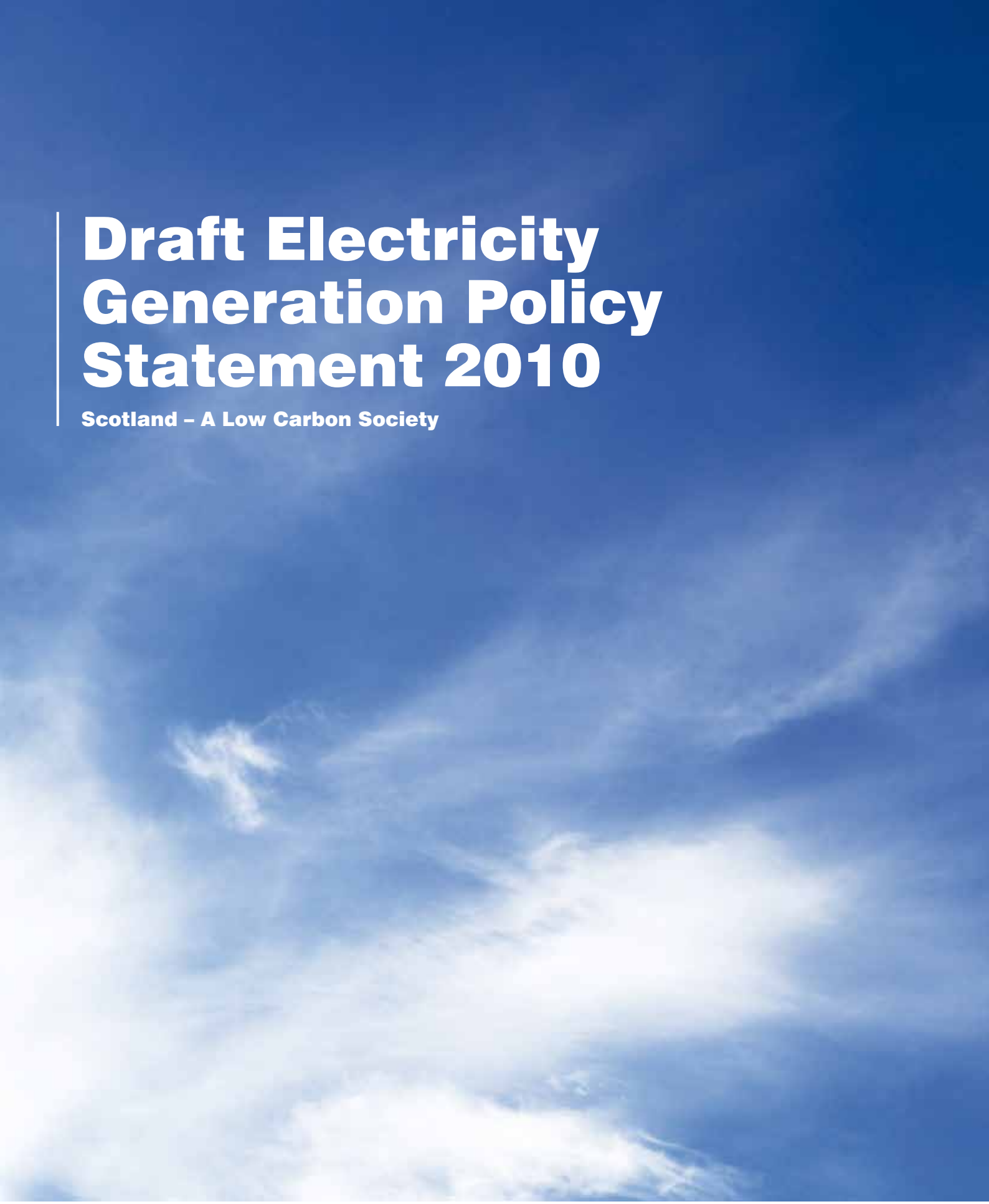

Draft Electricity Generation Policy Statement 2010

Scotland – A Low Carbon Society

The Scottish Government

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Scotland – A Low Carbon Society

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The Scottish Government
St Andrew's House
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EH1 3DG

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Draft Electricity Generation Policy Statement 2010

This report sets out the Scottish Government's latest position on the role of renewable electricity and fossil fuel thermal generation (coal, gas, oil) in Scotland's future energy mix. It gives a clear view on the need for both rapid expansion of renewable electricity across Scotland and the underlying requirement for new efficient thermal capacity in this low carbon generation portfolio. It is based on the latest 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 2nd National Planning Framework was published in June 2009.

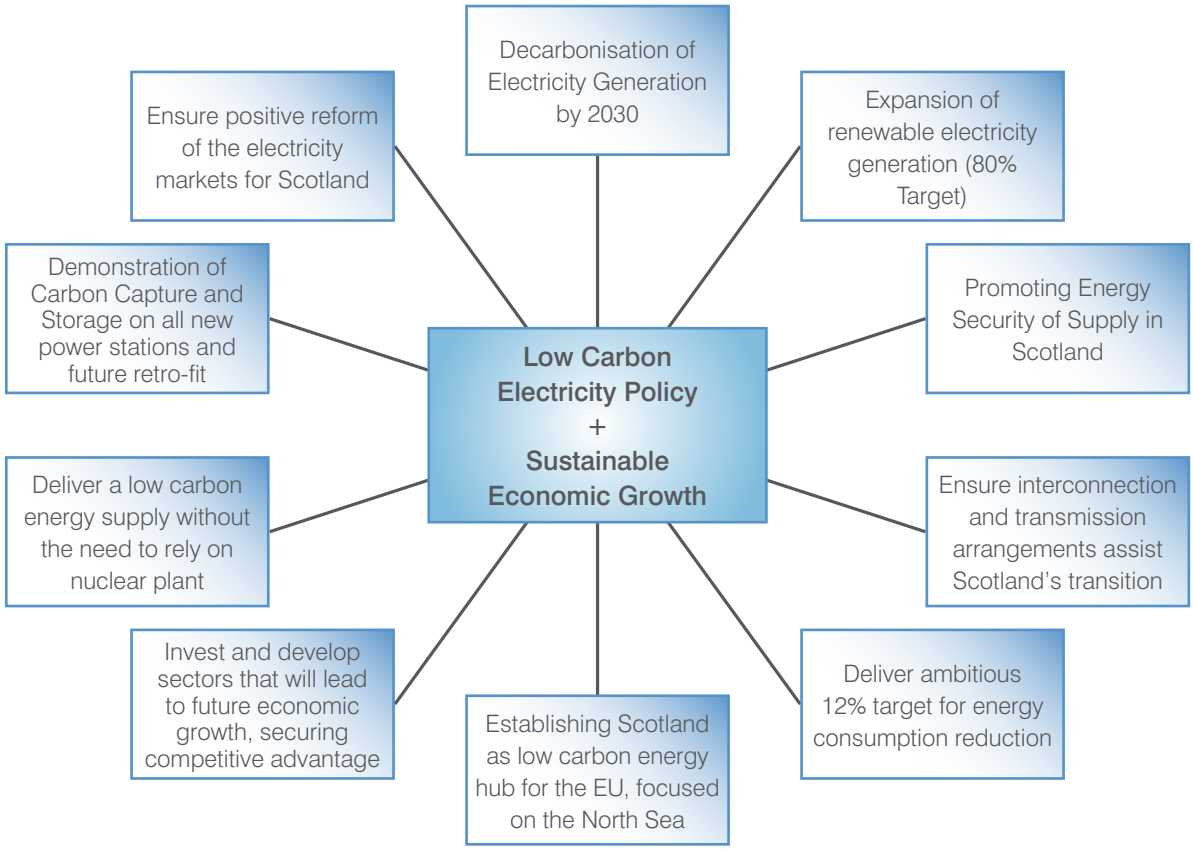
It sets out new developments and implications in the following four key areas:

- update the position on renewable generation
- update the position on thermal electricity generation
- update the position on energy efficiency
- update the position on transmission infrastructure and interconnection

These developments and implications for electricity generation are then analysed in the light of the latest research studies.

This draft report is published as a supporting document alongside the Climate Change Report on Proposals and Policies (RPP). It provides more detailed information about the policies that are presented in the Energy Supply chapter of the RPP and the rationale behind them. As a draft document, the Scottish Government welcomes comment from interested stakeholders on the policies set out below.

The report's issue also anticipates the statutory requirement under s.38 of the Climate Change (Scotland) Act 2009 for Scottish Ministers to report in respect of each year from 2010-2050 how exercise of their functions on electricity generation has impacted on net Scottish emissions. These years correspond to the years for which annual emissions targets have been or will be set. The first time Ministers will report on net Scottish emissions in relation to an annual targets will be in 2012, in respect of 2010. However, from next year onwards, in anticipation of the s.38 requirement, the s.38 report will provide an annual update on the issues outlined in this report. The drivers for this statement are illustrated overleaf:



Scottish Government electricity generation commitments

The Scottish Government's position on the role of thermal and renewable electricity generation is given in the context of our commitment:

- To decarbonise Scotland's electricity generation sector by 2030, in line with the recommendations of the Committee on Climate Change.

