2. BACKGROUND

2.1 INTRODUCTION

This chapter presents the rationale for the proposed wind farm development by describing the climate change context and alternative technologies which were considered.

2.2 CLIMATE CHANGE

2.2.1 Causes and effects

Man made emissions of greenhouse gases, in particular carbon dioxide from the combustion of fossil fuels, are widely believed to be accelerating the process of climate change by reducing loss of heat from the atmosphere. There is global concern that such climate changes may cause significant environmental change, in particular relating to impact on sea levels, altering patterns of temperature and precipitation, and driving increasingly frequent incidents of extreme storminess and drought (e.g. RCEP 2000 among many others). It is anticipated that such changes would have significant social, economic and ecological consequences and this has provided a stimulus for action (e.g. Commission of the European Communities (2005), King (2005), Stern (2006)).

Sir Nicholas Stern of the International Energy Agency presented the findings of a comprehensive study of the economic impacts of climate change. His report concluded that it was cheaper to act now to tackle the impacts than to deal with the consequences of inaction. The presentation further concluded that a significant contribution to resolving the problems of climate change could be made with existing, commercially available technology and co-operative action (Stern 2006).

2.2.2 Role of Renewable Energy

It is generally recognised that increasing the role of renewable energy can contribute to achieving greenhouse gas reduction targets by displacing the carbon dioxide emissions emitted at conventional fossil fuel fired generating plant. By operating additional renewable capacity, both demand and load factor on fossil fuelled plant will decrease with a consequent reduction in fuel consumed and associated carbon dioxide emissions.[1]

Renewable energy forms one element of a wider climate change strategy which includes energy efficiency, security of supply, the development of carbon trading and the promotion of more sustainable transport policies and measures.

[1] For a given national demand which is likely to change over time.

2.3 RENEWABLE ENERGY POLICY

2.3.1 Renewable Energy Policy - Background & Global Targets

Renewable energy policies in the UK and Scotland have their origins in international concern with regard to the production of greenhouse gases, in particular carbon dioxide, and the effects that increases of these are having on climate. Key conventions such as the Earth Summit (Rio de Janeiro, 1992) and the Kyoto Protocol (1997), to whose conventions the UK is a signatory, and to whose requirements the Government has stated it will be bound, resulted in targets being set for the reduction of greenhouse gases. Subsequently policies have been formulated in recognition of the fact that the burning of fossil fuels is having an adverse effect on world climate and that global measures are required to deal with it.

There have recently been a number of landmark reports published on the topic of the impacts of climate change. The International Energy Agency (IEA) the leading source for medium to long-term energy market projections and analysis has, in their 'World Energy Outlook' report (November 2007), stated that immediate policy action is required to reduce greenhouse gas emissions and to curb growth in fossil energy demand. The challenge for all countries is to put in place a more secure lower carbon energy system without undermining social and economic development.

The Intergovernmental Panel on Climate Change (IPCC) published their Fourth Assessment Report (page 1, and section 1) in November 2007 and the report made it clear that warming of the climate system is unequivocal.

Climate change featured on the agenda at the G8 Gleneagles Summit in July 2005. Attention was focused on the importance of urgent action to tackle climate change. The Gleneagles Communiqué acknowledged that climate change was real and included commitments and an action plan to address it. Climate change was also high on the agenda of the G8 summit at Heiligendamm in June 2007, at which the Chair's summary (page 2) noted "*combating climate change is one of the major challenges for mankind...we are convinced that urgent and concerted action is needed and accept our responsibility to show leadership in tackling climate change*".

A new target for global greenhouse gas emission cuts was announced by the G8 at the recent G8 summit in Japan. Prime Minister Gordon Brown MP, in his statement to Parliament of 10th July 2008 stated, "*for the first time the G8 agreed not to consider but to adopt – as part of an international agreement – a long term goal of a cut of at least 50 per cent in greenhouse gas emissions by 2050. For the first time also we all agreed on the need to have interim goals and national plans to achieve them*".

In his statement to Parliament, Gordon Brown also stated "*the G8 agreed that the global conditions for ensuring a more stable international energy market" include inter alia "accelerating the expansion of renewables*".

