2020 Routemap for Renewable Energy in Scotland

The Scottish Government

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The Scottish Government, Edinburgh 2011

ISBN: 978-1-78045-271-5 (web only)

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St Andrew's House
Edinburgh
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Produced for the Scottish Government by APS Group Scotland
DPPAS11805 (07/11)

Published by the Scottish Government, July 2011

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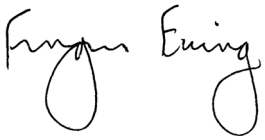
Ministerial Foreword

Scotland has massive green energy potential - from our vast natural resources of a quarter of Europe's tidal and offshore wind potential and a tenth of its wave power, to the legacy of Scotland's traditional energy industries. That's why we have set an ambitious target for the equivalent of all of Scotland's electricity needs to come from renewables by 2020, one of the most demanding anywhere in world. A target that is necessary to reindustrialise Scotland through 21st century technologies and seize the opportunities to create tens of thousands of new jobs and secure billions of pounds of investment in our economy.

Our record is good. Over a quarter of Scotland's electricity needs already come from renewables – and projects in operation, under construction or consented would provide around 50% of our electricity needs. Renewable heating uptake has doubled in the last year. But we need to go faster and further. The Renewables Routemap sets out how our target will be met through deploying all forms of renewable technologies, onshore and offshore, from the Borders to Barra to Banff - and beyond. The research and development, design, construction and servicing of these new technologies will create thousands of highly skilled jobs, give investors the confidence to continue to invest and give Scotland a sustainable, energy secure future.



Fergus Ewing
Minister for Energy, Enterprise and Tourism

Executive Summary

The Routemap for Renewable Energy in Scotland 2011 is an update and extension to the Scottish Renewables Action Plan 2009. The original Renewables Action Plan set out short term actions towards the delivery of 2020 targets for renewable energy. This updated and expanded Routemap reflects the challenge of our new target to meet an equivalent of 100% demand for electricity from renewable energy by 2020, as well as our target of 11% renewable heat.

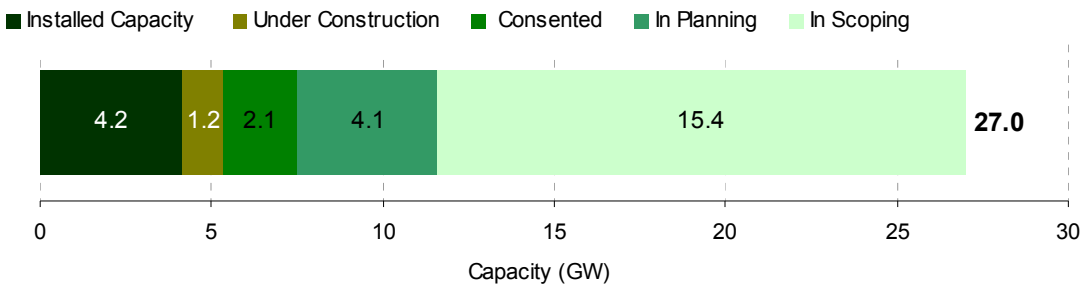
The new Routemap presents actions which are focussed on targets, within the current development of UK regulatory support, arguing constructively for the UK Government to ensure that such support matches Scotland's ambitions.

The Routemap should be viewed alongside the draft Electricity Generation Policy Statement, which is currently being updated, to understand how renewable technologies fit within the wider energy mix for Scotland. We are aiming for an output equivalent to 100% of Scotland's demand for electricity to be met from renewables, but it will be very important to understand that this does not mean Scotland will be 100% dependent on renewables generation: renewable energy is part of a wider electricity mix.

The draft Electricity Generation Policy Statement sets out the Scottish Government's position on the role of renewable electricity and fossil fuel thermal generation (coal, gas, oil) in Scotland's future energy mix, and is being updated in the context of the new target of the equivalent of 100% electricity demand to be met from renewables by 2020. The draft statement gives a clear view on the need for both rapid expansion of renewable electricity across Scotland and the underlying requirement for new or upgraded efficient thermal capacity in this low carbon generation portfolio, progressively fitted with CCS. It confirms our policy to phase out existing nuclear power stations as they reach the end of their operating lives, and shows that all of Scotland's future energy needs can be met without the need for new nuclear power stations. It is based on research studies on future energy supply, storage and demand, and takes account of the changing policy context in Scotland, the UK and the EU since the Second National Planning Framework was published in June 2009.

Progress to Date

Our deployment record is good, with Consent for 42 large-scale renewable electricity schemes worth over 2 GW in the past four years, and much more in the system:



Targets

Targets and implications are set out as follows:

- **100% electricity demand equivalent from renewables by 2020**: a formidable but achievable goal exploiting Scotland's rich renewable resources and our determination to exploit them for economic and carbon benefits. Detailed plans are in place to make progress, particularly to realise our offshore renewables ambitions, but this potential will need to be recognised in the regulatory framework being developed at a UK level;
- **11% heat demand from renewables by 2020**: significant progress has been made towards this goal, with Scotland leading the way in the UK at 2.8% heat demand already being met from renewables. But the challenge remains significant, particularly as we need to ensure best use of this limited resource as demand begins to grow, and that impacts on existing biomass users are mitigated. These issues will be included in our forthcoming review of support for large-scale electricity-only biomass under the Renewables Obligation Scotland;
- **New target of at least 30% overall energy demand from renewables by 2020**: our recently increased target for renewable electricity will allow us to raise the bar for our energy ambitions overall, with an expectation that at least 30% of all energy demand (heat, and transport as well as electricity) will be met by renewables by 2020. This will take Scotland to twice the UK's share of the European target, highlighting our leadership in Europe on renewable energy;
- **New target of 500 MW community and locally-owned renewable energy by 2020**: Scotland has led the way in the UK on community-owned energy schemes for the past decade with over 800 schemes supported from Unst to Moffat. With the advent of the Feed in Tariff and the Renewable Heat Incentive, the time is right to capitalise on this experience and transform the scale of local ownership, thus allowing communities and rural businesses to take advantage of the significant revenue streams that can accrue from this form of asset ownership.

The Challenge

Underpinning Scotland's ability to supply sufficient renewable electricity and heat to meet its targets in a cost-effective way is the principle of demand reduction. High demand requires more generating capacity to be built. Electricity demand may rise in the long term as greater use is made for transport and heat - therefore energy efficiency measures to minimise this rise will be crucial if electricity is to remain affordable. The Energy Efficiency Action Plan established a target to reduce total final energy demand in Scotland by 12% by 2020, covering all fuels and sectors. The actions set out in the full Renewables Routemap will be taken in tandem with our continuing drive to reduce demand.

Beyond demand reduction, there are a wide range of crosscutting challenges to be faced by the sectors that make up the renewables industry, all of which must be overcome if we are to realise our ambitions for 2020 and beyond:

- ***Costs and access to finance*** – this is the main prize as well as the main challenge, with achievement of the 2020 electricity target alone estimated to be worth up to £30b investment in Scotland. Appropriate regulatory support will be vital, and the Scottish Government continues to work to ensure that the UK Electricity Market Reform (EMR) matches Scottish ambitions. But there is also the challenge to develop the sector at least cost to the consumer to minimise impact on energy bills and mitigate fuel poverty.
- ***Planning and Consents*** – the need to continue to streamline systems and work for greater speed and transparency, without sacrificing proper consideration of the impacts on the local environment;
- ***Grid*** – the need for huge investment, including in offshore infrastructure, and to reform the inequitable charging system;
- ***Fuel Sources*** – sustainability of supply is a key factor in the bioenergy and energy from waste sectors, where renewable energy objectives need to be carefully balanced against supply and other environmental considerations
- ***Skills*** – Scotland's workforce needs to be prepared to meet the opportunities that will emerge, with up to 40,000 jobs predicted to be created in the renewables sector by 2020;
- ***Supply chain and infrastructure*** – the key focus of the Enterprise Agencies, with investment needed particularly to support the offshore energy revolution;
- ***Innovation and R&D*** – again the Enterprise Agencies will be working to bring in inward investment and to grow Scottish companies;
- ***Public engagement*** – renewable energy targets can not be met in the face of public opposition but only with the support and will of the Scottish public, gained through early and meaningful engagement on commercial schemes, and access to benefits – including the scope to develop community-owned schemes.

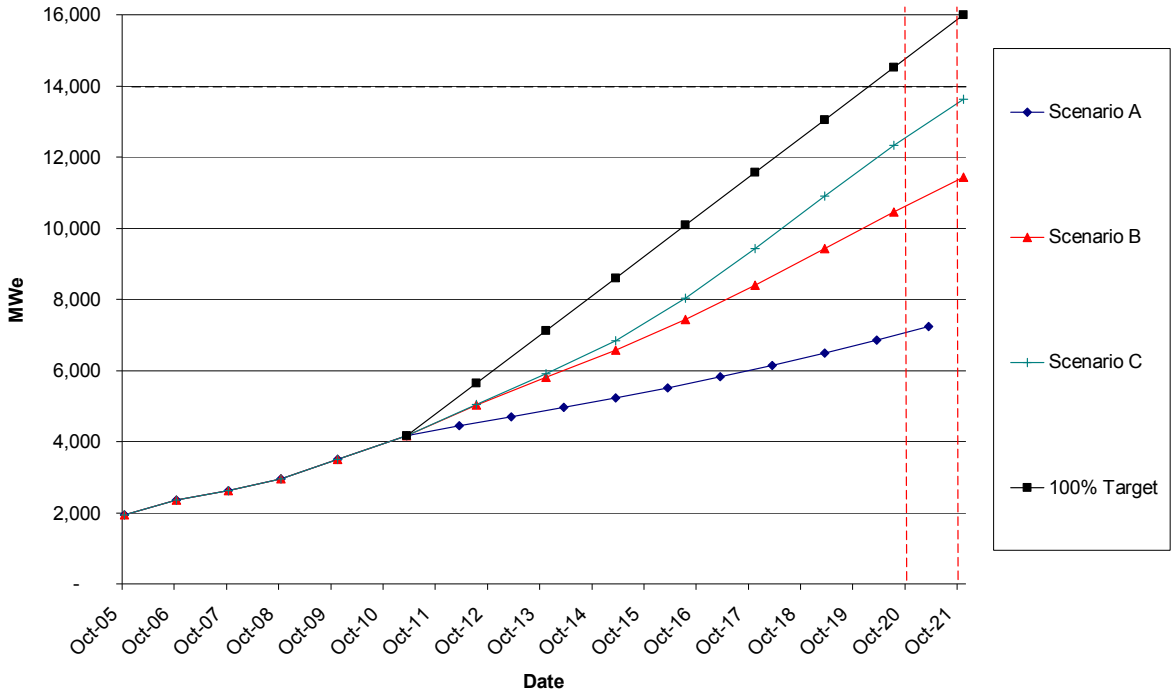
Deployment Trajectories

Renewable Electricity trajectory

The graph below demonstrates projections of potential patterns of deployment of renewable electricity capacity in Scotland, based on historical trends, with variables such as the speed of the planning system or the success of the Electricity Market Reform in matching Scottish ambitions.

The deployment of renewable electricity capacity depends on a number of complex and interdependent factors and as such these scenarios represent feasible but ultimately uncertain deployment profiles driven by the assumptions adopted.

Projections of Renewable Electricity Installed Capacity Based on Historical Data



The scenarios modelled in the chart above represent:

A. Deployment projection based upon an extrapolation of the annual deployment levels experienced in 2007-08.

B. Deployment projection based upon an extrapolation of the annual deployment levels experienced between 2009 and the start of 2011.

C. Deployment projection, based on Scenario B above, adjusted for the improvements in the planning/consent system that were introduced in recent years but which have not yet impacted upon actual deployment rates.

D. The 100% target line is a straight line extrapolation between current installed capacity and the estimated levels of capacity required to achieve 100% of gross consumption from renewables in 2020. This hypothetical line is incorporated to identify and acknowledge the scale of the challenge. In reality, it is recognised that deployment will not follow a straight line and would be expected to accelerate towards the latter part of the decade, particularly given the potential magnitude of offshore wind deployment.

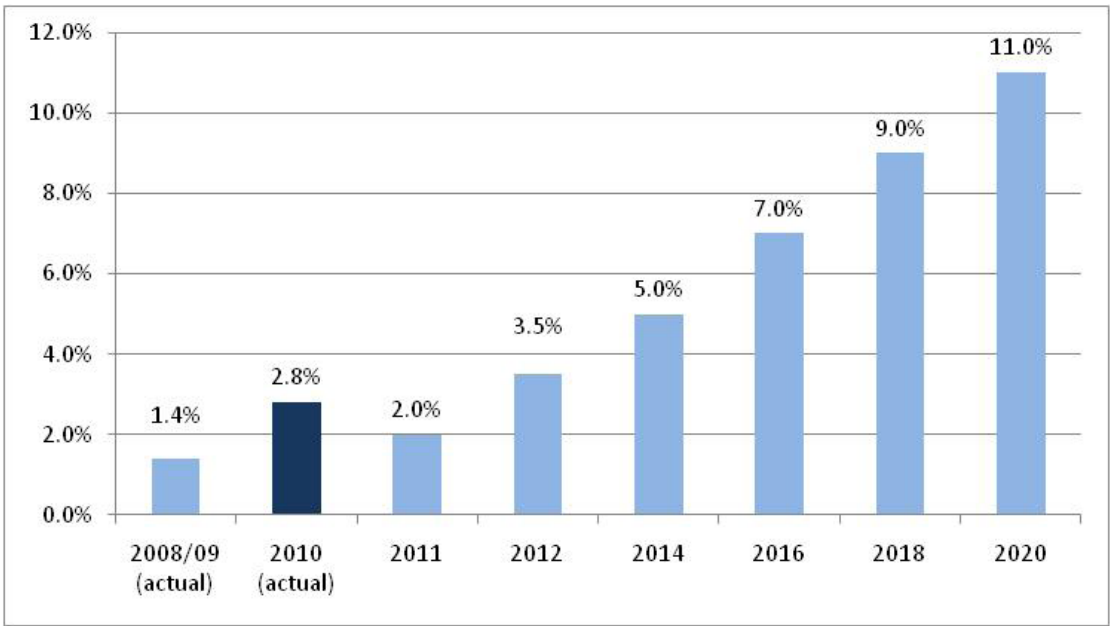
Each of the modelled scenarios places the ambition of the Scottish Government in the context of the very successful levels of deployment seen in recent years. The successful delivery of the capacity required to deliver the equivalent of 100% of Scottish electricity consumption will demand a significant and sustained improvement over the deployment levels seen historically. This approach sets out a number of feasible deployment scenarios but does not shy away from the challenge that this ambition presents.

Renewable heat trajectory

The Scottish renewable heat database was updated in March 2011 to include information on renewable heat installations which are under construction or in planning. These can be used to provide an estimate of future renewable heat output in Scotland, although there is necessarily a large degree of uncertainty around such figures.

If all the projects currently under construction, and 50% of those in planning come to fruition, in addition to the known micro and small to medium installations, this could bring total renewable heat output in Scotland to an estimated **2,733 GWh** a year, or around **4.5%** of forecast Scottish 2020 nonelectrical heat demand within the next 3 years.

Indicative interim milestones towards the 2020 target for renewable heat, compared with actual heat output in 2010.



Based on the rate of increase from 2008/09 to 2010, Scotland appears to be on track to meet its renewable heat target for 2020.

Sectoral Routemaps

The full Routemap provides status reports on deployment to date, by individual sector and identifies the main actions required to make progress to wards 2020 targets.

Headline actions for offshore technologies include maintaining stability of market incentives and level of support; investment in infrastructure; support for innovation; capital support (for wave and tidal), and a positive resolution of the issue of inequitable grid transmission charging.

Headline actions for onshore electricity technologies include maintenance of market incentives as appropriate, including the need to review support for large-scale electricity-only biomass, continued improvements in grid and planning, improved engagement with communities, and following up last year's "Securing the Benefits" consultation to provide greater clarity to communities from commercial schemes

Headline actions for heat-based technologies include ensuring best use of biomass, rolling out heat mapping, building on the current study on recovery of heat from fossil fuel power stations, and setting up an expert commission into the development of district heating.

The Scottish Government is also committing, through the new Routemap, to develop new strategies for microgeneration and for agri-renewables, to reflect the growing significance of small scale generation and opportunities for local and rural ownership of energy. We will also work with investors to establish a new Green Equity Fund for community renewables to ensure that the potential transformation of the scale of local ownership can be realised.

Conclusion

Across all scales of renewable generation, from householder to community to large-scale commercial schemes, the Scottish Government is working to make Scotland the renewables powerhouse of Europe. The benefits are not only in terms of energy generation and future security of supply, but can underpin our economic recovery over the next decade and beyond.

This Routemap for Renewable Energy in Scotland sets out how we can meet our challenging targets in harmony with the local environment and make a wider contribution to emission reductions through the displacement of fossil fuel generation.

1. Scotland's Renewables Ambition and Paths to Delivery

1.1 Securing the Benefits for Scotland

1.1.1 Overview and scope of Routemap

Over the next decade to 2020, renewables in Scotland could provide:

- up to 40,000 jobs[1] and £30b investment to the Scottish economy;
- significant displacement and reduction in carbon emissions;
- a strengthening of future energy security through the harnessing of sustainable indigenous resources;
- and a transformational opportunity for local ownership and benefits.

The Scottish Government is determined to ensure that Scotland benefits from the low carbon opportunity, and renewable energy is at the heart of that ambition. Scotland already meets nearly 30% of its electricity demand (equivalent), and nearly 3% of heat from renewable sources. Both rates lead the way in the UK.

We are now committed to generating an equivalent of 100% of electricity demand from renewable sources by 2020, along with at least 11% renewable heat.

Scotland's 100% renewables target is the most ambitious in the European Union. Meeting 100% of our electricity consumption from renewables in 2020 means that, together with our 11% renewable heat and 10% renewable transport targets, Scotland's overall share of renewable energy will be at least 30% by 2020. This exceeds the EU's 2020 renewable energy target of 20% and will be double the UK's agreed EU target of 15%. In reaching 30% renewable energy by 2020, Scotland's target is on a par with that for Denmark (30%), Portugal (31%), and considerably higher than Germany (18%), Ireland (16%), Spain (20%) and France (23%).

And our ambition is clear – that with the largest offshore renewable energy resources in the EU (25% of EU offshore wind; 25% of EU tidal; and 10% of EU wave power), Scotland will be making an even greater contribution to the EU's overall target than our population size. This is why we have developed clear links with our neighbouring governments in Ireland, Northern Ireland and across the North Sea to promote the development of offshore grid connections to harness the vast renewable

[1] Source: Skills Investment Plan for the Energy Sector (Skills Development Scotland, March 2011)

energy potential of the North and Irish Seas. The Scottish Government is pleased that the EU has now recognised these offshore grids as priority infrastructure projects, and will work with governments and industry to ensure deployment can take place rapidly over the next decade. It is also why we are working with governments in Spain, Portugal and Ireland to ensure greater EU support for the EU's vast marine energy resources located on its western seaboard. We want to make sure that these technologies can be commercially deployed during the 2020s, following full scale demonstration during the 2010s.

The scale of investor interest in Scotland's offshore renewables leasing is one of the largest in Europe (12 GW), and shows clearly that our target is viable and deliverable. The decision by large member states such as Germany and Italy to abandon nuclear power can only mean a larger market for renewables in future. Scotland will be a leading player in this market – exporting electricity directly to the EU through new grid interconnections; and through Scottish companies exporting our technical expertise and products for deployment in EU markets.

On transport, as well as having a 2020 target of 10% of transport fuels from renewables, the Scottish Government is committed to achieving complete decarbonisation of road transport by 2050, with significant progress by 2030 through wholesale adoption of low and ultra low carbon vehicles. While the focus of the this Routemap is on energy as electricity and heat, this is not to overlook the role of transport fuels and demand in the renewable energy mix, and a synopsis of policy to promote the use of renewables in transport is at 1.5.

A full exposition of Scottish Government policy to promote low carbon transport is being developed and will be published later this year.

1.1.2 Economic benefits

Renewable energy is identified as a key element of the Low Carbon Economic Strategy published last year.

With as much as a quarter of Europe's offshore wind and tidal energy potential and an estimated 10% of its capacity for wave power, Scotland is well placed to become the continent's green energy powerhouse.

A valuation of the UK's offshore renewable energy resource published in May 2010 estimated that Scotland has 206 GW of practical offshore wind, wave and tidal resource - almost 40% of the total UK resource.

Harnessing just a third of our offshore renewable energy potential could meet Scotland's electricity needs seven times over by 2050. The net value of this amount of energy, in terms of electricity sales, would be £14 billion by 2050.

The large scale development of offshore wind represents the biggest opportunity for sustainable economic growth in Scotland for a generation, potentially supporting up to 28,000 directly related jobs and a further 20,000 indirect jobs and generating up to £7 billion for the Scottish economy by 2020.

Resolving the current, anachronistic arrangements for management of the seabed will help Scotland realise the full potential of its enormous offshore renewable energy resources. Legislative competence over the management and revenues of the Crown Estate – which includes the seabed out to 12 nautical miles – should be devolved to the Scottish Parliament and these public assets managed in a way that brings direct benefit to Scotland and its local communities. The Crown Estate Commissioners' responsibilities to issue leases for renewables and CCS projects from 12 to 200 nautical miles should also be devolved, enabling integrated management and planning of Scottish seas.

1.1.3 Carbon Benefits

The displacement of fossil fuel heat and power generation by renewables is key to reducing our carbon emissions.

Our Climate Change Act (http://www.legislation.gov.uk/asp/2009/12/contents) sets world leading targets for at least a 42% cut in greenhouse gas emissions by 2020 and at least an 80% reduction by 2050. Growing the economy and cutting emissions is possible. In 2008, emissions in Scotland had fallen by 21% compared to 1990, reaching the half way point towards our target of a 42% emission cut by 2020. Energy efficiency is critical in this regard.

Making the transition to a sustainable low carbon Scotland is a huge challenge that will need everyone to contribute. The prize is securing our future: for our economy, for our environment, and for generations to come.

1.1.4 Energy Security Benefits

In an uncertain world where energy markets can be volatile and subject to wider political forces, maximising Scotland's own security of supply will be vital; and utilising our own indigenous sources of renewable energy will provide an important element of our overall energy security. Indeed, our rich resources of wind, wave, water and biomass, harnessed efficiently and in harmony with the environment, can help Scotland achieve energy independence.

Renewables play an important role in strengthening security of supply, as part of a wider energy mix which will include decarbonised thermal generation. **See section 1.2.4.**

1.1.5 Community Benefits and opportunities for local ownership of energy

Scottish Ministers are determined to see the benefits from our indigenous energy resources flow through to the people of Scotland. In particular there is an opportunity for a transformation in the level of local ownership of energy.

We are setting a specific target for local and community ownership of 500 MW electricity by 2020.

This level of energy generation in community hands, as well as making a significant contribution both to energy security and the achievement of our renewable electricity target, could represent up to £225m FITS revenue per year by 2020 going directly to local communities. The scale of potential local benefit is unprecedented and such revenue streams could play an important part in developing wider community asset ownership - which is a priority for the Government.

We are starting from a high baseline: Scotland is recognised as leading the way on community renewables in the UK. Not only have we supported community energy ownership through tailored schemes since 2003, resulting in over 800 projects across Scotland, but we are now also setting the benchmark for rates of community benefit offered in commercial schemes through our expectations of commercial developments on the public estate.

1.1.6 Framework for success

Over the past four years, we have already put in place much of the framework for future realisation of these benefits including:

Renewables Action Plan (2009-11)
- a rolling update outlining short term actions require to progress towards 2020 renewables targets
http://www.scotland.gov.uk/Publications/2009/07/06095830/0

Renewable Heat Action Plan (2009)
- a plan for the promotion of the use of heat from renewable sources.
http://www.scotland.gov.uk/Publications/2009/11/04154534/0

Roadmap for Scotland's Marine Renewables Industry (2009)
- assessment of the status and potential of the marine energy industry in Scotland, alongside recommended actions to ensure its continuing growth
http://www.scotland.gov.uk/Publications/2009/08/14094700/0

Marine (Scotland) Act 2010
- introduces a statutory framework for marine planning at a national and regional level as well as a streamlined marine licensing process.
http://www.legislation.gov.uk/asp/2010/5/contents. Marine planning will be supported by *Scotland's Marine Atlas*
http://www.scotland.gov.uk/Topics/marine/science/assessment/atlas.

Low Carbon Economic Strategy (2010)
- strategy to maximise job and wealth creation opportunities in Scotland while tackling emissions
http://www.scotland.gov.uk/Publications/2010/11/15085756/0

National Renewables Infrastructure Plan (NRIP) (2010)
- outlines the investment required to deliver Scotland's ambition to become a premier location for the manufacturing and deployment of wind turbine and marine energy devices
http://www.hie.co.uk/highlands-and-islands/key-sectors/energy/n-rip.html

Scotland's Offshore Wind Route Map (2010)
- makes a series of recommendations to develop the offshore wind sector in Scotland
http://www.scotland.gov.uk/Publications/2010/09/28115850/0

Energy Efficiency Action Plan (2010)
- helping Scotland reduce energy consumption; maximising opportunities for micro-renewables and reducing fuel poverty
http://www.scotland.gov.uk/Publications/2010/10/07142301/0

Draft Electricity Generation Policy Statement (2010)
- sets out the overall objectives of Scotland's electricity policy, charting a clear path to ensuring a decarbonised, secure energy supply by 2030 through: increased deployment of renewables, progressive adoption of CCS, phasing out of nuclear, grid enhancements, and improved demand management.
http://www.scotland.gov.uk/Publications/2010/11/17094217/0

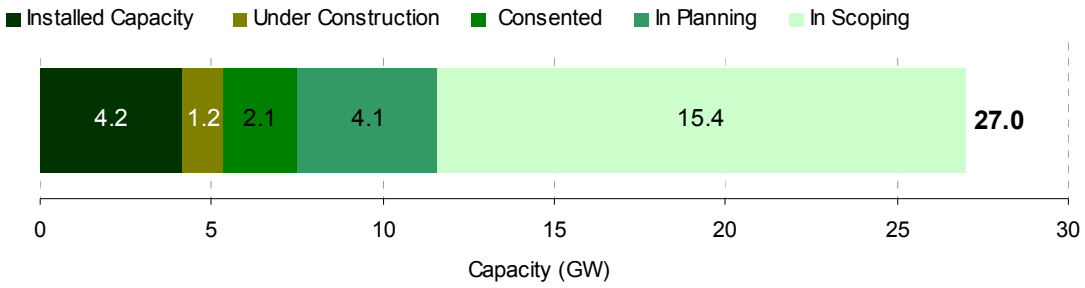
Low Carbon Scotland - Meeting the Emissions Reduction Targets 2010-2022 (2011)
- this report on proposals and policies sets out how we can meet our emission reduction targets in the most cost effective and sustainable way
http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/rpp

Blue Seas - Green Energy A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters (2011)
- sets out Scottish Ministers' policies for offshore wind development in Scottish Territorial Waters
http://www.scotland.gov.uk/Publications/2011/03/18141232/0

1.1.7 Achievements to date

Under the framework above, we have already achieved so much. Indeed, in the past four years Scottish Ministers determined a total of **50** energy applications, including consent for **42** renewable projects worth **over 2 GW** of capacity.