This statement on future electricity generation policy in Scotland contains important links to other important transitional low carbon outcomes for both renewable and waste heat. Working to decarbonise electricity generation by 2030 is entirely consistent with delivering our overarching climate change obligations under the Act, and will be complemented by moves towards the decarbonisation of the heat and transport sectors and by addressing emissions from agriculture, land use and forestry.

Our commitment to emissions reduction is also matched by our commitment to:

- ensure that Scotland continues to have a secure energy supply throughout the transition to low carbon energy, and to;
- ensure that Scotland can maximise our economic benefit and competitive advantage from the development of new low carbon energy resources such as CCS, offshore wind, marine energy, smart grids and offshore grids.

New Developments in Energy Sectors

Update the position on renewable generation:

- greater than expected penetration of wind energy in the future electricity generation mix, leading to a strengthening of our ambition for renewable electricity;
- publication of the industry-led Offshore Wind Route Map. This sets out the opportunities, challenges and the priority recommendations designed to help the sector realise its full potential, which is to maximise development and benefits from the construction over 10 GW of offshore wind capacity from the Crown Estate leasing zones in Scotland;
- the UK's most generous support for commercially deployed marine renewable energy projects (5 ROCs wave/3 ROCs tidal);
- the creation of a strategic Delivery Group following The Crown Estate's award of commercial leases to 10 projects to generate as much as 1.2 GW of marine energy in the Pentland Firth and Orkney Waters Leasing Round;
- Commitment of a combined £26m through the Wave and Tidal Energy Support (WATES) and its successor, WATERS. These awards and investments are supporting a number of marine energy projects at EMEC and elsewhere in Scottish waters;
- confirmation that that renewable electricity generation in Scotland reached 10,744 GWh in 2009;
- an increasingly clear role for energy storage and demand management systems that should ensure that intermittent renewable electricity generation can be matched more effectively to demand patterns than at present; and
- risk of a hiatus in the renewable heat market pending the introduction of a Renewable Heat Incentive at a UK level, reinforcing the need to maximise the efficient use of biomass supply for heat only and combined heat and power.

Update the position on thermal electricity generation:

NPF2 identifies a need for new baseload generating capacity to replace the power stations programmed for closure over the next 20 years. Since the publication of the NPF2, several developments have changed the policy context and the market fundamentals for thermal electricity generation in Scotland. NPF2 does not set policy in stone and energy policy has moved rapidly in the EU, UK and Scotland during the past year, in line with evolving technologies. We are now updating our expectations on the need for thermal electricity generation in the light of these developments:

- commitment by the Scottish and UK Governments that no new coal-fired power stations should be built without CCS fitted to at least 300 MWe of their capacity from day one, meaning that there can be no new unabated coal stations operated in Scotland;
- the commitment of the UK Government to support four CCS demonstrators, subject to decisions on financing via the CCS levy under the Energy Act 2010, with the potential for co-financing of up to two of these in the EU New Entrants Reserve competition;
- proposals from the Committee on Climate Change that one of the CCS demonstrators should be on a gas power station, which the Scottish Government has supported and which DECC has now adopted; and
- a range of new support measures for domestic and industrial energy efficiency in Scotland and the UK which should see greater reductions in demand.

Update the position on energy efficiency

Conserve and Save; the Scottish Government's Energy Efficiency Action Plan (EEAP) was published in Autumn 2010. It reaffirms our energy efficiency and microgeneration agenda for Scotland and sets out our wide-ranging programme of activity on behaviour change, household, business and public sector energy efficiency, infrastructure, skills, and finance. It builds on the consultation paper and the responses, and is a key component of our approach to meeting Scotland's climate change targets and securing the transition to a low carbon economy in Scotland.

The plan sets a framework for energy efficiency and microgeneration that furthers our climate change, economic and social agendas. It drives the cost-effective action required if Scotland is to meet its challenging statutory emissions reduction targets of at least 80% by 2050 and 42% by 2020, as set out in the Climate Change (Scotland) Act 2009. In doing so, it seeks to create employment, promote new technologies, and secure wider economic benefits for the low carbon economy. By reducing energy consumption, it aims to reduce costs for consumers whilst improving levels of comfort, and to improve Scotland's security of energy supply. The key actions relating to energy efficiency include to:

- improve the energy efficiency of all our housing stock to meet the demands of the future;
- establish a single energy and resource efficiency service for Scottish businesses;
- develop a public sector that leads the way through exemplary energy performance and provides the blueprint for a low carbon Scotland;
- reduce our transport energy demand, transforming how we use our transport systems;
- promote infrastructure improvements, e.g. by developing a sustainable heat supply; and
- ensure that people are appropriately skilled to take up the opportunities.

- The publication of the Energy Efficiency Action Plan established a Scottish Government target to reduce total final energy consumption by 12% by 2020. This will involve effort from all sources of energy consumption (i.e. heat, transport and electricity) across all sectors – domestic, industry, commercial, transport.
- This energy efficiency target is not simply business as usual and will require expenditure and action to achieve. However, meeting this target is consistent with the action required to achieve the Scottish Government's ambitious 42% emissions reduction target by 2020.

Update the position on transmission infrastructure and interconnection:

- delivering the Beauly to Denny consent in January 2010, with plans for the strategic set of grid upgrades across Scotland and highlighted in NPF2 – are now progressing;
- the publication of the Electricity Networks Supply Group (ENSG) study and a commitment by National Grid to reinforcement and upgrade of the Scotland-England interconnector which increases Scotland's capacity for electricity import and export to balance renewable intermittency;
- the parallel work on the need for new offshore grid connections and sub-sea cables, which will give Scotland greater capacity to import and export electricity to balance domestic supply and demand (route survey work on the West coast sub sea HVDC link from Hunterston to North Wales and Merseyside is already under way);

- changes in electricity regulatory frameworks for connection – with a connect and manage approach implemented in August 2010 to connect new renewable projects ahead of system reinforcement, with socialisation of the associated constraints costs;
- charges in transmission charging for wind generation based on system use rather than capacity that will facilitate connection and development of renewable energy;
- a fundamental review of transmission charging now underway by Ofgem through Project TransmiT which is now reviewing the GB gas and electricity transmission charging systems, to which the Scottish Government will input with a view to ending the current discriminatory locational charging element that mitigates against the development of renewable electricity in Scotland;
- the work by the North Sea Countries Offshore Grid Initiative to agree a memorandum of understanding to facilitate the development of a North Sea grid, which would substantially increase the potential for import and export of Scottish electricity, and which will be supported by the European Union's new Energy Infrastructure package; and
- the work of the Irish Scottish Links in Energy project, assessing options, opportunities and challenges for developing an offshore interconnected grid in the Irish Sea.

New developments which update the position on the electricity markets:

- as part of its first annual Energy Statement, the new UK coalition government announced that it will undertake a fundamental review of electricity markets, as well as a review of the role, powers and functions of Ofgem, and that it will consult on measures necessary to ensure decarbonisation of supply such as a carbon floor price, an Emissions Performance Standard, and low carbon capacity payments.

The Implications and Future Role for Energy Policy

Implications of these developments for the electricity generation statement

All of these developments – and especially the UK electricity market reform (EMR) exercise – will change the market fundamentals for investment in new sources of electricity generation. Given the wide-ranging scope of the EMR exercise – its potential to influence carbon prices, set emissions performance standards, and its impact on existing low carbon price support mechanisms such as the Renewables Obligation – the Scottish Government has a major interest its outcomes, and will be fully involved as the UK Government takes it forward. It is a real opportunity for the Scottish Government and the low carbon sector to make the case for reform so that we can realise the full potential of Scotland's low carbon assets and deliver greater market certainty for electricity producers and for consumers. The final decisions taken on EMR, and the new legislation that will be required to enact it, could have a substantial bearing on the policies set out in this Statement, and the 2011 s.38 statement will develop our thinking further in the light of the emerging proposals.

1). The role of renewable electricity generation

As highlighted by the new developments in renewable electricity detailed above, there has been a step change over the last few years in the contribution that these technologies could make towards both our climate change ambitions for decarbonisation and the provision of a secure and sustainable generation source. As such, the Scottish Government has increased the target level for renewable generation from 50% to 80% of gross electricity consumption in Scotland by 2020. The increased importance of renewable electricity in this statement reflects in part the success of the Scottish Government energy consenting regime, which remains committed to streamlining the consents process to meet a target of 9 months for determining Section 36 (Electricity Act) applications that do not go to public local inquiry. This Government has, to date, determined 43 projects in 45 months.

Biomass has a unique role to play in the generation of energy as it can be used for heat or electricity. In its liquid form, it can also be used for transport fuels. In terms of electricity generation, biomass can make a minor contribution to baseload and, if sourced locally, to security of supply. There is around 130 MW capacity for biomass electricity in Scotland, operating or in build, capable of making this kind of contribution.