2.3.2 Evolving European Policy

A draft Renewable Energy Directive from the European Commission was published in January 2008. In light of the significant increase in renewable energy required by this Directive, the UK Government has committed to publishing a strategy by early 2009 in

order to implement the obligations contained within the Directive. The EU wishes to see 20% of all energy to be generated by renewable sources. The 20% will be split between member states – so called 'burden sharing'. The current draft suggests that the UK will have to provide 15% of all its energy use from renewable sources by 2020. This is a considerable challenge and would represent a 10-fold increase from the current level of some 1.5% of all energy used in the UK coming from renewable sources.

2.3.3 United Kingdom Policy

The UK Government retains control of the overall direction of energy policy. Since devolution in 1999 some energy policy issues have been devolved to Scotland such as energy efficiency and renewable energy (including planning consents for generating plants covered by the Electricity Act 1989). Encouraging more electricity generation from renewable sources is an important element of both the UK and Scottish Climate Change Programmes. The Government is working towards a target of renewable energy providing 10% of UK electricity supplies as soon as possible. It hopes to achieve this by 2010. The 2003 White Paper confirmed the 10% target for renewables and superseded this by setting a further aspiration that by 2020, 20% of the UK electricity supply should be generated from renewable sources.

In January 2008, the UK Government published the Government's plans for developing a strategy to increase renewable energy use in the UK. As noted above, the draft EU Renewables Directive provides the framework for achieving the EU's target of securing 20% of all its energy from renewable sources by 2020. For the UK, the Commission's proposals include 16% reduction in UK greenhouse gas emissions by 2020 and for 15% of all energy consumed in the UK to come from renewable sources by 2020.

On 26th November 2008 the Climate Change Act became law in the UK, introducing the world's first long term legally binding framework to tackle the dangers of climate change. The key relevant provisions of the Act are:

- **Legally binding targets**: Green house gas emission reductions through action in the UK and abroad of at least 80% by 2050, and reductions in CO2 emissions of at least 26% by 2020, against a 1990 baseline. The 2020 target will be reviewed soon after Royal Assent to reflect the move to all greenhouse gases and the increase in the 2050 target to 80%.
- A **carbon budgeting system** which caps emissions over five year periods, with three budgets set at a time, to set out the trajectory to 2050.

The creation of the **Committee on Climate Change**.

2.3.4 Renewables obligation

The Renewables Obligation obliges electricity supply companies to source prescribed proportions of their total supply from eligible renewable sources or pay a 'buy out' fee of 3.324p/kWh.[2] By way of illustration, Scottish and Southern Energy's obligation in 2015

2 2006 buy out price, index linked for subsequent years.

equates to approximately 8 TWh (Terawatt hours), or the output from approximately 3,000 MW of renewable generation, [3] at present customer levels.

Eligible technologies are:

- Biomass;
- onshore wind;
- offshore wind;
- new hydro;
- refurbished hydro;
- solar;
- wave and tide;
- private micro hydro;
- landfill gas; and
- energy from waste.

The framework of the Renewables Obligation is creating significant demand for renewable generation and the market has reacted by bringing forward proposals for new renewable plant. A large proportion of these proposed new developments are for on-shore wind-powered generation in Scotland.

In this regard there is a needs case separate from overall Government targets. Licensed suppliers have a legal obligation that must be fulfilled otherwise penalties will be applied. Therefore, there is justification and need for the development related to Government policy but arising out of a separate legal obligation that seeks to bring about the policy change of increasing the proportion of electricity to be supplied from renewable sources. This can properly be regarded as a relevant and material consideration.

2.3.5 Consultation for a UK Renewable Energy Strategy (June 2008)

The UK Renewable Energy Strategy Consultation was formally launched on 26th June 2008 and ended in September 2008. The consultation sought views on how to drive up the use of renewable energy in the UK, to meet the share of the EU target to source 20% of the EU's energy from renewable sources by 2020. Responses will inform the UK Renewable Energy Strategy which is to be published in Spring 2009.

The consultation notes that 4,000 turbines (each of approximately 3MW) is the equivalent of 14GW of onshore wind and it is expected that a large proportion of onshore wind development will take place in Scotland. The consultation also outlines possible measures to facilitate a swift expansion of renewables and these measures include:

- Extending and raising the level of the Renewables Obligation to encourage up to 30-35% of our electricity to come from renewable sources by 2020; and
- ensuring appropriate incentives for new electricity grid infrastructure and removing grid access as a barrier to renewable deployment.