This puts Scotland in a strong position in terms of deployment:



Underlying this progress, support for the sector was focussed as follows:

- **£13 million WATERS fund** – Wave and Tidal Energy: Research, Development and Demonstration Support fund for the development and testing of new prototypes in Scottish waters.
- **£10m Saltire Prize** for marine energy is one of the world's largest ever innovation prizes and has generated 153 registrations of interest from 31 countries across the world.
- Further **Scottish Marine Leasing Round** to support the Saltire Prize announced in September 2010 creating new opportunities for Saltire Prize competitors.
- **£70 million National Renewables Infrastructure Fund** to ensure Scotland reaps the huge financial benefits of offshore renewables. This fund is in addition to Regional Selective Assistance (RSA) and other funding available for companies.
- **The Scottish Biomass Heat Scheme**, which targets SMEs, has been crucial in maintaining momentum in the sector with over £2.6 million paid to 44 projects delivering 10 MW (thermal) of capacity, with annual CO_2 savings of over 10,000 t CO_2-equivalent.
- Since May 2007, **over 800 grants for community renewables, worth over £16M**, have been allocated under the Community And Renewable Energy Scheme (CARES) and the previous Scottish Community and Householder Renewables Initiative (SCHRI).

Other key developments

- Granted consent for Beauly-Denny overhead line upgrade in 2010: the most significant electricity infrastructure project in Scotland in a generation.
- Scottish Government leading on British Irish Council marine energy and electricity grid work streams.
- Working with the EU North Sea Grid Coordinator (Adamowitsch) and the North Sea Countries Offshore Grid Initiative on the EU Memorandum of Understanding on developing North Sea grid;
- Working with the Governments of Ireland and Northern Ireland in the Irish Scottish Links in Energy project, assessing opportunities and challenges for offshore interconnected grid in the Irish Sea.
- Established Scottish European Green Energy Centre (SEGEC) in Aberdeen, which in its first year delivered over 100 million Euros of EU investment.
- Energy Technology Partnership (ETP), established in 2009, is the biggest collaborative research activity of its type in Europe, comprising around 250 academics from multidisciplinary backgrounds, with over 700 energy related researchers across the partner institutions.
- Raised the bar for community benefits from commercial renewables developments by requiring a rate of £5,000 per MW from new wind and hydro developments on the National Forest Estate – twice the standard industry rate.

Moreover, recent announcements of investment in Scotland maintain the momentum – from Consent for the world's largest tidal stream array (a Scottish Power Renewables facility to be built in the Sound of Islay), to Doosan Power Systems' decision to base its centre of excellence for renewables in Renfrew. Scotland continues to live up to its claim to be the powerhouse of renewable energy.

But the time is right to review what more can be done and to push further in order to build on our potential, to maintain momentum, and to continue to attract investment to realise our vision. The time is right for a new target.

1.2 Renewable Energy Targets and Energy Mix

1.2.1 EU energy targets and position on deployment across EU to date

The EU has been central to efforts to drive emissions reduction and increase levels of renewable energy across Europe. In 2008, the EU committed to a legally-binding 20% cut in greenhouse gas emissions by 2020 across all member states. This is being delivered by the EU 20/20/20 Climate and Energy Package (20% emissions cuts / 20% renewable energy / 20% energy efficiency by 2020). The EU has committed to strengthening this target to 30% provided other industrialised countries commit to comparable effort and developing countries contribute adequately to global action.

Scotland strongly supports this increased ambition to 30% (which is consistent with our own legally-binding 42% target in Scotland). The Commission's 2050 Low Carbon Economy Roadmap shows that on current policies the EU could meet its current 2020 emissions reduction target of 20%. Fully implementing its 20% energy efficiency target should enable the EU to deliver 25% emissions cuts by 2020. The Communication says that the economic crisis has reduced the cost of meeting the 2020 target and that the most cost effective trajectory is indeed now 25% by 2020, 40% by 2030, 60% by 2040, and 80% by 2050. However, the Communication does not go as far as recommending that the 2020 target should be raised. Scotland is continuing to work with the UK to press for this higher level of ambition.

1.2.2 UK Targets

Under the EU Directive on Renewable Energy, the UK has a target to source 15% of energy demand from renewables by 2020. This is further broken down into 30% electricity; 12% heat; and 10% transport fuels. The UK Government will be publishing a Roadmap for Renewable Energy for the UK based on the achievement of these targets.

The Scottish Government has also committed to ensuring we meet the EU's 2020 renewable energy target of 20% by setting a target to source 20% of energy demand from renewables by 2020. This is further broken down into 100% electricity; 11% heat; and 10% transport fuels. This will go beyond the legally-binding 15% renewables target that the EU has set for the UK under burden-sharing arrangements and shows the higher level of potential and greater ambition for renewables in Scotland

1.2.3 Scottish targets

Scotland's ability to supply sufficient renewable electricity and heat to meet its targets in a cost-effective way depends critically on **reducing demand**. High demand requires more generating capacity to be built. Owing to uncertainties over individual behaviours, electricity demand could vary but it is likely to rise in the long term as greater use is made for transport and heat - therefore energy efficiency

measures to minimise this rise in demand will be crucial if electricity is to remain affordable.

The Energy Efficiency Action Plan established a target to reduce total final energy demand in Scotland by 12% by 2020, covering all fuels and sectors.

Variation in the mix of fuels that make up final demand will depend on a number of factors including consumer choices, strategies taken by companies to meet the Energy Company Obligation, and individual behaviour.

Energy efficiency is at the top of our hierarchy of energy policies as the simplest and most cost-effective way to reduce emissions whilst seeking to maximise the productivity of our renewable resources. Energy efficiency complements our other energy-related strengths, and works across areas such as housing, business, and transport, all of which are major consumers of fuel, to help us create a more sustainable Scotland with opportunities for all to flourish.

Hence the actions set out in the full Renewables Routemap will be taken in tandem with our continuing drive to reduce demand.

Because the pace of renewables development has been so rapid in Scotland, with the nation now on course to exceed its milestone of 31% of electricity demand to be sourced from renewables by the end of this year, we can now commit to a new renewable electricity target.

Our new target is to generate the equivalent of 100% of Scotland's own electricity demand from renewable resources by 2020.

By then we intend to be generating twice as much electricity as Scotland needs – just over half of it from renewables, and just under half from other conventional sources. We will be exporting as much electricity as we consume.

This new target, roughly equating to 16 GW of installed capacity, is based on the fundamental wealth of renewables resource available; our analysis of deployment trajectories on the onshore side (see 1.3); and our concerted efforts to ensure a supportive policy framework for growth – particularly to realize our offshore energy potential.

Increasing our target for renewable electricity means that we are also able to increase our overall renewable energy target.

We are now aiming to meet at least 30% of demand for energy from renewable sources by 2020.

Scottish Ministers are not alone in the belief that such ambition is justified. The scope for a new electricity target has been endorsed by industry leaders in a recent (April 2011) open letter:

Scotland's renewable industry has made significant progress in recent decades and an ever increasing share of our electricity consumption is now generated by renewable sources with more coming online every month.

It is important that we continue to build on that. Scotland is already establishing itself as a world leader in renewables technology because of our engineering skill base, government commitment and the potential of our vast natural resources.

The target of 100% renewables by 2020 that has already been backed by a number of industry leaders, academics and politicians is ambitious but achievable. This means that Scotland will by then produce around twice the electricity that we consume with just over half coming from a variety of renewable sources.

It is vital that we maintain momentum on our renewables industry and continue to send out a clear message to act as a magnet for the capital investment needed to realise the vision. The 100% target will focus the minds of politicians, planners and industry bringing the certainty and leadership that will help attract further jobs and investment.

Scotland is well placed to meet the opportunities provided by the shift to the low carbon economy and the 100% target is another vital step in that journey.

Keith Anderson, Chief Executive Officer, Scottish Power Renewables,
Allan MacAskill, Business Development Director SeaEnergy Renewables
Roy MacGregor, Chairman, Global Energy Group
Martin McAdam, Chief Executive Officer, Aquamarine Power,
Richard Yemm, Chief Technical Officer, Pelamis Wave Power,
David Maxwell, Steel Engineering, Managing Director,
John Robertson, Managing Director at Burntisland Fabrications Ltd

Moreover, the ambition for a 100% target has been further endorsed (19 May 2011) in a public statement by Scottish Renewables as follows:

The renewable energy industry has come a long way in twelve years. Building on the hydro legacy of the post-war years, it has embraced onshore wind, cultivated the embryonic wave and tidal sector, pioneering deep-water offshore turbines and harnessing existing and new bioenergy solutions. With over a third of Scotland's electricity now produced from renewable sources, it has surpassed targets for both 2010 and 2011 for renewable electricity generation. Currently, if you take into account developments in operation, construction and with consent to build, renewables will provide over half of Scottish electricity demand.

100 per cent of electricity demand is ambitious, but it will require around half of the existing plans for offshore wind agreed with The Crown Estate, around a quarter of the wave and tidal agreements, steady growth in onshore wind, and modest increases in hydro and biomass to hit this target.

But the Scottish Government does not underestimate the scale of the challenge. Meeting the equivalent of 100% of Scottish demand for electricity from renewables within the next 9 years will be a huge challenge, and will be heavily dependent on regulatory processes which we will seek to influence but over which currently we do not have control.

A synopsis of the main challenges is as follows:

TYPE OF CHALLENGE	100% RENEWABLE ELECTRICITY TARGET
SCALE OF OVERALL CHALLENGE	**Target requires a sustained annual renewable deployment rate of more than twice that ever experienced in Scotland, and thus will depend upon installation of large-scale offshore wind schemes.**
ELECTRICITY MARKET REFORM	Higher deployment rates may require extended and additional technology support. They may also possibly require extra innovation spend for wave, tidal and even offshore wind.
	Extra costs of future grid balancing activities required for high renewable penetration, including incentivisation for storage.
TRANSMISSION BOUNDARY AND INTERCONNECTION	Need to make case for additional interconnection and grid upgrade over and above existing (ENSG) proposals and have these in place by 2020.
CONSENTS AND PLANNING	Further increase in consenting/deployment rates required especially for offshore wind – in harmony with environment.
	Need to ensure that, as renewable penetration increases onshore, environmental and land use consideration are not compromised.
SUPPLY CHAIN & INFRASTRUCTURE	Further work with the economic development bodies to promote supply chain and other economic benefits from low carbon energy development.
	Further and faster support needed for infrastructure, while considering the potential external constraints that high renewables penetration could trigger, e.g. steel availability / prices and vessel availability.

The Scottish Government continues to work hard to ensure that the regulatory framework for support for energy, currently being devised at a UK level, takes full account of the contribution Scotland can make on renewable energy, and that it nurtures our aspirations to their full potential. The Scottish Government's response to the public consultation on the electricity Market Reform proposals can be found at: http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Infrastructure/Grid-Connections/EMR-consultation-UK/EMR-consultation-UK

We also recognise the importance of ensuring that Scotland's ambitions for renewable energy are not pursued at the expense of the wider environment, and we are inviting comments on our new target and policies, and our assessment of the wider energy mix, under a Strategic Environmental Assessment consultation which is being undertaken alongside this Routemap.

1.2.4 Electricity generation mix

We are aiming for an output equivalent to 100% of Scotland's demand for electricity to be met from renewables, but it will be very important to understand that this does not mean Scotland will be 100% dependent on renewables generation: renewable energy is part of a wider electricity mix.

The electricity generation mix that we see for Scotland is set out in our Electricity Generation Policy Statement which we published as a draft last November and which we are now revising in line with our new target.

As mentioned above, the statement is subject to a Strategic Environmental Assessment, currently open to consultation.

The draft Electricity Generation Policy Statement sets out the Scottish Government's position on the role of renewable electricity and fossil fuel thermal generation (coal, gas, oil) in Scotland's future energy mix, and **is being updated in the context of the new target** of the equivalent of 100% electricity demand to be met from renewables by 2020. The draft statement gives a clear view on the need for both rapid expansion of renewable electricity across Scotland and the underlying requirement for new or upgraded efficient thermal capacity in this low carbon generation portfolio, progressively fitted with CCS. It confirms our policy to phase out existing nuclear power stations as they reach the end of their operating lives, and shows that all of Scotland's future energy needs can be met without the need for new nuclear power stations. It is based on research studies on future energy supply, storage and demand, and takes account of the changing policy context in Scotland, the UK and the EU since the Second National Planning Framework was published in June 2009.

The draft Electricity Generation Statement sets out new developments and implications in the following four key areas:

- *renewable generation*
- *thermal electricity generation*
- *energy efficiency*
- *transmission infrastructure and interconnection*

These developments and implications for electricity generation are then analysed in the light of the latest research studies, including new analysis on the implications of the 100% target.

The thermal generation that will form the baseload of Scottish supply will be decarbonised by our parallel ambitions for carbon capture and storage (CCS). CCS has the potential to reduce emissions from fossil fuel power stations by up to 90% and will be a vital element of a decarbonised power sector by 2030.

'*Opportunities for CO_2 storage around Scotland*', published in 2009, showed that Scotland has an extremely large CO_2 storage resource:

- offshore saline aquifers, together with a few specific depleted hydrocarbon fields can easily accommodate the industrial CO_2 emissions from Scotland for the next 200 years;
- Scotland's offshore CO_2 storage capacity is the largest in the European Union, comparable with that of offshore Norway, and greater than Netherlands, Denmark and Germany combined.

'*Progressing Scotland's CO_2 storage opportunities*' published in March 2011, confirms the European significance of Scotland's CO_2 storage resource with more detailed evaluation of the Captain Sandstone (beneath the Moray Firth).
http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/traditional-fuels/new-technologies/SGactionCCS/ScotlandsCO2Storage

As with renewables, Scotland has the opportunity to become one of the world's leaders in the development of CCS. Successful demonstration of CCS in Scotland over the next decade could create up to 5,000 jobs and be worth £3.5 billion to the Scottish economy. Proposals are well-developed for a number of Scottish sites, and Scotland's R&D capability in our universities or test sites (such as the Doosan Power Systems facility in Renfrew) gives us a leading position to develop projects in other markets. The Longannet coal CCS demonstration project is the most advanced in Europe and is likely to secure £1 billion funding from the UK government. Once fitted with CCS, 2 million tonnes of CO_2 will be saved from Longannet annually – Scotland's largest single emissions reduction in the next decade. And Scotland can also lead in the development of CCS on gas through the proposals to fit CCS to Peterhead power station.

Increasing our ambition on renewables is matched by our ongoing ambition for CCS. That is why the Scottish Government is articulating a clear and unambiguous case for Scottish discretion over funding support under UK Electricity Market Reform, to ensure we can prioritise our support for renewables and CCS in the most appropriate way.

1.2.5 Matching supply to demand: the contribution of intermittent generation to the energy mix

Ministers are committed to ensuring that Scotland continues to have a secure energy supply throughout the transition to low carbon energy, and also want to see increases in Scotland's capacity for electricity import and export to balance renewable intermittency. The Government is aware that output from renewables is variable, and that low probability weather events, such as years with exceptionally low precipitation in hydro catchment areas or exceptionally low wind productivity, happen from time to time, even if infrequently. For example, hydro output in 2003 was 35% lower than in the previous year as a result of exceptionally low rainfall in catchment areas.

Sometimes a wind turbine may be highly productive and in other periods it may produce very little or no power. But wind turbines are not all in one place, they are spread throughout different parts of the country which reduces the probability of many of them being out of action at the same time. Scotland is a windy country, and the probability of the whole of Scotland being without wind is relatively low. Scotland has long been a net exporter of electricity and has enough capacity from other sources to turn to when it is not windy. It is windy enough for most of the year so that wind farms reduce the need for power from other sources and help reduce fossil fuel consumption and harmful emissions. In 2009, renewables met over 27% of Scotland's electricity use, following the steady trend of Scotland's energy supply becoming greener and cleaner. There was a 20% increase in the amount of electricity from renewables on 2008 and Scotland also exported 24% of its electricity. Wind power, alongside other forms of onshore and offshore renewables, provides an electricity supply which is largely emissions-free, and contributes to greater security of supply.

Adding new wind farms to the energy mix has relatively little impact on the back-up already built into the system, in comparison with the electricity the wind farms generate. All generators have a risk of failure and the grid is already designed to cope with sudden loss of power from very large power stations, which happens from time to time, sometimes without any warning. Wind farms, in comparison with other generators, are relatively efficient. Less than half the energy of the coal or gas going into a power station is turned into useful electricity – most of it is wasted and still ends up producing ash, nuclear waste or air pollution. Although wind farm output is variable, it can be forecast with some confidence and be useful as one component of a broad energy mix.

1.2.6 Key Dependencies

As set out at 1.2.3 above, the key dependencies for the achievement of the new Scottish renewable electricity target will be the establishment of an appropriate level of support for deployment together with adequate grid infrastructure. These are both areas that the Scottish Government is working hard to influence. Scottish ambition for renewables and our potential to contribute to wider UK and EU targets both need to be recognised by the UK Government in forthcoming regulatory change.

The UK Government's Electricity Market Reform contains several mechanisms designed to replace the Renewables Obligation. We believe the Renewables Obligation is still fit for purpose and want to retain it, unless an alternative can be shown to improve deployment and maintain Scottish discretion to influence support for renewable technologies. Any Renewables Obligation Scotland (ROS) replacement must be at least as effective as the current framework of banded ROCs, with levels of support for all renewables capable of delivering capacity and new industries and jobs.

The investment hiatus which has already started must be stopped. If a case is made for a new mechanism, any transition to a new system must enable deployment and maintain momentum in the development of a supply chain. This will require extension of the ROS to 2020.

The UK Government must commit to maintain support for Wave and Tidal energy at around 5 ROCs to 2020, and to a comparable level of support under any successor "Contracts for Difference" (CfD) regime. This is necessary to enable the sector to break out from prototype/deployment stage into commercial stage. Without it, the sector may repeat its false start of the 1970s.

The Scottish Government needs to have powers over any independent body/system operator established to run the CfD/Capacity Payment mechanisms, and clear accountability links between that body and the Scottish Government.

Moreover our electricity target should not be considered in isolation from other energy and climate change targets all of which create a degree of interdependency. We will be working with industry and other stakeholders to consider whether our existing renewable heat target can be further stretched to encourage deployment. But in carrying out this assessment, we need to be mindful of:

- the interrelationship between our electricity and heat targets;
- the impact of transport demand;
- the underlying dependency on measures to improve energy efficiency and hence reduce consumption;
- the context of wider carbon reduction targets – where heat and transport will have a larger role than electricity;
- as well as other economic factors such as cost-effectiveness.

Taking the 100% electricity target and putting this together with existing heat and transport targets provides an opportunity to increase our overall renewable energy target to at least 30%. However, the uncertainties created by the interdependency highlighted above need to be recognised.

Key issues related to this interdependency include:

- the need to ensure that the limited resource of woody biomass is deployed in the most efficient manner, namely as heat or CHP which demonstrate 90% and 50-70% efficiencies respectively, rather than as electricity-only generation which is 30% efficient. To achieve 100MW installed capacity of biomass electricity requires a million green tonnes – equivalent to a sixth of the Scottish timber harvest, whereas, the same volume of woody biomass, could fuel 250 MW to 600 MW of heat capacity;
- moreover policy to promote the use of woody fibre for biomass needs to be balanced alongside the policy to promote low carbon construction and other uses of wood such as by the wood panel sector, which “lock in” carbon to the benefit of wider carbon emissions reductions targets, as well as of course providing value to the Scottish economy. The energy target should not be to the detriment of the climate change target and wider Scottish economy;
- a growth in the use of heat pumps may increase demand for electricity;
- similarly if Scotland achieves 10% market penetration of electric vehicles by 2020 as suggested by WWF Scotland in their report "Watt Car", May 2010, an additional 1TWh of additional electricity production will be required. While this is relatively small in the context of Scotland's renewable generation capacity, it needs to factored in as a demand pressure.

1.3 Analysis of Deployment Trajectories

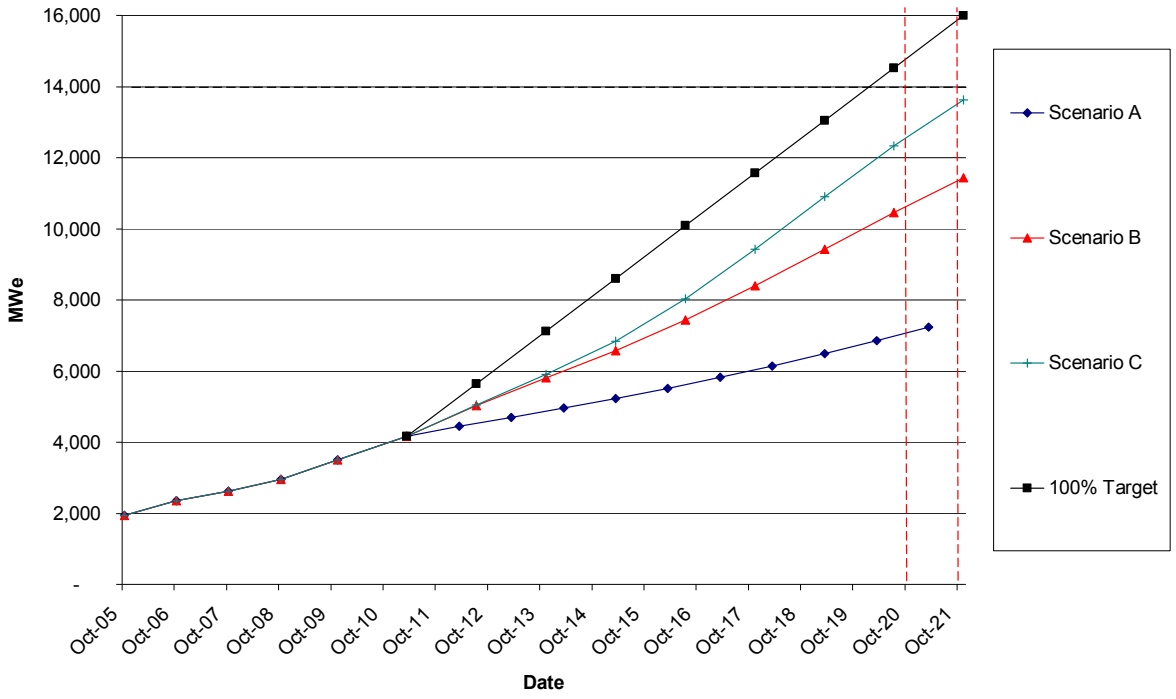
1.3.1 Renewable Electricity Deployment Trajectories

Figure 1 below demonstrates projections on potential patterns of deployment of renewable electricity capacity in Scotland.

The modelling assumes that it is possible to project future deployment rates on the basis of the progress of existing renewable projects from conception to operation. These historical trends have allowed us to estimate a number of future deployment scenarios by adjusting variables such as the speed of the planning system or the success of the Electricity Market Reform in delivering the incentive structures necessary to support the deployment of renewable electricity capacity in Scotland.

The deployment of renewable electricity capacity depends on a number of complex and interdependent factors and as such these scenarios represent feasible but ultimately uncertain deployment profiles driven by the assumptions adopted.

Figure 1: Projections of Renewable Electricity Installed Capacity Based on Historical Data



The scenarios modelled in the chart above represent:

A. Deployment projection based upon an extrapolation of the annual deployment levels experienced in 2007-08.

B. Deployment projection based upon an extrapolation of the annual deployment levels experienced between 2009 and the start of 2011.

C. Deployment projection, based on Scenario B above, adjusted for the improvements in the planning/consent system that were introduced in recent years but which have not yet impacted upon actual deployment rates.

D. The 100% target line is a straight line extrapolation between current installed capacity and the estimated levels of capacity required to achieve 100% of gross consumption from renewables in 2020. This hypothetical line is incorporated to identify and acknowledge the scale of the challenge. In reality, it is recognised that deployment will not follow a straight line and would be expected to accelerate towards the latter part of the decade, particularly given the potential magnitude of offshore wind deployment.

1.3.2 Data sources and approach

The data used to underpin the analysis is sourced from the Scottish Renewables database of Renewable Energy Projects. The database collates information on renewable energy projects dating back to 2006. The database can be found at http://www.scottishrenewables.com/publications/

The approach of applying past trends to project future scenarios is widely used for analysis but relies on the past being a good predictor of the future. However, given the limited historical deployment of some technologies in Scotland, notably offshore wind and marine technologies, this approach risks underestimating the likely deployment of these technologies.

Each of the modelled scenarios places the ambition of the Scottish Government in the context of the very successful levels of deployment seen in recent years. The successful delivery of the capacity required to deliver the equivalent of 100% of Scottish electricity consumption will demand a significant and sustained improvement over the deployment levels seen historically. This approach sets out a number of feasible deployment scenarios but does not shy away from the challenge that this ambition presents.

1.3.3 Renewable heat trajectory

The Scottish renewable heat database was updated in March 2011 to include information (where known) on renewable heat installations which are under construction or in planning. These can be used to provide an estimate of future renewable heat output in Scotland, although there is necessarily a large degree of uncertainty around such figures.

At the micro and small to medium scale, based on data for the Scottish Biomass Heat Scheme, CARES and the Energy Saving Scotland home renewables grants, a further **19 MW** of capacity and **41,000 MWh** of heat output are expected. This covers micro installations which began operating in 2010, and those which are expected to become operational during 2011 or 2012. A further **69 MW** of installed capacity and **487,000 MWh** are estimated from large projects which are currently under

construction, and around **198 MW** of installed capacity and **1,017,000 MWh** from large projects in planning.

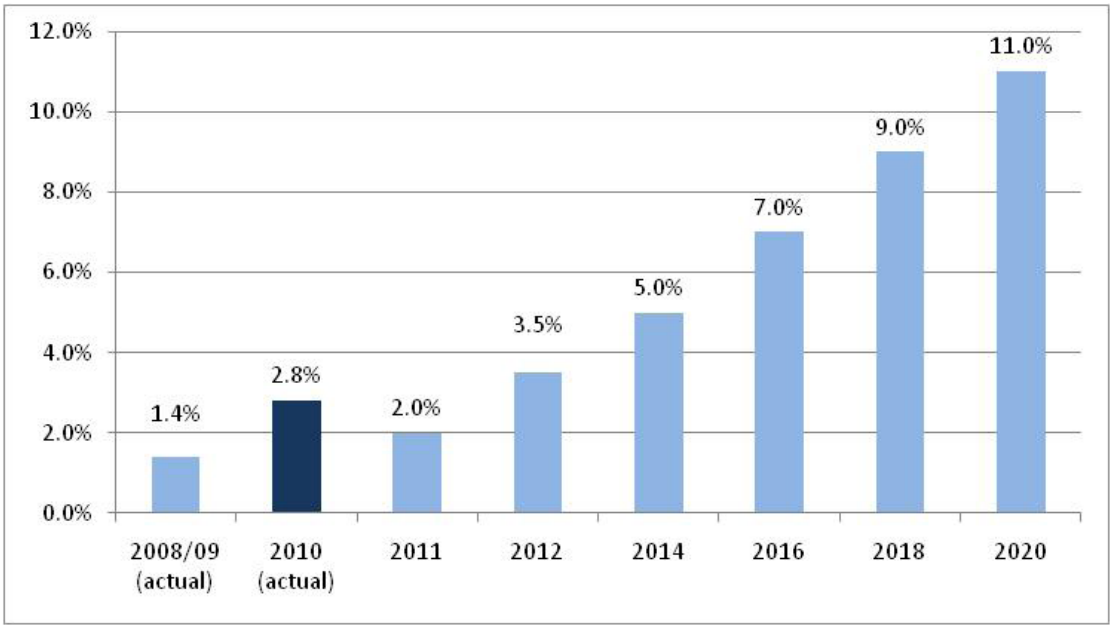
Were all the projects currently under construction, and 50% of those in planning to come to fruition, in addition to the known micro and small to medium installations, this could bring total renewable heat output in Scotland to an estimated **2,733 GWh** a year, or around **4.5%** of forecast Scottish 2020 nonelectrical heat demand.

