SCDI

Scottish Council for Development and Industry

POLICY SUBMISSION

THE FUTURE OF BRITAIN'S ELECTRICITY NETWORKS

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SCDI is an independent and inclusive economic development network which seeks to influence and inspire government and key stakeholders with our ambitious vision to create shared sustainable economic prosperity for Scotland.

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The Future of Britain's Electricity Networks

1. SCDI welcomes the opportunity to comment on the inquiry by the Energy and Climate Change Committee into The Future of Britain's Electricity Networks.

2. SCDI is an independent membership network that strengthens Scotland's competitiveness by influencing Government policies to encourage sustainable economic prosperity. Its membership includes business, trades unions, local authorities, educational institutions, the voluntary sector and faith groups.

What should the Government's vision be for Britain's electricity networks, if it is to meet the EU 2020 renewables target, and longer-term security of energy supply and climate change goals?

2020 Targets and *The Future of Electricity Generation in Scotland*

3. In December last year, SCDI published *The Future of Electricity Generation in Scotland* the first major independent study of the Scottish Government's renewable energy targets which it had commissioned from the independent international energy research consultancy Wood Mackenzie. This concluded that Scotland can hit its target of 50% from renewable sources by 2020 and maintain exporting electricity to England and Northern Ireland. Scotland's electricity sector will, consequentially, produce a third less carbon dioxide. Reaching this Scottish target is essential for the UK's renewable energy and climate change obligations.

4. In Wood Mackenzie's view, onshore wind will provide more than 80 per cent of the increase in Scotland's renewable electricity by 2020, with marine, biomass and hydro expanding at a tenth of the rate of new wind. This is likely to mean a 500 per cent increase in the numbers of wind farms, with Scotland needing around 450 MW of new wind power – more than twice the size of the country's biggest operational wind farm - every year until 2020. Expansion at this rate will mean £10bn of investment in new electricity generation between now and 2020.

5. Wood Mackenzie also provided a forecast of renewable generation capacity growth and compared it with the views put forward in the Scottish Government's draft Renewable Energy Framework. A comparison is set out in the table below:

Technology	Current (GW)	Scottish Renewable Energy Framework 2020 Estimate (GW)	Wood Mackenzie 2020 Forecast (GW)
Hydro	1.4	2.1 to 2.4	1.7
Onshore Wind	1.3	5 to 7	6.6
Offshore Wind	0	1 to 4	0.5
Wave & Tidal	0	0.5 to 1	0.2
Biomass	0.04	0.2 to 0.4	0.4
Total	2.8	8.8 to 14.8	9.3

6. While the report concentrates on the future of electricity generation in Scotland, this is within the context of Scotland's high voltage power transmission network being connected to systems in England and Northern Ireland and, following the introduction of BETTA in 2005, Scotland's integration into the wider GB electricity trading market. Wood Mackenzie also forecasts renewable generation capacity growth in the rest of the UK. These underline the fundamental importance of the growth of the UK's electricity transmission networks to the mix of future supply.

7. The recently published report by the Electricity Networks Strategy Group (ENSG) sets out three scenarios for the growth of renewable electricity capacity in Scotland by 2020: from a minimum scenario of a 6.6GW of wind generation, a second scenario of 8 GW of wind generation and a third scenario of 11.4 GW.

8. In Scotland, Wood Mackenzie forecast that onshore wind will increase by 5.5GW, from 1.3GW today to 6.6GW in 2020, towards the upper end of the estimate in the Scottish Government's draft Renewable Energy Framework. By way of comparisons, it forecasts that only 2.3GW will be added in England and Wales and around 1GW added in Northern Ireland. Wood Mackenzie's view is that:

   "The growth of onshore wind capacity, as perhaps the cheapest and most accessible form of renewable power, is likely to represent a large majority of the Scottish generation sector's response to current renewable energy targets. Some slowing of this rate at the very end of the period is assumed as desirable sites become more difficult to acquire and the sector finds itself competing for equipment and investment in an increasingly active international market."

9. The Crown Estate has announced that it will be offering exclusivity arrangements to companies and consortia for 10 sites for development of offshore windfarms within Scottish territorial waters. In total, the sites have the potential to generate more than 6GW of offshore wind power. The Crown Estate Round 3 Offshore Wind Farm identifies a further two potential development zones around Scotland.

10. However, Wood Mackenzie forecast that Scotland's offshore wind generation will only increase from 0GW today to 0.5GW in 2020 – 5% of the total capacity for renewable energy - a much slower growth than has been estimated in the draft Renewable Energy Framework. This contrasts with its forecast that there will be offshore wind development in England and Wales of 6.8GW. Its view is that:

    "…there will be a noticeable shift from onshore to offshore wind development in the UK during the period, as developers circumvent the planning issues associated with onshore wind projects by going offshore and take advantage of the greater flexibility this also provides to locate generation close to demand centres in the southern part of England. Unfortunately, without the introduction of significant offshore transmission networks, offshore wind in Scotland will rely upon much of the infrastructure being used by onshore projects, and seems set to remain less attractive than developments further south as a result."

11. The Crown Estate has invited initial proposals from developers for the UK's first commercial marine power sites in the Pentland Firth and surrounding waters. The aim is to deliver 700MW of new offshore wave and tidal power by 2020.