Box 1: The Role of Biomass

Heat constitutes some 50% of the current total energy demand in Scotland. The Scottish Government has therefore placed a high priority on the achievement of our renewable heat target of 11% of heat demand to be sourced from renewables by 2020 (the current level of renewable heat is around 1.4%). This priority is strengthened by Scottish Ministers' obligation (under the Climate Change Act Scotland) to publish a Renewable Heat Action Plan and to keep it updated to 2020.

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.

Policy summary

The Scottish Government has set out its policy on biomass in the National Planning Framework II, s36 Thermal Guidance, and in the s36 Biomass Scoping Opinion guidance. This policy can be summarised as follows:

The Scottish Government would prefer to see biomass deployed in heat-only or combined heat and power schemes, off gas-grid, at a scale appropriate to make best use of both the available heat, and of local supply.

The rationale for this policy is clear:

- Evidence suggests that the use of biomass for heat-only or combined heat and power use will be essential in order to meet Scotland's target for renewable heat[1];
- Use of available heat in heat-only and CHP schemes achieves 80-90% energy efficiency for the former and 50-70% for the latter as opposed to 30% in electricity-only schemes. Clearly with a limited resource, maximum efficiency needs to be encouraged;
- The use of biomass first and foremost off the gas-grid ensures the highest carbon savings (given that in most cases it will be displacing oil or coal), and can also make the greatest impact on alleviating fuel poverty;
- Whilst the Scottish Government is not categorically opposed to large scale development, it is likely that the larger the proposed scale, the more difficult it will be for the developer to utilise the heat generated and to source supply locally. Hence any development should be scaled appropriately to make efficient use of the available heat and local supply. Large scale developments which do not maximise heat use may also displace supply from our priority of delivering our heat target;

[1] http://www.sd-commission.org.uk/publications/downloads/SDC%20Renewable%20Heat%20Report.pdf

- The use of local supply minimises carbon emissions from transport and provides the best opportunities for economic and employment benefits. It also decreases the risk to security of supply and ensures the development can act as a decentralised energy plant, in line with stated Scottish Government aims. Scaling in accordance with local supply may also help to reduce the impact on other competitors, such as the timber processing industries which deliver low carbon products for the construction and other sectors and contribute to economic development; and
- There may be a significant role for imported biomass. However, the global market is an immature one and is likely to be volatile given projections of increased global demand. Its use will be dependant on price, availability and evidence of sustainability. As with the local resource, its use should be in plants that support maximum heat use and de-centralised energy production.

Next steps: review of support

The Scottish Government has signalled its intention to review support for biomass in order to ensure that it is aligned with the policy rationale above. This review will include consultation on future support for biomass electricity under the Renewables Obligation Scotland, due to take place in 2011, and will take into account the likely impact of the Renewable Heat Incentive being introduced at a UK level.

Box 2: Energy from Waste (EfW)

The Scottish Government believes that energy generated from waste (EfW) has a contribution to make to meeting Scotland's energy requirements. Anaerobic digestion has an important role to play in helping Scotland become a Zero Waste society, diverting food, garden and other organic waste from landfill, reducing methane emissions, producing fertiliser or soil additives for use on local farms, reducing climate change impacts, and creating biogas which can be used as a renewable energy source.

Energy from waste combustion processes (i.e. incineration, pyrolysis and gasification) can also make a contribution to both renewable energy and climate change targets, recovering value from resources that cannot be reused or recycled and would otherwise be lost in landfill, and offsetting consumption of virgin fossil fuels. The Scottish Government's Zero Waste Plan includes a commitment to regulate the types of waste that may be used in energy from waste combustion processes, to ensure that they are only used for materials that cannot be reused or recycled to yield greater value.

2). The role of electricity generation from thermal plants

The market will continue to bring forward proposals for new or upgraded thermal electricity generation capacity in Scotland – as is already the case with new applications for developments at Hunterston and Cockenzie currently going through s.36 consent procedures. Nevertheless, the introduction of the CCS levy, the 300 MWe CCS requirement, and the proposed UK carbon floor price and Emissions Performance Standard, mean that thermal plants will be operating in a highly regulated – and increasingly constrained – market.

It has never been the intention of the Scottish Government to support unabated new coal plants in Scotland. Such an approach would be wholly inconsistent with our climate change objectives. That is why we have made it a clear requirement that any new power station in Scotland must be fitted with a minimum CCS on 300 MWe of its generation from day one and why we are committed to decarbonising electricity generation by 2030 through a combination of renewable electricity and fossil fuels with CCS.

Box 3: Policy on carbon capture and storage on new thermal generation

The building of any new thermal-based stations requires consent from Scottish Government Ministers under section 36 of the Electricity Act 1989. In November 2009, the Scottish Government announced its intention to require CCS to be fitted to all new coal-fired power stations as follows:

- From 9 November 2009, any application for a new coal plant in Scotland will need to demonstrate CCS on a minimum of 300MW (net) of capacity from their first day of their operation;
- Further new builds from 2020 would be expected to have full CCS from their first day of operation;
- With regard to retro-fitting of existing coal plants, a 'rolling review' of the technical and economic viability of CCS will take place with the aim of taking a final view on retro-fitting by 2018, with the likelihood of having existing plants retro-fitted by no later than 2025; and
- If CCS is not seen as technically or financially viable at some stage in the future then alternatives will be considered based around the Emissions Trading Scheme, including the possibility of an Emissions Performance Standard.

This policy relates to coal stations only. The Scottish Government's position on gas, oil and thermal stations is that for stations over 300 MWe, applicants will have to demonstrate that any new applications demonstrate carbon capture readiness.

In sum, this means that our policy for reducing emissions from thermal generation is that CCS should be fitted to new or existing Scottish coal power stations by 2020, to be economically and technical proven by 2020 and progressively fitted to all coal and gas thermal plants thereafter by 2030.

As we have set out in our CCS Roadmap, published in April 2010, Scotland has considerable natural advantages in CO_2 storage, alongside our world-leading research and development expertise. Our ambition is for Scotland to lead the UK and EU in the development of CCS, and to maximise our competitive economic advantage through demonstrating this technology on Scottish power plants such as Longannet, which is now the UK's leading CCS project. This is a technology which can then be exported to meet the IEA's scenario of CCS providing 20% of global emissions reduction.

Box 4: Policy on waste heat from large thermal electricity and CHP plants

The Scottish Government is undertaking a research project to obtain an understanding of the economic and technical potential for using waste heat from large scale power stations and Combined Heat and Power (CHP) plants in Scotland to provide heating through local district heat networks and in other industrial applications.

- Power stations generating electricity are approximately 35% efficient in converting fuel to electricity, with the remainder being discharged as waste heat. If this waste heat is captured then significant amounts of fossil fuel use can be avoided; and
- There are approximately 2.4 million households in Scotland, using on average 20MWh of heat energy each per year. Combined to this are other large-scale users of heat such as public buildings, sports and leisure facilities, hospitals, schools and commercial buildings. These buildings have varying heat requirements for space heating or hot water and have peak loads at different times.

The Scottish Government recognised the opportunity for waste heat to increase energy efficiency and reduce Scotland's greenhouse gas emissions in the Energy Efficiency Action Plan, published in October 2010.

The Scottish Government has decided that as part of any future application, either for new or significant retrofitting for any thermal electricity generating station (gas, coal, biomass etc.), developers will need to provide evidence that they have demonstrated how waste heat from any thermal station could be utilised by residential or non-domestic developments including public buildings and industry. The application would need to demonstrate that a feasibility study on the use of heat had been undertaken and that discussions with local authorities had also been held to investigate the potential demand and identify users of the heat.

3). The effect of energy efficiency improvements on electricity generation

The Energy Efficiency Action Plan for Scotland sets out the framework for the Scottish Government's comprehensive approach to energy efficiency and microgeneration. It focuses on their contribution to energy and economic development, their role in reducing energy consumption in buildings and transport, and their role in delivering climate change targets.

Box 5: Policy on energy efficiency

In order to deliver the targets set in the Climate Change (Scotland) Act 2009, we must deliver a step-change reduction in energy use and move to non-carbon alternatives. Section A of the Energy Efficiency Action Plan reinforces the urgent need for action on energy efficiency. It outlines the challenge, our vision, and our approach. Section B introduces a headline target to reduce Scottish final energy consumption by 12% by 2020, with an indication of how this will be monitored. It also outlines a reporting framework with a number of key indicators that will provide supportive information to the headline target, and highlights a range of areas where the Scottish Government intends to improve data gathering, monitoring and reporting of key energy efficiency action. Section C outlines our actions, programmes and support across the following priority areas:

- We will focus attention on understanding and shifting behaviour through our co-ordinated approach to Climate Change research, sustainability in education, and influencing practical behaviour through social marketing, information and advice;
- Improving the energy efficiency of the domestic sector is vital, as around 29% of all energy consumed in Scotland is used in our homes for space and water heating, cooking, lighting, and running electric appliances;
- We will support businesses to maximise competitiveness through the improved energy efficiency of non-domestic buildings and business processes and by taking advantage of the opportunities that energy efficiency will offer in the transition to a low carbon economy;
- We will provide clear energy efficiency guidance and leadership to the public sector to enable the delivery of energy saving improvements and exemplary behaviour;
- We will drive improvements to the energy efficiency of Scottish building stock through building standards;
- We will proactively support developments across the built environment which strengthen the impact of energy efficiency;
- We will create an energy and fuel efficient transport system as part of our drive towards a low carbon future for Scotland;
- In making the most of the new opportunities presented by energy efficiency, we will ensure that our training and education systems are ready and capable to develop the required skills and knowledge so that as many people as possible take up the openings in employment';
- We will pursue our work on financing energy efficiency on three fronts:
  - making the case for spending on energy efficiency in future budgeting decisions as part of the broader climate change and economic agendas;
  - seeking to maximise the contribution that other public funding can make to energy efficiency, e.g. from Europe; and
  - exploring new finance mechanisms.

