

Scotland's Changing Power Sector

Summary of Key Points:

- Independent research shows **Scotland can securely and cost-effectively meet its 2030 power sector decarbonisation target with almost 100% renewable electricity generation**, playing to its natural strengths as part of a secure GB grid. Over the course of the year, **Scotland will continue to be a major net power exporter**.
- **Security of supply is delivered at a GB level in a single integrated grid. The GB grid is secure**, with numerous tools in existence, or being put in place, to ensure enough capacity is always available to meet demand. The notion of a 'Scottish capacity margin' is simplistic and incomplete, particularly once adequate transmission capacity is in place allowing any potential shortfalls between demand and supply during periods of low renewables output to be met.
- Unabated (i.e. without CCS) gas power is incompatible with decarbonisation in Scotland by 2030 unless it is idle for much of the time. **If the Scottish Government is to meet its 2030 decarbonisation target, it must rule out consenting any new thermal power** that is not fitted with CCS from the outset.
- **The Scottish Government's Electricity Generation Policy Statement needs to be reviewed** to reflect the changing economics of renewables, the slow progress of CCS, the outcome of Project Transmit and the economic/political realities of thermal power in Scotland and across the UK.
- The most cost-effective approach to securing and decarbonising the electricity system is through electricity demand reduction. Whilst the Scottish Government has only some powers in this area, it is currently afforded too little emphasis and **the Scottish Government should introduce an electricity demand reduction strategy** accordingly.
- In addition to progress with well-sited renewables development and demand reduction, **demand-side response, interconnection, decentralisation of generation, enhanced transmission and storage can all play a role in delivering security of supply** and help to reduce the need to build new generating capacity. The UK Government currently fails to adequately support these wider system services, and it should make amendments to the Electricity Market regime to incentivise them and level the playing field with generation.
- The UK and Scottish Governments need to work with industry to develop new revenue streams to **incentivise investment in pumped storage**, which has an important role to play in balancing variable renewable generation.
- The capacity market as currently designed provides a windfall to aging coal plant. Cross-party support exists for phasing out coal generation, and **the UK Government should therefore reform the capacity market to encourage coal phase out**.

Introduction to Scotland's Changing Power Sector

Scotland is in the midst of a major power system transition – away from the aging, polluting, centralised and increasingly uneconomic thermal generation of the last century towards a clean, dynamic, interconnected and increasingly cost-competitive renewable-centred system. Renewables are already meeting almost half of Scotland's demand for electricity and were the single biggest source of power in the first half of 2014¹.

Scotland's energy transition is by no means unique. The role of old baseload power stations is being eroded with every new megawatt (MW) of renewable capacity built around the world. Already in Germany we are seeing periods when fossil fuel power is scarcely required. The impact of this is most clearly seen in the decision by E.ON to radically restructure its business model to cut off its nuclear, and fossil fuel operations and focus on its thriving renewables business. Other countries such as Denmark and Sweden are also managing to slash emissions from their power sectors, whilst advice from the UK Committee on Climate Change indicates that the UK power sector will also need to decarbonise on par with Scotland by 2030.²

Maintaining system security during this energy transition is essential. **Independent analysis by engineering consultancy DNV GL³ shows that almost entirely renewable generation is perfectly feasible and cost effective in Scotland by 2030, with efforts to manage demand and enhance flexibility, with Scotland playing to its natural strengths as part of a secure GB grid.**

With abundant resources and a thriving green energy industry, it's clear that Scotland can continue to be at the forefront of this transition with continued progress with well-sited renewable energy and sensible, evidence-based policy choices on security of supply.

The Scottish Government must take policy decisions consistent with its long-term decarbonisation target.

Q1: Is there sufficient generation to meet demand to the end of the decade? What role will new generation play in Scotland? What does the decarbonisation target mean in practice? Are there enough tools to bridge the move from fossil fuels to renewables?