12. Wood Mackenzie forecast that wave and tidal energy generation in Scotland will increase from 0GW to 0.2GW in 2020, again a much slower growth than was estimated in the draft Renewable Energy Framework. This is incorporated in the "Other Renewables" category of its forecasts. In this period, its view is that:

    "…the nascent nature of wave and tidal technologies, challenges associated with connecting offshore generating capacity to the grid, and expectations of high capital costs (roughly double those of onshore wind) suggest it is unlikely that a significant volume of marine generation will be connected to the system."

13. The majority of Scotland's potential is located around the Highlands and Islands. For example, the Western Isles has the potential for at least 16GW of wind, 1GW of wave and 150MW of tidal. The proposed Viking Energy wind farm on Shetland would alone meet 12% of Scotland's renewable energy target and 5% of Scotland's CO_2 reduction target. The potential of the Pentland Firth has already been noted. Three of the ten potential sites for offshore wind farms sites announced by the Crown Estate in Scottish territorial waters are in Argyll and Bute, including the largest, the Argyll Array, at 1500MW. Off the east coast, the Beatrice site situated in the Outer Moray Firth has a potential capacity of 920MW.

14. At over 40% of installed capacity, the load factor for wind energy is generally much higher in these areas than in other areas of the UK. A wind farm on Shetland has recently achieved a

world record of 58% of capacity over the course of a year. Viking's wind farm is working on a conservatively calculated load factor of 46%. It has been estimated that to attain as much output on the Scottish mainland, the proposed scheme would have to be twice as big in size. The areas are a very reliable power source for the UK and - along with the local socio-economic benefits - the projects should be viewed as nationally significant.

15. Wood Mackenzie also presented an Alternative Case which assumes a lower rate of wind capacity expansion and the extensive development of more efficient, low carbon, fossil-fuelled power sources. Such technologies are yet to be proven at a commercial scale in the power sector and the feasibility of such additions will rely much upon the research and development activities of those companies currently active in the field. However, this Alternative Case would emit less CO_2 and put Scottish generation on a more competitive footing in the wider GB power market. By 2020, output from gas and Carbon Capture and Storage coal plants would account for nearly 55% of total generation. Due to the assumption of lower build rates, renewable energy supply would fall to 40% of Scottish demand.

Beyond 2020

16. The report also highlights the potential loss of base load generation, specifically nuclear and coal-fired plant closures that may occur in the period between 2020 and 2030, and the possibility that this could give rise to a generation shortfall. Wood Mackenzie states that if Scottish demand is to continue to be served by Scottish generation, it is highly likely that new base load capacity will be needed and that new nuclear generation could represent a viable option at this time.

17. In total, Scotland has an estimated potential of 36.5 GW of wind and 7.5 GW of tidal power, 25% of the estimated total capacity for the European Union and up to 14 GW of wave power potential, 10% of EU capacity. In the long-term, the renewable electricity generating capacity in Scotland may be 60 GW or more.

Britain's Existing Electricity Networks

18. Britain's electricity networks were designed for a different age in which electricity has been mainly generated from a relatively small number of large scale plants. The network is already under severe strain in Scotland as this pattern changes. After the development of hydroelectricity in the 1950s, the North has generally exported electricity to the Central Belt. However, the main North-South transmission lines are now at capacity. There are extra power flows in the South, and, in recent years, Scotland has typically maintained power transfers to neighbouring networks of around 10TWh per annum, which has been limited by the maximum operating capacity of the circuits between Scotland and England. However, all the generation scenarios for renewables assume significantly increased power transfers from North to South and from Scotland to England.

19. The current grid connection system was established to allow for the connection of a relatively small number of very large generation projects, often with long lead times available. The recent trend towards renewable generation has seen a much larger number of small projects seek access to the grid, which has contributed to the current backlog (the so called GB queue). As access is allocated on a 'first come, first served' basis, projects with planning consent can be stuck in the queue behind projects that are less well developed. Renewables projects can currently wait for 10 years for access to the grid and the Transmission Access Review 2008 by the UK Government and Ofgem found that "fundamental changes to the codes that govern access to the grid" are required.

20. The worst affected areas are often the ones with the biggest renewable resource. For instance, as Argyll and Bute's grid infrastructure is considered effectively "saturated" even very small projects are being refused connections before 2018.

Vision for Britain's Electricity Networks

21. SCDI has set the following objectives for UK and Scottish energy policy:

- **Security of Supply**
- **Decarbonising Supply**
- **Affordability of Supply**
- **Optimising Economic Benefit**

- **Security of Supply**

22. There has been significant underinvestment in the UK energy industry over many decades. A substantial percentage of the UK's generating capacity is scheduled to close over the next 15 years. Production of North Sea oil and gas is declining at a rate of 5% per year and the UK will soon, once again, become an importer of both. There is a real danger that a business-as-usual approach will fail to attract enough investment in generating capacity to meet peak UK demand. The UK has a relatively short time to shape its electricity networks for the decades to come.

23. The European Commission's *Energy Security and Solidarity Action Plan: 2nd Strategic Energy Review* which was published in November 2008 stated that "the development of a blueprint for a North Sea offshore grid, interconnecting national electricity grids and plugging in planned offshore wind projects" should be recognised as an energy security priority of the entire European Community.