- We will seek to drive forward energy efficiency through our partnerships within Scotland and our national and international engagement, using these to promote and learn from best practice.

The actions set out in the Scottish Government Energy Efficiency Action plan will work in conjunction with the ambitions set out in this electricity generation statement. The combination of reducing demand and incentivising clean supply will provide the most efficient route towards decarbonisation.

4). The role of upgraded transmission infrastructure and interconnections:

Box 6: Policy on transmission infrastructure and interconnections

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 are working to deliver a strategically-planned onshore and offshore electricity transmission network to connect and transport Scotland's vast offshore renewable energy potential.

The existing approach to energy regulation for access and use of the UK electricity grid works against the interests of Scotland's energy industry and impacts on delivery of Scottish, UK and European renewable energy and climate change policies and targets. The locational charging methodology applied by Ofgem levies higher charges on generators furthest from the main centres of demand for connection and use of the grid. 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 renewable energy targets. We have consistently pressed for a more equitable approach, and welcome the review of charging in Project TransmiT launched by Ofgem in September 2010. This must deliver fundamental and lasting change for a more equitable charging regime.

The Scottish Government is also working to develop interconnections and offshore grid. Making the a UK and EU interconnected Grid concept work requires a 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 the GB system (ands between Scotland and England in particular) and at connecting both our onshore and offshore renewable generators. The Electricity Networks Steering Group (ENSG) Vision 2020 report (published March 2009) identified the need for a range of grid reinforcement in Scotland, including two cables linking Scotland to the Southern part of the UK.

- a West Coast 1.8 GW High Voltage Direct Current (HVDC) link between Hunterston and Deeside – attracting investment of around £760M. Planning for this is underway and the target for commissioning the link is 2012/13; and
- an East Coast 1.8 GW HVDC link between Peterhead and Hawthorne Pit in Humberside – attracting investment in the region of £700M – the target for commissioning this link is 2018.

At inter-nation level, the Scottish Government is working In partnership with the Governments of Ireland and Northern Ireland on a feasibility study of offshore transmission grid to exploit offshore energy off our west coasts. This Irish Scottish Links in Energy Study (ISLES) project will become a key building block in delivering sub-sea grid in the Irish Sea. It will report by the end of 2011.

The Scottish Government is working with British Isles colleagues through the British Irish Council framework and an agreement was signed in June 2010 on areas of further joint working on grid development.

The Scottish Government is part of the Adamowitsch Working Group on North Sea grid connections. The Group is a unique forum for sharing information and learning about projects, developments and studies across Member States, helping deepen collective knowledge of offshore development and to promote Scotland's role and potential.

It has identified significant issues to be addressed – around interconnection, standardisation of regulatory and legal frameworks, financing development and political will. A Memorandum of Understanding between 9 Member States and Norway will be signed on 2 December committing to further joint work on: Grid configuration and integration; Market and Regulatory issues; Planning and authorisation procedures. The Scottish Government is working closely with the UK and the Irish Governments on this.

In order to give greater information on the likely scenarios for new low carbon electricity generation in Scotland in the light of the developments in the four key areas above, the Scottish Government has conducted an internal analysis on the future of electricity generation and transmission in Scotland. This work considers the constraints and presents a number of indicative scenarios that would enable us to meet our energy objectives for decarbonisation, security of supply, and for securing economic benefit for Scotland through the development of renewable technologies and carbon capture and storage.

Analytical Review of Electricity Generation and Transmission

The future electricity generation mix in Scotland should be, and will be, decided by the markets in the context of government regulation and incentives giving clear certainty on the expected direction of low carbon electricity development. UK wide reforms to these markets will therefore have a significant impact on the economics of the different sources of electricity generation.

The renewable electricity target was recently raised to 80% of gross electricity consumption by 2020, based on expectations of what the renewable industry could deliver by 2020, under current market conditions. However, there is the potential that the UK wide Electricity Market Reform (EMR) could radically alter the incentive mechanisms for renewables and other forms of generation. Changes could include:

- Carbon price support – which could deliver support for nuclear/CCS plants;
- Capacity payments – which could provide incentive for CCGT stations to operate as a 'shadow' plant to balance supply and demand;
- Reform to the Renewables Obligation and CCS Levy (e.g. partial replacement of the RO with a contract for difference/FIT mechanism); and
- Introduction of an Emissions Performance Standard to limit emissions from coal and gas power stations and to incentivise the deployment of CCS.

However, while attempting to address a number of market failures, the UK Electricity Market Reform project will fall short of providing a perfect market environment to achieve all of the objectives needed to move towards the vision of a low carbon Scotland. This is partly because of the Scottish Government's greater ambition for renewable electricity generation and interconnection, and the greater percentage of natural resources from sources such as offshore wind, wave and tidal located in Scotland. This will require the Scottish Government to use the powers at its disposal – particularly over the consenting of new electricity generation and transmission infrastructure onshore and offshore.

OBJECTIVE: Secure and Affordable electricity supply

The main objective in determining a stable and desirable future generation mix for Scotland is that the system must offer a secure source of electricity supply, at an affordable cost to consumers, whilst ensuring that this supply can be decarbonised by 2030.

The Scottish Government believes that the following targets will drive progress towards this low carbon Scotland and maximise economic and environmental benefits:

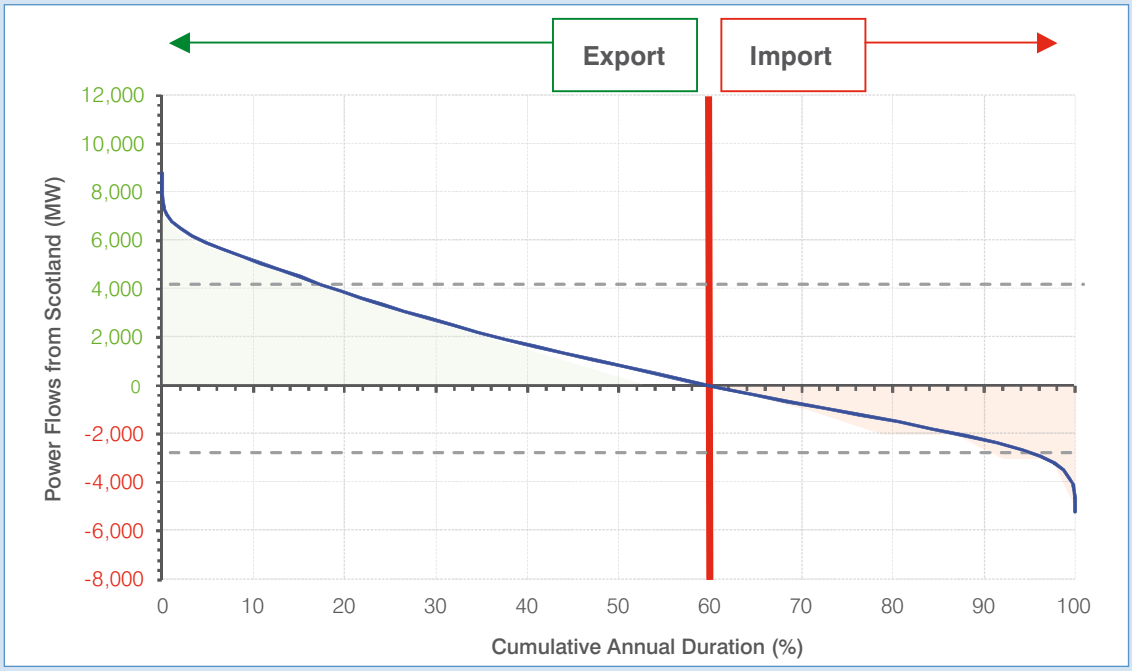
- Delivering at least 80% of gross electricity consumption from renewables by 2020;
- Lowering final energy consumption in Scotland by 12%;
- Demonstration of CCS at commercial scale in Scotland by 2020 and full retrofit across coal and gas power stations thereafter by 2025-30;

- Seeking increased interconnection and transmission upgrades capable of facilitating projected growth in renewable capacity; and
- Based on independent assessment of the economic dispatch of generation sources in Scotland under current market circumstances and in the current constrained transmission system[2], the following evidence supports our current energy policy for a higher renewable electricity target and route to market for backup thermal electricity generation with CCS. These interactions can be observed in the following charts.