1.3.4 Progress towards 2020 heat target

The update of the renewable heat database indicates that renewable heat output in Scotland approximately doubled between 2008/09 and 2010, from 845 GWh to 1,696 GWh. Large projects under construction or in planning, plus micro and small to medium projects known to have been installed during 2010, could potentially bring total heat output to around 2,733 GWh over the next few years.

Based on the rate of increase from 2008/09 to 2010, Scotland appears to be on track to meet its renewable heat target for 2020 (figure 2).

Figure 2: Indicative interim milestones towards the 2020 target for renewable heat, compared with actual heat output in 2010.



1.3.5 Caution

In attempting to construct deployment trajectories for both renewable electricity and heat, it is clear that there is a high degree of uncertainty both in terms of the limited historical evidence on which to base projections for the offshore technologies and heat, and in terms of the current wider regulatory uncertainty and the impact of any new regime on the pace and scale of the development of renewables in Scotland.

1.4 Monitoring and Advisory Groups

1.4.1 The legacy of FREDS

Ministers have been grateful for the input of members of the Forum for Renewable Energy Development Scotland (FREDS) which has been providing advice on policy on renewables in Scotland since 2003. During this time, FREDS has published a series of sectoral reports charting the way forward – from an early identification of the economic potential of marine energy for Scotland (2004) to the seminal report on renewable heat in 2008, which led to the statutory commitment to publish a Renewable Heat Action Plan the following year.

Since 2009, FREDS sub-groups, with over 200 members in total, have played a key role in driving forward activity under the Renewables Action Plan (RAP) - designed as a transparent and inclusive mechanism to deliver progress towards 2020 targets.

FREDS' achievements in this role include:

- recommendations on financial barriers to community renewables which led to the design of the groundbreaking CARES loan scheme for communities and the rural sector;
- hosting of a major stakeholder event to raise awareness of renewable heat;
- input to the design of new SEPA advice on hydro;
- development of a common Renewables Skills Framework for Action based on the Renewables Action Plan and with buy-in from the main skills agencies, industry representatives and educational institutes.

Other advisory groups, separate to FREDS, have provided valuable input on offshore energy policy. Outputs from these groups in the last two years include the publication of routemaps for the development of the offshore wind and marine renewables sectors, comprising a series of recommendations and actions necessary if Scotland is to deliver several GW of capacity from these technologies by 2020.

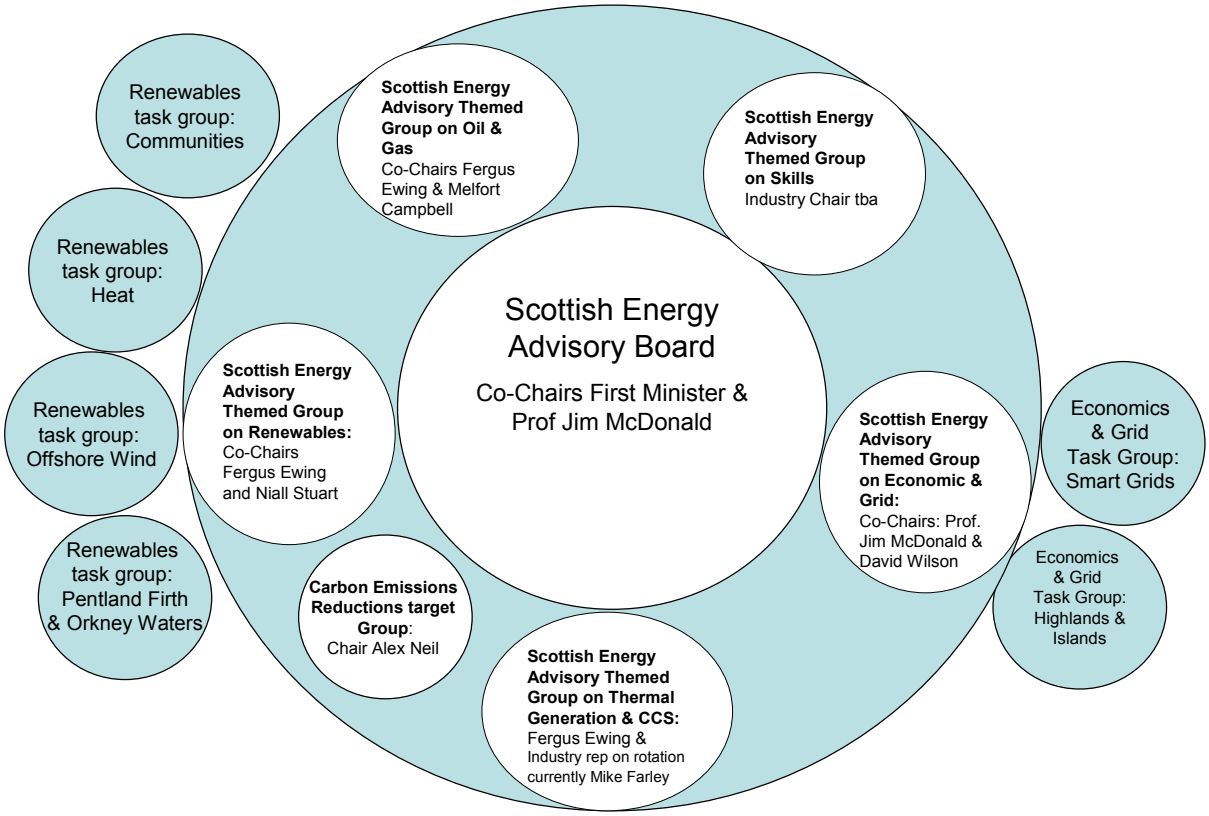
1.4.2 Restructuring to focus on the new challenges

When we published the RAP in 2009, and commissioned FREDS to drive delivery, we signalled the scope to review this structure after 2 years. Our heightened ambitions on renewable electricity and local ownership of energy will require focussed advice, support and commitment from industry and other stakeholders. Hence the time is right to restructure our advisory groups to meet these challenges.

We propose to remodel FREDS into the Scottish Energy Advisory Themed Group on Renewables, with a refreshed membership; a new secretariat from Highlands and Islands Enterprise (HIE), and a streamlined sub-group structure reflecting priorities for progress.

The new group will sit under the Scottish Energy Advisory Board, alongside the other energy themed groups, including a newly formed Employer Skills Council to replace the existing FREDS Skills Sub Group with a remit to govern the delivery and implementation of the Skills Investment Plan for the Energy Sector.

Scottish Energy Advisory Structure



1.5 Transport

1.5.1 Overview and contribution to energy policy

The transport sector consumes 29% of Scottish final energy use. Emissions from cars and vans greatly outweigh emissions from rail (66% compared to 2% of total UK transport emissions in 2006).

Electric vehicles offer a 'storage' function through the energy storage capacity of their batteries. It is expected that the majority of electric vehicle charging will occur at night at home, and, as such, this will flatten the demand curve. Through the application of smart grid technology it is envisaged that electric vehicles will be able to provide stored electricity back to the national grid when required. Commercial models for the supply of electricity for transport are likely to charge a premium for on-street daytime charging.

Feedback gathered via the Low Carbon Vehicles consultation exercise specifically from distribution network operators suggested that there would be minimal impact on the grid, apart from some very localised upgrades if demand was at the higher end of the demand curve. Electric vehicles are therefore likely to assist in achieving security of supply and demand objectives with negligible impact on the grid.

1.5.2 Scottish Government ambitions for low carbon transport

Ministers have strong ambitions for low carbon transport including:

- complete decarbonisation of road transport by 2050, with significant progress by 2030 through wholesale adoption of low and ultra low carbon vehicles;
- a mature market for low carbon cars, resulting in average efficiencies for new cars of less than 95 g CO_2/ km by 2020 (RPP);
- an electric vehicle charging infrastructure in place in Scottish cities by 2020.

We are also committed to promoting the use of Scottish sustainable biofuels for Scottish business to reduce emissions from heavy / specialist public sector vehicles, and have provide financial support to research and development in this area.

1.5.3 Biofuels

Targets for transport fuels are contained in the Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD). The RED sets a target of 10% of transport fuels from renewable sources by 2020 and is part of an overall 20% target for energy. The FQD sets a GHG reduction target of 6% by 2020 and this equates to the 10% by volume target in the RED. The rate of increase in the Renewable Transport Fuel Obligation has been slowed, following the Gallagher Review so that the level of biofuels mixed with mineral fuel at the pumps will increase to 5% by 2013/14.

'Second generation' biofuels made from a number of materials including landfill waste, agricultural or forestry waste and marine algae are in various stages of research, development and demonstration. However, predictions of when these will be commercially available vary and could be as much as 10 years. In addition, costs, as a result of the more technical nature of the production process, are likely to be high and a decision about cost-effectiveness will have to be made.

To enable the expansion of biofuels, infrastructure changes will be necessary on the production side, exploring new feedstocks and production methods as well as associated distribution methods.

1.5.4 Low carbon vehicles: Leading by example

The Government has responded directly to feedback on the role of the public sector in promoting low and ultra low carbon vehicles and we have already taken the following positive steps:

- Transport Scotland committed £4.3 million to support the procurement of low carbon vehicles and their supportive infrastructure in 2010-11. The Public Sector Low Carbon Vehicle Procurement Scheme provided funding support to Community Planning Partnerships to assist the uptake of a range of low carbon vehicle technologies in the public sector fleet. The scheme offers public bodies the opportunity to add low carbon vehicles to their fleets at the same price as conventional vehicles, while also supporting associated infrastructure provision. We are committed to extending support for the existing public sector procurement programme for LCVs. The procurement programme is planned to continue and will support the introduction of driver management instrumentation to improve public sector driver behaviour.
- As a starting point we have committed now to the installation of 375 electric vehicle charging points. This trial will enable the evaluation of a range of charging infrastructure and locations and inform the creation of a wider network of charging infrastructure. We will continue to take a leading role in piloting technologies and testing consumer demand and behaviours in relation to essential infrastructure in Scotland. This will be followed by robust evaluation, in partnership with stakeholders.
- We have provided £4.4 million of funding in 2010-11 for improving the environmental performance of the bus fleet through the Green Bus Fund.

1.5.5 The Prize

Our ambitions to harness our vast renewable energy resource could give Scotland an advantage in the development of electric and hydrogen fuelled vehicles in the long term - and perhaps initially for niche markets, making Scottish ultra low carbon vehicles some of the greenest in the UK. In order to seize the transport fuel opportunities potentially available from hydrogen, further research and development work will be necessary (see Section 3.8). Continued partnership between industry, academia, government and the voluntary and third sector is essential.

2. Crosscutting Challenges

2.1 Overview and Demand Reduction Context

There are a wide range of crosscutting challenges to be faced by the sectors that make up the renewables industry, all of which must be overcome if we are to realise our ambitions for 2020 and beyond. It will be helpful to consider these generic issues and assess their impact, before moving on to the individual sectoral routemaps (in Section 3).

But first it is worth reiterating that our ambitions for renewables will not be at the expense of the higher principle of reduction in demand for energy. The Energy Efficiency Action Plan takes a comprehensive approach, orchestrating action across all sectors to create a broad platform from which we can drive greater overall momentum. The Plan looks at energy efficiency within individual sectors (housing, non-domestic and public sector), as well as the supporting infrastructure, including planning, district heating and skills.

All the challenges for renewable energy below must be seen in this wider context of demand reduction.

The crosscutting challenge for renewables is set out in the following table:

Figure 3: Crosscutting challenges for Renewables and their sectoral impacts

	The cost of renewables	Planning Consents and regs	Secure grid access	Source sustainable fuel	Skills	Supply chain/ Infrastructure	Innovation/ R & D	Public Engagement
Renewable Heat	x	x		x	x	x	x	x
Bioenergy and Waste	x	x	x	x	x	x	x	x
Hydro	x	x	x					x
Onshore wind	x	x	x		x	x		x
Offshore wind	x	x	x		x	x	x	x
Marine Energy	x	x	x		x	x	x	x
Microgen	x		x	x	x			x
Other / Emerging†	x	x	x	x	x	x	x	x
Communities	x	x	x	x				x

†*Other and Emerging Technologies include deep geothermal, and storage technologies such as Hydrogen fuel cells*

The rest of this section provides analysis on the issues identified above.

2.2 Costs and Access to Finance

2.2.1 The Challenge

We recognise that meeting Scotland's ambitious renewable energy targets will come at a cost, and that this cost will be spread across a number of areas. There will be financial implications for the public and private sector in terms of the planning process and in relation to the necessary environmental surveys and monitoring which will underpin the delivery of much of the new renewable capacity which meeting the targets will require.

2.2.2 Access to Finance

Access to development finance will be key. To unlock this opportunity, the Scottish Low Carbon Investment Project has been set up as a public-private partnership, led by the Scottish Government to identify investment propositions, explore different models of investment in innovation, and connect with the international investment community. The second Scottish Low Carbon Investment Conference will take place in Edinburgh in November and will cover investment in energy consumption, resource efficiency and "clean technologies" as well as renewables.

In addition of course the Scottish Government has made clear our interest in the UK Government's proposed Green Investment Bank which will fund investment projects in the green economy. The UK Government has proposed that Scottish Ministers agree to waive our right to the Fossil Fuel Levy, now standing at over £200m, in return for a guaranteed investment of £250m by the Green Investment Bank in Scotland. This does not meet the clear wish in Scotland to see early investment of the Fossil Fuel money in Scotland by Scottish Ministers, and discussions are continuing with Treasury.

2.2.3 Technology costs and costs to consumers

Meeting our renewables target will require major advances in the development and deployment of a number of technologies, some of which are yet to be proven at any kind of scale, and some of which exist at present only in extremely limited form(s). For example, the renewable heat target of 11% will be built upon a much wider development and uptake of such sources as geothermal, solar and biomass heat which will rely on access to the Renewable Heat Incentive for support; meanwhile, the transport target relies at present on the success of the Renewable Transport Fuel Obligation, but will depend much more over time on advances in the electrification of private and public vehicles.

On the renewable electricity front, the key challenge (and thus the costs) connected with meeting our target will arise from the development and deployment of offshore wind, wave and tidal technologies. While offshore wind is already being developed commercially, there are still several technology challenges and developments to be addressed and which will unlock development on a much greater scale, including

installation and deployment techniques, the development of projects in deeper water (using new approaches such as floating turbines), and the build / testing of new and larger turbine types at purpose built facilities. It is likely that the public sector will need to play a continuing role in helping to meet these costs.

Wave and tidal development is at an earlier stage still. The public sector's investment at EMEC (upwards of £20 million) has delivered a world class facility which has been at the global forefront of full scale prototype testing for the past five years, and should be operating at full capacity in the next 12-24 months. However, the next stage of development, the build out of devices into small arrays in waters around Scotland, will be crucial in terms of driving costs down towards a commercial level. The marine renewables sector believes that the development of a 10 MW array based on current costs will amount typically to around £80 million, and that these will need to be supported through a mixture of public sector capital grant support plus an enhanced ROC rate through the Renewables Obligation (or its Electricity Market Reform process replacement).

Of course the costs of developing renewables have wider impacts. Significant upfront investment in low carbon technologies will not only provide more secure supplies, but will help reduce demand through increased efficiencies, allowing households to benefit to some extent from avoiding bearing the cost of increasingly expensive fossil fuels.

The Scottish Government have a number of initiatives underway to improve energy efficiency, aiming to mitigate the expected increases in customer bills.

In addition, in developing renewable technologies and encouraging take-up through market incentives, priority should be given to longer-term cost reduction in order to minimise impact on consumer bills and to mitigate any adverse impacts on fuel poverty. There is so much potential to grow the economy through renewables, including at a local level by means of asset ownership, but we need to make sure that this is not at the expense of the individual consumer.

2.2.4 Grid and Infrastructure

Connecting Scotland's enormous renewable resource will require major investment in new and upgraded electricity networks, not to mention the construction of local networks which will be necessary to capture and distribute renewable heat. The electricity grid investments and costs connected with our 100% target comprise upgrades to onshore networks and cables, as well as the construction of new subsea lines down the Scottish coast (see section 2.4). The extra costs involved in delivering these improvements will ultimately be met by consumers; the Scottish Government will continue to strive for an outcome which means that these costs are levied fairly and efficiently, and that they are socialised across the UK, given the importance of Scotland's renewable resources to meeting UK targets.

Meanwhile, the manufacture and transport of steel, turbines and other components, particularly with respect to offshore renewables developments, will require huge investment in Scotland's port and harbour facilities. The Scottish Government,

through Scottish Enterprise, has already announced its £70 million National Renewables Infrastructure Fund (N-RIF) to help secure matched investments from the necessary private sector utility and manufacturing players. The N-RIF is supplemented by individual investments made by Highlands and Islands Enterprise in the areas in which it operates.

2.2.5 Overcoming cost barriers to local ownership of energy

There is also the challenge to ensure that local communities do not face insurmountable costs challenges when considering developing their own renewable schemes.

We have already helped to mitigate risks for local ownership of energy through our CARES scheme, which is now supporting pre-planning costs with loans, and which are thus compatible with the Feed in Tariff and the Renewable Heat Incentive. But we recognise that this is solving only half the problem: many communities still face difficulties in gaining access to finance post-planning, particularly now that grant-funding is incompatible with access to the UK regulatory incentives above.

Thus we are committed to work with investors to establish a new Scottish Green Equity Fund to support the development of community projects. The first stage of this process will be to explore opportunities via the second Scottish Low Carbon Investment Conference which is taking place in September 2011.

2.2.6 Key opportunities

As set out above, Scotland needs to have access to UK funding opportunities to help us realise our full renewables potential, and the issues around Electricity Market Reform are set out at section 1.2. The advent of the Green Investment Bank (GIB) will also be an important step forward, and we are making a strong case for the GIB to be located in Edinburgh. Finally the issue of access to the Fossil Fuel Levy (FFL) without penalty to Scottish “Block” funding must be resolved in the interest of Scottish and UK renewables policy. At May 2011, the Scottish FFL account stood at over £201M: this is funding that, under statute, can not be spent on anything other than the promotion of renewables in Scotland, and it needs to be made available now.

2.3 Planning and Consents

2.3.1 The Challenge

Planning is a crosscutting 'challenge' across all of the different sectors identified in this Routemap. Electricity schemes below 50 MW and heat schemes of all scales fall to the planning system (except for certain microgeneration technologies which have Permitted Development Rights).

The planning challenge is to ensure that there is the right level of direction and support for renewables:

- at Government level in:
    - spatially co-ordinating planning effort on national priorities and targets
    - communicating national policy
    - providing proportionate guidance and advice
- at planning authority level in:
    - timeously providing spatial guidance for developers and/or policies to steer and stimulate the correct types of development activity in the most suitable locations
    - providing 'open door' pre-application services to encourage and guide development activity
    - providing efficient and effective development management process which deliver appropriate permissions within reasonable time frames

2.3.2 Existing planning framework

There is already firm support for growing renewables through Scotland's national planning policy which is set out in the National Planning Framework (NPF2) and Scottish Planning Policy (SPP).

NPF2 sets out a spatial strategy for Scotland's development to 2030 and core parts of the strategy relate to the realisation of the potential of Scotland's renewable energy resources.

SPP provides a statement of the Scottish Government's policy on nationally important land use matters and reaffirms that electricity generated from renewable sources is a vital part of the response to climate change. It encourages planning authorities to support the development of a diverse range of renewable energy technologies, guide development to appropriate locations and provide clarity on the issues that will be taken into account when specific proposals are assessed.

In relation to onshore wind, SPP requires planning authorities to support the development of wind farms in locations where the technology can operate efficiently and environmental and cumulative impacts can be satisfactorily addressed. The SPP

requires planning authorities to set out in the development plan a spatial framework for onshore wind farms of over 20 MW generating capacity and authorities may incorporate wind farms of less than 20 MW generating capacity in their spatial framework if considered appropriate.

Other technologies such as hydro, biomass, solar, energy from waste, landfill gas, offshore wind, wave and tidal are also encouraged through SPP, within the context of considering environmental and other constraints.

The Scottish Government is proactively engaged in enabling work on NRIP to secure the supply chain and appropriate infrastructure, in order to realise the full potential of offshore renewables, including wind, wave and tidal. This involves gearing up planning authorities in development planning, working with relevant interests on early survey and consenting, and ensuring effective development management processes.

Planning authorities are further supported by the Scottish Government in drafting Main Issues Reports, to ensure that they fully consider opportunities for renewables and consult early on these matters. The Scottish Government also supports planning authorities in developing fit for purpose Development Plans which encourage a diverse mix of renewables which make the most of locally available resources and guide developers to the correct locations.

Circulars and the recently launched online renewables advice offer further support for planning authorities in preparing main issue reports, development plans and installing efficient and effective DM processes.

Web based renewables planning advice was launched on the 14th February, 2011, and can be found on the Directorate for the Built Environment renewable energy policy pages:
http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables.

This comprises advice on a range of renewable energy technologies, improving planning authorities' awareness of different sectors, the dynamics that are influencing change within sectors, suggests areas of focus for planning authorities, it promotes opportunities for growing renewables and provides advice on best practice planning processes. Input is being invited to inform periodic review and refinement and the web based nature of the advice is designed to ensure that advice remains current and responsive.

Headline items in the Renewables Advice include:

- encouraging spatial planning for hydro and dovetailing planning and CAR processes for hydro applications
- greater emphasis on spatial planning for wind farms below 20 MW, as more development interest at this scale emerges
- heat strategies at local level linking woodfuel supply and waste streams to areas of high heat demand, based on heat mapping exercises

- gathering information to support emerging technologies such as deep geothermal and energy storage and ensuring that there is sufficient development plan land use allocations in planning authority areas.

2.3.3 Further planning activity

Ministers are also actively considering where there is a need for new planning advice, such renewable heat, carbon assessment, handling the relationship between offshore renewables and planning etc.

Further Scottish Gvoernment planning activity relates to the rollout of permitted development rights for domestic and non-domestic microgeneration in accordance with Section 70 and 71 of the Climate Change (Scotland) Act 2009. There is also a requirement under Section 3F of the Town and Country Planning (Scotland) Act 1997 (amended by the 2009 Act) to have development plan GHG emissions policies with the aim of promoting the installation of more low and zero carbon generating technologies in new buildings.

Delivering fit for purpose development plans and supplementary guidance for renewables, including spatial guidance, within suitable time frames is expected to be the most significant area of 'challenge', under 'planning', in generating greater numbers of renewables schemes, although further gains may be able to be achieved through time efficiency gains in development management processes or by suppressing / designing out planning constraints. It is likely that improving the 'front end' of planning will bring forward applications at the development management stage that are less contentious and have greater levels of support.

There will also be a number of 'technical' challenges in the coming months and years that will affect how many renewable energy development are deployed:-

- securing development plans that purposefully encourage a sufficiently diverse mix of renewables and provide adequate guidance on emerging technologies;
- dealing with onshore wind proposals on more difficult sites, closer to communities, on or near landscape and environmental sensitivities, on carbon rich soils etc;
- dealing with the cumulative impacts of renewables, especially onshore wind farms, in certain locations;
- securing spatial frameworks for wind above and below the 20 MW threshold together with effective spatial planning for other forms of renewables within useful time frames, when traditionally only some planning authorities have only been engaged in preparing spatial frameworks for wind over 20 MW;
- dealing with aviation / radar constraints as more wind farms are consented
- resourcing the rollout of heat mapping and dealing with the various interactions that affect the viability of heat networks,
- in preparing and resourcing planning authorities to deal with hydro applications up to 50 MW (previously only dealt with applications up to 1 MW)

- gearing up planning authorities to support NRIP, to effectively secure the supply chain benefits of renewables in Scotland, including working with relevant partners to identify land requirements and to bring about early consents around ports and harbours
- upskilling planners, particularly in dealing with the diverse technological mix of renewables, spatially planning for renewable heat, considering carbon assessment etc
- providing additional Government planning advice to support solutions in areas such as renewable heat, carbon assessment, relationship between offshore/onshore, etc.
- providing advice on development proposals within the inter-tidal zone, handling onshore elements of offshore proposals and dealing with onshore impacts of offshore wind, wave and tidal proposals
- considering new planning mechanisms to support the deployment of renewables, such as simplified planning zones, and monitoring the planning processes adopted by competitor countries in stimulating renewables

2.3.4 Consents and Deployment

In order to meet the 2020 target for 100% of electricity consumption from renewables, a further increase in consenting and deployment rates will be required, especially for offshore wind. This will be achieved by driving excellence in planning and consenting processes, improving advice and guidance, developing and promoting best practice, and supporting community involvement in development proposals.

The challenge will be to ensure this is achieved in balance with environmental and community issues. There remains a need to ensure that, as renewable penetration increases onshore in particular, environmental and land use considerations are not compromised.

The Scottish Government aims to increase the rate of deployment for renewables responsibly, by:

- Further streamlining the consenting process, and further emphasis on scoping, by promoting partnership working between developers and stakeholders leading to comprehensive pre-application engagement.
- Simplifying planning advice – the new online advice described in 2.3.2 above improves accessibility and consistency and is designed to evolve as issues and initiatives emerge.
- Resolving offshore consenting questions, e.g. uncertainty over regulatory route to consent and biodiversity issues.
- Overcoming barriers to deployment, particularly aviation/radar issues but also including all relevant environmental issues.

- Promoting community engagement in the design and siting of development proposals.
- Developing the agenda and advice on cumulative impact and environmental issues.
- Promoting community benefit – see 2.9.3, below – "Community benefits and ownership".
- Driving best practice – SG is leading the EU-funded Good Practice Wind project (GP Wind) which will record and share best practice for onshore and offshore wind development and deployment (see "GP Wind" below).

2.3.5 Improving the Quality of Energy Applications:

There will be a strong emphasis on pre-application engagement and the value of thorough scoping, aimed at generating better applications which travel more smoothly through the planning system and have more community support. This will minimise the need for further information (addenda to the application) and improve the likelihood of consent. This can be achieved by promoting, and requiring where necessary, partnership working with consultees and communities.

The consents unit will undertake to further gatecheck draft applications, in partnership with statutory consultees, to carry out a gap analysis aimed at identifying any areas where environmental information likely to be required is lacking.

