connection access to the grid to allow for the testing of marine wave devices for the generation of electricity. However efforts to expand this are currently being slowed by the limited space available on the grid due to its weakness in northern Scotland and the Isles. This is due to the fact that much of the available space on the grid has already been allocated to other developments which have yet to become operational and to start generating electricity. The allocation of additional connection space will require upgrades to the grid in order to increase its capacity. This supports the evidence received from groups such as ALIenergy and the main power companies[55].

169. The planning system is further complicated by the split of responsibility for final decision-making between the Scottish Ministers and local authorities. The Electricity Act 1989 is a piece of UK legislation which, amongst other things, governs the planning approval for the development of electricity generating stations developments above 50MW[56]. Section 36 of the 1989 Act allows for UK ministers to make the decision on granting or refusal of planning permission for the development of a wind farm of 50MW or above. The executive discharge of this section in Scotland has been transferred from the UK Government to the Scottish Ministers.

170. Many of the proposed wind farms in Scotland over the next decade are expected to be on or above 50MW in generating capacity. This places local authorities in a difficult position both in terms of planning policy and resources. The planning department of a local authority will be required to carry out the planning process for all wind farm development falling within their area, regardless of the generating size of the farm in question. Once the planning process is completed the local authority makes a recommendation to the Scottish Ministers on whether on not to grant permission for developments of wind farms over 50MW. This puts the local authority in the position of being seen not to have ultimate control of planning system in its own area. It can also be seen to be undemocratic by local communities who may oppose the development, especially if the Scottish Ministers grant permission to a wind farm which the local authority has recommended they should refuse. This sentiment was evident from the evidence received by the Committee from members of the public. For example, in his written submission to the Committee Dr Brendan Hamill stated that, on the planning system for wind farms in excess of 50MW:

"the Scottish Executive may be seen to be steamrollering applications through the planning process in an attempt to meet targets which are unachievable. [As a result] local authority planning procedures can be by-passed when any wind project is over 50MW. This encourages proposals for large wind farms from developers. Locals are being denied a local forum for discussion where they can air their views regarding such proposals"[57].

171. This point of view was also expressed to the Committee by local authorities. During the Committee's evidence taking session in Campbeltown on 20 January, the Director of Development Services for Argyll and Bute Council, Mr George Harper, stated that:

"the threshold of 50MW does not make sense to me as a professional or to my members. It takes away the democratic edge and accountability from applications"[58].

172. In any system of government it is necessary to balance the needs of local communities against the wider needs of what is in the strategic interest of society as a whole. National government must be able to ensure that the national interests are met. As the same time local government must be in a position to protect what it justifiably sees as the local interests of the community it serves. Striking the balance in this equation can often be a difficult and controversial task.

173. According to the submission from the Scottish Executive, as of early 2004 there were about 90 proposed wind farm developments either planned or seeking approval in Scotland[59]. Of these about 40% were 50MW or above. However only 15% of these proposals were in excess of 100MW. It is clear to the Committee that, given the rate of development of the renewable sector in Scotland today, the threshold of 50MW for planning approval on onshore wind farms, as established by section 36 of the Electricity Act 1989, is out of date. The 1989 Act allows the Secretary of State for Trade and Industry to amend the 50MW limit by way of secondary legislation in the UK Parliament. **This limit should be reviewed.**

174. One of the major disadvantages of the current planning system in relation to renewables is the uncoordinated approach often adopted by different developers to the location of proposed wind farms. During the Committee's case study visit to Orkney members were told that the `scattergun' approach taken by various developers when choosing sites for proposed wind farms was having a negative impact on overall planning policy. The Highland Council delegation cited anecdotal evidence of a case in Caithness where a developer applied to develop a wind farm on a site which the Council did not consider as suitable as others in the area. However, as there was no actual reason to turn down the application on national planning grounds, permission was granted. This meant that another wind farm application on a nearby site, which the Council considered more suitable but which was lodged later than the first, had to be refused because of opposition to the cumulative affect of having two large wind farms located in close proximity to one another. This example highlights what the Council sees as the need for a more detailed development and planning strategy from the Scottish Executive in relation to renewables.