The integrated GB grid provides security of supply with robust transmission links

There is more than adequate generation capacity to meet peak demand in Scotland, which is reducing over time as economic growth decouples from energy use⁴. The imminent closure of Longannet coal plant will reduce the availability of de-rated generation capacity located in Scotland by approximately 2 GW.⁵ However, Scotland is not an energy island. It is an integrated part of the GB grid and does not therefore need a standalone Scottish capacity margin. Provided there is sufficient transmission capacity to the rest of the GB this will not

¹ <http://www.scottishrenewables.com/news/historic-milestone-new-figures-show-renewables-now/>

² <http://www.theccc.org.uk/publication/fourth-carbon-budget-review/>

³ WWF Scotland report Pathways to Power: Scotland's route to clean, renewable, secure electricity by 2030.

<http://assets.wwf.org.uk/downloads/pathwaystopower.pdf>. Technical Report by DNV GL available here: Implications of a Decarbonised Power Sector in Scotland by 2030.

http://assets.wwf.org.uk/downloads/implications_of_a_decarbonised_power_sector_in_scotland_by_2030_dnv_gl_wwfscotland_fi_1.pdf

⁴ KPMG (2014): Assessing Scotland's security of supply in the GB market: <http://www.gov.scot/Topics/Business-Industry/Energy/resources/working-groups/energy-advisory-board/SecurityofSupply>

Scotland's notional de-rated capacity margin is currently more than 22%. By 2020, in all scenarios studied Scotland still has substantial excess capacity by 2020, even allowing for coal phase out in that year, although the balance will change with nuclear phase out in the 2020s which will be offset by transmission reinforcement. However, the scenarios did not model the effect of Longannet's closure in 2016, although this has been done elsewhere by National Grid, SHETL and SPT (see main text). Demand is currently approximately 5.5GW, expected to fall to 5.2 by 2020, rising slightly by 2030.

⁵ De-rated capacity is the installed capacity adjusted for the extent to which individual technology types can be relied on at times of peak demand.

pose a security of supply risk and Scotland will continue to be a net-exporter of electricity to the rest of GB.

Analysis by National Grid, SHETL and SP Transmission shows that transmission capacity to England and Wales can already support a transfer to Scotland in the winter months of approximately 2.65GW (48% of peak demand), rising to 3.9GW (70% of peak demand) once the Western HVDC bootstrap and the Beaulieu-Denny line are completed in 2017. De-rated generation capacity required from 2017 in Scotland is approximately 1.6GW in total, which is substantially less than existing nuclear and renewables capacity.⁶ With 70% of Scotland's peak demand backed by transmission links to the rest of GB, the need for conventional thermal power to be located in Scotland will be reduced. This need will continue to fall as transmission links increase, driven by installed renewables capacity.

There will be more than enough transmission to exceed any shortfall created by Longannet's closure at peak demand. National Grid has also prudently procured voltage control services from Peterhead to ensure system stability until the Western HVDC link is operational. Moreover, figures from DECC and the Scottish Government show that Scotland's electricity generation will still comfortably exceed Scottish demand across the course of a year without Longannet, so Scotland will continue to be a net exporter of electricity to the rest of Great Britain.⁷

Scotland's decarbonisation target will be achieved at lowest cost through renewable generation & efforts to manage demand and enhance flexibility

Longer-term, the Scottish Government's policy to hit its power sector decarbonisation target of 50g CO₂/kWh by 2030 is set out in the Electricity Generation Policy Statement (EGPS)⁸. This envisages high levels of renewables, coupled with 2.5GW of gas plant progressively fitted with CCS and no new build nuclear. However, the slow pace of CCS development globally, concerns about its commercial viability and the weak business case for new thermal power in Scotland⁹ mean this scenario is unlikely to be borne out in reality and will need to be updated¹⁰. **This means in practice that the decarbonisation target will be achieved in Scotland through renewable generation, which, coupled with efforts to manage demand, will be lower cost than scenarios with high amounts of CCS.**

WWF Scotland commissioned an independent study by engineering consultancy DNV GL to test security of supply in 2030 with almost entirely renewable generation located in Scotland (save for the 340 MW CCS demonstration project at Peterhead). It showed that **“with the transmission capacity to the rest of GB currently existing or planned, there is little or no need for conventional generating capacity in Scotland to maintain security of supply, even in periods of low renewables”**. The scenario builds in feasible progress on reducing electricity demand (1%/year) and new pumped storage (three new 600MW schemes), both of which need additional policy support from both UK and Scottish Governments.