2.3.6 Addressing Barriers to Deployment:

The Scottish Government will tackle barriers to deployment by engaging with stakeholders and promoting and investigating best practice, as follows:

- Continue engagement at UK level through the Aviation Management Board and Aviation Advisory Panel, including to promote the development of technical solutions.
- Chair and facilitate the SW Scotland Regional Aviation Solution Group.
- Finalise planning advice on the use of suspensive conditions for aviation issues in planning consents.
- Facilitate engagement and promote cooperation between developers, air navigation service providers and other aviation stakeholders.
- Continue engagement over the issue of deployment around the Eskdalemuir Seismological Monitoring Station, including working towards MoD acceptance of technological solutions, supporting required research and facilitating engagement between stakeholders.
- Lead the European GP Wind project, with a view to overcoming barriers presented by environmental and community issues through the development and promotion of good practice, see below.

2.3.7 GP Wind Project

The Scottish Government leads and manages this European Commission-funded project. Its objective is to share and record best practice in reconciling objectives on wind energy with wider environmental objectives and actively involving communities in planning and implementation.

GP WIND will develop a guide to good practice and a 'how to' toolkit, which will be used to facilitate deployment of renewable energy in support of the 2020 targets. Topics include:

- Reconciling environmental concerns with the benefits of wind farm development, in terms of energy needs, CO_2 reduction, and local social and economic benefits.
- Dealing with and understanding environmental impacts
- Development of planning policy and guidance
- Consenting processes, including interaction with stakeholders.
- Engagement with local communities in the identification, planning and ongoing management of wind farms, including the role of community investment.

2.4 Grid

2.4.1 Grid reinforcements

The electricity transmission network (the grid) in Scotland – as in the rest of the UK – is old and was designed for a different era of cheap power generated close to centres of demand. It is a fact that the best sources of renewable energy is found at the peripheries of the current network, and we face a real challenge in building a grid which will allow Scotland to harvest and export its vast resources of clean energy.

There are severe constraints on the grid in Scotland, and we welcome the implementation of the Connect and Manage scheme, which has seen many projects in Scotland connected to the grid in a much shorter timescale than under Ofgem's previous connections policy. However, we recognise that the need for grid reinforcement is greater than ever.

The Scottish Transmission System Owners (SSE and Scottish Power) are investing heavily in delivering the reinforcements we need, but it will take sustained effort from a range of parties – including the Scottish and UK Governments and the UK regulator, Ofgem – to allow this work to be completed in time for 2020, ensuring that the many renewable projects are not delayed by a lack of available grid connections.

The Scottish Government has worked with the Electricity Networks Strategy Group (ENSG) to identify those strategic developments in the grid that we will need to achieve our stringent 2020 renewable energy targets. We are working with a range of stakeholders across the UK, Europe, industry and academia to see that these projects are delivered on time.

2.4.2 Transmission charging

As a result of the strong locational pricing element in the charging methodology applied by Ofgem, generators in the North of Scotland have the highest charges in the UK (around £20.17 per Kilowatt Hour in the North of Scotland, compared to a subsidy of £5.87 per Kilowatt Hour in Cornwall).

Scotland has some of the best renewable energy resources in Europe, yet the locational charging approach to electricity generators results in Scotland facing the highest charges in the UK. This makes no sense.

Ofgem and National Grid believe locational charging gives signals about where to site new generation, and reflects the costs that generators cause. In practice it is a barrier to renewable energy generation in Scotland. It is not fit for purpose to deliver a more sustainable, low carbon energy mix, ensure security of energy supply and meet Scottish, UK and EU renewable energy targets.

In September 2010. Ofgem launched Project TransmiT, a review of the transmission charging system. Following a great deal of work, Ofgem has decided, in the short term, that Transmit will focus on options for change to TNUoS – instead of more

fundamental trading reforms - so that its original timescales for the project will be met, and a degree of certainty will be given to the industry. We welcome this approach, and hope that the changes that Ofgem will make to the charging system will result in a system which treats renewable generation in an equitable manner, and which is in line with the renewable goals of the Scottish and UK Governments.

2.4.3 Island links

The Scottish Government is determined that the proposed High Voltage Direct Current (HVDC) links to the Western and Northern Isles must go ahead – and within a timescale that will allow these areas to contribute their enormous potential resources towards our renewable energy targets.

The planned sub sea cable is a HVDC link capable of approx 450 MW to meet the requirements of proposed Wind Farms – and other renewable energy projects on the Western Isles. These cables are three of a number of key reinforcements in the Scottish grid network identified in the work of the ENSG. We consider it to be a crucial infrastructure development for growing the renewables sector in the Western and Northern Isles. In addition to supporting the renewable sector potential of the Western Isles, the cable links also have strong arguments from wider economic development and growth aspects as well as supporting the connection of remote and island communities across Scotland.

These resources – wind in Shetland, tidal in Orkney, and wind and wave in the Western Isles – must not be squandered. The Scottish Government will continue to work with the island councils and other interested parties to bring these island interconnectors to fruition.

2.4.4 Offshore connections

The Scottish Government vision is for Scotland to play its part in developing onshore and offshore grid connections to the rest of the UK and to European partners – to put in place the key building blocks to export energy from Scotland to national electricity grids in the UK and Europe.

We want Scotland to play its part in building a European supergrid to help meet Scottish, UK and EU renewable energy targets, address the challenges of climate change, and ensure security of future energy supply through greater interconnection.

Scotland's remarkable offshore wind and wave energy potential offers a major opportunity for Scotland to play a part. But the challenge in developing the grid connections to make this happen – and the costs of doing so - is significant.

There are a number of grid connections across Europe – existing and planned, eg UK - France, Scotland - Northern Ireland and Norway - Netherlands. These are evolving in a piecemeal way – responding to market demand in particular regions and with the development of wind farms.

Making the European Grid concept work will require a more strategic, co-ordinated and collaborative approach to developing interconnections between countries, regions and members states. Significant and sustained effort to work with EU countries and regions to standardise electricity transmission and energy regulation is necessary. The Scottish Government is working closely with UK and EU partners on this.

The period 2010-2018 will see significant activity to reinforce and develop these connections aimed at addressing some of the grid constraints within the GB system (ands between Scotland and England in particular) and at connecting both our onshore and offshore renewable generators.

The Scottish Government strongly supports the concept of an integrated European grid, incorporating offshore renewable generation. Scotland has remarkable potential, with an estimated offshore resource of 206 GW. This is of European significance, and its exploitation has been recognised as crucial to the ability of Scotland, the UK and the EU to meet their 2020 and 2050 carbon reduction targets. In his third annual report, published in December 2010, Georg Adamowitsch, the European Commission's North Sea grid co-ordinator, said that 'Scotland is a fine example of how different offshore technologies…..can be combined to form a coherent approach. To be able to use all these elements as part of a European sustainable energy policy, these Scottish renewables have to be connected to an integrated European grid.'

2.5 Fuel Sources

2.5.1 Bioenergy sustainability

It is essential that biomass feedstocks for energy, whether imported or domestic are sustainable.

Under the Renewables Obligation Scotland (ROS) the Scottish Government introduced mandatory sustainability criteria for solid biomass and biogas from April 2011. All generators above 50 kWe need to report against the greenhouse gas and land use sustainability criteria from April 2011. From April 2013, if generators above 1 MW do not achieve a carbon intensity of 285.12 $kgCO_2/MWh$ or lower they will not be eligible for ROCs. Waste, landfill gas and sewage gas will not need to meet or report against the sustainability criteria.

Eligibility for receipt of ROCs for electricity generated from bioliquids will be dependent upon generators demonstrating that the sustainability criteria have been met from 1 April 2011 (as required by the Renewable Energy Directive).

Heat installations with a capacity over 1 MWth will also be required to report against sustainability criteria, as set out in draft regulations for the Renewable Heat Incentive.

The introductions of these standards will help build public confidence in the sustainability of biomass feedstocks.

2.5.2 Energy from Waste

Generating energy from waste can avoid some of the competing uses and sustainability concerns which apply to virgin biomass feedstocks, but many other barriers, including public acceptability can apply. The recently published Zero Waste Plan sets out the Scottish Government's policy and ambition for EfW.

2.6 Skills

2.6.1 Skills for Scotland

As highlighted in the recent Scottish Parliamentary Debate on renewables (2nd June 2011), our ambitions for renewable energy in Scotland could provide employment opportunities across a broad spectrum of attainment. Our approach to skills for renewables should aim to provide opportunities for all.

The Scottish Government's refreshed skills strategy, *Skills for Scotland: Accelerating the Recovery and Increasing Sustainable Economic Growth,* published last October sets out a flexible, responsive, partnership approach to addressing Scotland's skills needs and improving economic performance. It outlines a vision for Scotland where, among other things, high skill, high productivity, healthy workplaces enable people to perform at their best. The strategy places a renewed focus on the skills challenges and opportunities across new and emerging sectors, particularly those offered in the low carbon economy. The Government's ambition is to deliver a skills system that is responsive to the future growth objectives of the key sectors (as set out in the Government's Economic Strategy) individually and collectively, addressing the demographic profiles within the current workforce and anticipating the future skills challenges which new technologies and business growth opportunities present.

2.6.2 Skills Investment Plan for Energy

Scotland has the resources and ambition to be a world leader in sustainable energy and to take full advantage of the opportunity we must continue to develop a highly skilled workforce. It is critical that we have the right people, with the right skills and expertise, deployed and utilised effectively to continue attracting our share of investment in energy for Scotland. The Skills Investment Plan for the Energy Sector, commissioned by the Energy Advisory Board and published in March 2011 by Skills Development Scotland, details the skills need for the key energy sectors to 2020. The Plan identifies the potential for up to 95,000 job opportunities to 2020 combining replacement demand to sustain more established energy sectors with new additional growth in emerging sectors. Of these, at least 40,000 opportunities are in the renewables sector. It also identifies key areas for action for further collaboration and development across the education and training sectors to ensure that not only our own people have the opportunity to take advantage of the employment opportunities that will arise, but also to offer a solid skills foundation supporting inward investment.

2.6.3 Employment opportunities analysis

Figure 4: Employment opportunities from Renewables as assessed under the Skills Investment Plan for the Energy Sector (SDS – March 2011)

Additional Demand	Opportunities to 2020	Notes
Renewables, offshore wind	Up to 28,000	The scale of opportunities is dependant on (a) the amount of capacity installed in Scottish waters and (b) the development of a robust Scottish offshore wind industry, servicing the local and global markets.
Renewables, marine	Up to 5,300	The uncertainty relates to the level of capacity deployed in Scottish waters. Covers direct employment only.
Renewables, commercial onshore wind	1,650+	Estimate derives by SQW from a number of sources. Covers direct employment only.
Renewable heat	1,350	Growth depends on the implementation of a robust UK renewable heat support mechanism. Covers direct employment only. Additional jobs are expected to arise in biomass fuel supply. More jobs could potentially be created if manufacturing capacity develops in Scotland.
Renewables, hydro power	Up to 1,400	Mostly small scale hydro (under 5 MW) Covers direct employment only.
Other microgeneration	~2,000	No authoritative, comprehensible microgeneration employment forecasts are available for Scotland. Jobs are likely to number in the low thousands, but difficult to be precise. Additional research is underway as part of the Energy Efficiency Action Plan. Covers direct employment only.

As noted in the Skills Investment Plan, the main skills requirements are widely recognised as engineers (especially civil, marine, engineering, structural and mechanical), leadership and management, project managers, welders, turbine technicians and divers. It also notes that the majority of jobs will be at technician level (SVQ Level 3, which can be supported through apprenticeship frameworks).

It is therefore forecast that the vast majority of demand will be filled by people already in the labour force. This will include people changing jobs (both from within and outside Scotland) and movement from unemployment into employment. To facilitate this movement a range of skills provision will be required which are focused around issues of transition. This need is likely to require: postgraduate courses and

individual modules; alongside technician-focussed college and private sector courses.

2.6.4 Uncertainties

In reviewing the current figures it is important to note that there is uncertainty around the figures and when employment opportunities may be realised owing to:

- The newness of much of the technology to be employed
- Financing and planning issues which always risk taking longer than expected
- The sensitivity of development to energy policy in Scotland and elsewhere which could change the development profile
- The sensitivity of employment projections to the culture and timing of a relatively small number of very large scale investment decisions
- The extent to which Scottish based employers further capitalise on the global market.

2.6.5 Existing provision and action

There is already significant investment from the public sector in skills provision for the energy sector including:

- Around 8,000 undergraduate entrants and 3,000 post graduates in related subjects;
- 25,000 to 30,000 college learners in similar subjects;
- A record 3,000 starts on engineering and energy related MAs each year over the last three years;
- The Low Carbon Skills Fund, developed by SDS with support from ESF that enables employers to up-skill and re-skill employees in low carbon technologies.
- A cluster of activity emerging around Tayside, Fife and Edinburgh colleges to support wind technologies, including the opening of the Whitlock Energy Collaboration Centre at Carnegie College and the launch of the MA wind turbine technician framework; and
- The award of £1.2m of Spirit funding by the SFC to Strathclyde University towards the development of the Scottish Energy Research Academy and its associated doctoral research programme.

Since its publication, the Energy Skills Investment Plan has been making an immediate impact on the skills and training provision across the energy and low carbon sectors.

- SDS and SFC have agreed to prioritise the energy sector when making future skills investment decisions;
- The college sector has agreed to adopt a more collaborative approach in responding to the needs of the sector. This approach will offer learners and industry a clear and easily understood route to training by creating specialist training hubs.
- Up to an additional £1m has been made available for SDS to create as many as 500 MAs in 2011/12 to specifically support Scotland's energy and low carbon industries.
- In late 2010 we commissioned the Alliance of Sector Skills Councils to undertake a piece of Energy Efficiency and Microgeneration Skills Research to allow us to develop a view on the implications for employment and skills that these areas present. This will enhance the evidence base for energy efficiency and microgeneration skills in Scotland.

2.6.6 Next Steps

Skills for the renewable energy sector will continue to be developed as part of the wider Energy Sector Skills needs. We will continue to work with key partners to take forward the key actions contained within the Energy Skills Investment Plan. Specific activity includes:

<u>- Increasing sector attractiveness to young people and job changers through:</u>

- Working with LTS, Scottish Renewables, STEM colleagues and SDS to produce short careers guidance leaflets
- Influencing the Curriculum for Excellence to include 'renewables' topics in STEM subjects
- Junior Green Energy Awards planned for June 2011
- SDS developing Energy Skills Gateway which will include a database for training provision to be linked to other employer portals
- Creating a 'national offering' of resources to support careers interest in renewables

<u>- Engaging with business to identify future skills need through:</u>

- Replacing the FREDS Skills Sub-group with an Employers Skills Council to govern the delivery and implementation of the Skills Investment Plan for the Energy Sector.
- Arranging with SDS Ministerial led Growth Sector conversation events with Industry
- Encouraging the adoption of the EU Skills workforce planning tool

- Developing training provision and infrastructure to meet future need through:

- Encouraging and supporting the college partnership process
- Increasing skills focus in Microgeneration
- Using output of the EU Skills workforce planning tool to inform training provision
- Monitoring for gaps in qualification provision

2.7 Supply Chain and Infrastructure

2.7.1 The Challenge

The Scottish economic development agencies will have to work hard to nurture and promote the supply chain and other economic benefits from the low carbon energy sector. The projects identified in the National Renewables Infrastructure Plan must be in place by 2020, and we will now require even greater investment in secondary infrastructure and business development to meet the new 100% renewable electricity target. This will have to be achieved while considering the effect of the potential external constraints such as steel availability and prices, and vessel availability.

Scotland's economic development agencies will have a key role to play.

The commitment to increase the development and deployment of renewable technologies across Scotland combined with the growing global market for renewables presents Scottish businesses across the full supply chain spectrum with significant market opportunities. Whilst there will be business growth prospects throughout the renewable spectrum, there are undoubtedly opportunities of scale within the offshore wind market, estimated at c.£7billion for Scottish projects alone (Offshore Wind Industry Group Routemap, 2010) and in wave and tidal markets *(see case study below on Pentland Firth and Orkney Waters).* Combined, these markets have the potential to lead to the re-industrialisation of Scotland.

Case study: Pentland Firth and Orkney Waters

During 2010 The Crown Estate announced development rights to eleven wave and tidal stream energy projects as part of the world's first commercial scale marine energy leasing programme. Developer intentions suggest a total capacity of 1,600 MW installed by 2020, and represent investment opportunities as follows:-

- £100 million on project development and consenting activities, to be incurred by 2015;
- £4 billion on device manufacturing, foundations, moorings, subsea cabling, offshore substations;
- £2 billion on installation costs
- Therefore a total capex in excess of £6 billion, with the majority being towards the latter half of this decade.
- O&M expenditure estimated at £100 million per annum

Such investment is dependent upon a range of significant challenges and dependent upon successful completion of each stage of the project development process, but nevertheless illustrates the potential scale of the opportunity.

Source: Wave and tidal energy in the Pentland Firth and Orkney Waters: How the projects could be built, A report commissioned by The Crown Estate and prepared by BVG Associates, May 2011

2.7.2 Enterprise Agencies' focus on offshore energy

The Enterprise Agencies and partners will progress supply chain development programmes with our indigenous companies with the relevant capabilities and competencies, supporting them to expand into renewable markets with tailored programmes of support including the Offshore Wind Expert Support Programme and through specific company investments. Whilst the aim will be to develop a supply chain capable of delivering projects around the UK, it will also be to replicate the success of the North Sea oil and gas industry where skills and expertise is exported worldwide and generating wealth throughout the country. We are still in the relatively early stages of developing the supply chain for the offshore sector, but building on a strong base from the North Sea oil and gas industry.

Notable examples of where Scotland's supply chain is already expanding into renewables include BiFab, based at Methil, Burntisland and Arnish, producing jacket foundations for the offshore wind market and manufacturing marine energy prototypes; Isleburn Ltd, part of the Global Energy Group, part of the team assembling and installing the Beatrice offshore wind prototype and manufacturing a range of full scale wave and tidal technology prototypes; and Technip and Subsea 7 establishing renewable divisions in Aberdeen.

Efforts to further mobilise the indigenous supply chain and to raise awareness of Scotland's expertise will include promotion of the Offshore Wind Portal and the Offshore Renewable Supply Chain Database, building upon the extensive capability mapping work already undertaken.

In conjunction with Invest Northern Ireland and Enterprise Ireland, Highlands and Islands Enterprise has submitted an Interreg IVA application for funding for a project centred around increasing the level of local content in future marine (wave and tidal) and offshore wind projects principally in the waters around Scotland and Ireland but also more widely around the UK. The Scottish Enterprise area is not eligible under this programme, but complementary activity is underway in this area to ensure that Scotland has a comprehensive offering to its existing supply chain.

HIE will apply learning from the development of indigenous supply chain collaborative networks in the Nuclear and Oil & Gas arenas to the offshore renewables sector. This will support companies to overcome barriers to market entry such as capability, capacity and scale/turnover, and facilitate effective engagement with offshore renewables project developers and top tier contractors.

2.7.3 Inward investment opportunity

The scale of proposed offshore developments will also necessitate major manufacturers to locate in Scotland to ensure projects develop in a timely and cost effective manner. Working with SDI we will work to secure inward investments that support the total supply chain and build upon recent successes including:-

- Doosan Power Systems – in March 2011 announced investment of £170m in Scottish wind power over the next 10 years, establishing a R&D centre near Glasgow creating 200 jobs;
- Gamesa – in Jan 2011 the Spanish company announced their intention to establish an offshore wind technology centre in Glasgow, with Dundee potentially benefiting from related manufacturing investment and the creation of 300 jobs;
- Mitsubishi Power Systems Europe Ltd – in December 2010 announced intention to invest in offshore wind turbine R&D facility in Edinburgh, likely to create 200 jobs;
- Wind Towers (Scotland) Ltd – joint venture between SSE and Marsh to take over the tower manufacturing facility at Machrihanish, safeguarding 80 jobs with the potential to create a further 40-50 over the next 3 years.

2.7.4 Onshore

Onshore renewables are projected to make a significant contribution to renewable energy targets before 2020. Recognising the opportunities for supply chain companies, HIE will fund a programme of activity through the area trade body, Energy North, to drive up the level of local content in onshore projects. Through the account management process, HIE will work with companies to overcome the challenges of supplying the renewable energy industry and build confidence in the supply chain.

2.7.5 Investment in infrastructure

Investment in key infrastructure developments will also be critical to ensure that there are suitable sites in strategic locations capable of serving the offshore sector. Through the National Renewable Infrastructure Plan (N-RIP) sites have been identified and promoted to the tier 1, 2 and 3 manufacturers and project developers, and plans are being progressed for investment at a number of the more favoured locations. The £70m National Renewable Infrastructure Fund (N-RIF) augmented by specific investments in the Highlands and Islands, aims to lever considerable private sector investment in to key facilities where there is strong market interest. The Enterprise Agencies have prioritised investment in this area, recognising they key role that the right infrastructure will play in securing lasting economic benefit from the renewable opportunity.

2.8 Innovation and R&D

2.8.1 The Challenge

Innovation and research and development within the renewables industry are essential to drive down capital and operational costs, increase adoption, and reduce risk and uncertainty. Across the offshore renewables sector in particular there is a common set of technology-based solutions required to enable the successful realisation of huge economic potential, e.g. in relation to offshore design and fabrication, installation, health and safety, operation and maintenance in a marine environment. Key challenges to be addressed include the need for commercial deployment of existing technologies, to reduce capital and operating costs and to develop and demonstrate the technical viability of new devices and systems i.e. their performance, reliability, deployment, maintenance and de-commissioning in a marine environment. Innovation is also required however in functions, logistics, business models and processes.

Innovation therefore needs to be embedded at the heart of the industry, and the appropriate policy measures and support infrastructure implemented to ensure barriers to innovation are minimised and overcome. This requires a co-ordinated, integrated and sustained effort from both public and private sector.

2.8.2 Scotland's strengths in innovation and R&D

Scotland has a number of strengths which can be capitalised upon to support a focused approach to innovation and R&D within renewables:

- Major global utilities, such as SSE, Scottish Power, EoN and Npower with both a track record and commitment to the Renewables sector.
- Leading marine energy device developers such as Voith Wavegen, Pelamis, Aquamarine Power Ltd, and EMEC, the world leading wave and tidal test centre.
- Independent project developers specialising in the offshore wind opportunity, namely Mainstream Renewables and SeaEnergy.
- Fabrication companies such as Neptune Deeptech, and Isleburn Ltd have recent experience of manufacturing full-scale prototypes of several marine energy devices while BurntIsland Fabrications Ltd (BiFab) are manufacturing offshore wind jackets as well as marine devices
- Numerous SMEs active in offshore wind and marine energy, bringing forward novel, potentially world-beating, technologies e,g NGenTec
- UK universities are world-leading in research into offshore renewables. The UK's SuperGen Marine Energy Research consortium is led by the University of Edinburgh and includes the University of Strathclyde, University of the Highlands and Islands (through the Environmental Research Institute in Thurso), Heriot-Watt University, The Robert Gordon University and several

other UK universities. Similar strengths exist in offshore wind R&D e.g. University of Strathclyde.

- Recent announcements by e.g. Doosan Power Systems, Gamesa and University of Strathclyde of significant investment in R&D in Glasgow highlight that the city is emerging as a global centre for R&D in offshore wind.
- Scotland has extensive test and demonstration facilities to support the development and commercial deployment of wind energy and an emerging supply industry.
- Oil & Gas industry with decades of experience in offshore construction, installation and operation and transferable skills and expertise in many areas.
- Strong government support

2.8.3 Recent key developments

Key achievements in renewables over the past four years are listed at Section 1.1.7, and many of these will support innovation and R&D - including the launch of the WATERS fund, the Saltire Prize, marine leasing round, SEGEC, and the ETP.

In addition there have been the following key developments in innovation and R&D:

- The announcement by TSB of the establishment of an **Offshore Energy Technology Innovation Centre.**
- **ITREZ (the International Technology Renewables Energy Zone)** will be established in Glasgow with over £100M of investment which is aimed at establishing Scotland as an international centre for research, design and development in offshore renewables
- The **Scottish Energy Laboratory (SEL)** will enable organisations to identify appropriate R&D and test facilities within key energy sectors in support of product development and commercialisation.
- £10m **Advanced Forming Research Centre**, opened in 2010 to support the development of large offshore wind structures and turbines has attracted interest and funding from global companies.
- The **Power Networks Demonstration Centre** – the first of its kind in Europe- has been created by the University of Strathclyde and leading energy companies and will play a key role in increasing the UK electricity grids efficiency and reliability as well as testing next generation of smart electrical technologies.
- The proposed £40m **European Offshore Wind Deployment Centre** in Aberdeen will provide 12 grid connected demonstration and test pods is also attracting interest from major turbine manufacturers.
- The development of nursery sites at the **European Marine Energy Centre** (EMEC) in Orkney, to complement the existing full scale sites already in

place, further reflecting industry needs and further positioning EMEC's leading role in the development of the sector.

Case Study - Innovation opportunities in Offshore Wind

Technology and market foresighting carried out by Scottish Enterprise (and validated by work by other agencies including the Carbon Trust and others) has highlighted opportunities which have potential to address the challenges highlighted above, through the application of innovation.

In total these opportunities, if all were successfully implemented, could cut the cost of offshore wind by nearly 50% and would be sufficient to offset expected cuts in UK Government support for offshore wind projects in 2014 and in the longer term bring costs down to parity with current onshore wind costs.

Innovation opportunities identified by this Foresighting touch on nearly all parts of an offshore wind project and a significant portion (covering 61% of total project costs) are in areas where it is considered innovation would provide Scottish firms with a good way of winning more value from a project.

Top ten identified opportunities

- Next generation turbine designs
- Support structures
- Operating and maintenance strategies
- Novel drive train technology
- Deepwater installation vessels
- Next generation blade technology
- Personnel access for challenging offshore sites
- Condition based monitoring
- Wind farm array management
- Innovative turbine maintenance methods

2.8.4 Priorities going forward

There is a need to continue to prioritise and focus on research & funding activities across the sector. Building on work to identify innovation priorities, such as the offshore wind foresighting highlighted above, R&D and innovation priorities will be developed and shared with partner organisations to develop a clear and focused agenda for R&D and innovation across renewables. These priorities need to be communicated to academia, potential technology developers and supply chain to ensure innovation activity is focussed and targeted in areas where the impact can be realised in lower deployment and operational costs.

Current funding mechanisms will be reviewed to assess their alignment against these agreed priorities and discussions will be held with key funders such as Carbon Trust, Energy Technology Partnership and the Technology Strategy Board to encourage greater alignment of funding priorities. This will also include maximising European funding opportunities through SEGEC. Consideration will be given to the development of further targeted support mechanisms.

The Enterprise Agencies will continue to build upon initiatives such as WATERS, Scottish Energy Laboratory and ETP to strengthen the links between the research base and industry through the development of effective collaboration and knowledge flows.

The Enterprise Agencies will also continue to support the effective implementation of the many significant initiatives such as ITREZ and the Offshore Energy Technology Innovation Centre highlighted above to maximise their impact across the Scottish renewables industry.

We will also continue to examine the research and technology landscape for the emergence of new and/or disruptive technologies and assess their impact upon the sector.

2.9 Public Engagement

2.9.1 Low Carbon Scotland Public Engagement Strategy

A low carbon society is one that uses less energy and fewer resources through greater energy efficiency, which can also mean reduced costs for households and businesses. It is one where the energy we do use increasingly comes from renewable sources such as wind, water, wave and solar power that produce fewer carbon emissions. It is a society that is ready and able to realise the economic opportunities that come from developing new technologies, creating new low carbon manufacturing industries and reshaping Scotland's infrastructure and creating thousands of jobs. It is a society that provides opportunities for healthier, more sustainable lifestyles.