175. In its written submission to the Committee, Aberdeenshire Council echoed this sentiment by calling for the Executive to develop "a more robust and clear planning framework...for large scale wind and hydro developments"[60].

176. The Royal Town Planning Institute in Scotland stated in its written submission that:

"as with many of the NPPG series, national [planning] policy is based on criteria which local authorities are expected to apply in their statutory development plans, particularly structure plans, to define preferred areas for renewable energy development. Many structure plans continue to opt for a criteria approach which means that there is no clear vision for the pattern of renewable energy, particularly

wind farm developments across Scotland"[61].

177. The Executive has included renewable energy as part of the new National Planning Framework (NPF) for Scotland. The NPF estimates that Scotland will require 2000 - 2500MW of renewable generating capacity by 2020. This would represent a build rate of about 120 - 150MW per annum[62]. The NPF says that the National Grid should "take account of the opportunities for unlocking the potential of additional renewable energy sources." However, it does not refer to the issue of *preferred development zones* for renewable energy, an issue raised in the submission from the Royal Town Planning Institute as a key issue[63].

178. COSLA also reflected the views of local authorities in its evidence to the Committee by seeking the development of a dedicated Scottish renewable energy strategy. This could bring together issues of local planning and democracy with an approach to decide how all renewables technology are implemented[64].

179. The major power companies in the Scottish market, Scottish Power and Scottish and Southern Energy, were however more cautious about the benefits of a dedicated Scottish renewable energy strategy. In his evidence to the Committee, David Sigsworth of Scottish and Southern Energy stated that:

"We have heard a spectrum of views about how supply companies will fulfil the challenge that has already been given to us to develop renewable energy. You keep asking us, "Are you going to do things here or there?" The Parliament has already set the hurdle for our customer supplies. There must be a certain level of renewable energy at certain dates, but currently the Government in Scotland and-to an even greater extent-the Government in England are not facilitating renewables developments at the rate that is required for us to do what is required of us. There is a conundrum and we should consider whether writing a policy would help us"[65].

180. Susan Reilly of Scottish Power agreed for the need to ensure specific Scottish issues are addressed but expressed caution about the development of any Scottish renewable energy strategy which might place additional burdens on Scottish generating companies, disadvantaging them in relation to their competitors south of the border. In her evidence she stated:

"We agree that we need to pay attention to certain Scottish issues, which we have mentioned. In particular, as we move into the Great Britain-wide trading system, we must be careful that, in comparison with generators elsewhere in the country, Scottish generators are not discriminated against and that renewables are not discriminated against"[66].

181. It is clear from the evidence received by the inquiry that the current planning system in Scotland is struggling to cope with the accelerating pace of renewable energy development. Despite recent guidance on planning in Scotland such as NPPG6, PAN45 and the National Planning Framework for Scotland, weaknesses in the planning system still exist in relation to renewables. Both developers of renewable energy projects and members of the public have expressed frustration with the way the planning system is coping with the development of renewables. Local authorities have also expressed concerns over the burdens which the

renewable sector is placing on them, especially in relation to onshore wind farm development. Part of the problem is that, for the most part, consultation on the development of a wind farm rarely commences until just before or after the lodging of a formal application for planning approval.

182. Several witnesses also expressed concern over the issue of planning fees in relation to those wind farm applications which come under section 36 of the Electricity Act 1989. This requires planning consent for proposed electricity generating stations in excess of 50MW to be made by the Scottish Ministers as opposed to the local authority in question. Both COSLA and the Scottish Renewables Forum highlighted that currently the planning department of a local authority carries out all of the required work on an application for a wind farm. However, under the terms of the 1989 Act, the planning fee for applications above 50MW goes to the Scottish Ministers, as it is they and not the local authority in question, who grants or refuses permission[67]. This gives rise to a situation where a local authority must bear all the costs associated with processing the application from its own resources, without receiving a fee from the developer. In its submission to the inquiry Highland Council stated that the typical planning fee for a proposed wind farm up to 50MW is £11,000, depending on the area of the land the farm will cover[68]. For applications above 50MW, local authorities still carry out the same planning procedure in order to be able to make a recommendation to the Scottish Ministers, but do not receive a fee. So the cost of site visits and environmental assessments have to be met by the Council, placing additional pressure on the planning system by using up resources.