24. The future of Britain's electricity networks is within international cooperation on an entirely new scale. Scotland is leading the way in the development of a North Sea Grid, which should ultimately form part of a Europe-wide electricity system. It will then be possible to balance variation in the energy generated from solar in southern Spain, with wind, wave, and tidal resources from the north of Scotland.

25. Technology choice will proliferate and the system will become customer driven rather than supply driven. The Energy Savings Trust has estimated that microrenewables could potentially supply as much as 30-40% of the UK's total electricity demand by 2050. Power will flow to users and surplus from distributed generation will flow back to the grid, supporting intermittency management.

- **Decarbonising Supply**

26. The electricity networks must support the complete decarbonisation of electricity generation which is essential if the 2050 climate change target is to be achieved. Scottish Ministers believes that Scottish supply could be decarbonised by 2030.

27. CO_2 emission reduction and wider energy services will drive energy utility company revenue. It has been estimated by National Grid that the introduction of smart metering could meet 6% of the UK's 2020 target for CO_2 emission cuts.

- **Affordability of Supply**

28. The cost of grid infrastructure improvements could add about £15 per year to the average UK household electricity bill. Therefore, when decisions are made on investment, it is important that the costs to consumers now and in the future, including the estimate by the Stern Review that climate change could lead to a loss of between 5% and 20% of annual global GDP, are taken into account.

29. The roll-out of smart meters would enable customers focus on economic value, using a wider range of products and services. Initial analysis by National Grid of the levels of benefits suggests £8bn in 10 years, mostly from reduced demand.

- **Optimising Economic Benefit**

30. As a result of the credit crunch, economic downturn and lower price of hydrocarbons, the global growth in renewables is slowing from the 30 to 40% seen in recent years. However, the sector is still enjoying comparatively high investment. The European Investment Bank has increased its lending this year to about a fifth of its total lending for energy projects. This amounts to 3bn euros compared to 2.3bn in 2008. The Bank is considering lending to a large number of big offshore wind projects in the North Sea worth more than 1bn euros. This lending could eventually amount to 7 or 8bn euros. Investment in Britain's electricity network is not only an economic stimulus in itself, it is essential if the UK is to attract projects and take advantage of this so-called 'Green New Deal'

31. Island authorities and offshore developers support 'bootlaces' around the coasts of Scotland to take the power they generate to the population centres. These sub-sea grid developments would offer a springboard for developing the North and Irish Sea Grids. It will be important that Government supports sufficient generation capacity in order that investors have confidence in these proposals. This is a once-in-a-generation socio-economic opportunity for the communities.

32. The exploitation of Scotland's and the UK's renewable electricity potential and its transmission through an offshore grid will, eventually, create the opportunity to export power to Europe. This would benefit the UK's balance of payments.

33. The offshore wind and marine energy markets offers great promise in terms of developing a wider indigenous supply chain. The aim for the UK should be not simply to exploit the resource, but to create the world's leading technological hub. This will only happen with early projects in Scotland and the rest of the UK. The sustainable development of offshore wind and new marine and tidal renewable developments will only be taken forward in the Highlands and Islands if the necessary capacity is first built into the grid. Early progress in the marine renewable field is critical because the global competition is quickly catching up.

34. Smart grid technologies will not only improve electricity networks, but stimulate economic development through competition which automatically encourages innovation. Several studies done in US and Europe show that these cross cutting technologies have the potential to open new markets, new revenue streams and create several high end jobs to serve the new markets. The smart grid is likely to serve as the foundation for the growth of many new industries just as broadband is creating new markets in e-commerce, telehealth, and online banking etc.

<u>Electricity Networks Strategy Group</u>

35. With the Britain's electricity transmission networks recognised as a key determinant of the pace of expansion and mix of renewable energy technologies, SCDI welcomes the ENSG report. This proposed the largest single expansion of the gird in the UK since the 1960s, utilising 1000km of new cables, at a total cost of £4.7bn. The resulting network could accommodate a further 45 GW of which 34 GW could be a combination of onshore and offshore wind generation by 2020.

36. SCDI supports ENSG's view that the upgrade of the Beauly-Denny line is simply essential on any potential pathway towards the targets. It is the only practical and affordable way to proceed, and its completion will also unlock the upgradeable potential of the rest of the northern Scotland transmission network through relatively uncontroversial reconductoring on existing routes and towers, without the need for new overhead transmission routes, at a total cost of £780m. These are required to make maximum use of the existing infrastructure and overhead lines routes to connect renewable generation on the mainland and the islands. Offshore connections will only proceed if the Beauly-Denny upgrade is approved.

37. The ENSG propose the provision of connection capacity to the Western Isles, Orkney and Shetland via subsea links to the main interconnected system, together with a subsea link

between the Kintyre peninsula and Hunterston, allowing the contribution of 1.5-2 GW of renewable generation from these areas.

38. Further proposals by the ENSG would increase the transfer of power between Scotland and England. One would further boost the Scottish/ English inter-connectors. The Western subsea 1.8GW High Voltage Direct Current Link (HVDC) would link Hunterston and Deeside on Merseyside at a total cost estimated at £760m. The Eastern subsea 1.8GW HVDC Link, would link Peterhead and Hawthorne Pit, Country Durham at a total cost of around £700m.