Our Low Carbon Scotland Public Engagement Strategy highlights the ways in which we are seeking to meet the obligations in the Climate Change (Scotland) Act 2009 to inform people in Scotland about the climate change targets specified by the Act, encourage them to contribute to the achievement of those targets, and identify actions people in Scotland may take to contribute to the achievement of those targets. Our goal is to engage with a wide range of audiences on why Scotland can benefit from becoming a low carbon society, and the opportunities it can bring for jobs, skills, and quality of life.

2.9.2 The role for developers

Public engagement is also a crucial aspect for responsible and forward-thinking private sector developers of renewables. Involving communities at the earliest possible stage in the design and siting of developments will garner support and acceptance and improve the likelihood of consent. It will also reduce the chances of further information being required in support of an application which can lead to the requirement for further consultation and delays in the planning process. Community buy-in further reduces resistance to development and the chances of issues arising during and after construction.

2.9.3 Community benefits and ownership

While full details on this area can be found in the Routemap for community energy at Section 3.9, it is worth highlighting here that community benefits and scope for local ownership of energy are key elements of public engagement in renewables, helping to change cultural attitudes to renewables as well as to generate local revenue as part of the green low carbon economy.

The Scottish Government is committed to ensure that community benefits from renewables are maximised, including from commercial developments. We are already acting as an exemplar in this regard in terms of the renewables developed on the public estate. We have also consulted (in Securing the Benefits) on other options to increase benefits, including setting up a register of community benefits

from commercial schemes and looking at the scope within the planning system to provide greater consistency. We will be following up this consultation shortly.

Case Study - Engaging with our young people and their communities

Highlands and Islands Enterprise recognises the need to raise public awareness of renewable energy and the opportunities it presents. HIE has organised various public education awareness raising activities over the last five years, and continues to run education programmes aimed at our young people in primary and secondary schools who will be required to service the industry, make policy decisions and at the most basic level make decisions about their energy use.

By the end of this year, every primary school in the Highlands and Islands will have a renewable energy toolkit and will have received CPD training in how to deliver renewable energy lessons in the classroom using the kit. The toolkit is aimed at primary 6 and 7 teachers and pupils and contains a range of activities, factsheets, games and gadgets to bring the subject to life in the classroom. All the different renewable energy technologies are covered using specially designed cartoon characters.

The Big Green Challenge debating competition is aimed at S1-S3 pupils to raise awareness of the opportunities and challenges surrounding renewable energy development. In order to ensure the successful growth of the sector we need our young people to be considering careers in renewable energy.

HIE has worked closely with teachers to ensure that both programmes fit with the Curriculum for Excellence. Targeting pupils in P6-P7 and S1-S3 ensures that they are able to consider a career in energy before they select their subjects.

3. Sectoral Routemaps

3.1 Offshore Wind

Ambition and Targets

With 25% of Europe's offshore wind potential, the manufacturing, supply chain, job creation and training opportunities present Scotland with huge scope for sustainable economic growth.

Scotland's Offshore Wind Route Map, published by the Offshore Wind Industry Group (OWIG) (http://www.scotland.gov.uk/Publications/2010/09/28115850/0) in September 2010, illustrates and examines these opportunities in detail, as well as the challenges that exist.

Current Deployment

There are currently two offshore wind sites within Scottish Territorial Waters:

- the Beatrice wind turbine demonstrator project in the Moray Firth – two 5 MW turbines, funded in part by a Scottish Government grant; and
- Robin Rigg, an 180 MW development in the Solway Firth.

Planned Deployment

Following the award by The Crown Estate of "exclusivity agreements" to developers in a number of areas within Scottish territorial waters (up to 12 nautical miles from shore), the Scottish Government published **Blue Seas - Green Energy A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters** (http://www.scotland.gov.uk/Publications/2011/03/18141232/0) in March 2011. The Plan identifies the following 6 areas as possessing favourable conditions for the development of offshore wind, with the potential to deliver almost 5 GW of electricity generation capacity:

- Islay;
- Argyll Array;
- Beatrice;
- Inch Cape;
- Neart na Gaoithe; and
- Forth Array

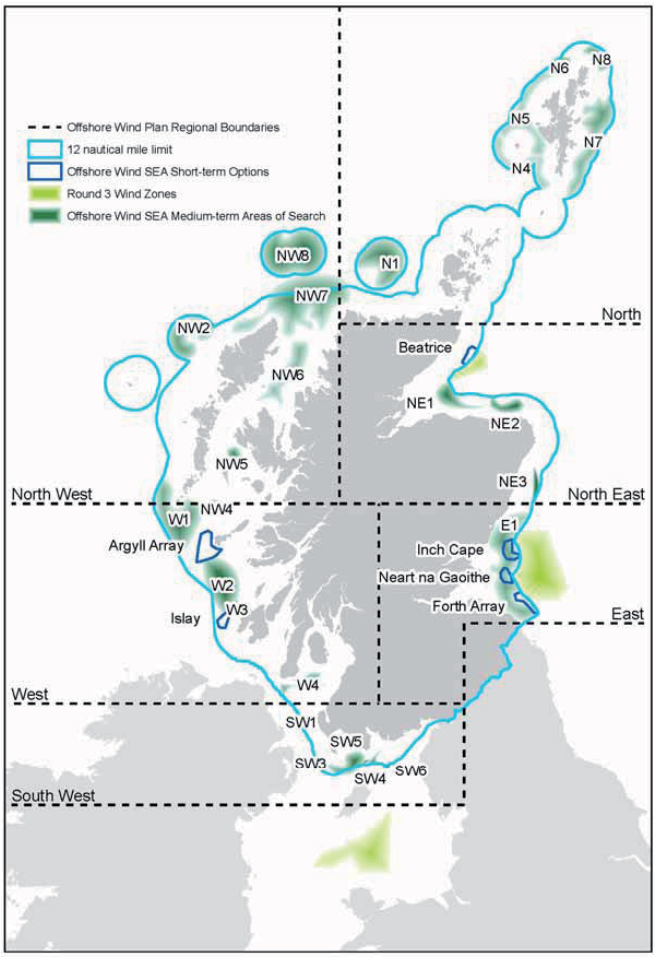
The conclusion of this process now permits The Crown Estate to enter into *Agreement for Lease* with the developers involved in these sites, giving those developers the ability to prepare and submit their consent applications to Marine Scotland. The Sectoral Marine Plan for Offshore Wind forms a material consideration to the consenting process for offshore wind projects in Scotland.

Two leases have also been awarded by The Crown Estate for sites in the Moray Firth and Firth of Forth, beyond 12 nautical miles. These amount to a further 4.8 GW, giving a combined total potential of approximately 10 GW of electricity.

Deployment Potential

The Sectoral Marine Plan identifies a further 25 areas for further exploration in Scottish Territorial Waters. The Scottish Government has held initial discussions with The Crown Estate to gauge the level of interest in further leasing round opportunities.

This process will be carried out using an approach which takes developers' ambitions fully into account but which is also consistent with the results and conclusions of the recent Plan and public consultations.



Short-term sites and Medium Term Areas of Search.

Successes to Date

We are still in the early stages of developing an offshore wind industry and capacity. However, the combination of our huge offshore renewables potential (estimated at 206 GW), supportive market mechanism (the Renewables Obligation) and our

commitment to continue developing the necessary infrastructure has led 3 of the world's leading turbine manufacturers to announce an intention to locate here:

- **Doosan Power Systems** – in March 2011 announced investment of £170m in Scottish wind power over the next 10 years. An R&D centre will be set up near Glasgow, creating 200 jobs, following which the company is looking to establish a manufacturing and assembly facility in Scotland. Doosan expects its offshore wind plans in Scotland to create up to 1,700 new jobs.
- **Gamesa** – in Jan 2011 the Spanish company announced their intention to establish an offshore wind technology centre in Glasgow. Dundee could also benefit from related plans to establish a manufacturing and maintenance base in the city. This could represent a further investment of £42 million in Scotland and the creation of 300 jobs.
- **Mitsubishi Power Systems Europe Ltd** – in December 2010, Mitsubishi announced intention to invest in an engineering facility in Edinburgh to carry out R&D into offshore wind turbine technology. Their presence in Scotland is likely to create up to 200 jobs over the next 5 years and lever up to £100 million investment into the economy.

We also have indigenous companies diversifying successfully and entering the offshore wind supply chain – notably **BiFab** from their bases in Fife.

Challenges to Deployment

	OFFSHORE WIND CHALLENGE
The cost of renewables	Only one proven turbine currently on the market. Essential that other original equipment manufacturers (OEMs) bring tried & tested alternative turbines to the market to create competition. Market mechanisms must continue to drive investment – Electricity Market Reform (EMR) outcome critical for further development of sector.

Planning and regulation	Need to maintain the work undertaken thus far by Marine Scotland on streamlining the planning and consent process for marine renewables, and related efforts to establish a pragmatic approach to observing environmental effects (through 'survey, deploy and monitor' framework). Planning advice needed on development proposals within inter-tidal zone, handling onshore elements of offshore proposals, dealing with onshore impacts of offshore wind proposals. Continued support from The Crown Estate in respect of further leasing rounds. Imperative to continue a research programme on the interactions between offshore wind developments and the natural environment to ensure the planning and consenting processes are fully informed.
Secure grid access	Lack of grid access in areas of high resource still an issue. Sector and stakeholders can overcome some of these issues by working in partnership, but key influence in this area lies in outcome to Project TransmiT and a more sensible approach to grid investment and charging issues.
Skills	SDS's Energy Skills Investment Plan identifies the route to providing the skills required. Repriorisation of the college and university sectors has ensured that the necessary courses are available
Supply chain development	Critical that supply chain development keeps pace with and enables marine renewables deployment, and that Scottish businesses are in position to support and benefit from this sector and its huge potential. Key role for Government and development agencies in taking forward the National Renewables Infrastructure Plan (NRIP) and advising and connecting relevant companies with the opportunities that exist – from device and foundation design, manufacture and installation to electrical design and cabling provision / installation.
Innovation / R & D	Ongoing need for technology support. Key issues need to be addressed – reliability, survivability, installlation techniques, anchoring. Requirement for both on and offshore test & demo sites to be identified.
Public Engagement	Ensuring Scotland's communities are engaged with the process. Ensuring developments consider public and community views.

Key Actions

- **Market incentives** – the relative stability for renewables investors created by the Renewables Obligation (RO) has been affected by the UK Government's Electricity Market Reform consultation which proposes that the RO should be replaced from 2017. This process must maintain an appropriate and effective level of support, and a system which is capable of continuing to support offshore wind development in a way which will grow an industry here and help meet the Scottish Government's ambitious targets. **Action – Scottish Government to maintain the appropriate level of market support for offshore wind, both through the RO and its possible replacement.**
- **Invest in infrastructure – ** offshore wind deployment needs the right infrastructure from which projects and turbines can be manufactured, launched and serviced. Scotland's £70 million National Renewables Infrastructure Fund (NRIF) is designed to help address this issue, and to leverage considerable private sector investment into key facilities. **Action – continued focus by Government and development agencies on using NRIF to deliver and attract appropriate infrastructure investment**
- **Support for innovation – ** there is still genuine scope to reduce the costs of offshore wind development, developers estimate by approximately 30%. Achieving these reductions will lessen the risk attached to project development and investment, aiding the delivery of the proposed developments across Scotland by 2020. **Action – the Scottish Government's continued support for initiatives such as the Carbon Trust's technology accelerator programme can help stimulate greater confidence in the technologies and attracting private investment.**
- **Grid** – the grid transmission charging and underwriting issues identified above must be tackled effectively through project TransmiT. The existing charging regime is a barrier to development; its satisfactory and timely resolution will play a vital role in developing the sector. **Action – Scottish Government to continue arguing strongly for a positive outcome on grid regulation and charging issues**.

Supporting Actions

- Marine Scotland to maintain its focus on the simplification and streamlining of offshore planning, monitoring and determination of consent applications.
- Link to wider focus on regulation and management of Crown Estate and seabed in Scottish waters.
- Implementation of SDS's Skills Investment Plan
- Repriorisation of the college and university sectors has ensured that the necessary courses are available
- SE & HIE to engage and stimulate supply chain to the opportunity
- EU SET Plan inclusion – key to unlocking further resource and support for the sector.
- JIP project – in conjunction with SE/TSB
- Continued support for CT's offshore wind accelerator

3.2 Onshore Wind

Ambition and Targets

The Government is committed to the continued expansion of portfolio of onshore wind farms to help meet renewables targets, with a robust planning system providing spatial guidance, a clear policy framework and together with a timely and efficient processing of Section 36 Electricity Act and planning applications.

Our ambition is that by 2020, onshore wind developments ranging from small and community-scale to large power utility scale maximise engagement with communities; contribute electricity to renewables targets; and, through displacement of fossil fuel generation, help to reduce fossil fuel consumption.

Onshore wind is a mature and relatively low cost renewable technology with a large supply chain already established. It is capable of being deployed at a high rate. Onshore wind turbines can make a very large contribution to the progress to Scotland's renewable electricity target, and help establish Scotland's reputation as rapidly becoming the green powerhouse of Europe thanks to its underlying political commitment to make it happen. This could be crucial to attracting investment to Scotland for the other emerging technologies with their associated potential for job creation and economic benefit.

Onshore wind also presents a prime opportunity for communities and the rural sector to generate local revenue and sustain local economies, and could be a key contributor to the target for 500 MW of renewables in community ownership by 2020.

Scotland's onshore wind resource has given favourable load factors to generation from wind, in line with the UK mean load factor and better than other more extensive adopters of onshore wind in Europe such as Germany and Denmark. The most recent load factor published in official statistics is 27.2% for 2009. However, even annual load factors can fluctuate considerably from year to year depending on the weather.

Current Deployment

- 2.4 GW / 1367 turbines / 117 sites installed and operating.
- 1 GW / 450 turbines / 20 sites under construction.

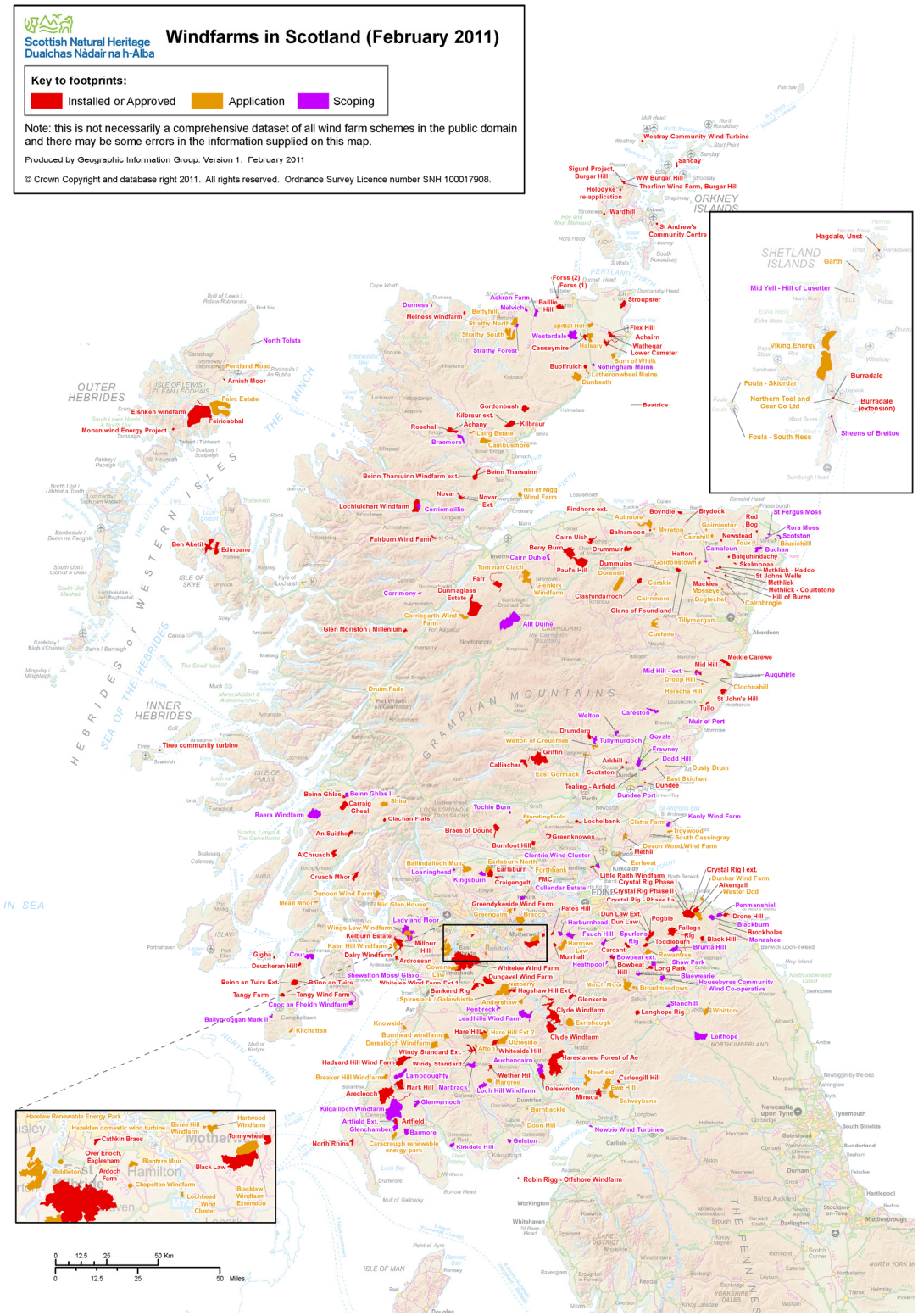
Planned Deployment

- 2 GW / 755 turbines / 76 sites consented and ready to be deployed if developer proceeds.

Deployment Potential

- 3.5 GW / 1445 turbines / 100 sites awaiting planning determination.
- 3.9 GW / 1628 turbines / 94 sites have requested pre-application scoping opinion.

Development Sites



Successes to Date

- **Requiring that proposals demonstrate carbon saving potential:** to ensure that any wind farms which get built provide real carbon savings as well as renewable electricity, we have published **Calculating carbon savings from wind farms on Scottish peat lands - A New Approach** (http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/17852-1/CSavings) and updated it in June 2011. We will make use of this to provide a calculation of carbon payback time a requirement in all onshore wind farm planning consent applications to Scottish Ministers which are sited on peat lands as a means to influence design to optimise the benefit of schemes.
- **Removing barriers to community ownership:** through the launch of the Community And Renewable Energy Scheme (CARES) loan fund, discussed further in the Community section of this document.
- **Streamlining the planning system:** consolidating the various documents which previously formed the Scottish Planning Policy into a single document. Planning advice on a range of renewable energy technologies launched as an online resource, giving greater scope to keep pace with the frequent changes in the renewables sector, particularly in terms of new technologies, innovations, new national policy initiatives, targets, incentives and planning practice.
- **Streamlining the Section 36 energy consents process:** Introducing 9 month target for determination of Section 36 Consents applications which clear early gate-checking and provision of associated guidance to developers on the requirements of a good application.
- **Requiring leading-edge community benefit from wind farms on the National Forest Estate** – FCS has streamlined its procedures for leasing land for renewable energy development including a mandatory requirement that communities receive a payment of at least £5,000 per megawatt of installed capacity per annum from the developer.
- **Leading the way on best practice in Europe:** Scotland is leading the co-ordination of the ambitious GP Wind project from 8 European countries. This project will address barriers to the deployment of onshore and offshore wind generation, specifically by developing good practice in reconciling objectives on renewable energy with wider environmental objectives and actively involving communities in planning and implementation.
- **Guidance on Siting and Designing Wind Farms in the Landscape** has been published by SNH, aimed at planners and developers to promote best practice.
- **Making Progress on Removing Aviation Barriers:**
  - Blackcraig Hill and Blacklaw Extensions consented, both having overcome aviation objections.
  - Agreement in principle between developers and Prestwick Airport on financing of new radar.

- Joint flight trials underway to confirm theoretical mitigations for numerous developments.
- SG consultation on planning advice for the determination of wind farm applications with aviation issues and use of suspensive conditions now complete and advice to be finalised by June 2011.

Challenges to Deployment

	ONSHORE WIND CHALLENGE
The cost of renewables	The uncertainty about future support for onshore wind caused by the wide ranging review of the electricity markets by the UK Government has the potential to hold back investment decisions as the industry loses confidence in the longevity and level of support. What the UK Government does could have profound implications for the development of onshore wind in Scotland.
Secure grid access	Lack of grid access in areas of high resource still an issue. Sector and stakeholders can overcome some of these issues by working in partnership, but key challenge in this area lies in the timescale for grid upgrades and refining the approach to grid investment and charging issues.
Public Engagement	Public acceptance issue around environmental impacts and benefits for local communities. Related issue around extent of genuine community engagement and benefit from onshore wind farms.

Key Actions

To ensure the momentum of onshore wind deployment is kept, a key action will be to provide the right kind of financial support alongside a supportive planning system which provides clear spatial and policy direction, continues to engage local communities, and balances the need to protect the environment alongside the need to continue to make progress to renewable electricity targets:

- **Market incentives** – Support for large onshore wind farms is given by the Renewables Obligation, which is banded to give different levels of support according to what has been deemed necessary to encourage the range of renewables technologies. The Feed-In Tariff provides support for smaller wind farms up to 5 MW in capacity. The Electricity Market Reform proposals from the UK Government introduce uncertainty for investors in predicting what the revenues of their proposals might be. These reviews and proposals **must** combine to deliver a coherent and effective level of support. **Action – Scottish Government to maintain its effective market support for onshore wind, both through the RO and its possible replacement.**
- **Grid** – the grid transmission charging and underwriting issues identified above must be tackled effectively through project TransmiT. The existing charging regime is a barrier to development; its satisfactory and timely resolution will play a vital role in developing the sector. **Action – Scottish Government to continue arguing strongly for a positive outcome on grid regulation and charging issues.**
- **Planning** – The planning system must continue to balance environmental sensitivities with the need to make progress on renewables targets, and support planning authorities in maximising opportunities.. Planning Authorities should also be encouraged to complete the spatial frameworks required by Scottish Planning Policy, deliver development plans which clearly set out the spatial and policy context for renewables and implement development management procedures that allow for appropriately designed and sited onshore wind proposals to emerge. **Action – Scottish Government to continue encouraging planning authorities to meet the requirement to produce spatial frameworks, to look for solutions in technical challenges around aviation, noise, proximity to communities, cumulative impacts in the landscape and to encourage best practice through the GP Wind project when complete.**
- **Community Engagement** – this should take place from an early stage so that communities are fully aware of what is proposed and the benefits that could be provided. **Action – Scottish Government to consider responses to "Securing the Benefits"consultation.**
- **Eskdalemuir** – work continues between SG, DECC, MoD and developers to verify technology which can combat the noise and vibration emissions from wind turbines affecting the Seismic Array, and enable more turbines to be built near it. There is agreement from industry (subject to further consideration) to undertake a baseline study examining the issue as well as the potential for technological solutions. **Action – Scottish Government to chair a new working group** (after Newfield public inquiry)

3.3 Wave and Tidal Energy

Scotland's wave and tidal energy resource is almost unparalleled, representing a quarter of Europe's tidal stream and 10% of its wave energy potential.

The wave and tidal energy sector is still at an early stage; however, it has made remarkable progress over the past 3 years. Wave testing started in Orkney in 2004 and tidal in 2007, and all EMEC's berths are scheduled to be full by 2012, and further demand is strong for the newly developed nursery sites. There are also firm plans in place for pre-commercial and commercial arrays of wave and tidal machines from 2014 through to 2020. Much of the scale-up activity will take place within the Pentland Firth and Orkney Waters Strategic Area following on from the award of commercial leases in the area. These leases, the first of their kind in the world, amount to 1.6 GW of potential capacity which could be built out by 2020.

These technologies can make a huge contribution to Scotland's longer term renewable energy and carbon reduction targets. Reducing costs will be absolutely crucial in terms of helping the sector become commercially competitive; this heightens the importance attached to the learning effects that will be a product of the prototype and pre-commercial plans referred to above. This means that the next few years will be crucial for this sector, and why it is so important that all stakeholders continue working together to tackle the issues which can affect its progress. By doing so successfully, we can help build momentum and continue to attract investment to this hugely promising sector.

Current Deployment

The following devices are currently deployed and operating in Scotland:

- Voith Wavegen's 500 kW Limpet on Islay is currently in its 11th year of successful operation.
- Pelamis P2 750 kW machine (commissioned by EON) deployed at the European Marine Energy Centre (EMEC) in Orkney
- Open Hydro 250 kW tidal turbine deployed at EMEC
- Tidal Generation Ltd 500 kW turbine deployed at EMEC
- Atlantis 1 MW tidal turbine deployed at EMEC
- Scotrenewables 250 kW tidal generator deployed at EMEC

Planned Deployment

The following devices are scheduled for deployment in summer 2011:

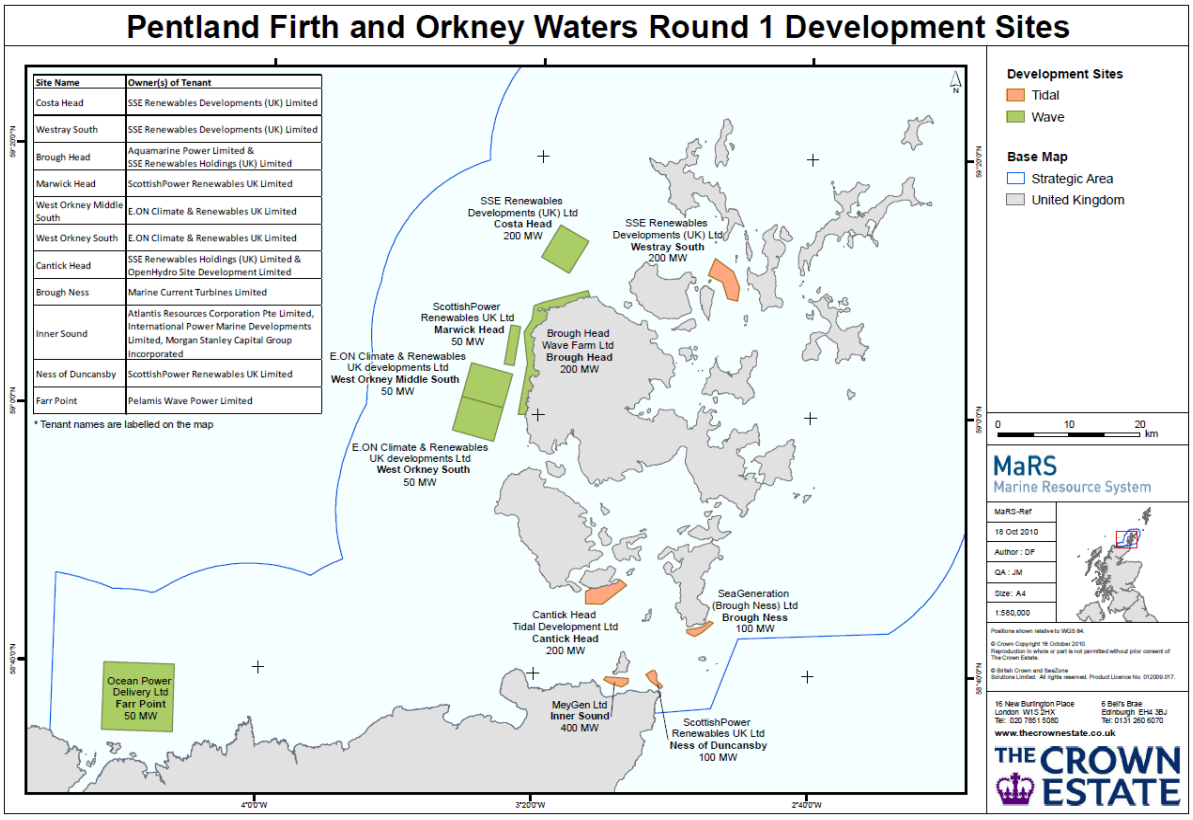
- Aquamarine Power's Oyster 2 wave energy hydro converter is due to be installed at EMEC in June/July 2011 (following on from successful deployment of Oyster 1 prototype during 2009/2010) – initially 800 kW, but building to 2.4 MW over 12 months.