Box 7: What the graphs show:

- The charts show the economic dispatch of a specific generation mix scenario based on merit order using a half-hourly GB dispatch model. The blue line in the chart below represents one generation mix scenario in one year.
- The power duration curves show the amount of time that power flows are above a certain value (net exports would equate to the time above the line minus the time below the line in the example below it would be the green area minus the red area).
- The charts also show the transfer limit for export and imports given the current and proposed interconnection limits, (represented by dotted grey lines).

Example 1: Hypothetical Power Flows Diagram



- One point that should be drawn from the example chart above is that the green area where the power duration curve is above the dotted line and the red area where it is below the dotted line represent output that would be constrained off, as it cannot flow over the interconnector.

[2] Evidence based on the Energy Storage and Demand Management Study, October 2010

The charts in Figures 1 and 2 provide analysis using power duration curves, which are based on the approximate generation mix Scotland could move towards under:

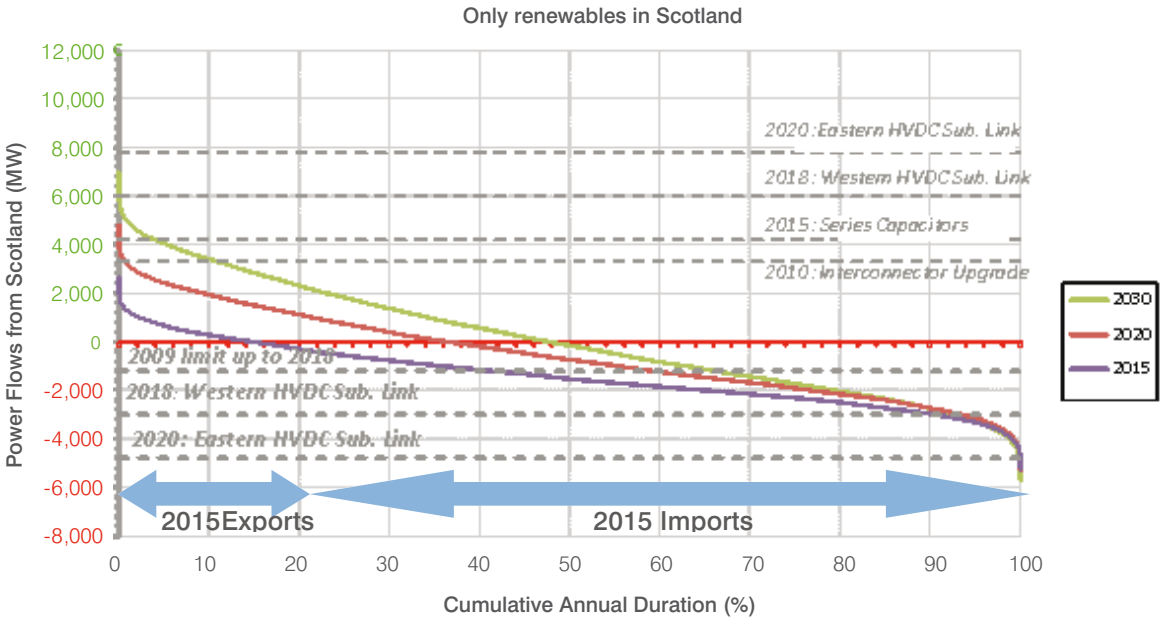
- A renewables target equivalent to 80% gross electricity consumption
- Around 2.5 GW of new build thermal electricity generation capacity, which Scottish Government consents policy would ensure was progressively fitted with carbon capture and storage technology (300 MW net from day one).
- The gradual phasing out of nuclear plant in Scotland.

A number of analytical findings can be drawn from these curves:

Renewable Electricity Generation in Isolation

- Figure 1 below represents economic dispatch of only renewable capacity in Scotland, under a generation scenario consistent with an 80% renewable electricity target. This would require between 10.5 GW and 12.5 GW of renewable capacity to achieve this target, depending on the load factors assumed.

Figure 1: Power Duration Curve – Only Renewable Generation



Source: Scottish Government Energy Storage and Demand Management Study, October 2010

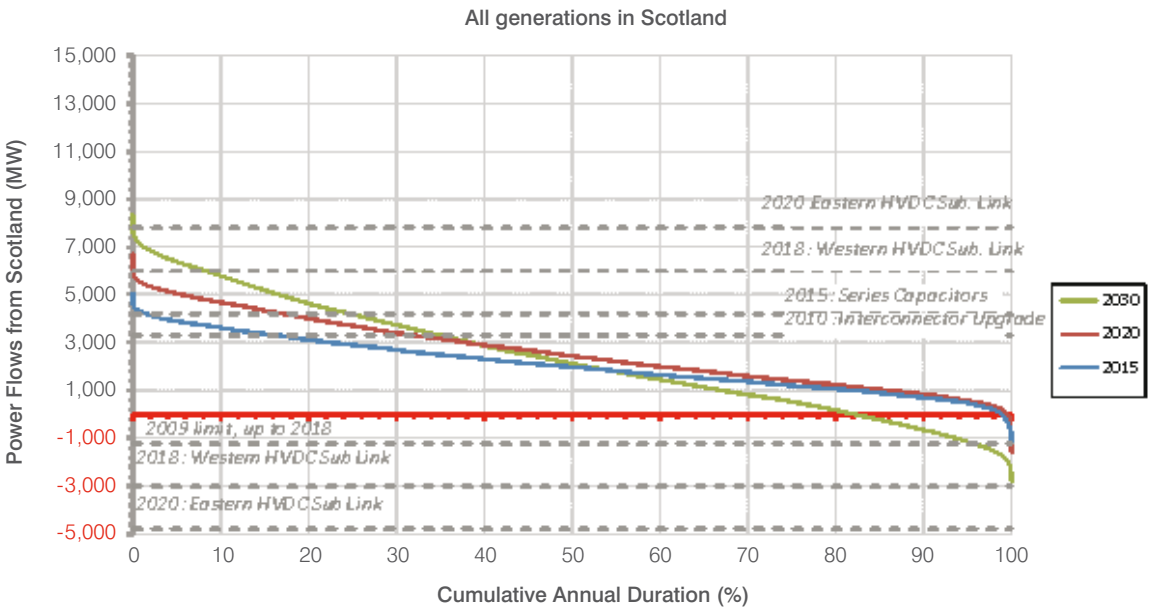
- The three coloured lines represent power flows in 2015, 2020 and 2030. These demonstrate that renewables alone cannot provide the security of electricity generation that would be required. The lines to focus on are the 2020 and 2030 lines as an 'only renewable dispatch' scenario would be unrealistic with the current baseload provisions prior to this period. In the 2020s and 2030s the curve demonstrate that without thermal electricity generation dispatch, Scotland would require to import electricity for between 50% and 60% of the time.
- Another more significant point is that at the end of the chart (i.e. the final 1% – 2% of the time) the power imports could exceed the maximum current and planned interconnection to Scotland.
- Due to the intermittency of renewable generation there will also be time periods when large amounts of electricity will need to be exported. To some extent by 2020 and more significantly by 2030, this export capacity may exceed the interconnection proposals, therefore requiring either further interconnection infrastructure to be constructed (in addition to that planned) or the construction of energy storage projects or demand management technologies.

Why a Balanced Generation Portfolio is Needed

Figure 1 above provided an illustration of the generation mix with only renewable generation economically dispatched. There were clear constraints with this approach and significant security of supply concerns. However, we can consider a similar generation mix scenario that also includes thermal electricity generation plant operating on an economic basis.

- In this example (Figure 2), the required imports – at times when intermittent renewable generation is not able to produce electricity and thermal stations cannot meet demand – are much lower (around 18% of the time by 2030 and this is completely offset by the 82% of the time Scotland will be exporting power – this would result in a generation mix with a large net export potential) while remaining within the interconnection constraints.
- Apart from at the extreme, the export potential is maintained at a level that is within the transmission and interconnection constraints, providing all planned ENSG upgrades are taken forward and completed on time.

Figure 2: Power Duration Curve – All Generation in Scotland



Source: Scottish Government Energy Storage and Demand Management Study, October 2010

- We can also observe from the chart above that by 2030 Scotland will require to import electricity for a larger proportion of the time, but conversely we will be able to export electricity for a much greater proportion of the time. This highlights the key benefits that increased electricity storage and demand management can deliver.

This analysis does not consider the full extent of regional and distributional considerations that may be involved with this level of interconnection across Scotland and Northern England. These factors could suggest an even stronger requirement for demand responsive, baseload or large-scale centralised generation plant to be located in specific areas within Scotland.