39. The need for these reinforcements depends on which scenario for the growth of renewable electricity capacity in Scotland proves to be correct. However, as the report from Wood Mackenzie highlighted, the availability of significant offshore transmission networks in Scotland will itself be a determinant of the growth of offshore renewables. The ENSG propose to proceed with the Western HVDC Link and the incremental upgrade immediately, with a target completion date of 2015, and then with the Eastern HVDC link with a target completion date of 2018.

How do we ensure the regulatory framework is flexible enough to cope with uncertainty over the future generation mix?

40. Ofgem has highlighted the significant challenges in forecasting. It has suggested that future electricity networks may have to be larger to transmit more renewable energy and conventional power. In evidence to the Environmental Audit Committee, E.ON UK stated that if the UK needs around 40000MW renewable electricity to meet the EU renewable energy target, 36400MW of conventional supply will also be needed to ensure that winter peak demand can be met. But Ofgem has also said that with smart grid technology, energy efficiency and more decentralized generation activities, the national energy networks could shrink.

41. In *The Future of Electricity Generation in Scotland*, Wood Mackenzie forecast that demand for electricity will rise by 10 per cent between now and 2020 despite continued attempts to encourage greater energy efficiency. This projection is probably applicable to the rest of the UK. SCDI believes that much more could be done to promote energy efficiency. But the use of electric powered vehicles is likely to increase sharply, the Scottish and UK Government are expected to support major phased programmes of rail electrification over the next decades and the anticipated new high-speed rail lines would increase energy consumption by 90% at top speeds. So overall demand for electricity may increase further.

42. The regulatory framework must be flexible enough to cope with the following:

- closures of existing generating plants due to various legislation and age profile;
- contracted new connections for all types of generating plant;
- the potential for, and location of onshore and offshore wind generation; and
- the potential build rates for wind and new nuclear generating plant.

43. The ENSG report stated that there is a “high probability that at least 8GW of wind generation will connect in Scotland”, and that this could potentially be 11.4GW. The critical point for Scotland, especially the Highlands and Islands, is that planning begins now for grid upgrades which will transport and export up to 11.4GW. Large hydro power schemes in north of Scotland offer a prime example of the benefits of an initial, ambitious investment in infrastructure to access renewable energy. These areas now boast some of the cheapest, if not the cheapest, generation in the UK free from the effects of fluctuating fuel prices.

44. The uncertainty can be reduced through planning. The Scottish Government has announced that it will complete a Strategic Environmental Assessment for offshore wind. It is intended that this assessment will ensure that Scotland’s offshore resource is developed in a strategic and coordinated manner. Ministers have stated that they will prioritise the completion of the process within one year.

What are the technical, commercial and regulatory barriers that need to be overcome to ensure sufficient network capacity is in place to connect a large increase in onshore renewables, particularly wind power, as well as new nuclear build in the future? For example issues may include the use of locational pricing, or the availability of skills.

Planning

45. The average time between planning application and completion of the construction of major infrastructure seems to be over ten years. The UK will not be able to meet its energy objectives if such projects are not fast-tracked. SCDI welcomes the inclusion of electricity grid reinforcements as a national priority within the Scottish Government's National Planning Framework (NPF2) and the proposals for a National Policy Statement in the UK Government's Planning Bill.

46. The upgrade of the Beauly-Denny line is simply essential on any potential pathway towards the renewables targets. It is the only practical and affordable way to proceed, and its completion will also unlock the upgradeable potential of the rest of the northern Scotland transmission network through relatively uncontroversial reconductoring on existing routes and towers, without the need for new overhead transmission routes. Any further delay would be likely to halt development in large areas of the country with the best renewable resource.

47. The report from the ENSG builds on NPF2, but the documents are not entirely consistent. The ENSG refer to a subsea link between the Kintyre peninsula and Hunterston, and the need for a new sub-sea cable link between Hunterston and Carradale to allow future capacity to be built into the grid for Argyll and Bute is mentioned in the text of the NPF2. However, it is not actually shown on the network map (map 8) in the document nor is it detailed in the annex (unlike other proposed links to Shetland, Orkney and the Western Isles). This may lead to challenges in the planning. It is important that all these links receive sufficient priority if the major renewable electricity potential in these areas is to be realised.

Regulation

48. The regulatory regime has served its purpose. The Social and Environmental Guidance recently given to Ofgem by the Secretary of State for Energy and Climate Change is a step forward. But Ofgem's remit now needs to be more strategic, supporting transmission reinforcements, and considering the total costs to consumers now and in the future, including the costs of climate change.

49. One of the most significant barriers to renewable energy development in Scotland is access to the electricity transmission system. The additional capacity is needed both for larger scale renewable projects and for smaller scale, community driven projects. Renewables projects can currently wait for 10 years for access to the grid. A more flexible and responsive network connection regime needs to be put in place. SCDI is encouraged by the on-going work on the Transmission Access Review and GB Security and Quality of Supply Standard, including the consideration by the UK Government and Ofgem of interim arrangements to allow for the immediate connection of new capacity. SCDI welcomes moves by National Grid to reduce delays and more speedily connect projects before major transmission reinforcements are made. These short-term measures are possible as the rapid growth of variable wind on the system increases the potential for greater sharing of existing capacity. It is a concern to SCDI that Ofgem has recently threatened to block the initiative by National Grid.