- Voith installing 1 MW tidal turbine at EMEC in July 2011.
- Wello Oy installing 750 kW wave energy converter at EMEC in July 2011.
- Pelamis P2 750 kW machine (commissioned by Scottish Power Renewables) installing at EMEC in June 2011.
- Hammerfest Strom 1 MW tidal generator deploying at EMEC in Autumn 2011.

Deployment Potential

The Pentland Firth and Orkney Waters strategic area is where the majority of planned marine renewables deployment over the next decade will take place. The map below shows the 11 development sites leased by The Crown Estate in 2010. There are different forecasts as to what can be practically delivered in these waters by 2020, ranging from several hundred MW to 1 GW.

Recent work commissioned for the Pentland Firth and Orkney Waters Delivery Group demonstrates that while the deployment of the full 1.6 GW by 2020 is theoretically achievable, any deployment on this kind of scale will depend upon project developers and other stakeholders addressing a range of technical, economic, environmental and planning issues; these are set out in the sections below.



We also expect projects to go ahead in other areas around Scotland. For example, Scottish Power Renewables, in partnership with Hammerfest Strom, secured consent in March 2011 for a 10 MW tidal array. Meanwhile, the Crown Estate has

embarked on a rolling programme of further leasing activity aimed at supporting entrants for the Scottish Government's £10m Saltire Prize.

Marine Scotland will be taking forward development of a Sectoral Marine Plan for Marine Renewables in Scotland's Renewable Energy Zone during 2011. The Sectoral Marine Plan will guide development of marine renewable energy by identifying potential Plan options for development. The Final Plan will form a material consideration to the consenting process for wave and tidal energy projects in Scotland.

Successes to Date

- The commercial lease awards totalling 1.6 GW in the Pentland Firth and Orkney Waters, as set out above;.
- The award of £13 million to 5 projects through the WATERS fund to support technology development and deployment – which, when added to the earlier WATES scheme and our investment at EMEC, took Scottish Government support for the sector to more than £30 million over the last decade;
- The granting of consent by the Scottish Government for Scottish Power Renewables and Hammerfest Strom's 10 MW tidal project near Islay – the largest of its kind in the world;
- The coming together of industrial and utility investors with technology developers to develop and advance particular technologies and projects, both in the PFOW strategic zone and in other areas;
- The continued strengthening and growth at EMEC, reflected in the pipeline of full-scale prototypes to be deployed there during the coming year and the recent completion of nursery test facilities;
- The inclusion of 4 marine renewables projects as part of the UK's application for funding to the European Investment Bank for consideration under the New Entrants Reserve mechanism;
- Marine Scotland's progress on developing a marine spatial plan process which will underpin the consenting process;
- The development of a National Renewables Infrastructure Plan, a strategic approach to the development of offshore renewables infrastructure to support manufacturing, construction and deployment;
- Three confirmed applicants for the Scottish Government's £10 million Saltire Prize.
- The establishment of key partnership structures to support the successful deployment of commercial arrays, and maximise their regional and Scottish economic impacts.

Case Study – Aquamarine Power Limited (APL)

Aquamarine Power Ltd (APL) was established in 2005 to bring its Oyster wave power technology to the commercial market. The company has grown rapidly and continues to expand, now employing over 60 staff. The Oyster technology captures energy in nearshore waves and converts it into clean sustainable electricity. Essentially Oyster is a wave-powered pump which pushes high pressure water to drive an onshore hydro-electric turbine. In 2009 the 315 kW Oyster 1 was successfully installed at the European Marine Energy Centre (EMEC) in Orkney – this has operated successfully over a sustained period. The next generation Oyster 2 is ready for installation at EMEC in summer 2011, with 2 further devices scheduled for installed at the same location in 2012 and 2013.

In March 2010, a joint venture partnership with SSE Renewables was awarded exclusive development rights to an area of the seabed in the Pentland Firth & Orkney Waters as part of the world's first commercial leasing programme for marine energy projects. Additionally, in north west Lewis, the company has secured seabed leases with potential to capture up to 40 MW of wave energy.

In November 2010, Scotland's First Minister opened Aquamarine Power's new offices in Edinburgh and welcomed a new £11m funding announcement involving £3m follow on investment from SSE and a new £8m investment from multi-national engineering company ABB.

The Oyster development has created significant employment and economic benefit opportunities for Scotland. In December 2010, Aquamarine Power awarded a £4 million contract to BiFab to build their second Oyster wave power device at Methil, with planned installation at EMEC in summer 2011. The Arnish fabrication yard in Lewis is manufacturing the foundation piles for Oyster 2 and has been awarded an extension to the contract for the two additional Oyster machines scheduled for deployment in 2012 and 2013.

Sectoral Marine Planning Approach to develop wave and tidal energy in Scotland's Renewable Energy Zone

Marine Scotland has being developing and taking forward marine planning approaches to aid the identification and location of wave and tidal energy developments in Scotland's seas. The emerging Sectoral Marine Plan(s) will form a material consideration to the consenting process for marine renewable developments in Scotland.

The Pentland Firth and Orkney waters were identified in the Scottish Government's Strategic Environmental Assessment of Marine Renewables (2007) as areas of high energy resource for wave and tidal power. To aid potential development and to guide development opportunities, Marine Scotland published draft Regional Locational Guidance and a Marine Spatial Plan framework for the region. This work assessed the energy resource within the sea against environmental and socio-economic considerations.

The Marine Spatial Plan framework sets out a 3 stage process for the development or regional marine plans and regional locational guidance. Stage 1 was the publication of the framework and an assessment of the identified gaps in knowledge. Stage 2 of this work consists of commissioning a set of studies to fill in the identified gaps in knowledge and to determine the likely interaction between future renewables activities, other sectors and the natural environment.

Building upon the work to inform development within the Pentland Firth Strategic Area, Marine Scotland commissioned a Scotland wide study to scope potential areas for wave and tidal development to compete for the Saltire Prize. Published in early 2010, the Scoping Study on the proposed geographic areas to be included in the Further Scottish Leasing Round for wave and tidal energy, identified seven areas as potentially suitable for wave and tidal energy generation - two areas were identified for tidal energy and five areas for wave energy.

Areas were identified using The Crown Estate's Marine Spatial Resource System (MaRS) to provide a spatial representation of the relative strength of constraints applying to different areas of the sea. Information on the necessary natural resources of wave and/or tidal stream power, was combined with areas where developers had informally expressed an interest resulting in a series of models showing the differences in levels of constraint in different areas. An assessment of the constraints and potential resource allowed a map of potential areas to be developed which formed the basis for the preparation of more detailed regional location guidance for developers.

In response to the comments received on the Scoping Study, Marine Scotland undertook a further, more detailed analysis of the proposed areas and produced a Regional Locational Guidance (RLG) report. The report investigated the resource and physical characteristics of the seven areas and the potential for interactions with other users and the environment. It concluded that five areas – West of Shetland, Southwest of Shetland, West of Lewis, Mull of Kintyre and Southwest of Islay – avoided the most environmentally sensitive areas and minimised the impact on other users of the sea. The RLG was used by The Crown Estate for the Further Scottish

Leasing Round for wave and tidal energy projects to support The Saltire Prize competition.

The Marine Planning approaches utilised in the Pentland Firth and for guidance to support The Saltire Prize are forming the basis for the development of a Sectoral Marine Plan for Wave and Tidal Energy in Scotland's seas. Building upon the work already undertaken, Marine Scotland will develop an Initial Plan Framework which will outline the potential areas for development of wave and tidal energy.

The Initial Plan Framework will then be subject to a Sustainability Appraisal process which utilises existing assessment methods in tandem with innovative marine planning approaches – Strategic Environmental Assessment, Habitats Regulations Appraisal, Socio-economic Impact Assessment, public consultation and further scoping to include the extent of Scotland's Renewable Energy Zone (200 nautical miles). The application of the Sustainability Appraisal process will inform the preparation and development of a draft Sectoral Marine Plan for wave and tidal energy. The resulting draft Plan and SEA Environmental report will be subject to formal consultation and if necessary, further assessment. Following completion of the analysis of consultation responses and any adjustment made to the draft Plan, a final Sectoral Marine Plan will be published. The final Plan will guide development of marine renewable energy in Scotland's Renewable Energy Zone by identifying potential Plan options for development.

Challenges to Deployment

	WAVE & TIDAL ENERGY CHALLENGE
The cost of renewables	Ensuring that the market mechanisms in play deliver the right level of support as well as a clear signal that this support will be available in the long term, driving deployment and reducing costs. The future of the RO, and the support for these technologies in the longer term from any replacement mechanism, will be of paramount importance.
Planning and regulation	Need to maintain the work undertaken by Marine Scotland thus far on developing planning advice and guidance tools. The developing Sectoral Marine Plan for wave and tidal energy and the Pentland Firth Marine Spatial Plan Framework will ensure development is taken forward in a sustainable way, which seeks to accommodate and consider sectoral, community and public views.
Secure grid access	Lack of grid access in areas of high resource still an issue. Sector and stakeholders can overcome some of these issues by working in partnership, but key influence in this area lies in outcome to Project TransmiT and a more sensible approach to grid investment and charging issues.

Skills	The Skills Investment Plan for Energy produced by Skills Development Scotland highlights up to 5,300 additional direct job opportunities in marine renewables to 2020. dependent on the level of capacity deployed. The main skill requirements are widely recognised as marine engineers, leadership and management, project managers and divers with opportunities for graduates, apprentices and individuals already in the labour market across the energy sectors and elsewhere.
Supply chain development	Critical that supply chain development keeps pace with and enables marine renewables deployment, and that Scottish businesses are in position to support and benefit from this sector and its huge potential. Key role for Government and development agencies in advising and connecting relevant companies with the opportunities that exist – from device and foundation design, manufacture and installation to electrical design and cabling provision / installation.
Innovation / R & D	Need for ongoing technology support is critical. There is still only a relatively small number of devices at full demonstration scale. These demonstrations, more of which are due to take place over the coming year, will be vital in proving the technologies and beginning to move down the cost curve. Continued public sector support aimed at focused R&D – e.g. reliability, componentry / materials, survivability, installlation techniques, anchoring – likely to be vital.
Public Engagement	Public engagement with regard to planning and consenting is critical in order to ensure that development is sustainable and takes into account community and public views, linked to the debate on management of The Crown Estate and its revenues.

Key Actions

The sector needs to continue its progress through the stages of technology proving and deployment, moving from full-scale demonstration (currently taking place) through to the deployment of the first pre-commercial arrays and onwards to commercial development. There is a consensus that, in order to make this progress and transition, the following factors are critical:

- **Market incentives –** Scotland has led the UK and indeed the world in recent years through our introduction of enhanced levels of support for wave and tidal stream generation to the Renewables Obligation (RO). Those bands are presently being reviewed, but in the context of Electricity Market Reform proposals from the UK Government which propose that the RO should be replaced from 2017. These reviews and proposals **must** combine to deliver a coherent and effective level of support, and a system which is capable of bringing these technologies through the stages identified above and to a competitive and commercial cost basis. **Action – Scottish Government to maintain its effective market support for marine renewables technologies, both through the RO and its possible replacement.**
- **Grid –** the grid transmission charging and underwriting issues identified above must be tackled effectively through project TransmiT. The existing charging regime is a barrier to development; its satisfactory and timely resolution will play a vital role in developing the sector. **Action – Scottish Government to continue arguing strongly for a positive outcome on grid regulation and charging issues.**
- **Capital support** – the sector has stated that the next phase of development – the deployment of small arrays on the 5-10 MW scale – will not take place without significant capital grant support, potentially on the scale of around £20 million per project. Identifying resources to support and enable this – from within Government, the European Commission and potentially the Green Investment Bank, as well as more investment leveraged from private sector capital – remain a key factor. **Action – Scottish Government to work with its partners and the sector on costs issues, and to pursue every available option to ensure resources and investment are available on the necessary scale.**
- **Innovation support** – coherent and co-ordinated action to address issues related to device reliability, survivability, installation techniques, inter-connection and anchoring can play a crucial role in reducing early project costs. **Action – Scottish Government to continue its collaborative discussions with public sector partners and agencies and to ensure that R&D support is available, targeted and effective**.

Supporting Actions

- In addition to the actions above, the inclusion of wave and tidal technologies within the EU Strategic Energy Technology Plan – for which the Scottish Government is lobbying alongside British-Irish Council and other EU Member States – could un-lock significant R&D and project finance, and encourage industry collaboration to help drive marine renewables down the cost curve.
- Marine Scotland to maintain its focus on the simplification and streamlining of marine planning, monitoring and determination of consent applications.
- Link to wider focus on regulation and management of Crown Estate and seabed in Scottish waters.
- Undertake review of existing Strategic Environmental Assessment for wave and tidal energy.
- Maintain focused efforts on supply chain development arising from lease awards and planned activity in Scottish waters.
- Identify and capitalise on areas where Scotland is strong and has natural advantage.
- Build on early and positive examples of public engagement such as recent successful events in Caithness and Orkney.

3.4 Renewable Heat

Ambition and Targets

Heat makes up about half of all energy demand and, unlike the so-called "traded" sector for electricity, heat forms a key element of wider EU and UK carbon emissions reductions targets. Use of heat is also integrally linked to our aims to improve energy efficiency. Thus it is right that heat policy should be a high priority for the Scottish Government, and we aim to deliver a commercially viable, diverse, renewable heat industry in Scotland in support of our 2020 renewable energy target and to help tackle climate change.

Our current heat target is to source 11% of demand from renewable sources by 2020.

We are making good progress with 2.8% of heat demand in Scotland being met from renewable sources and we intend to work with industry to explore whether it will be possible to extend our target further, including considering cost-effectiveness and net impact on wider carbon emissions.

We have been working with UK Government to ensure Scottish interests are reflected in the design of the Renewable Heat Incentive and we will continue to do so until its full implementation in 2012.

In particular we need to ensure that the interests of early adopters of renewable heat in Scotland, notably the wood panel sector, are not put at a disadvantage by the introduction of the initiative. Thus we continue to engage with DECC to ensure that impacts on existing users are properly assessed and measures taken to remove any unintended consequences which would put these users at a commercial disadvantage.

We are also working in with DECC and Ofgem on the Heat Partnership Project which will explore the Scottish experience of renewable heat deployment in order to identify barriers and successes and thus create a template for good practice across the UK.

Renewable heat policy should not stand alone. As highlighted above, it is linked to aspirations to improve energy efficiency. As such, renewable heat should also be viewed within a wider policy to make the best use of heat within a low carbon economy. The Scottish Government has taken on this mantle to promote the most efficient use of heat in order to reap the benefits of a low carbon economy – non-renewables as well as renewable. It is only by embracing both forms of heat in the short-term that we can make the ultimate transition towards decarbonisation of the heat network, envisaged by 2050.

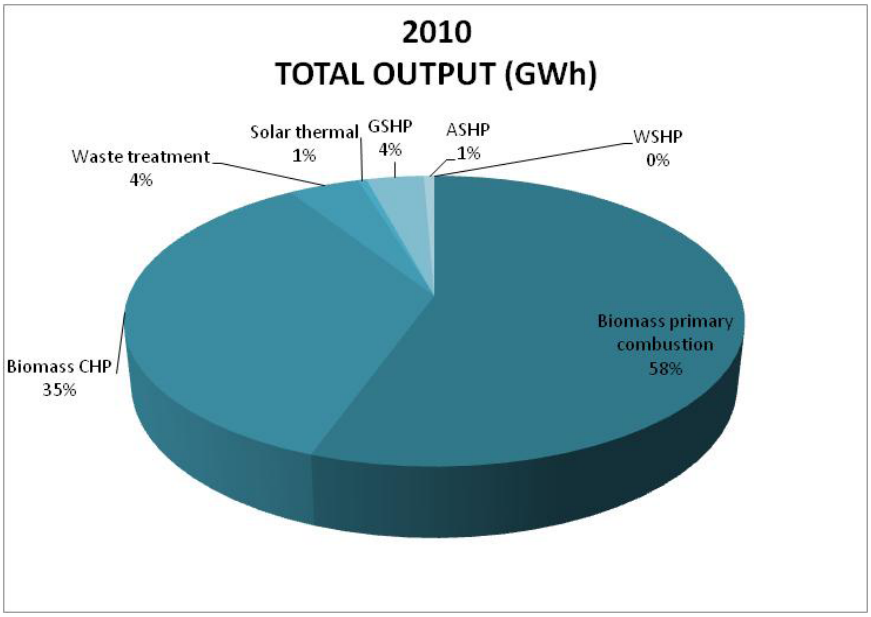
Hence we will shortly publish the results of a study by AEA Technology into the potential to recover "waste" heat from fossil fuel power stations in Scotland and will be considering the policy implications.

Building on the results of the AEA study into the recovery of heat from power generation in Scotland, district heating has been placed at the centre of our strategy for deploying heat, including renewable heat. Ministers are committed to establishing an Expert Commission on the Delivery of District Heating that will advise on the steps we need to take to ensure a major move to district heating in Scotland. Until recommendations and further financial support is established, our recently launched District Heating Loan scheme will be an important resource for taking this forward.

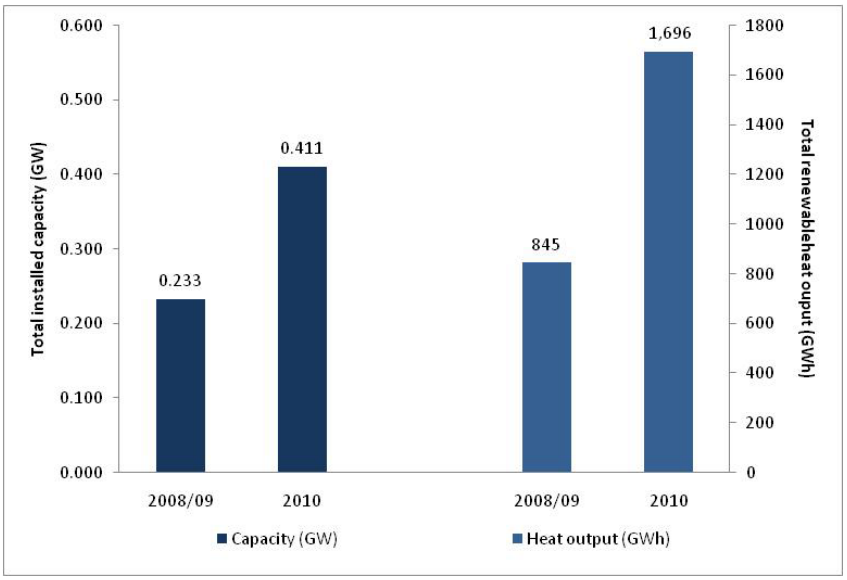
Renewable heat will play an important role in communities and there is a commitment to encourage and support Housing Associations to have greater freedom to develop renewable heat schemes within new and current developments. Local authorities will also receive support through the roll-out of the heat mapping methodology after a successful pilot exercise in The Highland Council region and we have committed funding to initiate this.

Current Deployment

- 1,696 GWh – equating to 2.8% of Scotland's current renewable heat target. This is mainly made up of biomass as illustrated in the following chart:



Moreover this represents good progress – with a doubling of output in 2 years (as can be seen below), making the Scottish level of renewable heat twice the UK level of demand.



Planned Deployment

- A further **69 MW** of installed capacity and **487,000 MWh** are estimated from large projects which are currently under construction,
- plus around **198 MW** of installed capacity and **1,017,000 MWh** from large projects in planning.

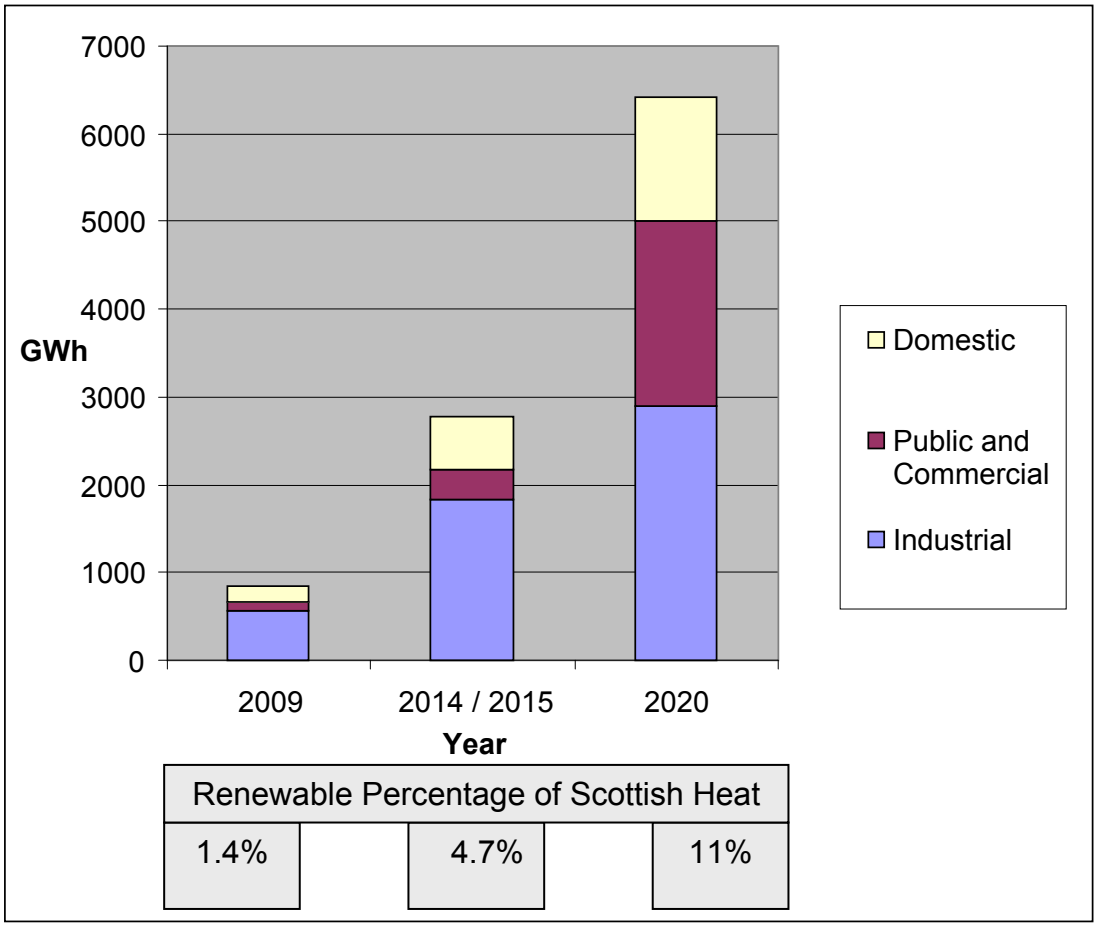
If all the projects currently under construction, and 50% of those in planning came to fruition, in addition to the known micro and small to medium installations, this could bring total renewable heat output in Scotland to an estimated **2,733 GWh** a year, or around **4.5%** of forecast Scottish 2020 nonelectrical heat demand.

In other words, in the next two or three years, we should continue to make reasonable progress towards the 2020 target. The key will be to maintain this momentum.

Deployment Potential

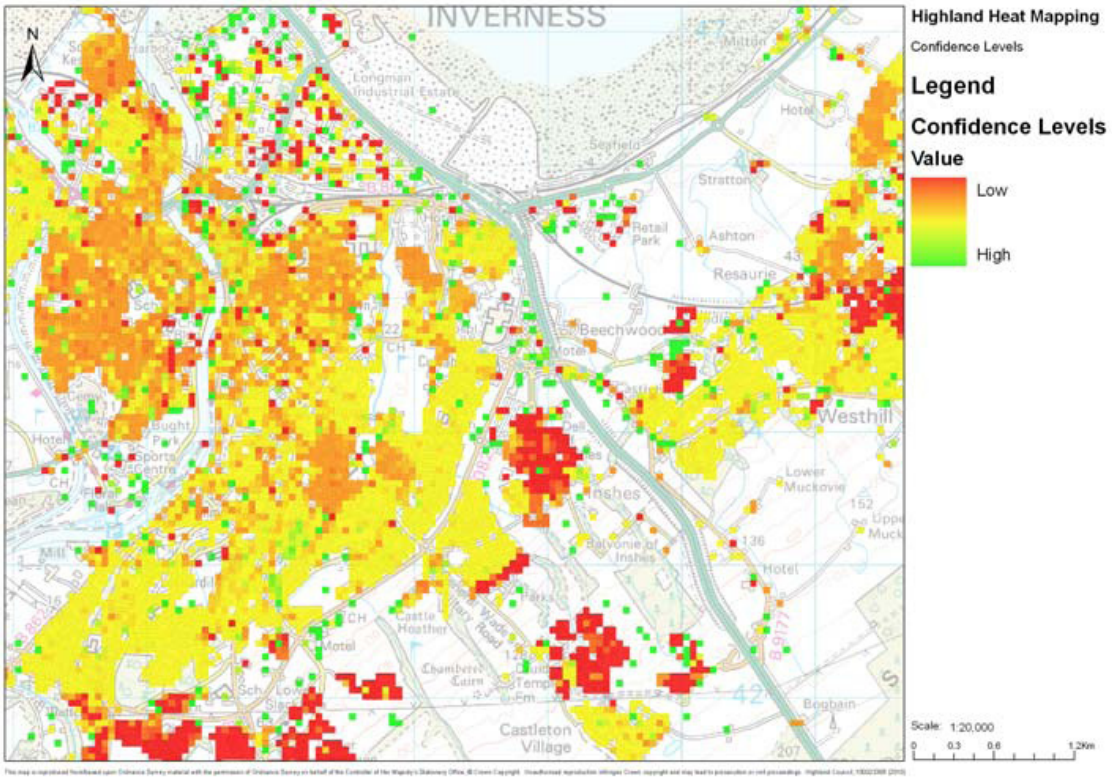
As can be seen in Section 1.3, there is potential for Scotland to meet its 2020 target for renewable heat. Progress needs to be made across all scales of installation from microgeneration to large scale industrial –as can be seen from the following projection of deployment from the Renewable Heat Action Plan (2009):

Indicative Level of Heat Usage by Market Sector



Successes to Date

- Publication of Renewable Heat Action Plan (2009), backed up by progress report in March 2011 produced by the Energy Saving Trust on behalf of Scottish Government showing that output from renewable heat sources had doubled in the past 2 years.
- Successful heat mapping pilot in The Highland Council region. The methodology can be replicated by other local authorities which will help imbed renewable energy at the centre of local strategic planning. We have committed funding to assist in rolling out to other local authorities over the next financial year.