The report shows that the decarbonisation target can be achieved well within the current renewables pipeline, which currently stands at over 12GW of pre-operational capacity in addition to over 7GW already installed. However, this should not be seen as a cap

⁶ National Grid (2015): Security of Electricity Supply in Scotland

⁷ See WWF Scotland briefing at:

http://assets.wwf.org.uk/downloads/wwf_scotland_briefing___scottish_conservative_energy_debate_25th_feb_2015_.pdf?_ga=1.232067100.2090807888.1430927136

⁸ <http://www.gov.scot/Topics/Business-Industry/Energy/EGPSMain>

⁹ KMPG report

¹⁰ We support the testing of CCS at Peterhead but given the slow pace of development it is critical that energy system planning does not rely on its commercialisation and risk locking in unabated thermal power.

by any means. Future renewables growth will be dictated by the economics of renewables, climate imperatives, and the wider planning and environmental constraints on individual projects.

During infrequent periods of high demand and low renewables production, power will flow to Scotland from the rest of GB, but ongoing and planned grid upgrades will be more than enough to accommodate this (potentially rising to 13GW by the mid-2020s) and the balance will be firmly in Scotland's favour overall. On an annual basis, the study shows that, under this scenario, Scotland would remain a net power 'exporter'.

While there are a number of system stability issues associated with the move towards high levels of renewable generation and the phase out of conventional thermal power in Scotland (such as black start and voltage control), options for mitigating any potential grid impact are being considered by National Grid in its System Operability Framework. This will ensure that system stability remains robust in the low carbon transition. In its analysis, DNV GL is confident that solutions to any challenges can be found.

There are multiple tools to ensure security of supply across the UK

In terms of overall GB-wide security, the Committee on Climate Change, National Grid and others have published long-term decarbonisation scenarios that maintain system security with high levels of renewables. While the GB capacity margin has tightened in recent winters, it is due to rise again by winter 2016/17, and a suite of balancing tools is already available to National Grid to prevent any supply disruptions and ensure that capacity is always available to meet demand. The capacity market from 2018 onwards is specifically designed to ensure adequate capacity is available to meet demand as older thermal plants are phased out. We suggest improvements to this mechanism at question 4 below.

What role for gas generation in Scotland?

Most power sector decarbonisation scenarios envisage a 'bridging' role for flexible gas plant to help manage the transition to renewables.¹¹ While it is feasible that some of this generation could be based in Scotland, given the transmission regime, it is likely to be cheaper to locate it closer to major demand centres in England. DNV GL's analysis shows that while, in principle, **1GW gas plant could be located in Scotland, it would have to operate at a low capacity factor (<50%) to avoid breaching the decarbonisation target, which further undermines the economic case for new gas plant in Scotland.**

If the Scottish Government is to achieve its decarbonisation target and fulfil its climate change commitments, it must **rule out consenting any new thermal power that is not fitted with CCS from the outset.**

Q.2 What impact will demand-side response have and what can be done to improve developments in this area?

Demand-side policy is the most cost-effective approach to achieving security of supply

Far less gas generation capacity will be required across the UK to complement renewables if progress is made on demand-side response (DSR), demand reduction and storage as we transition to a dynamic, smarter system that manages and smooths peaks in demand, and is

¹¹ See UKERC (2013) The UK Energy System in 2050: Comparing Low Carbon Resilient Scenarios.

supply- rather than demand-driven. While renewable resources are variable, they can be forecast with a high degree of accuracy by comparison with thermal plant which often has unforeseen outages. This allows domestic and commercial consumers to respond to changing levels of renewables on the system.