50. TEC-Sharing (called CAP163) allows generators to share transmission capacity as long as they ensure that the combined total of their projects does not exceed a pre-agreed maximum. This works where co-incidence of peak output is rare.

51. Regional Power Zone (Active Load Management) allows the distribution operator to control small generators in a given area so that they can restrict output when necessary for grid control. This is currently being applied on Orkney and its introduction is allowing a further 15MW of generation to

connect. The distribution operator, SHEPD, have the right to request Ofgem approval for another scheme in Argyll and there is an intention to implement another one in the Western Isles.

52. A 'Connect and Manage' system would oblige National Grid to provide (where a physical link to the transmission system can be put in place) grid access within four years of generators making a commercially committed application. The generator has to accept flexible operation. Such an arrangement would significantly reduce uncertainties for generators and send strong signals for investment in grid infrastructure and generation projects. SCDI hopes that a finalised 'Connect and Manage' system can be introduced as soon as possible.

Locational Pricing

53. Grid capacity and transmission charging mechanisms which disadvantage those looking to develop in rural locations away from the central grid network, are proving to be a serious barrier to ensuring sufficient future network capacity. The current regime of locational pricing is designed for high load factor, baseload generators, but it is also being levied on low load factor, intermittent generators. SCDI members have questioned whether the model and inputs reflect the network and power flows, and whether the short term year-on-year approach to charging properly reflect economic decisions in an industry with long-life assets.

54. The UK's system of transmission charging results in higher and less predictable charges for Scottish based generators and is a particular disadvantage to those developing renewable energy projects in those areas with the best resource.

55. A report for ScottishPower has shown that under the pricing regime energy producers in Devon and Cornwall receive almost £9 per kW, those in London receive £5 and those in south Wales and Gloucester receive £3. In Scotland, they are charged almost £14 and those in the north of Scotland pay £22. The operator of a 50MW wind farm would pay a locational charge of about £1.1m per year, while one in southern England would receive subsidies of about £450,000. The additional locational costs for generators in the north amount to 15% of their total costs and appear to run contrary to Government energy and climate change policy, by making it harder to finance projects in optimal, but peripheral locations. This too is a barrier to the geographical dispersal of projects to counter variability.

56. Charging is also volatile. Some generators have experienced year-on-year increases of over 100%. It does not appear credible that a generator can impose twice as much cost on the network from one year to the next. Stability and predictability are necessary for a healthy climate for new generation investment.

57. SCDI accepts the view that there are other important barriers to new generation, renewable or otherwise, especially the present planning regime. However, it believes that the current transmission charging regime is a significant disincentive and that a more appropriate approach is needed to achieve the stretching renewable energy and climate change targets which the UK Government has agreed for the European Union. Early renewable projects have been sited in areas of best resource. The UK and Scottish renewable energy targets will now require an unprecedented and rapid expansion in areas which are increasingly marginal. SCDI would suggest that the current economic climate is also important. Renewable energy companies are experiencing serious difficulties in financing projects. When growth takes off again, this will also pose problems. Global demand for turbines will drive up the cost of projects and squeeze the margin of financial return which will mean that locational pricing will increasingly become a barrier to renewable development in peripheral areas. It will also disincentivise investment in extending the life of and constructing new thermal plants to back up the variable power supply from renewable sources.

58. SCDI has called for a fundamental review of locational charging. It is supportive of the proposals by the Scottish Government, ScottishPower, Scottish and Southern Energy, and the Scottish Renewables Forum for a new methodology in which there is a level-playing field with generators

using the UK transmission network being levied at a uniform rate for each unit of energy that enters the system, irrespective of its location. This would appear a simpler, more predictable and fairer system, which is more aligned with Government policy objectives and would not impose extra costs on National Grid or the consumer. Locational signals could be provided in other ways under consideration by the industry, such as charging for network losses associated with generators' output. The new approach would support integration of the European energy market.

59. Transmission costs currently make up 3% of customer bills. Therefore, if these changes to the charging methodology are implemented, consumers would not be affected. The total revenue recovered from the generators would not be altered either. The charging would, rather, be more evenly and fairly distributed.

60. The lack of a formal charging method and the resultant uncertainty/ potential volatility is the biggest barrier to renewable energy projects being developed on Scotland's islands. The Viking wind farm project will create a new industry on Shetland which will compensate for the rundown of the oil and gas industry. An average of 230 local jobs will be created during each year of the construction phase and more than 50 local jobs created during the anticipated 25-year life of the wind farm. Through a unique community-private sector partnership, it will return an estimated £25 to £30m to the Shetland economy every year, including £18m profits on average to Shetland Charitable Trust. Electricity demand on the island peaks at 60MW and a large project (540MW) is needed to justify the estimated £250m capital cost of the cable connection. The indications are that transmission charging could be over 100 times greater than in London and even 20 times higher than in Aberdeen. This would be a greater cost on an annual basis than all the other costs put together and could make it commercially unviable. But Viking Energy is still awaiting finalised figures and the project is proceeding into planning blind of its single biggest cost after project finance.