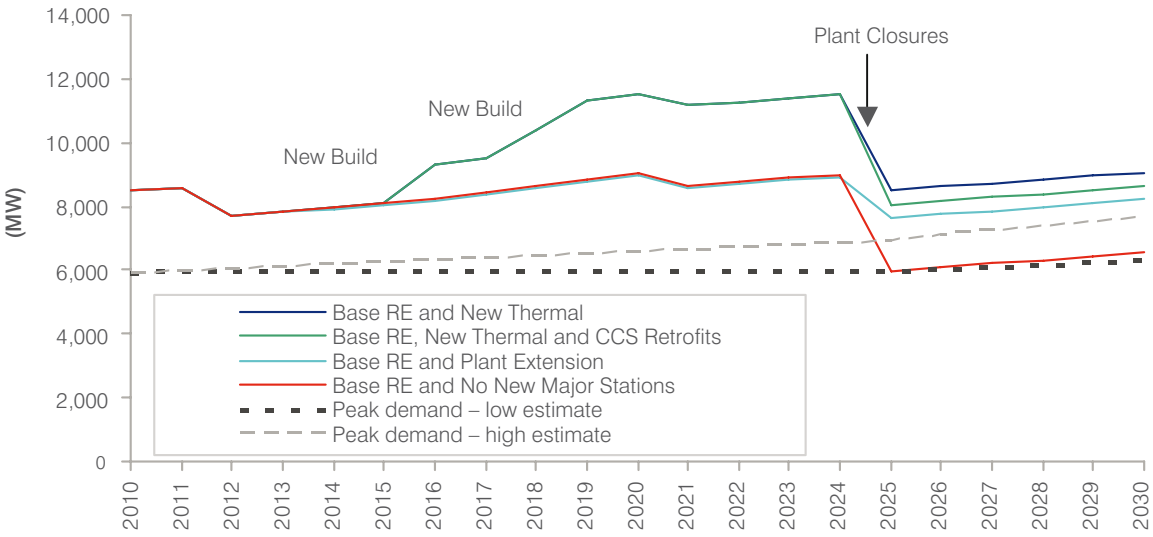
The conclusions that can be drawn from the analysis above are that:

- Firstly, a target to generate at least 80% of gross electricity consumption from renewable sources does not place an extensive burden on the transmission system and therefore would not lead to significant costs being passed on to consumers across the UK.
- Secondly, it is clear from the charts above that renewables alone are not sufficient to deliver secure and affordable electricity. These charts demonstrate how new build thermal plants for generating electricity can assist Scotland in achieving a more balanced generation portfolio, and can reduce the cost burden that may be passed on to consumers in the absence of these plants.
- Thirdly, it demonstrates the benefits that increased interconnection or the combination of energy storage and demand management measures can bring.

Some Indicative Scenarios to Examine Other Considerations

Figure 3 demonstrates that the ability to meet the momentary peak demand in Scotland post 2024 is compromised in the absence of any new thermal plant build – even under expectations of ambitious renewable capacity deployment (again consistent with renewable generation achieving 80% of gross electricity consumption by 2020) and extension to one of the Scottish nuclear plants' closure date. However, as illustrated by the light blue line (Base RE and Plant Extension scenario), the extension of existing thermal plant can help to uplift the de-rated capacity above the minimum levels.

Figure 3: De-rated Capacity[3]



Source: Scottish Government, Base RE refers to renewable electricity and is consistent with the 80% target.

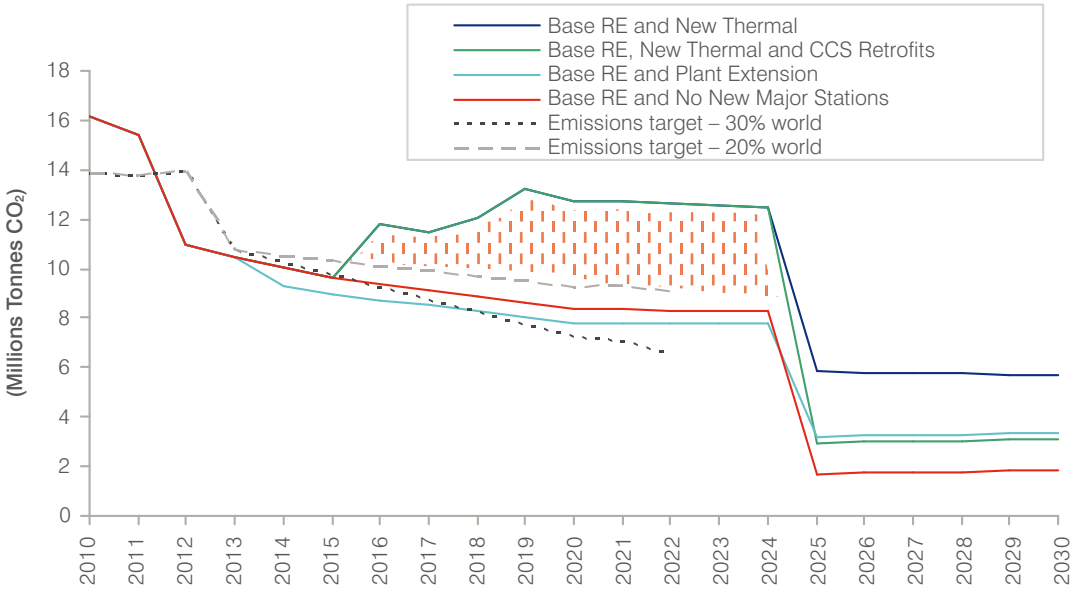
OBJECTIVE: Decarbonisation of Electricity Supply

The second aspect of a desirable future generation mix is decarbonisation of the electricity supply. The following analysis and charts provide useful illustrations of this transformation to a decarbonised Scottish generation mix, an objective that is achieved in the long-term (i.e. to 2030) by all the scenarios considered.

Figure 4 plots the modelled emissions from the scenarios against Scotland's power generation sector share of the EU ETS cap. The dotted lines illustrate the current 20% ambition level and the proposed 30% EU ambition level. This provides some useful context in terms of the source based emissions in Scotland.

[3] All scenarios consistent with 80% renewables target, where new build is identified this suggests the construction of between 2.5 GW and 3 GW of (either coal or gas capacity) and plant extension implies the upgrade and extension of existing large scale coal plant,.

Figure 4: Scottish Territorial Emissions



Source: Scottish Government, Base RE refers to renewable electricity and is consistent with the 80% target.

Box 8 outlines the key role the EU ETS will play in the decarbonisation of electricity generation and the progress towards the 2020 emission reduction targets and how this relates to the territorial emissions illustrated by Figure 4.

Box 8: The EU ETS

All emissions from electricity generation fall within the traded sector and for consistency with international accounting methodologies, the Net Scottish Emissions Account will record emissions from this sector as Scotland's share of the declining cap set by the EU ETS, regardless of total electricity production or the amount of renewable electricity.

Therefore, while territorial or source-based emissions provide an indicative trajectory towards long-term decarbonisation, these will not impact on the achievement of the emission reduction targets or the overall EU level of emissions.

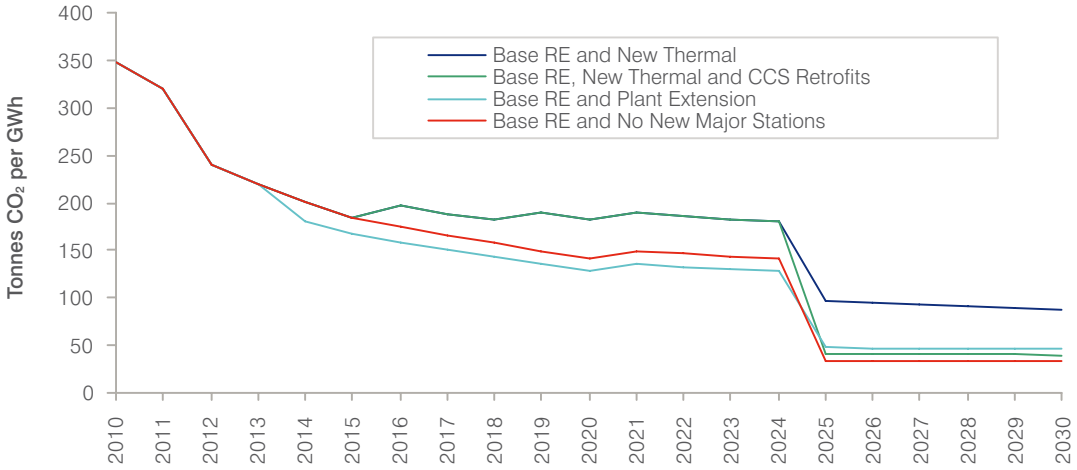
For example, if a new build fossil fuel plant in Scotland is constructed, from 2013 it will be required to purchase all of its carbon permits at auction. The purchase of these permits will fund more cost-effective emission reduction elsewhere in Europe – this is why the actual emissions from fossil fuel plants are not counted in the net emissions account (as it would be double counting global emissions reductions).