183. In evidence from the major power companies there was agreement on the issue of planning fees in relation to wind farms both above and below 50MW generating capacity. Alan Mortimer of Scottish Power told the Committee that a planning fee of about £10,000 was "nothing like enough to cover local authorities' resource requirements to deal with an application as it moves through the process"[69]. Scottish Power recommends an increase in the planning fee for proposed onshore wind farms to enable the planning process to deal with them more quickly.

184. In evidence to the inquiry the Deputy Minister for Enterprise and Lifelong Learning stated the Executive's belief that current Scottish planning guidance is sufficient to deal with the development of the renewable sector in Scotland[70]. The Deputy Minister pointed out the ability of local authorities to consider location issues for renewables as part of development of their structural plans for their area. In his evidence to the Committee the Deputy Minister for Enterprise and Lifelong Learning accepted the point about the planning fee in relation to section 36 of the 1989 Act. The Minister stated that the Executive is "happy to consider that point and whether there is a way in which we [the Executive] can satisfactorily address that concern"[71].

185.**It is clear that the planning guidance from the Scottish Executive is inadequate to deal with the current pace of onshore wind farm development in Scotland. The Executive must take an active lead and develop a national strategic framework for wind farm applications and engage with local authorities on how to deliver this within their area.** The Committee believes the current Executive review of the planning process provides an ideal opportunity to

achieve this.

186. The development of such a framework should also seek to address the wider development of the renewable sector in Scotland. This may include arriving at agreements with local authorities as to their level of contribution in meeting Scotland's renewable targets for 2010 and 2020. Part of any framework could also include a requirement for pre-application consultation between renewable developers, local authorities and other interested parties as well as a requirement for developers to consult with each other on applications for proposed renewable projects in a given area. This may assist in addressing some of the issues we have highlighted in relation to the development of onshore wind farms.

187. In relation to the issue of planning fees for proposed electricity generating developments coming under section 36 of the Electricity Act 1989, **the Committee recommends that the Scottish Executive examines the level of the planning fee for proposed wind farm developments to ensure it is adequate. The Committee also recommends that the Executive establishes a system which would allow local authorities to keep, or to be reimbursed for, the value of the planning fee for all renewable developments coming under the provisions of section 36 of the 1989 Electricity Act**.

THE DEVELOPMENT OF MARINE TECHNOLOGY IN SCOTLAND

188. Over the course of the inquiry the Committee has heard from many witnesses who have lamented the fact that Scotland allowed the advantage it held in the development of wind technology some 25 to 30 years ago to slip to competing economies such as Denmark. Many witnesses have noted how a small economy such as Denmark has capitalised on the development of wind technology to increase its production of domestic energy generation and, at the same time, deliver greatly for the Danish economy in terms of manufacturing jobs, intellectual capital and technology exports. Figures from the Danish Energy Authority show that, in 2002, Denmark exported 14.6 billion Danish Kroner worth of renewable technology (£1.3 billion) and 81 million Danish Kroner in renewable energy consultancy services (£740,000)[72]. Wind energy is expected to become Denmark's biggest export earner over the next five years.

189. Over the last two decades Scotland has established an impressive base in the development of marine technology in terms of research and application development. Many witnesses have expressed the view that it is vital that Scotland uses the lead it has developed in the field of marine technology to the maximum benefit both for the Scottish natural environment and the Scottish economy. It is also clear from the evidence received that if Scotland is to meet its renewable energy targets it must expand its developing renewables sector into other areas apart from onshore wind. The marine sector appears to hold out the best prospect for Scotland to achieve its twin objectives of environmental protection and economic development

190. The potential economic benefits of marine technology for local communities are indicated in the National Planning Framework for Scotland which states that "coastal

areas will play a key role in Scotland's bid to become a world leader and exporter of marine power technology"[73].