61. The European Commission's Renewables Directive of 2001 stated that: "Member states shall ensure that the charging of transmission and distribution fees does not discriminate against electricity from renewable energy sources, including in particular electricity from renewable energy sources produced in peripheral regions, such as island regions and regions of low population density."

62. SCDI has long supported the capping of transmission charges from the islands, would be a step towards integration with the wider European market, and is very disappointed that, based on what is a strongly disputed report, the UK Government appears to have rejected such a positive step. The effect on UK consumers of any special measures to adjust transmission charges for the islands would be virtually nothing. On the other hand, the socio-economic value of renewable energy developments to the islands would be transformational.

Skills

63. There is a need for greater clarity on the ability of the Scottish supply chain to take advantage of natural resources and deliver the UK and Scottish Government targets. Meeting the targets will require a change in the skills base across Scotland as at present it would seem that there are gap in skills across most sectors in relation to renewables projects. However, this provides an opportunity particularly in the current economic climate as opposed to necessarily representing a barrier. For example, in science and engineering (for research and development), and in trades (for deployment and installation). Planning for training facilities for offshore energy services should be commenced.

What are the issues the Government and regulator must address to establish a cost-effective offshore transmission regime?

64. The Crown Estate announced the third leasing round for offshore wind energy is intended to deliver up to 25 GW of new offshore wind generation by 2020. In addition the leasing application process for offshore wind in Scottish Territorial Waters has granted 6.4GW of exclusivity

agreements pending the outcome of a Strategic Environmental Assessment. The Energy and Climate Change Department estimate that 5000 to 7000 wind turbines, which would generally have to be more than 22 miles from the coast, could be in the water by 2020. The Crown Estate is also holding a tender for marine renewable energy installations in the Pentland Firth. It anticipates that up to 700MW will be achieved by 2020.

65. Further significant infrastructure upgrades will also have to be made if the full potential of offshore generation in Scotland is to be realised in this period. A report prepared by the Dutch marine energy firm Tocardo found that "the current policy associated with obtaining grid connection agreements will not permit any tidal energy developments over 5 MW in the Pentland Firth before 2016."

66. In December 2008, The Crown Estate published a connection study in support of Round 3. This work considered a scenario for connecting 25GW of offshore wind. The study identified that approximately £10 billion of network reinforcements would be needed. Of these, approximately 7% related to onshore works.

67. Developing a grid will be a major challenge which calls for regular review. The offshore regime must work together in a co-ordinated way around the UK and there is some concern about a lack of clarity on decision-making. The decisions and actions of the Crown Estate will clearly have a pivotal role in the development of marine energy. In Scotland, SCDI welcomes the integration of the proposed National Marine Plan into the NPF2. But details are needed on how the Scottish and UK marine legislation will be co-ordinated. There is a risk that this uncertainty will make Scotland less attractive for international investment.

68. A report by the Crown Estate made the following recommendations for Round 3:

1) That environmental and planning constraints may affect connection solutions for each zone
2) That the extent of constraints on supply chain may impact delivery of the Round 3 connections
3) The power transfer capacity of the HVAC and HVDC technologies should be raised to improve economies of scale
4) A process to effectively manage the Round 3 grid connection applications should be put in place
5) That 'no regret' onshore reinforcement options should be progressed immediately to provide the necessary transmission capacity in a timely manner.

69. Improved access to the National Grid system for offshore wind, wave and tidal developers must be implemented within a reasonably tight timeframe if the UK is to attract investment, and a major opportunity for UK manufacturing and economic development, for example on the Scottish islands, is not to be missed. This will be, ultimately, offer access to the wider UK and European markets.

70. A strategic approach needs to be taken to planning, design, licensing and investment. The Crown Estate believes that the offshore licensing regime can accommodate development of the required offshore transmission infrastructure.

71. This co-ordinated approach should also extend to associated onshore reinforcements and there is case for commencing these ahead of connection applications. This will lead to the most cost effective solutions. The ENSG found that timely investment in associated onshore networks could save £850m overall.

72. This strategic approach would also give the supply chain the confidence it needs to invest in infrastructure to support transmission development. The establishment of offshore networks offers the opportunity to establish testing, manufacturing and monitoring facilities in island and remote communities.

What are the benefits and risks associated with greater interconnection with other countries, and the proposed 'supergrid'?

73. The future of Britain's electricity networks is within international cooperation on an entirely new scale.The European Commission published a new energy plan in November which identified as a strategic priority the ultimate aim of combining a North Sea grid with ones in the Baltic and Mediterranean to create a pan-European super-grid. A Europe-wide electricity system would be able to balance variation in the renewable energy generated from solar in southern Spain, with wind, wave, and tidal resources from the north of Scotland. This would improve security of supply, decarbonise supply, provide protection from fossil fuel prices, and, given UK renewable energy export potential, optimise economic benefit.

74. The full super-grid which would be developed incrementally over 30 years. Scotland is leading the way in the development of a super-grid through a study by the Scottish and Irish Governments into a connection between Ireland and the west coast of Scotland which should ultimately form part of a super-grid.