Understanding the role that the EU ETS and carbon price has, it is still helpful to consider the potential territorial emissions trajectory – i.e. the actual emissions associated with electricity generation in Scotland. A timely path towards decarbonisation in Scotland will improve local air quality, ensure economic benefits and help Scottish installations avoid the purchase of ETS permits. The scenarios illustrated by Figure 4 support the following conclusions:

- the scenarios with new build fossil fuel plant will temporarily increase the territorial emissions above the indicative trajectory of the power sector share of the ETS cap (as demonstrated by the dotted shaded area of the graph). The graph demonstrates that all the scenarios, where CCS becomes technically and economically feasible, will fall in line with this trajectory once the existing less efficient thermal plant is retired and the CCS retrofits are proven technically viable to roll out across the entire thermal generation fleet assumed to be 2025 in the indicative analysis below.
- The graph also indicates that it would be possible for Scotland's territorial emissions from electricity generation to remain consistently below a 20% emissions cap, and a 30% trajectory with either no new major stations or with plant extension. However it is also clear from the graph the potential increase in territorial emissions (over a 2015-2025 period) from new build thermal while only at the CCS demonstration phase.
- This analysis is based on output and therefore emissions under current market arrangements; for example, if a gas plant were to be constructed it would have to operate at a minimum load factor to be economically viable for investment. However, market reform – such as the introduction of a capacity payment – would allow a CCGT plant to be constructed and operate in a 'shadow capacity' role. Therefore, the demand responsive backup would be available, but the annual output (load factor) and therefore emissions would be much lower.

Figure 5 also provides a modelled estimate of the average carbon intensity of the entire Scottish generation mix, this is an important factor to consider if an emission performance standard (EPS) for power generation was to be adopted by the UK Government.

Figures 5: CO2 Intensity of Generation



Source: Scottish Government, Base RE refers to renewable electricity and is consistent with the 80% target.

The chart highlights the importance of carbon capture and storage technology becoming economically and technically proven by 2025, as can be observed from the dark blue line (which represents new build thermal electricity generating plants with only demonstration levels of CCS fitted – i.e. 300MW net capacity), the emissions from the generation mix are significantly higher if full CCS retrofit is not achieved.

OBJECTIVE: Economic Growth Resulting from Low Carbon Electricity Generation

Given Scotland's comparative advantage in the generation of clean electricity (both to serve UK, Irish and, in time, wider EU demand, and to export technology and expertise globally) the analysis in this statement provides a strong message. The evidence supports the current policy objectives to ensure both in Scotland and across the UK, any obstacles that prevent the development of these clean energy sources need to be addressed, whether through the acceleration of transmission and interconnection upgrades, fairer transmission charging, the reform of the electricity market or support for the smart electricity grid.

Caveats with Analysis and External Factors

All of the indicative scenarios above illustrate the impact of a range of potential outcomes on the generation mix in Scotland. While the eventual outcome will be delivered through the economic incentives provided by the market, the Scottish Government has a key role in ensuring that the future generation mix is consistent with our low carbon vision. Some activities that will have an impact on the outcomes are as follows:

- Electricity market reform – will impact on the economic dispatch of the thermal and renewable plants, which could materially change the resulting output levels.
- Transmission upgrades – under ambitious renewables scenarios, output may be limited due to transmission capacity and interconnection constraints. Wider considerations about long-term proposals such as North Sea grid have not been considered.
- Energy storage/demand management – the ability to store excess electricity and to match demand and supply more closely will have a significant impact on the annual generation levels. Technological development in these areas could have a significant impact.
- Proving the technical and commercial viability of CCS – the analysis works on the assumption that CCS will be proven technically and commercially by 2020; if this is not the case then other measures will have to be adopted to ensure that generation plant decarbonises by 2030.
- Exogenous Demand – this type of modelling assumes that the 'consumer' at the other end of the interconnector wants the Scottish exported electricity. (As an indicative example, a large new build nuclear plant in North England could reduce the import demand in that region, therefore could lead to less demand for Scottish electricity export).

Conclusions for Electricity Generation Policy

The analysis shows that whilst Scotland can achieve its 80% target for renewable electricity generation, it is unlikely that Scotland will meet its future energy needs without some form of electricity generation from thermal plant as part of a balanced generation mix portfolio – either as baseload or as peaking plant. The evidence suggests that this is now less than we expected several years ago, because of the greater penetration of renewables and opportunities for energy storage and greater interconnection, but will remain significant for many years to come.

As a high-level conclusion, this analysis suggests that a Scottish electricity generation mix cannot currently, or in the foreseeable future, operate without baseload and balancing services provided by thermal electricity generation. The analysis demonstrates that the scheduled closure of existing plants and the construction of a minimum of 2.5 GW of new efficient thermal electricity generation would satisfy all security of supply concerns and operate within the current and proposed transmission constrains delivering large amounts of electricity exports. This generation portfolio would be consistent with our climate change targets and reporting under the net Scottish emissions account.

However, the analysis also indicates that the construction of lower levels of new build thermal electricity generation capacity, and considerable upgrade and extension of existing thermal electricity generation stations, could also deliver the vision of a low carbon Scotland as well as offer some benefits in terms of lower territorial emissions.

As we move closer towards 2030 it will be important to ensure that plant increasingly deploys CCS and ensures maximum return from energy used, and certainly after 2020, a full programme of CCS retrofit across gas and coal power stations will be required. As suggested there will therefore be a need for some new build in this mix as well as plant life extension and upgrade – both with retrofitting of full CCS across their capacity by 2025-30. Any application for new thermal capacity should be judged on the merits of its proposed contribution to the various objectives of energy policy in Scotland. These include economic and social benefit as well as climate change, energy efficiency, wider environmental and security of supply considerations.

The Scottish Government is clear that emissions from thermal generation must fall in line with the 2030 decarbonisation objective. Any new coal or gas plant coming forward must plan for compulsory retrofitting of CCS by 2025, and existing plants must plan to either upgrade to CCS or progressively reduce their output. Subject to a rolling review on technical and economic feasibility from 2018, all thermal generation in Scotland will be fully fitted with CCS by 2025-30 at the latest or will be required to close. This does not prevent proposals for new thermal generation coming forward after CCS has been technically and economically proven, although the above security of supply analysis shows that Scotland can comfortably meet its demand with only limited amounts of new thermal capacity. In considering applications for thermal generation, therefore, as much attention will need to be given to environmental, economic and social considerations as to security of supply.

The development of CCS in this way – on both gas and coal – will maximise the economic benefits to Scotland from an early lead in CCS technology before global roll-out in the 2020s.

To support this process, we are now developing a streamlined framework for consenting new thermal power stations with CCS. Following an exercise to test the regulatory matrix for CCS, the Scottish Government, and other regulators responsible for CCS in Scotland (SEPA, HSE, Crown Estate, DECC offshore licensing, Marine Scotland, local authorities) have agreed that our aim should be that new applications for thermal

power stations with CCS should be taken forward in a parallel consenting process. With this in mind we intend that such new applications should have one Environmental Impact Assessment (or a series of co-ordinated Environmental Impact Assessments) and accompanying Environmental Statement(s) prepared for all of the onshore activities (power station, capture plant and pipeline) and a separate one for offshore activities (pipeline, storage and decommissioning). This will provide a clearer assessment for the public and for regulators of the environmental and emissions impact of the whole project. We will issue further guidance on this planned requirement in due course.

The need for electricity market reform

As stated earlier, the Scottish Government can ensure that decisions taken on specific plant proposals, using our consenting powers, are consistent with our security of supply and decarbonisation objectives. However, without long-term price certainty and a regulatory framework in the UK market which facilitates rather than acts as a barrier to renewable energy developments in the areas of highest resource and ensures that new or upgraded low carbon capacity comes forward at sufficient speed, there is a danger that that these objectives will not be met and our low carbon energy potential not exploited to its full extent. The success of the Renewables Obligation has shown in practice that where there is a clear long-term price support mechanism, the market will bring forward investment at a scale and speed beyond that originally envisaged by regulators. Through careful targeting of additional support to sectors such as marine or offshore wind, the Scottish Government has used the Renewables Obligation to provide support for new generation capacity. The strategic value and long-term nature of this mechanism has been a vital factor in the raising of our renewable electricity target to 80%.

A similar framework now needs to be put in place by the UK Government to give long-term price support for CCS and other low carbon electricity measures such as grid upgrades and improved interconnection. As the electricity industry has argued, without such certainty and support, the development of these other low carbon measures may not come forward at sufficient speed to replace existing capacity or ensure decarbonisation.

The key to achieving a proper market for all forms of low carbon electricity generation will be the range of new measures proposed by the UK Government in its Electricity Market Reform exercise – such as an Emissions Performance Standard, operating in conjunction with the Emissions Trading Scheme, the proposed carbon floor price, and some form of low carbon electricity capacity payment, applicable to all low carbon options such as renewables and CCS – and fundamental changes to the current locational charging regime. Reform of the regulator, Ofgem, is also essential to ensure its regulatory frameworks better support Scottish Government policies for the transition to a low carbon economy and works to support low carbon investment and not against it – as is the case with the current transmission charging regime that discriminates against renewables. If the UK Government gets it right, there will be a clear regulatory framework for both security of supply and decarbonisation that will give certainty to markets about the investment decisions that they need to take.