[3] At 30% load factor

There is therefore a growing need case in favour of infrastructure which will assist the delivery of these challenging targets.

2.4 SCOTTISH GOVERNMENT POLICY

2.4.1 Renewable Energy Generation Targets

In Scotland, policy and commitment generally reflects that of the UK Government. Scotland has a larger proportion of pre-existing renewables provision, mainly hydro plant.

The Scottish Executive set a target that 18% of electricity supplies in Scotland should be generated from renewable resources by 2010. Scotland's Climate Change Programme 2006 (page V) makes it clear that Scotland has a leadership role to play in tackling climate change. The programme notes (paragraph 5.30) that operational and consented renewable projects are such that the 2010 target of 18% of electricity generation from renewables can be met.

However, the longer term Scottish Executive target was to achieve 40% of its electricity from renewable sources by 2020. This figure has been further increased by the Scottish Government which demonstrates that the Scottish Ministers have a long-term energy policy.

With regard to the current SNP administration that forms the Scottish Government, the Government Spending Review in late 2007 provided the first detailed insight into how the Scottish Government intends to deal with the global issue of climate change over the next few years.

The Scottish Budget Spending Review[4] (SBSR) for the next three years contains a 'Greener Scotland' strategic objective.

In the Spending Review, the Government *states "we are committed to playing our part in the global effort to reduce greenhouse gas emissions. We will work towards an ambitious target: to reduce Scotland's emissions by 80% (from 1990 levels) by 2050"* (SBSR, p39).

In addition, a strategic objective is set in the SBSR that 50% of electricity in Scotland is to come from renewable sources by 2020 (SBSR, p47). As noted above, the current target, as set down in Scottish Planning Policy (SPP) 6 is 40% by 2020. These new higher targets, as contained in the SBSR are to be contained in a statutory framework through the introduction of a Scottish Climate Change Bill which was laid before the Scottish Parliament in draft form on 4th December 2008.

[4] Scottish Government Spending Review, The Scottish Government, Edinburgh, November 2007.

2.5 ALTERNATIVE TECHNOLOGIES CONSIDERED

2.5.1 Introduction

The Viking Wind Farm project evolved from two projects being developed independently by the two Partner companies (see Chapter 1). Thus the technology selection process was also undertaken independently by the partners, prior to the formation of the Partnership.

This section describes the alternatives considered by the two partners, at the time of developing their initial independent proposals. The fundamental difference between the two partners is that Scottish and Southern Energy operates in a national and international context, whereas Viking Energy was specifically set up to serve Shetland. Consequently the following paragraphs consider each technology in general, and then (if appropriate) specifically in a Shetland context.

As far as Scottish and Southern Energy is concerned, it must develop eligible renewable energy sources on a large scale[5]. It should be borne in mind that the current proposal forms an element of a broader strategy, which has an element of diversity to it, and is not a solution in isolation. For Scottish and Southern Energy, technology options must satisfy the following initial criteria before a more detailed evaluation, which would include further environmental considerations, is conducted:

- Eligible technology
- Adequate potential resource
- Mature commercially proven technology
- Commercially viable
- Absence of complicating factors
- Appropriate scale.

For Viking Energy Limited, the above general criteria were also relevant, but in addition the following specific criteria were fundamental:

- The site must be on Shetland
- The project must provide significant local economic benefits
- The economics of the project must be able to bear the costs of connecting to a new sub-sea connection.

[5] Scottish and Southern Energy has other activities which decrease carbon emissions, including consumer energy efficiency programmes, and investment in combined cycle gas turbine gas-fired generation and combined heat and power generation. However, whilst contributing to greenhouse gas reduction targets, these activities are outwith the scope of the Renewables Obligation.

2.5.2 Biomass

(a) **General**

There are a number of biomass resources, including agricultural and forestry wastes (e.g. forestry by-products, straw, and poultry litter) and energy crops (e.g. short rotation coppice). Technologies include mass burn, pyrolosis to form biodiesel for combustion in gas turbines, and co-firing with fossil fuels in conventional coal fired power plant.