- Committed £2.5M funding for a district heating loan fund which has opened for expressions of interest and which will provide loans for low carbon and renewable technologies in order to overcome a range of infrastructural issues and costs of developing these projects. The loan scheme is due to open by the end of May 2011.
- Provided funding via CARES & SRDP to support renewable heat installations
- Supported over 60 projects through the Scottish Biomass Heat Scheme (more information in Bioenergy and Waste Routemap).
- Published guidance for developers considering new build thermal power stations.

Challenges to Deployment

	RENEWABLE HEAT CHALLENGE
The cost of renewables	Need to ensure that subsidy available under RHI does not adversely impact on existing users, notably the wood panel sector. The RHI will support district heating but there is no proposed uplift in the initial phase to take account of infrastructure costs. Scottish Government must assess and ensure additional necessary support is in place in order to encourage investment in renewable heat technologies.
Planning and regulation	Need to build on the excellent work produced in the Highland Heat mapping project to assist planning authorities to highlight existing and potential opportunities. There is both a challenge to upskill planners new to heat mapping and to support planning authorities in planning for heat where there is no heat mapping resource. Developing the findings of the study into the recovery of heat from power generation in Scotland in order to overcome planning and regluation barriers in the deployment of heat. Considering policy position regarding a presumption in favour of connecting to district heating networks where one exists for certain developments. Working in partnership with DECC and Ofgem to showcase Scottish experience and help develop UK policy.
Source sustainable fuel	Detailed heat mapping will play a crucial role in identifying existing and potential opertunities as well as proximity to fuel sources (including their capacity). Necessary to find technical and economical way of recovering heat from large scale power generation. More information on the sustainability of biomass can be found in the Bioenergy and Waste Routemap.
Skills	Renewable Heat Implementation Group (RHIG) and its skills sub-group should ensure Government is fully informed of skills requirements in the renewable heat industry and identify barriers with options on how to overcome these.
Supply chain development	Heat mapping must incorporate supply chain opportunities. More information on woodfuel supply change can be found in the Bioenergy and Waste Routemap (Section 3.5).

Innovation / R & D	Need to build on research already undertaken into the recovery of heat from power generation. Expert Commission on the delivery of district heating to investigate and provide recommendations on areas that need further development.
Public Engagement	Engagement with industry, local authorities, housing associations and other key stakeholders is crucial in delivery of increased use of renewable heat. There is a need to work with DECC, EST, Carbon Trust and other agencies to increase awareness in renewable heat and its benefits.

Key Actions

- **Continue to engage with DECC on RHI to ensure net benefit to Scotland,** including mitigation of impact on wood panel sector
- **Undertake Heat Partnership Project with DECC and Ofgem** to develop a template for good practice on deployment of renewable heat.
- **Roll out heat mapping pilot to other local authorities**
- Scotland can lead the way in producing a bottom up approach to a national heat map of Scotland with the same level of detail produced in the pilot project. Funding is committed to roll out the methodology to other local authorities. This will include the upskilling of planners to integrate renewable heat into spatial policy.
- **Set up Expert Commission into development of district heating**
- The Renewable Heat Implementation Group and the assessment panel for the District Heating Loan Fund will be used as a starting point for discussions on how the Expert Commission should take its form. Once in place, the Commission will provide recommendations which will ensure a major shift to district heating in Scotland (both renewable and low carbon heat).
- **Build on results of current Study into recovery of heat from power generation in Scotland in order to promote recovery of heat from large scale power stations**
- District heating will play an important role in realising our ambitions on heat. While the study is mainly focussed on the deployment of low carbon heat, lessons learned can be transferrable to renewable heat. Ultimately the creation and extension of district heating networks will provide opportunities for an increase in renewable heat in the future. This area of work will be a priority for the new Expert Commission above.
- **Provide support for renewable heat projects through CARES and district heating loan funds**
- Financial support is essential to stimulate the market and de-risk capital investment in renewable heat projects. We will continue to seek sources of financial support for these projects and continue to recognise the impact investment in this sector can make on progress towards our renewable heat target.
- **Engage with key stakeholders to promote renewable heat and the forthcoming renewable heat incentive and renewable heat premium payment scheme**
- In order for Scotland to fully benefit from the RHI and the Premium Payment Scheme, we must ensure we engage with industry and the wider general public to raise awareness of renewable heat and the support that is available.

Supporting Actions

- Promote RHI premium payment scheme for domestic users
- Assess levels of investment in renewable heat through engaging with stakeholders and the renewable heat implementation group
- Update and improve planning guidance and support to ensure renewable heat projects are supported
- Link to wider actions on skills and supply chain opportunities
- Engage with DECC to build on and learn from research work they are undertaking on heat mapping and heat strategy
- Link into and learn from research projects underway. Representative from Scottish Government to act as Advisory Board Member and the Heat in the City research programme run by Edinburgh and Strathclyde Universities
- Continue to provide support and information on renewable heat technologies through working with the Energy Saving Trust

3.5 Bioenergy and Energy from Waste

Ambition and Targets

Bioenergy and energy from waste both have an important part to play in meeting renewable energy and climate change targets, with biomass expected to make a key contribution to the delivery of the Scottish Government's target for 11 per cent of heat to come from renewable sources by 2020. In 2010 83% of renewable heat capacity, and 91% of renewable heat output, came from installations which used biomass primary combustion or biomass combined heat and power. (http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/Heat/RHiS)

Given the multiple energy uses to which biomass can be put, the limits to supply, and the competition for that supply from other non-energy sectors, biomass policy and support need to encourage the most efficient and beneficial use of this finite resource. For that reason:

Scottish Government policy supports the deployment of biomass in heat-only or combined heat and power plants, particularly off gas-grid, and to a scale which maximises heat use and local supply.

We also need to ensure that incentivisation of biomass takes into account existing users and does not disadvantage them for the early adoption of this technology. Scotland has a significant timber processing industry, which provides much need employment in rural areas. The wood panel sector is also the major existing generator of renewable heat via biomass. We need to make sure that this sector is not put at risk by the introduction of the Renewable Heat Incentive to the detriment of the economy as well as (perversely) to the renewable heat target itself.

In terms of energy from waste, the renewable fractions of municipal and commercial wastes are eligible for support under the Renewables Obligation Scotland. However, since we want to encourage the development of more efficient technologies, such as combined heat and power, anaerobic digestion or pyrolysis / gasification, only these types of stations are eligible for Renewables Obligation Certificates.

The Scottish Government recognises the benefits of anaerobic digestion (AD) as a renewable technology which can contribute to its targets for renewable electricity and renewable heat. Moreover it is an example of how we can close the production loop, with the food we waste going back into producing high quality fertiliser, completing the Nitrogen cycle and helping us move towards sustainable farming.

This is why we are looking at separate collections, starting with food waste to ensure the standard AD inputs facilitate the production of high quality digestate. Delivering zero waste policy and meeting future waste targets will require changes and improvements to our waste collection and treatment infrastructure.

Current Deployment

- In 2010 Biomass primary combustion capacity in Scotland stood at 203 MW (941,000 MWh) of heat.
- the heat capacity of Biomass CHP plant stood at 138 MW (Output of 601,000 MWh).
- Waste treatment (energy from waste, landfill gas & anaerobic digestion) stood at 23 MW of heat capacity (74,000 MWh).

(http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/Heat/RHiS)

The following devices are examples of biomass and energy from waste plant currently operational in Scotland:

- E.ON's Steven's Croft biomass plant at Lockerbie – 44 MWe and 6 MWth;
- 20 MWe Biomass CHP plant at UPM's Caledonian paper mill provides half the mill's electricity needs and all of its process steam requirements;
- 8 MWe CHP unit at Balcas' pellet plant in Invergordon which provides the renewable heat for the pellet manufacturing process, as well supplying 5 MWe to the grid;
- Scottish Water Horizons AD plant at Deerdykes – 1 MWe and 1.1 MWth;
- John & Andrew Rennie's 450 kWe AD plant at Gask Farm, Turriff;
- The Earthtech/Linde AD plant on the Isle of Lewis;
- Shetland Heat & Power provides heat through a district heating network to over 1000 local properties - including homes, community centres, schools, churches and commercial buildings. The heat used in the scheme is generated at a Waste to Energy plant located on the outskirts of Lerwick; and
- DERL's energy from waste plant in Dundee.

Deployment Pipeline

The following plant are in the deployment pipeline:

- RWE npower Cogen's 50 MW CHP plant at Tullis Russell's papermill in Markinch is scheduled for operation in late 2012;
- 15 MWe Charlesfield biomass CHP and pelletising plant in Newton St Boswells, with potential to create a local heat suppy network; and
- NEDL projects at Lochilphead and Dunoon.

Deployment Potential

The biomass resource available will be an important factor in the potential for deployment. The updated Wood Fuel Task Force report indicates that there is currently around 432,000 odt of wood potentially available from all sources of wood fibre in Scotland, increasing to over 1.2 million odt by 2020. The volumes identified could make a substantial contribution to the Scottish Government's renewable heat target but clearly show that we need to make best use of this important resource.

Energy from Waste could contribute approximately 2.0 TWh of useful heat and 0.90 TWh of electricity per year (245 MWth and 112 MWe capacity) according to the Energy from Waste Potential in Scotland Report. The report also found:

- Heat only plants could meet 6% of Scotland's existing heat needs
- Electricity production in energy from waste facilities could meet 8% of Scotland's existing electricity demand.
- Combined heat and power waste treatment plants could meet 3% of Scotland's total heat and electricity demand.

Successes to Date

- The £7 million Scottish Biomass Support Scheme ran in the financial year 2007-08 and supported 60 projects with a combined output of 20 MWth. It also helped to establish a supply chain in scotland.
- The Scottish Biomass Heat Scheme, which has been crucial in maintaining momentum in the sector, has paid out over £2.6 million to 44 projects delivering 10 MW (thermal) of capacity, with annual CO_2 savings of over 10,000 t CO_2-equivalent
- Recently made it easier for owners of public buildings and businesses to generate energy using technologies such as biomass boilers by introducing permitted development rights (subject to restrictions in air quality management areas).
- Introduced Thermal Guidance and Biomass Scoping Opinion guidance for large scale plants.
- Published report on contribution Energy from Waste could make to Scotland's energy needs.

Challenges to Deployment

	BIOENERGY & ENERGY FROM WASTE CHALLENGE
The cost of renewables	Need to ensure that market mechanisms deliver the right level of support. Current incentives driving large scale biomass electricity schemes rather than most efficient use of biomass through CHP or heat only. Need to ensure that any new incentivation – notably the RHI – does not unfairly penalise existing users.
Planning and regulation	Need to maintain the excellent work undertaken thus far by Scottish Government on streamlining the planning and consent process for biomass and energy from waste developments. Developing joined up strategies between planning & woodfuel producers and waste streams to make best use of resources at local level in heat only applications.
Secure grid access	Restricted grid access in many of gas grid areas. Sector and stakeholders can overcome some of these issues by working in partnership, but key influence in this area lies in outcome to Project TransmiT and a more sensible approach to grid investment and charging issues. Connect and manage will play a part for smaller schemes. Not an issue for bioenergy for heat applications.
Source sustainable fuel	Scotland has a limited domestic biomas resource. Sourcing sustainable (preferably local) fuel is essential. The Forestry Commission Scotland and the Scottish Government will continue to work on requirements for sustainability in biomass in the UK through the Department of Energy and Climate Change sustainability working group (see Section 2.5).
Skills	The Skills Investment Plan for Energy produced by Skills Development Scotland highlights up to 1,350 additional direct job opportunities in renewable heat. Additional Jobs are expected to arise in biomass fuel supply. More jobs could potentially be created if manufacturing capacity develops in Scotland. Whilst there does not seem to be a gap in the underlying skills base, there will be a requirement for top-up skills and upskilling of the existing workforce. As such, there is a need to develop a more detailed assessment of specific skills demands.
Supply chain development	Critical that supply chain development matches demand. Enabling long term supply contracts will be a key challenge for all forms of bioeenrgy. Key role for procurement scotland in developing biomass procurement strategy.

Innovation / R&D	Will need to work closely with Forestry Commission on energy forestry trials and with Crown Estate on its work looking at marine biomass.
Public Engagement	Public perceptions energy from waste and bioenergy can often be negative. It will be important to keep providing factual information through sources such as usewoodfuel and zero waste Scotland and to promote succesful projects through case studies.

Key Actions

- **Review support for large scale biomass electricity only plant under the Renewables Obligation Scotland;**
- **Work to influence UK Government Strategy on bioenergy to make case for small scale heat;**
- **Work to ensure that existing users of biomass heat, particularly the wood panel, are not penalised by the introduction of the RHI;**
- **Raise awareness of opportunities for renewable heat for businesses** through supporting the Carbon Trust in encouraging take up of biomass heat, targeting Scottish companies that are high heat users, with a view to getting them to switch to renewable heat and making them aware of biomass support under RHI and through the following mechanisms:
    - Forestry Commission's Fuel good factor campaign
    - Regional biomass forums
    - Ongoing information provision and dissemination through the Usewoodfuel website and other media
    - Support for the Woodfuel Suppliers Group in Scotland;
    - Working with Forestry Commission Scotland at a regional level to provide better information on local biomass resources.

Supporting Actions

- Procurement scotland will continue to develop a National Strategy for biomass procurement;
- We will seek in particular to expand small scale anaerobic digestion from food and farm waste by introducing separate food waste collections;
- Work with UK Government to ensure incentives for anaerobic digestion encourage take up of the technology in Scotland, particularly on farm based AD where take up of the Feed in Tariff has been low;
- Take forward plans to ensure that waste is pre-sorted before it can be used in energy from waste plant;
- Support more effective harvesting to provide more material for local, small-scale biomass; and
- The Forestry Commission Scotland and the Scottish Government will continue to work on requirements for sustainability in biomass in the UK through the Department of Energy and Climate Change sustainability working group.
- Following the publication of the Skills Investment Plan for the Energy Sector future efforts will focus on continuing to work with key partners to take forward the key actions contained in the plan. Specific activities include:
  - Increasing sector attractiveness to young people and job changers;
  - Engaging with business to identify future skills needs;
  - Developing training provision and infrastructure to meet future need.

  A key element of this will be in identifying the nature and scale of anticipated skills demands and mapping the current supply of skills and qualifications within Scotland in relation to those identified demands.

3.6 Hydropower

Ambition and Targets

Scotland has a proud tradition of generating hydro electricity, and many of the projects installed in the post-war years continue to provide clean and reliable power to Scotland's homes and businesses. The combination of Scotland's location, natural resources, R&D and manufacturing capabilities, creates clear advantages for developing our hydro energy resource.

The Scottish Government recognises the valuable contribution that hydropower generation makes to Scotland's renewables targets, and is seeking to achieve a balance between hydropower development and Scotland's water environment.

Hydro accounts for a significant proportion of our existing renewable output and contributes around 10% to Scotland's total current energy generation. It has a high level of efficiency and has a high level of predictability. Hydro pump storage schemes are a commercially viable way to provide energy storage. Power can be generated when it is required so is therefore very predictable and can be used as a powerful grid management tool.

Most output is produced by large scale hydro schemes. There are, however, an increasing number of proposals for small run of river hydro projects and these projects, together with the continuing refurbishment of the large hydro schemes will ensure that hydro will continue to play its part in Scotland's renewable energy mix and help tackle climate change and contribute to economic growth.

A recent update on the 2008 Hydro Resource Study estimates there could be 1.2 GW of financially viable new hydro capacity across over 7,000 schemes, and highlights the jobs potential from these developments. However, we will need to ensure not only the financial but environmental viability of the schemes.

Micro/Pico hydro schemes can bring economic benefits to communities through incentives including the FIT. Many of the suitable hydro sites in Scotland are in environmentally sensitive areas. However, these schemes can be housed underground or in existing buildings, with little or no visible impact on the landscape or harm the environment.

Current Deployment

Scotland is already home to a significant amount of hydro power over 1.4 GW, some half of current installed capacity. Scotland's Hydro sector is well established, including several large scale run of river which have been operating for several decades, although SSE has proposals for two new major pump storage schemes above the Great Glen. There are also a large number of schemes of schemes of between 100 kW and 1 MW.

Since 2007 the Scottish Government has consented 17 hydro schemes which total 43 MW. Until recently the Scottish Government consented all onshore hydro scheme applications of 1 MW and above. This has changed recently (as of 1 June 2011) and now applications for schemes smaller than 50 MW will be determined by Planning Authorities. The Scottish Government will still determine applications above this.

Below is a table to show Hydro schemes that were licensed by SEPA in 2010.

Hydro Schemes Licensed by SEPA in 2010	
Installed Capacity (kW)	Number
<100	37
100	4
>100	18
(of which >2 MW)	(2)

Deployment Potential

The Employment Potential of Scotland's Hydro Resource 2010 study suggests that up to a further 1200 MW of economically-viable, small-scale hydro could be exploited in Scotland. http://www.scotland.gov.uk/Publications/2010/01/19141527/0.

New hydro schemes are likely to be mainly small and micro-scale. Although there maybe an increase in medium sized schemes due to the raising of the S36 threshold.

Successes to Date

- The 1 MW threshold for hydropower over which applications are dealt with under Section 36 of the Electricity Act was identified as a barrier. SG consulted on proposals to transfer the determination of all onshore hydro scheme applications of 50 MW or less to Planning Authorities. The move brings Scotland in line with England and Wales and seeks to encourage developers to size their scheme appropriately. It also allows planning authorities to recover more of their cost from application fees than they are currently able to. The raising of the threshold was laid in Parliament on 21 February 2011 and will revoke to the previous level of consent to Scottish Ministers to 50 MW. This will take effect from 1 June 2011 onwards.
- To help support the sector to deal with the challenges of protecting the environment when developing new schemes a couple of publications were created - Run of River guidance by SEPA and hydro guidance from SNH
- Two studies were commissioned by FREDS to provide an assessment of the potential for development of hydropower resources within Scotland. The first was The Scottish Hydropower Study which was published in 2008. Following on from the study, further research into potential job creation from micro-hydro

schemes was published in 2010 in the Employment Potential of Scotland's Hydro Resource study.

Challenges to Deployment

Hydro power is facing challenges from regulation, securing finance and access to the grid.

	CHALLENGE
The cost of renewables	Access to finance has become an issue due to uncertainty caused by the review of FITS. The Scottish Government, in its previous term, wrote to the Energy Minister to say that they shares the UK Government's concerns that certain developments in the industry may push FITs off trajectory. It also highlighted that we are keen to avoid the confusion and lack of guidance that was prevalent when FITs were introduced and requested that officials at DECC work in partnership with SG officials. Reform of the Transmission Network Use of System (TNUoS) charging framework to encourage investment, through Project Transmit. The sector needs stability and security so that investment can be secured. The uncertainty of the FITs review means that investment has stalled until the outcome is announced.
Planning and regulation	There is a challenge in providing more spatial guidance at local level to indicate where there are the greatest opportunities for hydro and to handle cumulative impacts. There is scope to improve co-ordination between the water licensing and planning consents processes, following the suggested processes outlined in the online renewables planning advice for hydro schemes . Planning authorities may need support in handling hydro applications at the increased scale up to 50 MW. A review is being conducted of the UK Technical Advisory Group (UKTAG) environmental standards to ensure that these standards are representative of the status of Scotland's rivers and do not work in conflict with the Scottish Government's policy on renewable energy.

Secure grid access	The transmission system is becoming increasing constrained in the North of Scotland. This situation will not change until several major reinforcements to the transmission system are completed – including Beauly-Denny. Distribution network operators are obliged to offer a connection date despite the fact that, following a Statement of Works undertaken by National Grid, reinforcement works on the transmission system may significantly impact the original connection date. This is causing delays in many projects. This is not a devolved matter and is currently subject to review by the Department of Energy and Climate Change and the regulator Ofgem. While the Scottish Government cannot control the outcome of this review, it will continue to lobby for a fairer charging regime.

Key Actions

- A **rapid expansion of renewable energy production by Scottish Water** – (SNP manifesto commitment). Renewable energy projects developed on public land are leaders in the provision of community benefit.
- Continue engagement with DECC officials on the **FIT review** to address any Scottish issues to ensure that the outcome is beneficial for Scotland.
- Continue **engagement with Ofgem/National Grid** and transmission operators on barriers to access through Project Transmit.

3.7 Microgeneration

Individual households use more than a third of the electricity and more than half of the heat consumed in Scotland. Rising fuel costs are driving more households into fuel poverty. Microgeneration can enable households and other small-scale users to reduce their fuel costs and carbon emissions by generating their own renewable energy.

Microgeneration includes a range of technologies: biomass; biofuels; fuel cells; photovoltaics; water (including waves and tides); wind; solar power; geothermal sources; combined heat and power systems; and air, covering devices with a generation capacity of the device no greater than 50 kilowatts (kWe) for electricity generation and no greater than 45 kilowatts (45 kWth) for heat.

Ambition and Targets

Our ambition is to see more householders, public sector organisations and businesses generating their own energy from micro-renewables, moving the technology from a niche market to the mainstream.

Microgeneration is integrally linked to energy efficiency as part of our overall policy to move towards a low carbon economy. Microgeneration technologies are most effective in terms of cost effectiveness, carbon emissions reduction and reduced energy bills only when combined with energy efficiency measures, such as insulation. By far the most popular micro-renewable technologies currently in use in Scotland are heat-based - over 90% of current deployment. The heat section of this Routemap also reflects the need to link to microgeneration and energy efficiency.

In order to move towards a low carbon economy, Scotland needs to capitalise on the opportunities offered by Feed in Tariffs, Renewable Heat Incentives and Green Deal. We have made progress, but we must do better. We need to see a step change in our deployment from the current position of 60 MW.

Alongside that, Scotland must also deliver a highly skilled workforce capable of reacting to the increased demand through the up-skilling or re-skilling of an already talented workforce. Consumers need to have confidence in the ability of the sector to deliver cost-effective, well designed installations and in the reliability of information and advice on the available technology choices.

By the end of 2011, we will produce a Microgeneration Strategy for Scotland.

We think this is necessary given the wider policy in which microgeneration operates. It will complement the Renewables Routemap, but provide more details on how we will support microgeneration sector towards 2020.

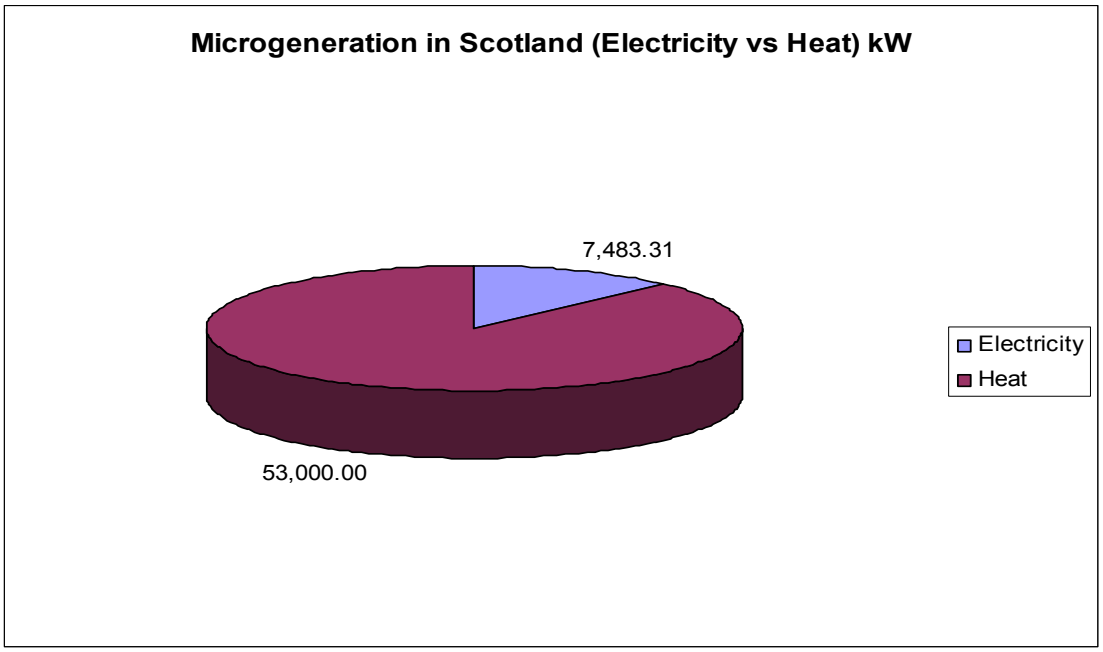
Successes to Date

- 1,322 microgeneration installations in Scotland have benefitted in the first year of the Feed-in-Tariff delivering 7.5 MW (electricity) of capacity, following on from over 2,500 microenewables installations, mainly for heat, previously grant aided by SCHRI and Energy Savings Scotland householder grants.
- Permitted development rights introduced for most micro renewables on domestic properties in 2009 and 2010. This lifted or reduced the requirements for planning permission for most domestic microgeneration technologies.
- A range of permitted development rights for micro renewables on non-domestic properties was introduced this year.
- Sponsored the Construction Licensing Executive (CLE) to become a Scotland-based certification body for the Microgeneration Certification Scheme (MCS).
- Energy Saving Trust's highly successful Solar Thermal hot spot campaign was run in partnership with Fife Council and EcoWarm Heating Ltd. This resulted in 41 Solar Water heating systems being installed in Fife.

Current Deployment

Current deployment is estimated to be around 60 MW. This is made up 7 MW* electricity and 53 MW** heat.

(*Source: OFGEM FIT register, **Source: Renewable Heat in Scotland, 2010, Report by Energy Saving Trust)



Deployment Potential

It is difficult to estimate potential deployment. In the coming years, the data provided via the FIT and the proposed RHI register will provide a data source on which to base estimates.

Challenges to Deployment

	MICROGENERATION CHALLENGE
The cost of renewables	Initial capital costs are high, offset by fuel cost savings and financial incentives. Consumers need clear and reliable information on costs, savings and payback to have the confidence to invest in microgeneration.
Planning and regulation	Permitted development rights have made uptake of microgeneration more straightforward. Concerns over noise for micro-turbines and heat pumps need to be addressed before permitted development rights can be extended and widespread deployment of small biomass heating systems in urban areas may negatively impact on local authority air quality targets.
Secure grid access	Can grid accommodate influx of small scale microgen technology exporting onto grid?
Skills	All installers of microgen technology must be fully accredited through MCS. A lack of accredited installers to meet demand may be a barrier to uptake. CLE now agreed as accreditation body in Scotland by UKAS (installers of technologies above 50 kWe and 45 kWth do not, as yet, need to be accredited).
Public Engagement	Consumers are faced with a varied technology choice, not all of which will be appropriate for their circumstances. Poor choices may result in increased energy bills or system failures, reducing consumer confidence. Clear signposting and awareness raising of information avaialble from EST, CT and other bodies such as SBSA is essential.