The next UK Government needs to adjust the electricity market regime in order to provide a level playing field with new revenue streams for these important system services. For instance, there is currently no support mechanism to enable the building of new pumped storage and the capacity mechanism does not do enough to drive the development of demand reduction or response (see more in Q4 below). **There is also a need to focus on energy consumers and business models for power companies in the energy transition.** Important consumer tools in the delivery of DSR include smart meters, which will form the basis of dynamic demand response, alongside tariff structures that incentivise load shifting in response to changing levels of renewables on the system.

In Scotland, there is already an EU-funded pilot project underway in Findhorn which uses sophisticated weather forecasting and demand data to drive load shifting. The Origin project¹², led by Heriot Watt University, is already achieving impressive results, even before the introduction of dynamic tariff structures. A number of other demand management projects in Scotland are also being supported by the Energy Challenge Fund.¹³

Q3: What role will transmission projects have in securing supply and where should investment be directed? What role for the distribution network and a single European electricity market play in securing supplies?

Transmission improvements are required for Scotland to maximise its renewables resources

With increasing levels of renewables in peripheral areas and decreasing conventional power to provide system services such as voltage control, transmission projects will have a significant role to play in ensuring that Scotland can continue to maximise its renewables strengths as part of the GB grid.

National Grid have set out a range of flexible scenarios as part of their transmission network upgrade planning, including commercial and operational practices as well as new build transmission projects.¹⁴ In all these scenarios, there is a need to boost transmission capacity to accommodate new renewable generation in Scotland over the coming decades, though this will be offset to some extent by thermal power closures. In addition to major reinforcement already in construction or in design, there are a variety of projects in scoping and options are being considered for a new Eastern HVDC link, though the need for this will depend on the extent of renewables build out over the coming years.

More immediately, **it's important that the UK and Scottish Governments work with industry and regulators to find a solution that would allow grid connections to the islands to be built to help contribute to hitting the decarbonisation target.** Given the renewable resources available on Scotland's islands, this would unlock several hundred MW of onshore wind generation cheaper than offshore wind. These upgrades should be planned with a long-term view of the power which can come from the seas around and beyond our islands.

¹² <http://origin-concept.eu/>

¹³ <http://www.localenergyscotland.org/funding-resources/funding/local-energy-challenge-fund/phase-two-projects/>

¹⁴ 2014: <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Electricity-Ten-Year-Statement/>

In terms of integration with European markets, Scotland is already connected to Northern Ireland through the Moyle interconnector with plans underway to develop a 1.4GW interconnector between Norway and Scotland by the early 2020s. This will further enhance security of supply given the importance of hydro pumped storage to Norway's energy mix, which helps to balance wind variability. With 25% of Europe's tidal and offshore wind and 10% of its wave energy potential located in Scotland, greater interconnection with Norway's pumped storage capacity would help enable Scotland in the long-term to export its renewable energy across Europe, as part of the growth of a single European grid

The direction of travel for other European countries is increasingly towards greater interconnection, with a 15% target for interconnection set by European leaders by 2030 and ultimately towards a single European Grid and transnational energy markets, with technological and geographical diversification. This kind of integration is already well underway in the Nordic countries.

Q4: Are policies such as the capacity market adequate and what other long term signals are needed?

The UK Government must improve the Electricity Market to achieve decarbonisation cost effectively

The UK Capacity Market as currently designed under EMR is inadequate for achieving Scottish or UK decarbonisation objectives cost-effectively for three key reasons. We suggest improvements for the next UK Government to make below.