For non co-firing, there are a number of issues, primarily relating to fuel supply, technology and economics:

- Plant size will always be limited by the economics of transport, which affects economies of scale
- The nature of fuels burned and the need to keep technology simple can create difficulties in terms of emission standards
- The technology is not yet mature, and projects are innovative, with attendant risks
- There are fuel supply issues, with potentially complicated supply chains, and potential difficulties in encouraging farmers to invest in the necessary machinery and crop establishment associated with energy crops
- Immaturity in understanding of crop husbandry
- Transport may be an environmental issue
- High capital costs
- High operating costs (fuel and transport).

Scottish and Southern Energy co-fires biomass at conventional coal fired plant, and this contributes to its Renewables Obligation. They have also developed a strategy to build and operate multi fuel facilities throughout the UK with fuel being provided from Ready to Use (RTU) waste fuels (mainly consisting of refuse derived fuel (RDF) and waste wood), pure biomass energy crops, and biogas produced from anaerobic digestion processes. The production of gas from gasification processes, including pyrolysis and plasma, are still regarded as emerging technologies and at this moment are not included in the multifuel strategy.

(b) **Shetland**

Shetland is not a suitable environment for growing biomass resources. There is no commercial forestry and limited arable agriculture. Any significant biomass would need to be imported. There are no power generation facilities on Shetland which are suitable for co-firing[6].

Consequently biomass was rejected by the partners as a technology in Shetland.

[6] The Lerwick district heating scheme, powered largely by the incineration of municipal solid waste (MSW), does not generate electricity.

2.5.3 Onshore wind

(a) **General**

The generation of energy from wind has a relatively well-understood range of environmental issues which are assessed on a site by site basis. The technology has the following characteristics:

- Relatively low capital cost;
- relatively low operating cost;
- proven commercially available technology; and
- significant potential resource.

Onshore wind is included as a main element within Scottish and Southern Energy's new renewable energy strategy, subject to environmental assessment on a case by case basis.

In addition to commercial scale wind farms, Scottish and Southern Energy is now promoting the emerging technology of domestic scale wind turbines. The capacity of these 'rooftop turbines' is in the order of 1.5 kW, and therefore significantly less than that of a commercial scale wind turbine (1,000 to 5,000 kW), but there is, potentially, a significant resource.

(b) **Shetland**

Shetland has an outstanding wind resource, and is therefore extremely suitable for wind energy projects (one of the turbines at the small windfarm at Burradale is believed to have the highest load factor of any wind turbine in the world). Since wind energy has the most favourable economics of the renewable technologies, it is most likely to be able to bear the cost of sub-sea grid connection. Shetland-based contractors are likely to be capable of undertaking the civil works associated with wind farm construction. Rental revenues to landowners and relevant crofters will remain within the local economy.

For these reasons onshore wind energy was deemed to be a suitable technology for Shetland.

2.5.4 Offshore wind

(a) **General**

Offshore wind power has emerged from the onshore wind industry. There are similarities between onshore and offshore wind power, but the offshore environment presents additional technical issues (in terms of technology and materials, construction and operations), and a different scope of environmental issues. The technology has the following characteristics:

- Higher capital cost than onshore wind;
- higher operating costs than onshore wind;
- emerging commercial technology; and
- generally higher wind resource than onshore wind.

Offshore wind forms a core element of Scottish and Southern Energy's new renewable energy strategy to 2020. SSE/Airtricity is actively developing offshore wind farm sites off the Scottish coast and is actively bidding for Round 3 seabed rights from the Crown Estate with a goal of 10GW of UK offshore wind developments.

(b) **Shetland**

Airtricity/SSE has no offshore wind sites under development in the Shetland area, due in part to the deeper water around Shetland and also the significant potential for onshore wind development in the area. Furthermore, rental payments would be made to the Crown Estate, rather than local interests, contrary to the requirements of Viking Energy Ltd.

For these reasons offshore wind was not deemed to be a suitable technology for development in Shetland.

2.5.5 New hydro-electric

(a) **General**

Hydro power is the most extensively developed renewable source in the UK, in particular in the Scottish Highlands. New build hydro has the following characteristics:

- Higher capital cost than onshore wind
- Lower operating costs than onshore wind
- Proven commercial technology
- Relatively limited potential new resource (the resource having been well developed in the mid 20th century).