191. Scotland is by no means the only country to see the potential for economic success in the `green jobs' revolution. The Committee has already heard from witnesses such as the Scottish Energy Environment Foundation about how other European countries, particularly Portugal, are actively trying to gain a lead in the development of marine renewables. The Portuguese government has established a subsidised feed-in tariff for the first 20MW of electricity generated by marine resources of €225 per MWh.[74] This is substantial considering the fact that, under the present Renewable Obligation Certificate, the subsidy for onshore wind in the UK is the equivalent of approximately €90 per MWh.[75]

192. The Deputy Minister for Enterprise and Lifelong Learning, Lewis Macdonald, maintained in evidence that Scotland would continue to remain competitive against Portugal:

"Portugal is keen to be in the game and is working hard at it. The country has a good natural resource, but it is nothing like as good as ours. One university there has a active interest in marine energy, but we have four universities with an active interest"..."I am not aware that Portugal has test facilities that would compete with ours"..."I do not accept that Portugal is ahead of us"[76].

193. This is a clear indication, however, that Scotland cannot afford to take for granted that the development of a thriving marine sector is guaranteed based on the lead we currently hold. **Government in Scotland and the renewables sector must learn the lesson from wind technology and put in place any additional measures required to ensure that Scotland achieves the ambition of becoming a leading economy for the development and production of marine renewables**.

194. Scotland currently has several advantages on which to build a solid platform for the development of a thriving marine renewable sector, both in wave and tidal stream technology. Both these areas of marine technology also have the potential to play a significant role in helping Scotland to meet the renewable targets it has set.

Wave Power

195. The first of the two main areas of marine technology currently being developed is that of wave power. While there are many various forms of wave generator under development, all work is based on the principle of harnessing the kinetic energy of wave motion to generate electricity. This electricity is then brought ashore and transmitted via the national grid.

196. Wave motion is powered by the movement of wind currents across the surface of the ocean. So, just as with wind technology, wave power can suffer from an intermittency problem. In a Scottish context, wave generators have to operate in a marine environment which can vary from very calm `millpond' conditions to the extreme of a `once a century storm'. Co-incidentally this can mean that the times when wave generators may be unavailable to supply power, either because it is too calm or the seas are too heavy, can coincide with the same variables for onshore

and offshore wind power.

197. While these conditions are the extreme ends of the scale and are therefore rare, they must be considered when assessing the potential for wave power to contribute to meeting Scotland's energy targets. Nonetheless, it is estimated that Scotland has the largest natural resource from wave power of any country in Europe. Much of the evidence received by the Committee points to the enormous potential of wave power to supply electricity. In its submission to the Committee, Wavegen Ltd stated that the potential energy from wave power around the shores of the UK is greater that the whole of the UK's electricity consumption[77].

198. This is a view supported by Dr Robin Wallace of the Institute for Energy System based at the University of Edinburgh. In his written and oral evidence to the Committee Dr Wallace pointed out that Scotland has some of the best wave resources in the world[78].

Tidal Stream Power

199. The other main form of marine renewables is that of tidal stream generation. Tidal stream generation operates on the principle of using the kinetic power generated by the ebb and flow of tides to produce electricity. Tidal patterns are driven by a complex combination of gravitational forces (the Earth's gravity as well as that of the moon) acting on the body of water composing the oceans and other environmental factors. For this reason, tidal flow has two major advantages over wave generation. Firstly, as it is not dependent on the atmospheric conditions at any given time, it provides a constant source of energy. Secondly, as tidal and gravitational patterns can be very accurately calculated by modern science, it is possible to predict tidal patterns and their resultant energy generating potential, for a very long time into the future (i.e. centuries). This has the benefit of allowing firm forward planning which helps to reduce the problem of intermittency of supply.

200. In relation to both the main forms of marine renewables, the Committee has heard from witnesses that the key factor in the successful development of this sector is in producing `market ready' technology as quickly as possible. As already outlined in the report, currently the only market-ready renewable technology available for widespread use is that of onshore wind generation.

Making Marine Renewables Market-Ready

201. Many of the witnesses who have given evidence to the Committee on marine renewables have stated that the most important factors to address in the development of the marine sector are getting the technology through the development cycle quickly and providing a suitable market support structure to allow marine technology to compete effectively in the energy marketplace.

