scottish science advisory council

Scottish Science Advisory Council (SSAC) response to the Scottish Government's ***Energy Strategy: The Future of Energy in Scotland***

May 2017

1. Introduction

The Scottish Science Advisory Council welcomes the opportunity to engage with the Scottish Government's new Energy Strategy. Clearly the future of energy in Scotland is a topic of key importance to our future economic, social and environmental well-being. In our response we aim to provide a range of overarching comments and questions which we hope will support the on-going development of Scotland's Energy Strategy. Links to specific consultation questions are also noted.

We have not responded directly to the Scottish Government's parallel consultation on unconventional oil and gas (an earlier independent expert panel provided a thorough analysis of the relevant technical issues, July 2014[i]). However, we do comment on the requirement for a long-term supply of methane feedstock if hydrogen is to be considered as an energy vector for heating.

The Scottish Science Advisory Council is Scotland's highest level science advisory body, providing independent advice and recommendations on science strategy, policy and priorities to the Scottish Government. It is a broadly-based group, including practitioners and users of scientific innovation.

2. Scenario Modelling [Consultation questions 1-4]

2.1 A clear statement of principles is required to provide clarity on future decisions. It is generally agreed that energy policy will underpin future economic growth and will be driven by the energy trilemma: cost effectiveness, security of supply and low carbon. Unfolding the impact of these principles should be undertaken through a technology-neutral stance in scenario building.

2.2 There is a need to provide open and transparent information on assumptions and data. We would therefore welcome the future sharing and co-development of the TIMES modelling framework[ii] (underpinning the analysis of the Energy Strategy) with Scottish academic institutions.

2.3 An exemplar of open and transparent engagement with professional bodies, industry, NGOs and the public was delivered by the (then) UK Department of Energy and Climate Change through an on-line calculator, allowing a range of energy mixes to be explored through to 2050. The calculator allowed all interested parties to propose a range of energy futures.

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2.4 The opportunity to deliver similar engagement through a publicly accessible interface with the outputs from the TIMES modelling framework would be extremely beneficial in Scotland. We believe that open and transparent access to data and modelling tools would move our national conversation away from often polarised and qualitative debates to quantitative analysis and an understanding of the benefits and limitations of a range of energy futures.

2.5 Decarbonisation will be expensive, so an open and technically-sound conversation on our energy future is required. Comparative costs need to be assessed at a system level, rather than directly comparing the levelised cost of thermal plant with intermittent renewable energy which can be misleading. We also note that there is a poor understanding of future costings of technologies which are assumed to play a key role in the Energy Strategy, such as bioenergy with carbon capture and storage (CCS), and new heat technologies.

3. Robustness and Resilience [Consultation questions 3-4]

3.1 The Energy Strategy document considers a future for electricity generation largely driven by renewable energy. We assume a combination of thermal plant with carbon capture and storage (CCS) and interconnectors are used to balance the grid. We note that if substantial thermal capacity with CCS is available then the impact of renewable energy will be to reduce the capacity factor of CCS plants. Renewables then become a fuel-saver, but the costs of the CCS plant must be included in the full system-level costs.

3.2 With the uncertain future of CCS and the forthcoming closure of both the Hunterston B and Torness baseload nuclear plants, there is a risk that Scotland's future electricity generation may be almost entirely dependent on intermittent renewable capacity and imports from strengthened interconnectors to England, Ireland and Norway. In this scenario the electricity grid would be balanced by imports, so that security of supply in Scotland would be dependent on the excess dispatchable capacity of our neighbours. The consequences of such an outcome need to be fully scrutinised and preparatory research undertaken well in advance of such an eventuality.

3.3 We note that with the closure of the Longannet coal plant, Scotland's electrical energy generation is almost entirely low carbon (nuclear, wind and hydro with a modest contribution from the Peterhead gas plant). A key issue for the future is therefore replacing the capacity of Hunterston B and Torness. We also note that the closure of Torness in 2030 will coincide with the need to repower older onshore wind farms with a design life of order 20 years. The closure of thermal plant such as Longannet has already highlighted future issues concerning 'black start' grid recovery.