75. If a Europe-wide electricity system is to be realised then work needs to start now. This will involve surveying the seabed, planning, overcoming technical challenges and resolving how they would be funded and regulated, who would be licensed to build them in the UK, and how European projects will be co-ordinated.

76. Finance is a major potential stumbling block. It has been estimated that upgrading the EU's power infrastructure will cost upwards of £500bn. Ultimately, billions of pounds of investment will need to be attracted from the private sector. The European Commission has revealed that it could plough £30m into research. This could be attracted to a proposed test centre which is planned for Aberdeen. The Scottish and UK Governments should work together to secure funding.

77. Looking ahead to the 2020 to 2030 period, it is critical especially critical for generation on the Scottish islands to be linked into an offshore electricity grid network which would interconnect with the Irish and Atlantic sea developments to the south, and Norway and Iceland in the North. Furthermore, the creation of an offshore HVDC power station and onshore control capability to harness the future offshore wind and marine energy sources, whilst also controlling power flows to and from northern Europe, could maximise economic and social benefits for the islands by claiming a portion of the transmitted energy value for their economies.

What challenges will higher levels of embedded and distributed generation create for Britain's electricity networks?

78. The Energy Savings Trust has estimated that microrenewables could potentially supply as much as 30-40% of the UK's total electricity demand by 2050. Short-term progress depends on Government support for the industry in the current economic downturn by helping to maintain orders and removing the planning barriers so that it can contribute towards the 2020 target and build towards 2050.

79. SCDI favours feed-in tariffs with an upper capacity limit at a level which is complementary to the ROCs system and does not undermine investor confidence in it. SCDI believes that feed-in tariffs could better support an expansion of smaller scale and decentralised renewable electricity schemes including domestic microgeneration, onsite and community owned renewables. It recognises the strong case for front-loading this support to stimulate demand.

80. The Scottish Renewables Forum has highlighted that small generators are charged as if they are using both the transmission and distribution networks all of the time, but the power that they generate often does not reach the transmission system. It is promoting the concept of a 'gross-net' model in which the small generators would pay for the amount of transmission which they actually use.

81. One model for the new electricity networks would include more large-scale renewables, local self-sufficient networks and some commercial micro-generation. This would mean that suppliers need

to look at new business models to maintain their revenues and there would be different regulatory pressures. The system would change from a supply driven to a customer driven model. Customers would focus on both economic and environmental value, using a wider range of products and services. Electricity would both flows to users and back from distributed generation, supporting intermittency management. CO_2 emission reduction and wider services would drive energy company revenue.

82. While offshore grids are being planned and constructed, a temporary solution would be possible if smart-grids are piloted for decentralised energy in north of Scotland and on the islands. This would involve the electricity generated from these variable power sources supplying local consumers and industries when it is available and the national grid supplying the electricity when it is not. This would enable the Government and National Grid to test the impact of more unpredictable power on the network and help to develop larger smart-grids. Hydrogen transport and storage are also potentially future options in these areas.

83. Higher numbers of electric vehicles would increase demand, provide distributed storage capacity and smooth levels of electricity demand on the grid. Battery manufacturer Axeon Holdings has calculated that 5000 electric light good vans would result in carbon emissions reductions of 43,585 tons per year and increase electricity demand by 29,190 mWh (or 54,987mWh for heavier box vans). More electric vehicles will probably not cause problems in electricity supply in the short term. Early adopters are likely to be light good vehicles and they can be charged overnight. This would result in no significant extra demand on the grid and smooth demand. Smart metering and new tariffs could be needed to make efficient use of electricity and avoid overloading the grid, especially if Plug-In Hybrid Electric Vehicles prove popular following their introduction in 3-5 years. Fast charging would place significant demands on the grid: overnight is better.

84. There are a number of associated challenges for Britain's electricity networks. At present, there is a serious lack of public charging infrastructure in most parts of the country – there are only two locations in Scotland, both in Glasgow - and insufficient progress has been made by Government in sorting out the regulatory issues. Clarity is needed on how the electricity supply infrastructure will be developed and charged for (public ownership/ public good or competitive market) and on smart metering to get the best value from current electricity generation.

What are the estimated costs of upgrading our electricity networks, and how will these be met?

85. Achieving the renewable electricity targets will depend on investment in the expansion transmission capacity on a scale which has not been delivered for many years. But any delay could temporarily sterilise the development potential of large areas of the country, which might otherwise provide suitable sites for new generation, and severely restrict Scotland's renewable energy potential.

86. According to a recently published report by Ernst & Young report for Centrica an investment of £234bn will be needed by 2025. Last June it estimated that £165bn was needed by 2020. Since then the cost of renewables has increased significantly, especially for offshore wind, due to component inflation and the weak pound. Investment rates will have to be double what they are at present.

87. The costs broken down in the Ernst & Young report include: £12bn for an offshore transmission grid; £12bn for onshore grid reinforcement; £4.2bn for enhancement to the distribution network; and £13.4bn for smart metering.

88. Electricity consumers will help meet the costs of upgrading UK electricity networks. The cost of grid infrastructure improvements could add about £15 per year to the average UK household electricity bill. Therefore, when decisions are made on investment, it is important that the costs to consumers now and in the future, including the estimate by the Stern Review that climate change could lead to a loss of between 5% and 20% of annual global GDP, are taken into account.