First, it is providing windfalls to existing plant rather than incentivising the building of new capacity (whether demand side response, interconnection, storage or 'bridging' flexible gas plant). 94% of the capacity procured under the first auction was old/refurbished capacity, despite the fact that many of these plants (e.g. existing nuclear, hydro, many coal plants outside of Scotland) are already profitable. **We believe that providing lump payments to already profitable capacity is an inappropriate burden on consumer bills.**

Secondly, the capacity market has provided a lifeline for coal plants in many parts of the UK, which might otherwise have closed due to the carbon price floor and the cost of compliance with the Industrial Emissions Directive. Providing consumer funded payments to coal plants is directly in conflict with affordability and decarbonisation objectives. Evidence¹⁵ from industry experts indicates that a rapid phase out of coal could be managed using system balancing tools available to National Grid, posing no risk to security of supply. **Coal capacity payments should therefore be phased out now across the UK and an Emission Performance Standard introduced for existing plant.**

Moreover, we do not support proposals for a carbon price support exemption for UK generators purchasing 'restoration related coal', and consider this to be a high-risk and counter-productive approach to funding restoration of derelict mines in Scotland.¹⁶

Thirdly, the market discriminates against demand-side response and electricity demand reduction. Given that demand is well below peak for the majority of the time, building new power stations which will sit idle almost permanently is unlikely to be the most cost-effective security of supply solution compared to demand reduction and load shifting. At the moment, new demand-side response – paying electricity users willing to shift their demand away from

¹⁵ Skilling et al (2015) Assessing the balance of risks associated with coal plant phase out:: <http://www.e3g.org/news/media-room/security-of-supply-is-no-excuse-uk-needs-a-coal-phase-out-policy>

¹⁶ See RSPB briefing here: http://www.rspb.org.uk/Images/rspb_parliamentary_coal_briefing_tcm9-396884.pdf

peak times through the capacity market – is only able to access one year contracts in the capacity market, disadvantaging it compared to new generators what are able to access fifteen year contracts. In the US PJM capacity market, 9% of the capacity for delivery year 2015/16 is demand-side response compared to only 0.35% of the successful capacity in the UK's first auction¹⁷.

If we're to achieve decarbonisation securely and to the advantage of the consumer, the playing field should be levelled for all new capacity solutions, with reduced maximum contract lengths available of 3-5 years. Access to main auctions (as opposed to year ahead) from 2018 should be allowed for demand-side response projects that attract pilot funding in 2016 and 2017. Already profitable existing plant should not be incentivised.

Saving electricity is 'no regrets' policy from a security of supply and an economic perspective, helping to reduce the cost of decarbonisation for consumers by avoiding the need to build new generating capacity. However, it is currently undervalued in the GB electricity market.

DECC's research indicates the technical potential for demand reduction of 32TWh/year GB wide.¹⁸ DNV GL analysis for WWF Scotland shows that moderate demand reduction (1% per year) would allow Scotland to securely decarbonise electricity well within the current renewables pipeline, even allowing for electrification of heat and transport. While there has been steady progress in reducing electricity demand in recent years in Scotland, it is important that the downward trend continues with economic recovery.¹⁹ However, there is increasing evidence UK wide that energy demand and economic growth are decisively decoupling²⁰.

Therefore, other GB-wide mechanisms outside of the capacity market should be explored for electricity demand reduction, including the possibility of energy efficiency feed in tariffs, which provide a clear revenue stream for electricity demand reduction irrespective of whether there is a capacity shortfall in any given year. While the Scottish Government has only some powers in this area, demand reduction is afforded too little emphasis and the Scottish Government should also produce an electricity demand reduction strategy accordingly.

Despite its important role in storing energy generated from variable renewables and in providing balancing services to ensure system stability, pumped storage is not recognised under the current EMR regime. Consent for one scheme in Scotland is already in place, with another included in the National Planning Framework. **The UK and Scottish Governments therefore need to work with industry to develop revenue streams that can unlock the potential of this and other forms of storage technologies.**

¹⁷ See WWF Capacity Market Briefing: http://assets.wwf.org.uk/downloads/wwf_capacity_market_briefing_march_2015.pdf

¹⁸ DECC (2013)

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246126/Impact_Assessment_for_Electricity_Demand_Reduction_Policy_Options_FINAL.pdf

¹⁹ See KPMG report for evidence of declining demand

²⁰ <http://www.bbc.co.uk/news/business-30518649>