202. The Scottish Executive has already made a substantial and welcome investment in ensuring Scotland remains at the forefront of marine renewables development. The Committee commends the Executive's contribution of a £2 million investment in the development of the European Marine Energy Centre (EMEC), at Stromness in Orkney[79]. This centre was established by Highlands and Islands

Enterprise in co-operation with the Scottish Executive, the DTI, Orkney Islands Council, Scottish Enterprise, Orkney Enterprise and the Carbon Trust. It is the first centre of its kind and gives Scotland a significant lead in the field of marine technology development.

203. EMEC's main objective is to become a world centre of excellence for the testing, development and certification of marine technology devices. EMEC will play a crucial role in bringing marine devices to market readiness and its location in Scotland should help to give Scottish firms a lead in the development of market-ready marine technology. Previous experience with wind technology has shown that those firms which can deliver reliable cost effective technology to the marketplace early, develop a lead in establishing dominance. This will be vital if the Scottish economy is to achieve the `critical mass' necessary to corner the marketplace in marine technology.

204. **The establishment of a market support system for marine technology will be crucial to the economic viability of the sector and, consequently, its contribution to meeting Scotland's renewables targets.** As previously stated the Renewable Obligation (Scotland) (ROS) places a duty on Scottish electricity generators to produce 18% of their electricity from renewable sources by 2010 and an `aspirational' 40% by 2020. The current system of market support for electricity generated from renewable sources in the UK system is that of the Renewable Obligation Certificates or ROCs. This is a system of tradable certificates awarded on the basis of each unit of electricity generated from renewable resources. Generators who meet or exceed their renewable generating target can trade in ROCs with those generators who have not met the target. The technologies to which the ROCs system applies are outlined in paragraph 97. Given the current scarcity of renewables in the UK energy market, ROCs currently provide a value of about 6.8p/kWh for electricity generated from onshore wind farms. This price, when compared to the wholesale price for electricity of 2.3p/kWh, provides a significant financial incentive for the development of onshore wind power[80].

205. As the proportion of electricity generated from renewables approaches the targets set (15.4% by 2015 in the UK), the value of ROCs will decrease to the point where they converge with the wholesale price of electricity. As a result it is likely that the development of onshore wind farms will slow down at this stage. This means that the ROCs will have achieved their objective and developed one source of renewable energy, wind technology, to a stage where it can compete in the marketplace without government support.

206. ROCs are designed to be technology neutral, that is to say not to favour one form of renewable energy generation over another. However, as we have seen from the examination of the onshore wind sector, this is not the case in practice. If the development of the marine sector is to be achieved then it must be able to compete on a financial basis with onshore wind generation. This will require the ROCs system to encourage developers to invest in marine technology and so deliver the critical mass required to allow marine technology to compete effectively.

207. It is clear that the vast majority of renewable generation is being delivered by onshore wind farms. This is because, as a mature developed technology, it is

currently the renewable technology which will provide the best market return for the generating companies. Because marine technology is still largely in the development stage, the investment costs and financial risks for generating companies are higher than for onshore wind farms. The end result of this situation is that the development of marine technology is being smothered by the current ROC system.

208. In its evidence to the Committee SEEF stated that in examining the economies which currently dominate the international wind technology manufacturing market, namely Denmark and Germany, a key element in their success was the development of a strong domestic market before developing exports[81]. The international market for wind turbine technology is now estimated to be worth £4 billion[82] per annum.

209. Applying the lessons learned in the development of wind technology over the last two decades, it is even clearer that Scotland's success in capturing the international marine technology market will depend on growing a strong domestic market for marine technology. The Committee believes that this domestic Scottish/UK marine market cannot be achieved under the current system of ROCs.

210. The current system of ROCs covers the generation of electricity from marine technology. However, given the expected increase in the use of onshore wind generation over the next decade, it is likely that the value of ROCs will decrease too quickly to provide enough of a financial incentive to encourage the market to invest in marine technology to develop it to a level where it can compete with onshore wind farms.

211. One way of addressing this problem would be to vary the current value of the current ROC system so as to provide a higher value per kWh for electricity generated from marine. This could provide a financial stimulus for developers to invest in the development of marine technology and so make it more viable in the UK electricity marketplace.