89. There may also be a role for more direct Government support, especially at this time. Other governments, such as the US, appear to be intervening more directly. The *Climate for Recovery* study for HSBC found that the UK is investing $2.1bn in green stimulus (6%), less than a third of France's $7.2bn (21%), less than a sixth of Germany's $13.8bn (13%) and 110 times smaller than China's $221.3bn (38%). The recent Canadian Government Budget included a $1 billion green infrastructure fund for transmission lines to connect renewable energy projects.

90. Lord Stern has said that the world should spend $400bn, 20% of the planned global fiscal stimulus, to support low-carbon technologies such as home insulation and renewable energy. He believes that public investments being made now must not lock in carbon emissions. This investment would have long-term benefits. A report for World Resources Institute found that every $1 billion spent now in the US on technology such as energy efficiency and renewable energy would generate 30,100 jobs and save the economy $450 million a year.

91. The UK should explore international sources of funding. The Scottish and UK Governments have independently been speaking to sovereign wealth funds in the Middle East. This year the European Investment Bank is increasing its lending to renewables sector to about a fifth of its lending for energy projects – a total of 3 billion euros in 2009, up from 2.3 billion in 2008 and 2 billion in 2007.

How can the regulatory framework ensure adequate network investment in light of the current credit crunch and recession?

92. The carbon price has fallen from rates of between 30 (£28) and 40 (£38) per tonne a year ago to well under 10 per tonne today. This is reducing the value of carbon credit which renewable electricity generators receive in the carbon trading scheme and reducing the incentive for investment in the in low carbon technologies. Decisions are being postponed though not yet cancelled outright.

93. National Grid has said that the Government needs to introduce fresh incentives to guarantee that over £100 billion of investment is made over the next decade to ensure the stability of the power grid. This could include placing a floor on the price of carbon to boost investment in new nuclear and offshore windfarms.

94. The credit crunch and recession has made it more difficult for network owners to fund investment. Charges are capped at a level which does not at present create a high enough return on investment to enable them to borrow money from banks. A recent report by Ernst & Young that said that rates of return on electricity projects would have to rise by a couple of percentage points to satisfy investors. In response to similar pressures, the new US Administration has increased the rate of return on investment in order to fund a programme to build new networks. The UK Government and Ofgem need to consider the UK's competitive position.

How can the regulatory framework encourage network operators to innovate, and what is the potential of smart grid technologies?

95. Greater variability of the power supply to the grid network will mean that the system needs constant balancing. Pump storage technologies can help address this variability, providing significant quantities of power at very short notice. However, one barrier to the development of pump storage is that it is currently treated and charged as electricity generation. In SCDI's view, pump storage should be regarded in the regulatory framework as storage and not generation.

96. The grid's character will have to change. A smart grid is needed to go with smart metering. As generation becomes less controllable, it will have to be more controllable. Customer load will have to adapt to supply capability, for example demand from electrical appliances could be remotely turned down at times of lower supply. There is also the potential for more decentralised networks. Network operators should be encouraged to accept newer technologies like power electronics which will act as key enablers for the smart grids of the future.

97. Smart grid technologies will not only enhance electricity networks but also stimulate economic growth through competition which automatically encourages innovation. They have the potential to open new markets and revenue streams, and create several high end jobs to serve them. The regulatory framework can encourage network innovation to go hand in hand with market innovation.

Is there sufficient investment in R&D and innovation for transmission and distribution technologies?

98. SCDI has been told that it is not the scale of the investment in R&D and innovation which is inadequate, but rather that insufficient progress is being made from feasibility studies to testing and proving these technologies. It may be that stricter guidelines should be attached to public funding for R&D and innovation to incentivise demonstration projects above fundamental research.

99. The innovations which produce the next generation of networks are likely to be made by the manufacturers such as Siemens. Utility companies should be encouraged to approach them collectively with clear indications of requirements. Industry consultations should include a wider representation from the industry and not just network operators. It is very important to understand the future energy mix and the role of innovation to address these changing requirements.

100. Particular attention needs to be given to innovations in response to global warming. At present, increasing temperatures would make transmission wires less efficient, which would mean that even more electricity has to be generated.

101. There are a number of exciting and innovative projects and developments in Scotland which aim to enhance the quality of renewables projects and increase their rate of deployment. If grid capacity is increased, there would be the potential to undertake more testing here and to create centres of excellence.

What can the UK learn from the experience of other countries' management of their electricity networks?

102. SCDI understands that no country in Europe or North America has made much progress on restructuring their physical electricity networks. Progress has been focussed on managing the existing resources better by reducing costs.

103. A recent European study by Capgemini concluded that UK electricity Distribution Network Operators lead the field on controlling costs and reaching operational efficiency targets by employing good outsourcing and performance management techniques. It suggested that Europe can learn from the UK.

104. It is important to remember most of the countries within Europe have different operational structures. The only example of multi-national trading system to date is Nord-Pool operating between Norway, Sweden and Finland. This could potentially help aspects of managing integrated networks in the UK.

105. The experience in Germany offers an alternative model for developing subsea infrastructure for offshore wind and marine energy generation. It has passed legislation to “accelerate” infrastructure via planning and finance by one Transmission System Operator on behalf of groups of offshore projects.

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