New hydro is included as a main element within Scottish and Southern Energy's new renewable energy strategy, although it is recognised that the resource is insufficient on its own to meet the Renewable Obligation. Environmental issues will be assessed on a case by case basis.

(b) **Shetland**

The topography of Shetland is not well suited to hydro development, and there are no large scale opportunities.

For these reasons new hydro-electric was not deemed to be a suitable technology for development in Shetland.

2.5.6 Refurbished hydro-electric

(a) **General**

Refurbishing hydro schemes may improve their efficiency and output, and extends their life. It has the following characteristics:

- Low capital cost

- Unchanged or reduced operating cost
- Minimal change to existing environmental effects
- Proven technology
- Limited resource (only sub 20 MW schemes are eligible under the Renewable Obligation)

Refurbished hydro is included as a main element within Scottish and Southern Energy's new renewable energy strategy, although it is recognised that the resource is insufficient on its own to meet the Renewable Obligation.

(b) **Shetland**

The partners do not have any hydro-electric schemes on Shetland to refurbish.

2.5.7 Solar energy

(a) **General**

Solar energy includes active solar, whereby heat is generated (which can be converted to electricity), and photovoltaics, which generate electricity. Solar sources have the following characteristics:

- The UK's solar climate characteristics means that active solar is best suited to low temperature heating applications
- High capital costs
- Active solar best suited to integrated building design
- Absence of mature market to support investment in cost-effective high volume manufacturing
- Not yet established on a large scale
- Large areas needed for large scale production.

Solar energy is recognised as an immature technology that needs to achieve manufacturing economies of scale to break into the mass market. Recognising the potential, Scottish and Southern Energy has recently invested in solar energy company Solar Century with the aspiration of achieving commercially viable solar products in the medium term. However, solar does not currently form a key element of Scottish and Southern Energy's new renewable energy strategy.

(b) **Shetland**

Shetland currently has no commercial solar energy generation, and the meteorological conditions do not make Shetland a suitable location for large scale energy production using solar means.

For these reasons solar power was not deemed to be a suitable technology for development in Shetland.

2.5.8 Tidal and Wave

(a) **General**

Tidal and wave energy are emerging technologies, which are likely to become commercially established in the coming years. They have the following characteristics:

- Generally unproven technologies requiring further development and testing
- Difficulties associated with the marine environment
- Currently undergoing commercial scale trials
- High capital costs but expected to reduce with further development
- Significant resource.

Wave and tidal has currently been excluded from Scottish and Southern Energy's new renewable energy strategy primarily on the basis of immature commercialised technology. However, it is recognised that there is significant potential, and since 1993 Scottish and Southern Energy has invested over £10m in research and development of tidal and wave technologies, including a £6.3m investment in Edinburgh based Aquamarine Power Ltd (APL). APL has built a 325kW wave device, known as Oyster, planned for deployment at the European Marine Energy Centre (EMEC) in 2009, and is also developing a 2400kW tidal stream device, known as Neptune, also proposed for deployment at EMEC. Over the next 5 to 10 years it is expected that commercialised marine technologies will emerge and start to make a contribution to renewable energy generation. Environmental issues would be assessed on a case by case basis.

(b) **Shetland**

There are significant tidal and wave resources around Shetland. However the immaturity of technology currently precludes its development at a commercial scale in Shetland. Furthermore, rental payments would be made to the Crown Estate, rather than local interests. However, development of a sub-sea link between Shetland and mainland Scotland as a result of the Viking Wind Farm may facilitate future development of wave and tidal energy.

For these reasons tidal and wave power has been discounted as a suitable technology in Shetland for the time being.

2.5.9 Private micro hydro

This resource is limited, and is discounted on this basis.

2.5.10 Landfill gas

(a) **General**

Landfill gas is produced by the biological breakdown of organic matter in the absence of oxygen in waste landfills. It comprises mainly methane and carbon dioxide, and can be combusted in the presence of oxygen to run gas engines for the production of electricity. It can also be compressed and used to power motor vehicles.

As a rule of thumb, approximately 1,000 tonnes of MSW (municipal solid waste) will produce enough landfill gas to run a gas engine of approximately 1MW output for approximately ten years (The Landfill Gas Website, 2008).