4. Energy Storage [Consultation question 2]

4.1 Energy storage is a key technology for the future which can transform how energy is both generated and consumed. However, an assessment of storage needs must be made through quantitative analysis, with energy storage included in system level costs of future energy scenarios.

4.2 It is clear that research and technology development is required to provide storage systems which meet future energy storage requirements, including across energy type (particularly electrical and thermal), scale, capacity, storage length (daily and seasonal) and storage efficiency.

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4.3 We note that truly low cost energy storage could also transform the utility of baseload thermal plant by storing overnight production until peak hours when prices are high. Indeed we understand that the Ben Cruachan pumped storage system was constructed in parallel with the Hunterston A nuclear plant partly to provide such services.

4.4 The scale of energy storage required for electricity alone is potentially extremely large, particularly if Scotland is reliant on intermittent renewable energy and interconnectors in future. However, a key issue for energy storage is also heat, which can be of order 4 times larger than peak electricity demand and is seasonally variable. This poses significant challenges.

4.5 Storage technologies which address seasonal heat demand e.g. by storing heat energy in above or below ground water reservoirs or subsurface rocks are technologically feasible, but have not been tested or deployed at the scales required.

5. Energy for Heating [Consultation question 7]

5.1 The bulk of Scotland's heating is provided by natural gas, a clean-burning fuel which can be safely distributed through an extensive distribution network. Given that natural gas is mostly methane (CH_4), 4 out of 5 atoms delivered through the network are hydrogen, with 1 in 5 being carbon.

5.2 Decarbonising heating through electrification is possible, however we note that per unit of energy delivered natural gas is substantially cheaper than electricity. For this reason most homes in Scotland use gas delivered through the distribution network for heating rather than resistive electrical heating delivered via the grid.

5.3 As an alternative to electrical heating (either resistive or heat pumps), the Energy Strategy considers the use of hydrogen. If steam methane reforming is used to produce hydrogen, then the capacity to store the carbon removed from methane feedstock at scale will be required. The additional costs of hydrogen production and carbon storage at scale needs to be clearly assessed.

5.4 In principle hydrogen could be generated by electrolysis of water using low carbon electricity. However, the costs would likely be greater than steam methane reforming, particularly at the required scales. Hydrogen production would therefore require a secure and cost effective supply of methane feedstock. Clearly, this impinges on the parallel consultation on unconventional oil and gas. We note that natural gas feedstock is also required for gas turbine plants for dispatchable electricity generation (and for long-term production at Grangemouth (e.g. ethylene cracker)).

6. Future Energy Strategy

We recommend that:

6.1 A number of future energy scenarios should be developed, starting from the guiding principles outlined in 2.1, rather than beginning with targets for specific energy technologies. The scenarios should be technology neutral and include an assessment of long-term system level costs. However, asserting which option is best to deliver the lowest system level costs to 2050 is difficult, due to social as well as technological factors (e.g. application of building standards in new homes).

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6.2 In looking to the future as far as 2050 Scotland needs to keeps its energy options open. However, now is the time to de-risk future energy technologies through small-scale proof-of-concept projects allowing measured, technically informed decision to be made.

6.3 A range of difficult questions for the future should be openly and properly framed now. These include clearly assessing the impact of removing nuclear power from the energy mix and providing a secure, cost effective supply of natural gas as a feedstock for hydrogen production (if pursued).

6.4 Data driven innovation needs to be central to future energy strategies, first to drive energy efficiency but also to acknowledge the potential for future grid services (frequency control, energy storage as a service).

6.5 New technologies which could impact on the energy economy of 2050 should be assessed. These include the use of small modular reactors (SMR), compact supercritical CO_2 turbines, where their high efficiency can be used to partly offset the additional cost of carbon capture, and molten tin methane cracking for hydrogen production. We also note the importance of future social factors, such as the use of autonomous electric vehicles and the impact of future IT-driven working practices on commuting and transportation.

We acknowledge helpful discussions with Professor Graeme Burt (University of Strathclyde) and Dr Andy Kerr (Edinburgh Centre for Carbon Innovation).

[i] http://www.gov.scot/Publications/2014/07/1758
[ii] http://iea-etsap.org/index.php/etsap-tools/model-generators/times

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