The Scottish Government will work closely with the UK Government to realise our own domestic objectives through the EMR. The EMR needs to create a long-term capacity payment mechanism for all forms of low carbon electricity generation including CCS. This must also include support for renewables that is both stable and at least consistent with the current support given under the Renewables Obligation, and which leaves intact the Scottish Government's existing powers

to set support levels. We also want to see an EPS which is consistent with driving emissions down towards the Committee on Climate Change's recommendation of a decarbonised power sector by 2030. This should be a market-wide EPS which also reduces emissions from gas generation as well as coal. This will not only ensure the levels of emissions reduction necessary to meet the 2030 target and remain within our carbon budgets in the Scottish Act, but it will also give the regulatory certainty necessary to incentivise investment in CCS across the thermal generation sector.

If the EMR exercise can achieve these outcomes, the Scottish Government can then use its consenting powers to ensure that we approve the new low carbon generation and transmission infrastructures that will deliver our objectives. If the Scottish Government had full control over energy policy (including on price support) this is something that we could achieve domestically – as we have shown with our different banding under the Renewables Obligation where we have executively devolved powers and greater deployment of renewables than elsewhere in the UK. Full devolution of energy policy, and the financial mechanisms to support low carbon electricity, would ensure that we could create an electricity market best suited to maximising our huge low carbon potential. In the absence of this, we want to ensure that the UK Government uses this opportunity to take the right decisions that will give the regulatory and financial certainty right through to 2030 which has been lacking during the past decade.

Conclusion and Policy Summary

- A huge increase in the potential of renewable electricity has led to a downward revision in the estimated requirement for new build thermal electricity generation plant and reinforced the policy against new nuclear capacity in Scotland.
- By 2030 fitting full CCS to either upgraded or replacement thermal plant and maintaining a minimum thermal electricity capacity of above 2.5GW would satisfy security of supply concerns and would be consistent with a long-term path towards decarbonisation.
- As a result of renewable generation ambitions and interconnection upgrades, there is no current need for an increase in overall thermal capacity.
- Each application for thermal electricity generation capacity should therefore be considered based on its own economic, environmental and social merits.
- The EU Emissions Trading Scheme (ETS), The Electricity Market Reform and the grid, transmission and interconnection developments will be fundamental for providing a framework to deliver secure and low carbon electricity investment.

2011 report

In our 2011 electricity generation statement under s.38 of the Climate Change (Scotland) Act 2009, we will be able to set out more clearly the actions that we will take in the light of the UK's EMR proposals. Where there is to be new UK legislation to enact these reforms, the Scottish Government will be negotiating strongly to ensure that our powers are properly respected, and where possible, enhanced. This will enable us to set out more fully in the 2011 report a revised set of electricity generation and emissions scenarios that reflect the significant changes expected at UK level, and so this 2010 report should be read on an interim basis until that time.

Annex A

Power Duration Curve - Generation Mix

The power duration curves used in this analysis are based on independent research published in the Energy Storage and Demand Management Study[1]. Using the generation profile from the tables below, the power flows across the Scotland to England boundary were determined in the research using a half-hourly GB dispatch model based on merit order. These flows were calculated for years 2015, 2020 and 2030. The outputs from this analysis have been used to generate the charts in Figure 1 and Figure 2

Table 1 – Installed Capacity (MW)

MW	2008	2015	2020	2030
CCGT	1,524	1,524	1,524	1,200
Pumped Storage	740	740	1,040	1,340
Biomass	123	150	300	500
CHP	275	313	368	478
Coal	3,456	2,304	2,304	1,200
Hydro	1,340	1,361	1,407	1,407
OCGT	55	55	55	55
Other	92	49	49	49
Offshore Wind	0	500	1500	3000
Onshore Wind	1915	5000	6500	7500
Nuclear	2332	1200	1200	0
Tidal	0	0	200	400
Wave	0	0	300	600
Total	11,852	13,197	16,748	17,730
Renewables as % total installed capacity	29%	53%	61%	76%

Thermal Capacity (MW)	**5,035**	**3,883**	**3,883**	**2,455**

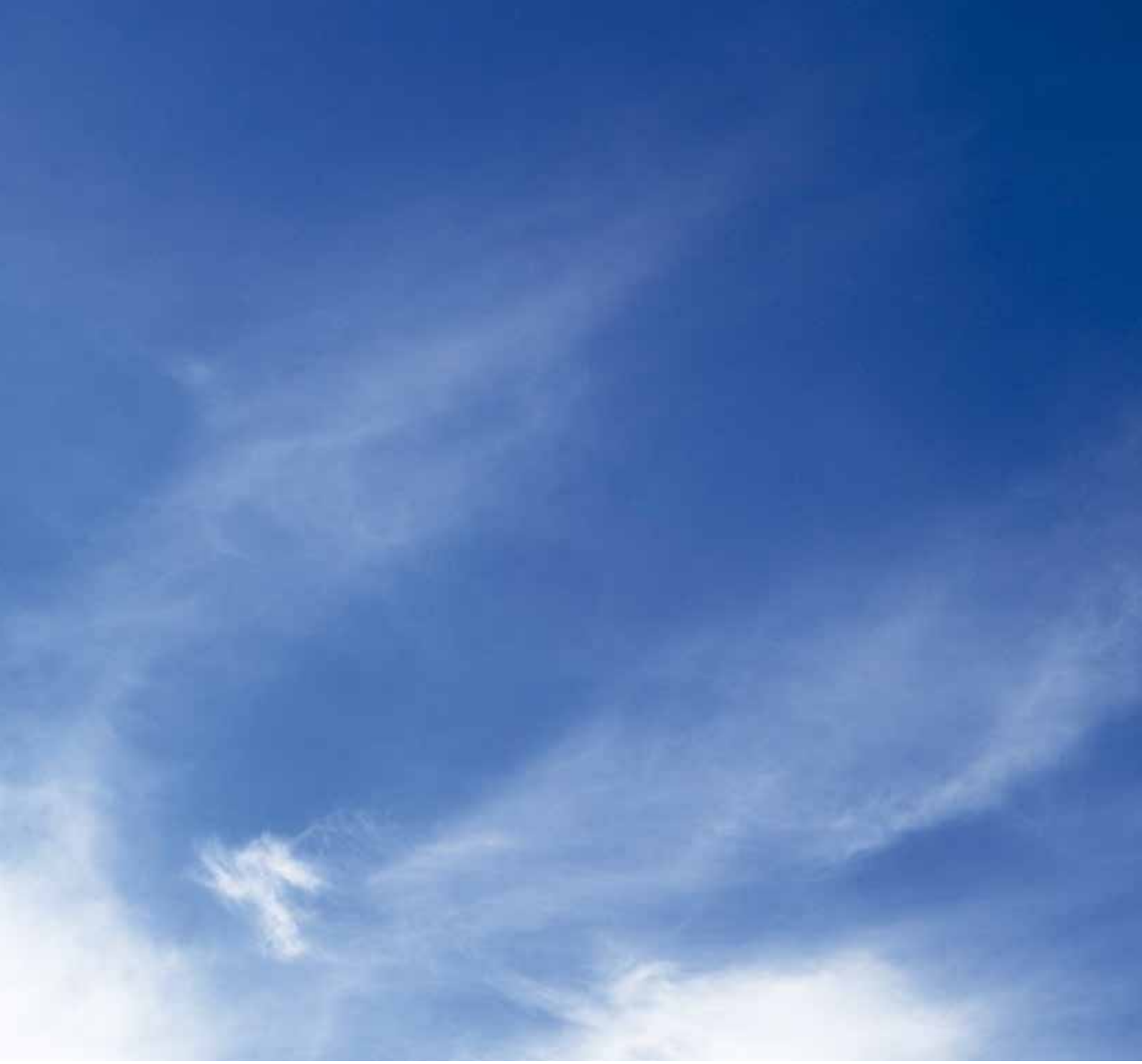
1 http://www.scotland.gov.uk/Resource/Doc/328702/0106252.pdf

Table 2 – Generation Output (TWh)

TWh	2008	2015	2020	2030
CCGT	6.7	8.4	6.9	3.2
Pumped Storage	1	1.1	1.6	2.1
Biomass	0.9	1.1	2.2	3.7
CHP	1.9	2	2.9	3.8
Coal	14.8	6.3	5.3	3.1
Hydro	2.9	2.7	3	2.9
OCGT	0	0	0	0
Other	0.6	0.4	0.4	0.4
Offshore Wind	0	1.8	5.4	10.6
Onshore Wind	5	13.4	17.1	19.8
Nuclear	14.3	8.5	7.8	0
Tidal	0	0	0.5	0.9
Wave	0	0	0.7	1.4
Total	48.2	45.8	53.6	51.9
Renewables as % of Scottish Gross Consumption	25%	52%	76-80%	94-100%

Approximate Net Exports *	**18%**	**13%**	**22%**	**12%**

* Assumes the level of 'loss and own use' in each year are based on the same percentage share as in 2008 (11%) and projections of Scottish electricity demand are taken from the AEA Energy Storage Study



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