212. Another method would be to provide a funding mechanism to support the research, development and demonstration phase of marine technology in order to encourage it to develop to market readiness more quickly. This would allow it to enter the market at a stage where the current ROC system would provide enough of a financial benefit for the sector to gain the necessary `critical mass' in the domestic market and to establish the necessary supply chain, services and infrastructure. This is the approach favoured by organisations such as Wavegen[83].

213. Alternatively, a separate dedicated ROC system could be developed specifically to support the development of marine renewables. However, evidence taken from the major power companies suggests that the introduction of another ROC system should be considered in the light of any potential impact on the current system of ROCs. They fear that two or more market support systems for different renewable technologies could increase bureaucratic demands on companies and interrupt the free flow of the market[84].

214. Irrespective of the advantages or disadvantages of the various financial support mechanisms proposed in the evidence received by the Committee, it is clear there is a real and urgent need to address the outstanding issues in relation to the

development of the marine sector, namely how to develop a strong domestic marine renewable sector and how to capitalise on the benefits of the developing international manufacturing market.

215. **The Committee recommends that the Scottish Executive undertakes a speedy analysis of the potential market supports systems to establish the system best suited to delivering Scotland's economic and environmental marine renewable goals. This could include varying the current market support systems, such as ROCs, to encourage the development of marine technology. Given the current pace of development in the renewable sector this process must be undertaken immediately. The Executive should not wait for the Department of Trade and Industry review of the Renewable Obligations system due in 2005/06[85].**

Footnotes

[1] A watt is the unit of measurement of power. A megawatt (MW) is one million watts.

[2] Carbon sequestration is the long-term storage of carbon dioxide in the forests, soils, ocean or underground in depleted oil and gas reservoirs, coal seams and saline aquifers.

[3] The Utilities Act 2000, section 68(8).

[4] The petitioners from whom the Committee took evidence are listed in paragraph 81

[5] Department of Trade and Industry White Paper `Creating A Low Carbon Economy' February 2003

[6] A watt-hour is an electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electrical circuit steadily for 1 hour. A kilowatt hour (kWh) is 1000 watt-hours

[7] Mr William R Graham, 13 January 2004, Official Report column 363

[8] Mrs Marilyn Henderson, 13 January 2004, Official Report column 362

[9] 13 January 2004, Official Report columns 363 and 383

[10] 13 January 2004, Official Report column 390

[11] John Thomson, Scottish Natural Heritage, 3 February 2004, Official Report column 543

[12] Bill Band, Scottish Natural Heritage, 3 February 2004, Official Report column 544

[13] Anne McCall, Scottish Renewables Forum & Royal Society for the Protection of

Birds, 3 February 2004, Official Report column 561

[14] Angus Gilmore, Argyll and Bute Council, 20 January 2004, Official Report column 419

[15] Alan Baillie, Ministry of Defence, 23 March 2004, Official Report column 779

[16] www.dti.gov.uk/energy/renewables/publications/index/shtlm

[17] Written submission from Mr John Macdonald, page 1

[18] Written submission from Mr John Macdonald, page 1

[19] Written submission from the Scottish Renewables Forum, page 2

[20] Written submission from Scottish and Southern Energy, page 4

[21] Scottish Renewable Forum is Scotland's largest representative body for the renewables industry. Further information is available at http://www.scottishrenewables.com/about_SRF.asp

[22] Written submission from the Scottish Energy Environment Foundation, page 4

[23] Written submission from the Scottish Energy Environment Foundation, page 3, table 1

[24] Written submission from the Scottish Energy Environment Foundation, page 3

[25] Written submission from the Scottish Energy Environment Foundation, page 1, introduction,

[26] Written submission from Scottish Power, page 5, paragraph 4.3

[27] Written submission from Scottish Power, page 5, paragraph 4.3

[28] Renewable Obligation and Renewable Obligation (Scotland)