Landfill gas generation is an established technology in the UK. It has the following characteristics:

- Based on mature technology
- Relatively limited resource
- Small scale developments
- Competitive costs.

Landfill gas has currently been excluded from Scottish and Southern Energy's new renewable energy strategy primarily on the basis of relatively limited resource.

(b) **Shetland**

A waste-to-energy incinerator at Gremista, Lerwick takes all of the combustible domestic, industrial and clinical waste from Shetland, and also imports selected waste from Orkney and offshore installations. The total of fuel burned amounts to about 22,000 tonnes per year. It has an operating capacity of 7 MW, the energy being exported in the form of hot water to the Lerwick District Heating Scheme.

Approximately 25% of MSW (municipal solid waste) arriving at the Lerwick site goes to landfill, comprising mainly incombustible, inorganic waste. Ash from the incinerator (screened for ferrous waste) is also sent to landfill and used as capping material. Landfill gas is vented and monitored and is currently produced in very small quantities.

MSW is therefore already efficiently used for the recovery of energy, and the very small residual resource is insufficient for the commercial production of electricity. Landfill gas is therefore not deemed to be a suitable technology for development on Shetland.

2.5.11 Conclusion

A variety of technologies have been considered. In the first instance, in a commercial context the decision making is necessarily based on technical and economic criteria, rather than environmental criteria – it being pointless to select the technology which is considered to be the most environmentally acceptable, if in practical terms it is unlikely to meet its functional requirements.

Operating in a national context, Scottish and Southern Energy's renewable energy strategy to meet its Renewable Obligation is diverse, and comprises:

- Refurbishing existing hydro stations
- Development of new hydro schemes
- Co-firing biomass
- Development of new onshore wind farms
- Monitoring and supporting development of emerging technologies, in particular offshore wind and marine technologies

Consequently, of the alternatives considered, a diverse range of technologies has been selected for development. The greater emphasis on onshore wind reflects, in Scottish and Southern Energy's opinion, the technical and commercial maturity of the technology, and the available resource, compared with other technologies.

The proposal to develop the Viking Wind Farm fits within this overall strategy as part of a balanced approach to develop new renewable energy sources.

Viking Energy Limited operates within a Shetland context, and has some additional drivers. It has concluded that onshore wind energy is the preferred technology for development in Shetland since, in addition to technical criteria, it is considered that a wind farm project in Shetland can provide significant socio-economic benefits.

Thus, both Viking Energy Limited and Scottish and Southern Energy plc concluded independently that a large scale onshore wind farm was the preferred technology alternative for development in Shetland, thus providing a basis for developing the Viking Energy Partnership.

In Summary, with regard to the renewable energy policy context this Chapter has explained that:

- Concerns about climate change have prompted international efforts to reduce man-made emissions of greenhouse gases;
- targets for reductions of greenhouse gases have been implemented at EU and UK level;
- the draft EU Renewables Directive provides the framework for achieving the EU's target of securing 20% of all its energy from renewable sources by 2020. For the UK, the Commission's proposals include 16% reduction in UK greenhouse gas emissions by 2020 and for 15% of ALL energy consumed in the UK to come from renewable sources by 2020;
- further development of renewable energy is a central element of the UK climate change programme, and is being implemented by means of the Renewables Obligation;
- alternative technologies were evaluated by the two Viking Energy partners independently prior to the development of the Partnership, and each has different drivers;
- Viking Energy Limited operates in a Shetland context, and is seeking to provide socio-economic benefits to Shetland;
- Scottish and Southern Energy has a significant Renewables Obligation which it is seeking to meet, and operates in a national context;
- of the eligible technologies, it is onshore wind that currently has the greatest resource, has the most favourable economics, and is technically proven; the wind resource on Shetland is outstanding;
- onshore wind forms a key element of Scottish and Southern Energy's new renewables strategy, with additional contribution from refurbishment of existing hydro, development of new hydro, and biomass co-firing. The Company is seeking to commercialise marine and deep offshore wind technologies;

- the proposed development is an element of a broader renewable energy programme being developed by Scottish and Southern Energy in response to government policy;
- furthermore, onshore wind in Shetland can deliver socio-economic benefits not available from other technologies, and therefore meets Viking Energy Limited's aspiration to deliver significant benefits to the Shetland community.

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