Others	Microgeneration technology can help address fuel poverty in the most vulnerable section of society. Adoption of microgeneration needs to be available to all. Links back to uptake costs and general consumer awareness. Landlords in both the public and private rented sector can benefit from FITS and RHI and greater awareness of microgeneration opportunities required. Opportunity to build on Scotland's record of success in developing microgeneration in schools as part of wider activity on climate change reduction - for instance over 98% of local authority schools now participating in the international Eco-Schools programme, and School Estate Strategy commits national and local government to creating a more sustainable school estate which contributes to meeting the Government's climate change targets.

Key Actions

- **Publish a Microgeneration Strategy**.
- **Maximise take-up of RHI premium payments scheme and FIT** in Scotland
- Provide **online planning advice** for renewable technologies
- Equip Scots with Green skills by delivering **500 dedicated apprenticeships** for energy and low carbon and build capacity with networks of providers through regional skills academies.
- Increase number of accredited installers in Scotland, with accreditation now available in Scotland through CLE.
- Strengthen links between energy efficiency and microgeneration.
- Signpost available information on costs, incentives and regulations.

3.8 Emerging Technologies and Energy Storage

Introduction

This section refers to both emerging and existing technologies which have yet to make a substantial impact on the energy landscape in Scotland but which have the potential to play a significant role in our energy future.

We have identified Energy Storage, Hydrogen and Fuel Cells, and Geothermal Energy as being particularly important for Scotland.

However, we anticipate that other technologies will emerge over time, and that a clearer picture will develop as to which options are best suited to complement and enhance the growth of renewable and low carbon energy in Scotland.

Energy Storage

To achieve our target of meeting the equivalent of 100% of Scotland's electricity demand from renewables by 2020 we will need to increase the deployment of energy storage systems alongside interconnection and demand-side response. Energy storage can help to overcome many of the challenges associated with accommodating high levels of intermittent generation from renewable sources onto the grid, and can allow us to harness our renewable resources more efficiently. In addition, small-scale decentralised energy storage offers a number of potential benefits, such as avoiding or deferring the need for grid upgrades.

There are a wide range of energy storage options, at varying stages of development. AEA's Energy Storage and Management Study for the Scottish Government, published in October 2010, summarised the various technologies and assessed their applicability to Scotland (available online at http://www.scotland.gov.uk/Publications/2010/10/28091356/0). Currently Scotland has two hydro pumped storage schemes, and a number of small scale hydrogen-based energy storage systems.

Key Actions

- The Scottish Government will continue to press for incentivisation of storage to be a key consideration in the design of the Capacity Mechanism proposed under the UK Government's Electricity Market Reform, given the important role it can play in addressing capacity constraints.
- Intelligence gathering, e.g. modelling and analysis to understand characteristics of peak flows; exploration of the potential for heat storage; exploration of the support needed for small decentralised storage
- Exploration of funding options for energy storage demonstration projects

Hydrogen and Fuel Cells

As an energy carrier, hydrogen could play a significant role in Scotland's energy landscape. Potential applications include hydrogen storage to increase the effectiveness and penetration of intermittent renewable generation, and as a fuel for sustainable transport. While hydrogen can be produced from a range of different sources, Scotland's vast renewable energy resource and the Scottish Government's ambitious renewables targets make the production and use of 'green hydrogen' a strong proposition.

Fuel cells convert a fuel source such as hydrogen into electricity, heat and water. There are a number of different types of fuel cell, offering highly efficient fuel conversion and the potential for low or zero carbon emission energy across a range of applications including stationary power generation, vehicles, and portable power systems, such as consumer electronics.

Scotland has a dynamic hydrogen and fuel cell sector, which includes world-leading R&D and academic expertise, as well as a small number of market leaders operating commercially. The sector has a strong and coherent voice in the form of the Scottish Hydrogen and Fuel Cell Association (SHFCA). The Scottish Government and its agencies will continue to work with industry and relevant partners to build on the sector's achievements to date, some of which are outlined below.

Successes to Date

- **Hydrogen Office** A state-of-the-art demonstration and research facility in Methil, which is supporting the development of hydrogen and fuel cells, and showcasing the role energy storage can play in Scotland.
- **PURE Energy Centre** A pioneering project on Unst which demonstrates how energy needs can be met through a combination of renewables and hydrogen technology. The first community owned project of its kind in the world, it also included an electric/fuel cell hybrid car. PURE provides a wide range of renewable energy services, including engineering consultancy, project management, R&D, and training courses.
- **Lews Castle College / Hydrogen Lab** - a teaching and research Hydrogen Lab with 80 fuel cells at a range of scales. By September 2011, a second hydrogen lab will be operational. It operates alongside a major facility in the Outer Hebrides to demonstrate the benefits of small scale renewables and the workings of the technology. A range of devices has been gathered in a compact area called the Renewable Energy Croft, which includes six wind turbines, four PV arrays, a ground source heat pump, and a range of solar collectors. A micro-hydro scheme is under construction on the stream running through the facility. Load generated on the croft is balanced by a large battery bank, hydrogen storage, and, as a last resort, a backup biodiesel generator which uses fuel processed on site. The project has demonstrated that it is possible to deliver a reliable supply from variable sources of energy.
- **H2seed** - The Hebridean Hydrogen Seed (H2seed) project created a renewable hydrogen production, storage and distribution facility at Creed Enterprise Park

just outside Stornoway. The H2seed Facility produces renewable, or "green", hydrogen by water electrolysis using excess power available from the bio-gas combined heat and power unit at the Comhairle's Integrated Waste Management Facility; the bio-gas is produced by anaerobic digestion of the organic matter contained in municipal waste. The hydrogen is compressed and stored in readiness for dispensing. Between June and August 2010 the Facility supplied renewable hydrogen to Royal Mail Group's trial of a hydrogen Ford Transit delivery van operating on regular delivery routes served by the Stornoway Delivery Office. During the six week trial the H2seed Facility performed 24 successful refuelling operations supplying a total of 71 kg of hydrogen as the vehicle clocked up 723 miles operation using hydrogen.

- **H2Growth** – The project aims to demonstrate hydrogen applications in a wider range of domestic and industrial contexts including transport and heat and power generation. The project will establish hydrogen fuel cell electric vehicles as pool vehicles for Comhairle nan Eilean Siar staff and establish a low carbon vehicle workshop facility at Lews Castle College to provide local training opportunities to support the regional deployment of battery electric and fuel cell electric vehicles. The project will continue the development of the H2seed Facility and install a hydrogen fuel cell system to increase the supply of renewable electricity to the Comhairle's Integrated Waste Management Facility.
- **Logan Energy** A fuel cell systems integrator with its HQ in Edinburgh, which has delivered a large number of commercial fuel cell projects worldwide, including a system which provides electrical energy, heat and cooling for Transport for London's Palestra building.

Key Actions

- **Raise awareness** of the benefits of hydrogen and fuel cells; demonstrate how the application of these technologies will complement and enhance the growth of Scotland's renewables sector.
- **Work with industry and regulators** to overcome the barriers to commercial deployment in Scotland.
- **Explore funding opportunities** to ensure Scotland plays a leading role in the emerging European market.
- **Engagement with stakeholders** to explore existing and emerging hydrogen **transport technology** and capacity to deliver emissions reduction through the use of renewables.
- Establish exemplar projects in appropriate locations to gather data to inform H2 infrastructure development.

Geothermal

Deep geothermal energy may represent a substantial and almost entirely untapped resource in Scotland. In particular, it could help realise our ambitions on renewable heat and given that it is naturally aligned with district heating and heat networks, there is the potential to improve fuel security and combat fuel poverty in deprived areas. Deep geothermal could also significantly contribute to our renewable electricity targets. In other policy areas, there is scope to regenerate brownfield sites, particularly disused mining sites, and there are obvious economic and job creation opportunities.

We recognise that commercial interest will depend upon a licensing framework being put in place (to protect exploration); clarity in planning; and high-level mapping of potential, and we are working towards ensuring all of these requirements are met:

- We are actively exploring the scope to license extraction in Scotland, including the demarcation of reserved/devolved responsibilities.
- We are also responding to the call for clarity in planning by including a new section on deep geothermal energy in our revised online planning guidance on renewables.
- Further research is still required to gain greater clarity on Scotland's geothermal potential and we will be commissioning a research programme in order to identify the next steps necessary in order to take forward the commercial exploitation of deep geothermal heat.

This is in line with recommendations set out by the International Energy Agency in their latest Technology Roadmap on Geothermal Heat and Power, where they called for national governments to step up research and development of geothermal energy if the technology is to become commercially viable.

Successes to Date

- **Shettleston, Glasgow:** Residents in the Glenalmond Street estate in Shettleston, a traditional inner-city area in Glasgow's East End, are utilising geothermal heat in their homes. A borehole of 100 metres depth is used to extract water at 12°C from flooded coal mine workings. The water is increased to 55°C using a heat pump and circulated to 16 newly built homes. The scheme has been successfully operating since 1999.
- **Planning guidance:** Web based renewables advice for planners was recently produced and now includes a section on deep geothermal energy. The advice will be regularly updated. (http://www.scotland.gov.uk/Topics/Built-environment/planning/National-Planning-Policy/themes/renewables/Deepgeothermal)

Key Action

- **The Scottish Government will commission a research programme** to identify the next steps that are necessary to take forward the commercial exploitation of deep geothermal heat (including the scope for licensing).

3.9 Community Renewables

Ambition and Targets

We wish to maximise the benefits for communities from renewables and to transform the level of opportunity for local ownership of energy. Our ambition is for all Scottish communities to share in the rich rewards of our next energy revolution.

Scotland is already leading the way across the UK in how it supports local ownership of renewable energy projects which provide wider community benefits.

We can achieve:
a new target of 500 MW community and locally-owned renewable energy by 2020.

To reach this challenging target will require concerted action from Government and industry, building on established policy.

Over the last year we have:

- Revamped our CARES grant scheme, to put in place a more sustainable financial model by offering loans in place of grants. We will learn from this to engage with investors to establish a new Scottish Green Equity Fund for communities.
- Led by example on how we maximise community benefit opportunities from renewable projects being developed on the public estate. Achieved a leading edge community benefit rate of £5,000/MW per year. We will continue to push industry to offer these rates.
- Led by example by making it a requirement of our loan scheme to have in place a binding legal agreement on community benefit, payments to begin when a project becomes operational, and continue for a period of 20 years.
- Consulted on how development of renewables and low carbon energy can be supported (http://www.scotland.gov.uk/Publications/2010/11/26094907/0).

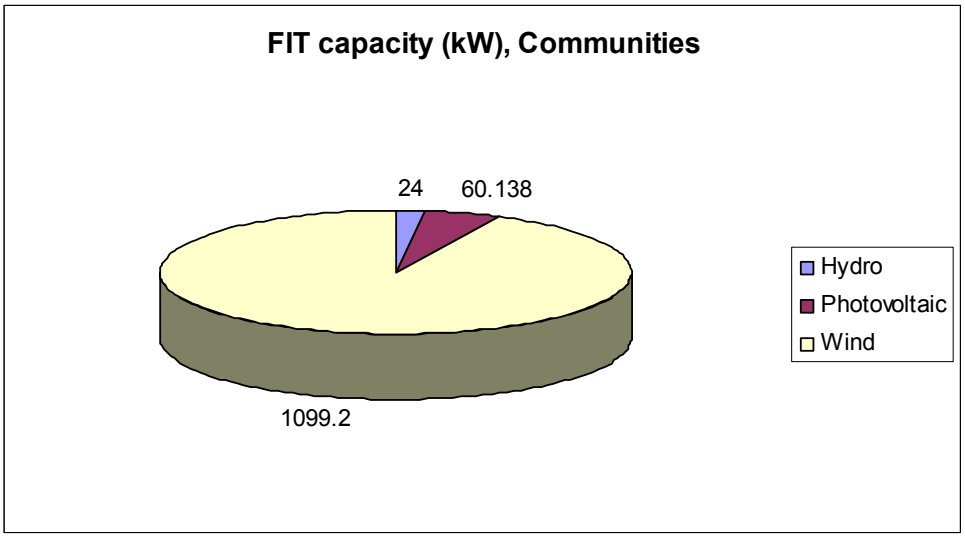
With the introduction of the Feed-in Tariff scheme in April 2010, we have seen a significant increase in interest from communities wishing to develop their own renewable projects, but there is still no “one size fits all model” for engagement and it is not for Government to tell communities what is right for them. Our role is to work with all parties to deliver a system that is simpler and which encourages the growth of the sector.

What we do need to ensure however is that there is clarity and transparency for communities seeking to derive benefits from commercial schemes. Our consultation above set out options to improve transparency, including setting up a public register for commercial community benefit payments and looking at the scope to include planning guidance on community benefits rates and methods, without subverting wider planning principles. We will follow up this consultation as a priority.

Current Deployment

There is no official record which captures all community renewables projects installed in Scotland, but it is clear that most community-owned schemes to date have been mostly very small scale:

- The FIT register, operated by Ofgem, records new community electricity projects in Scotland from 2010 as **1183.338 kW**, mainly wind, as illustrated in the following pie chart:



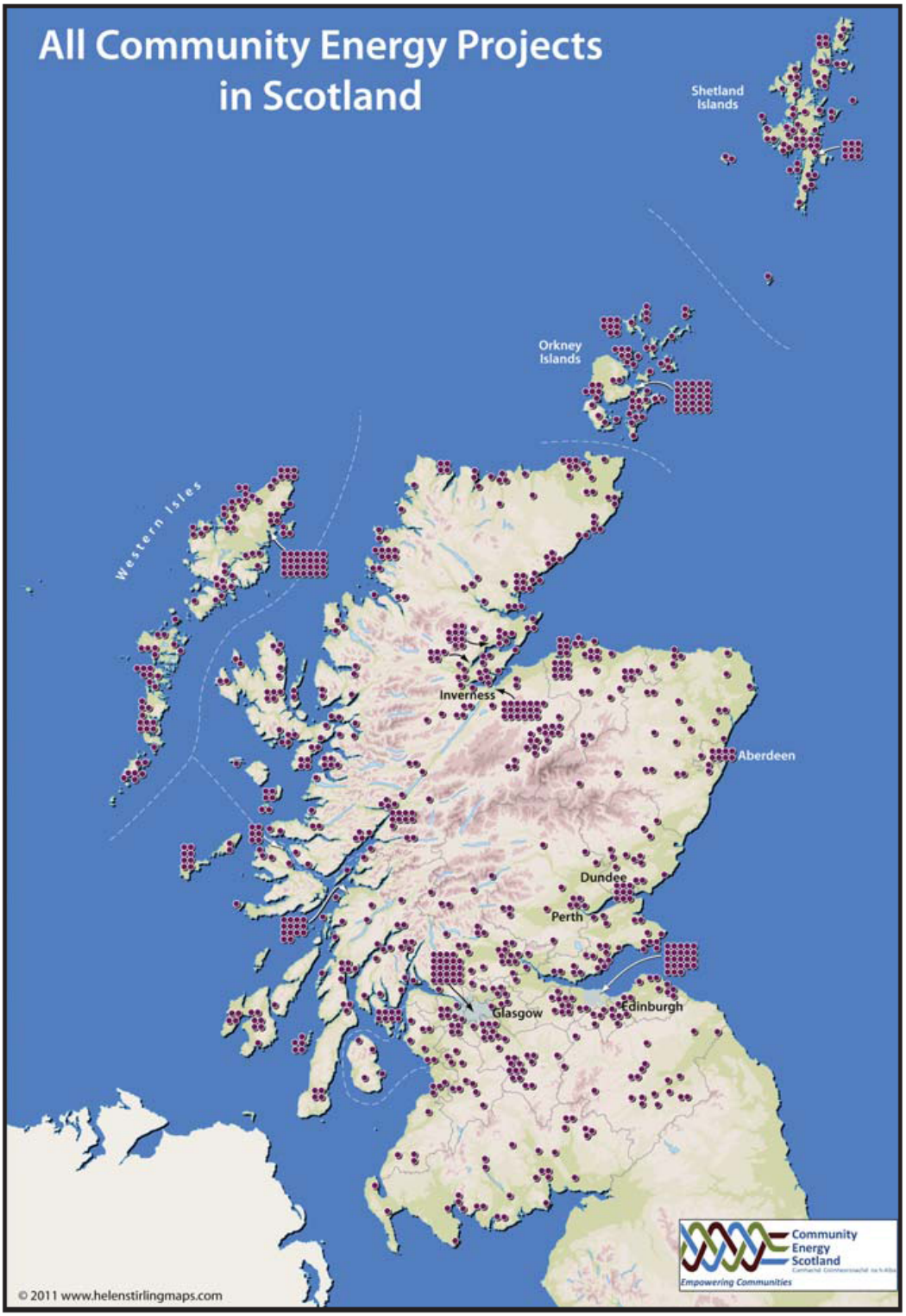
- The Scottish Government's Community and Renewable Energy Scheme (CARES) has assisted **105 electricity generating projects** over the last 2 years which will result in an installed **capacity of 53 MW**. The wider and social impact of these projects is estimated to generate on average **£2M over 20 years to local communities**.

The wider geographical spread of projects established over the past decade has been informally mapped (see following page) by Community Energy Scotland (CES), a charity that has helped to deliver support to community groups over a number of years. CES have identified 800 community-owned projects.

The vast majority of these projects are very small scale heat schemes, located in off gas grid areas, and designed to mitigate fuel poverty for community-operated facilities such as village halls Innovative deployment of resources include "wind to heat" designs in Shetland, exploiting high wind capacity factors, and overcoming lack of local resource for other forms of heat such as biomass.

Overall the historical rationale for such community installations has been to go green and save money and carbon. With the introduction of the FITS and the forthcoming Renewable Heat Incentive, the opportunity for local communities to make money, as well as to go green and save carbon is being keenly grasped, with the prospect of huge benefits for local regeneration. The Scottish Government's Climate Challenge

Fund has helped to create a pool of communities ready to exploit this opportunity to local benefit.



Deployment Potential

A report carried out for the Scottish Government by the Scottish Agricultural College and Community Energy Scotland in 2010 suggests that if risks could be reduced for the pre-planning stage of renewables projects proposed by communities and the rural sector, then there may be potential to provide up to 900 MW of renewable electricity and around 80 MW of renewable heat over a period of 5 years. Such scale of development would require a structured approach by planning officers to mitigate any potential issues around cumulative impact.

Link to Report: http://www.scotland.gov.uk/Publications/2010/10/01105500/0

Deployment Pipeline

As highlighted above, most of the community renewables schemes installed to date are very small scale heat based projects, but this should not be taken as an indication of deployment trends, given the transformative potential offered by FITS and RHI.

Work is in hand to construct a database to provide a clear baseline for development of locally owned energy schemes in Scotland. Community Energy Scotland estimate that there is potential for about 180 MW installed capacity of community owned renewables schemes currently under different stages of development.

Successes to Date

- **Launched a £7.75 million Loan Fund for communities**, focusing on pre-planning costs of developing renewable projects that will maximise local ownership of energy and secure wider community benefits. Over 280 expressions of interest have been received to date.
- Forestry Commission Scotland, leading the way on the public estate. Achieved a leading edge **community benefit of £5,000/MW per year**. Local communities also given opportunity to invest in scheme.
- **Published a Community Renewables Toolkit** to help communities develop and own renewables projects to secure maximum benefit.

Challenges to Deployment

	CHALLENGE
The cost of renewables	To put in place a long term, sustainable funding mechanism to address pre-planning risk and any market failure in terms of equity funding post-planning
Secure grid access	To ensure any barriers to grid access are removed
Skills	Individual communites' capacity to develop renewable projects is varied across Scotland. Important to ensure that we do not create a environment where commuities are either renewable rich or poor. Through CRIG and other government means important to address the needs of all communites across Scotland to engage in renewbles.
Public Engagement	Community renewables cover a wide spectrum of interests; the challenge will be to enusre that all support is integrated and streamlined to ensure a simpler system for all.
Planning	Challenge around maintaining clear advice for planning authorities in respect of community renewables / community benefit (SPP support for community renewables but community benefit not normally a material consideration (unless it meeets the tests set out in Circular 1/2010 Planning Agreements). Challenge of addresing potential cumulative impact issues arising from increased volume of community-scale schemes

Key Actions

- **Secure the establishment of a new Scottish Green Equity Fund for Communities.** In order to achieve our target of 500 MW of community owned electricity by 2020, we will identify a long term funding mechanism which will give communities the certainty and confidence to take forward projects. We will learn from the CARES loan fund in progressing this action.
- **Deliver a simpler system for developers and communities.** We recently consulted on how the development of renewable and low-carbon energy can be supported, while ensuring that Scotland and its local communities enjoy long-term returns from the assets on their door steps. Key to that will be to deliver a simpler system.
- **Ensure renewable projects developed on the public land are leaders in the provision of community benefit.** Forestry Commission Scotland is leading the way on the public estate. Achieved leading edge **community benefits of £5,000/MW per year**. We will use this as a benchmark for other developments on the public estate and to push industry to offer this rate.
- **Develop an agri-renewables strategy** to ensure that agriculture businesses are able to benefit from the renewables revolution and simplify the planning process to help achieve this. The Scottish Government will also consider the creation of local energy co-operatives.

4. Conclusion

This Routemap sets out a comprehensive path of actions to deliver on Scotland's ambition to be the green powerhouse of Europe. By setting Europe's most ambitious target for renewable electricity and putting in place the measures required to deliver it we are creating a competitive advantage for Scotland which will secure a prosperous and sustainable low carbon economy for the future.

Scotland is already leading the way in deploying renewable energy in the UK and in key sectors such as wave and tidal power and increasingly offshore wind. We now need to work together as a nation to turn this opportunity into real progress in sustainable economic growth which benefits all parts of Scotland and all communities, large and small. There are great opportunities for young Scots to develop successful careers in the low carbon economy.

We can only achieve these goals if we work closely in partnership with our neighbours in the British Isles and in Europe. Our high targets will make a disproportionate contribution to UK and EU targets and therefore help our neighbours as well as Scotland itself. Our growing skills and knowledge in this area will also allow us to work with countries from across the world to develop sustainable low carbon economies and to tackle climate change.

Our renewables ambition gives a clear answer to MacDiarmid's ironic question, “Scotland small? Our multiform, our infinite Scotland _small_?” By working in partnership on the wide range of activities set out in this Routemap we can make the real contribution to the future of our planet to which our country aspires.

Glossary of Terms

AD	**Anaerobic Digestion**
BiFab	**Burntisland Fabrications Ltd**
CAR	**Controlled Activities Regulations**
CARES	**The Community And Renewable Energy Scheme**
CCS	**Carbon Capture & Storage**
CES	**Community Energy Scotland**
CfD	**Contracts for Difference**
CHP	**Combined Heat and Power**
CLE	**Construction Licensing Exec**
CO_2	**Carbon Dioxide**
CRIG	**Community Renewables Implementation Group**
CT	**Carbon Trust**
DECC	**Department of Energy & Climate Change**
EfW	**Energy From Waste**
EMR	**Electricity Market Reform**
ENSG	**Electricity Networks Strategy Group**
ESF	**European Structural Funds/European Social Fund**
EST	**Energy Saving Trust**
ETP	**Energy Technology Partnership**
FCS	**Forestry Commission Scotland**
FFL	**Fossil Fuel Levy**
FITS	**Feed-in Tariff Scheme**
FQD	**Fuel Quality Directive**
FREDS	**Forum for Renewable Energy Development Scotland**
GB system	**Great Britain System (Grid)**
GHG	**Greenhouse gas**
GIB	**Green Investment Bank**
GP Wind	**Good Practice Wind Project**
GW	**gigawatt**
GWh	**gigawatt Hour**
HIE	**Highlands and Islands Enterprise**
HVDC	**High Voltage Direct Current**
ITREZ	**International Technology Renewables Energy Zone**
JIP	**Joint Investment Project**
kW	**kilowatt**
KWe	**kilowatt electrical**
LCVs	**Low Carbon Vehicles**
LTS	**Learning Teaching Scotland**
MAs	**Modern Apprenticeships**
MCS	**Microgeneration Certification Scheme**
MoD	**Ministry of Defence**
MW	**megawatt**
MWe	**megawatt electrical**
MWh	**megawatt hour**
MWth	**megawatts thermal**
NGenTec	**Noval Generator Technology for Green Energy**

NPF2	**National Planning Framework**
N-RIF	**National Renewables Infrastructure Fund**
NRIP	**National Renewable Infrastructure Plan**
OEMs	**Original Equipment Manufacturers**
OWIG	**Offshore Wind Industry Group**
PFOW	**Pentland Firth and Orkney Waters**
R & D	**Research and Development**
RAP	**Renewables Action Plan**
RED	**Renewable Energy Directive**
RHI	**Renewable Heat Incentive**
RHIG	**Renewable Heat Implementation Group**
RO	**Renewables Obligation**
ROC	**Renewables Obligation Certificates**
ROS	**Renewable Obligation Scotland**
RPP	**Reporting policy & proposals**
RSA	**Regional Selective Assistance**
SBSA	**Buildings Regulation Scotland**
SCHRI	**Scottish Community and Householder Renewables Initiative**
SDI	**Scottish Development International**
SDS	**Skills Development Scotland**
SE	**Scottish Enterprise**
SEA	**Strategic Environment Assessment**
SEGEC	**Scottish European Green Energy Centre**
SEL	**Scottish Energy Laboratory**
SEPA	**Scottish Environment Protection Agency**
SET Plan	**Strategic Energy Technology Plan**
SFC	**Scottish Funding Council**
SG	**Scottish Government**
SHFCA	**Scottish Hydrogen and Fuel Cell Association**
SMEs	**Small to Medium Enterprises**
SNH	**Scottish Natural Heritage**
SPP	**Scottish Planning Policy**
SRDP	**Scottish Rural Development Programme**
SSE	**Scottish & Southern Energy**
STEM	**Science, Technology, Engineering and Mathematics**
STW	**Scottish Territorial Waters**
SVQ	**Scottish Vocational Qualification**
TNUoS	**Transmission Network Use of System**
TW	**terawatt**
TWh	**terawatt hour**
UKAS	**United Kingdom Accreditation Service**
UKTAG	**UK Technical Advisory Group**
WATERS fund	**Wave and Tidal Energy: Research, Development and Demonstration Support**

Units of Electrical Energy

kilowatt	1 kilowatt is equal to 1000 watts
megawatt	1 megawatt is equal to 1000 kilowatts
gigawatt	1 gigawatt is equal to 1000 megawatts
terawatt	1 terawatt is equal to 1000 gigawatts

In the electric power industry, megawatt electrical (abbreviation: MW_e or MWe) is a term that refers to electric power, while megawatt thermal or thermal megawatt (abbreviations: MW_t, MW_{th}, MWt, or MWth) refers to thermal power produced. Other SI prefixes are sometimes used, for example gigawatt electrical (GW_e).

A kilowatt-hour is the amount of energy equivalent to a steady power of 1 kilowatt running for 1 hour.

To give some indication of scale,

- the average annual electricity usage by households in Scotland is 4.9 MWh
- a domestic electric kettle will typically be rated at about 2.5 kW
- the largest power station in Scotland (Longannet) can supply up to 2400 MW of electrical power
- over a year, 1 MW of installed renewable capacity is estimated to deliver sufficient electrical energy to power the equivalent of 470 average Scottish homes.

ISBN: 978-1-78045-271-5 (web only)

APS Group Scotland
DPPAS11805 (07/11)

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