[29] ROCs: Renewable Obligation Certificates

[30] http://www.offshorewindfarms.co.uk/else.html

[31] Written submission from the Scottish Executive, annex a

[32] Written submission from Scottish Power, paragraph 4.2

[33] Written submission from the Scottish Energy Environment Foundation, page 4

[34] www.scotland.gov.uk/about/ELLD/EN-CS/00017058/page633376673.aspx

[35] www.scotland.gov.uk/about/ELLD/EN-CS/00017058/page1525243087.aspx

[36] Electricity Act 1989 and the Utilities Act 2000

[37] Key Scottish Environment Statistics 2003: page 1 - www.scotland.gov.uk

[38] m/s: Meters per second

[39] BWEA - The British Wind Energy Association - www.bwea.com

[40] Steve Watson, ALlenergy, 20 January 04, Official Report column 421

[41] Steve Watson, ALlenergy, 20 January 2004, Official Report column 422

[42] Further information on Incoteco AsP is available on their website http://www.scottish.parliament.uk/enterprise/reports/www.incoteco.com

[43] Further information on ELTRA is available on their website http://www.scottish.parliament.uk/enterprise/reports/www.eltra.dk

[44] Dr Brian Smith, Scottish and Southern Energy, 20 January 2004, Official Report column 435

[45] Alan Mortimer, Scottish Power, 20 January 2004, Official Report column 436

[46] Written submission from the Scottish Executive, annexe a

[47] BWEA's UK operation grid connected wind farm list 2004

[48] BWEA's UK new wind farm's projects list 2004

[49] Cllr Alison Hay, COSLA, 13 January 2004, Official Report column 395

[50] COSLA, 13 January 2004, Official Report columns 395 and 396

[51] NPPG6 - Scottish Executive's National Planning Policy Guidelines (Version 6) published 2000

[52] PAN45 - Scottish Executive's Planning Advice Note 45 (Renewable Energy Technology) revised 2002

[53] National Planning Framework for Scotland, paragraph 1

[54] National Planning Framework for Scotland, paragraph 94

[55] 20 January 2004, Official Report columns 417, 418, 443 and 444

[56] Section 36 of the 1989 Electricity Act does not include generating stations which are "wholly and mainly" driven by water.

[57] Written submission from Mr Bernard Hamill, page 2 - www.scottish.parliament.uk

[58] George Harper, Argyll and Bute Council, 20 January 2004 Official Report column 416

[59] Written submission from the Scottish Executive, annex a

[60] Written submission from Aberdeenshire Council, page 2

[61] Written submission from Royal Town Planning Institute Scotland, paragraph 4

[62] National Planning Framework for Scotland, paragraph 138

[63] Written submission from Royal Town Planning Institute Scotland, paragraph 5

[64] COSLA, 13 January 2004, Official Report column 397

[65] David Sigsworth, Scottish and Southern Energy, 20 January 2004 Official Report column 442 to 443

[66] Susan Reilly, Scottish Power, 20 January 2004, Official Report column 443

[67] 30 March 2004 Official Report column 451

[68] Written submission from Highland Council, page 8, paragraph 9

[69] Alan Mortimer, Scottish Power 20 January 2004, Official Report column 435

[70] Deputy Minister for Enterprise and Lifelong Learning, 30 March 2004, Official Report column 818

[71] Deputy Minister for Enterprise and Lifelong Learning, 30 March 2004 Official Report column 833

[72] Danish Energy Authority's 2002 Energy Sector Exports Report: http://www.ens.dk/sw1212.asp

[73] National Planning Framework for Scotland, paragraph 173

[74] Dr Gary Connor, Scottish Energy Environment Foundation, Official Report column 798

[75] A watt-hour is an electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electrical circuit steadily for 1 hour. A megawatt-hour

(MWh) is one million watt-hours.

[76] Deputy Minister for Enterprise and Lifelong Learning, 30 March 04, Official Report column 839

[77] Written submission from Wavegen Ltd, page 1, paragraph 2

[78] Written submission from Institute for Energy System, page 4

[79] Deputy Minister for Enterprise and Lifelong Learning, 30 March 04, Official Report column 821

[80] Written submission from the Scottish Energy Environment Foundation, appendix b

[81] Written submission from the Scottish Energy Environment Foundation, page 4

[82] Written submission from the Scottish Energy Environment Foundation, page 4

[83] Written submission from Wavegen ltd , page 3

[84] Scottish Power, Official Report column 432 to 433

[85] Deputy Minister for Enterprise and Lifelong Learning, 30 March 04, Official Report column 827