

## **Response to The Royal Society of Edinburgh's "Call for Evidence" on Scotland's Energy Future – Part 1**

Dr Euan Mearns, Aberdeen 21 July 2018

Having attended the public meeting on Thursday 19<sup>th</sup> July at James Hutton Institute, Aberdeen, I am submitting my opinions on this important matter. My submission will be in two parts. Part 1 will endeavour to answer the questions raised in the official "Call for Evidence". Part 2 will address a range of other issues raised at the meeting.

### **About Euan Mearns**

Dr Euan Mearns has BSc and PhD degrees from the University of Aberdeen. He has worked as a researcher in Norway for 8 years before setting up an isotope geochemistry analysis and consulting company in Aberdeen in 1991. He subsequently became involved in blogging on energy issues in 2005 and is well known internationally for his endeavours in this area. He once held an honorary research position at the University of Aberdeen. Since January 2018 he has been employed as a Senior Researcher at ETH Zurich.

This submission is made as a private citizen.

### **Priorities in Energy Policy**

My number one priority in formulating Scottish energy policy is to place the best interests of the Scottish people first. In so doing, there are three vital categories to measure policy against:

1. Cost of energy.
2. Health and wellbeing.
3. Environment.

All with equal weight. These resemble the three pillars of sustainable development. Unfortunately, current Scottish electricity policy fails on at least two of these categories (cost and environment).

If we delve a little deeper we will find that a sustainable electricity policy cannot be founded on these three pillars alone. Electricity grids are a complex engineered commons where voltage and frequency need to be maintained within narrow limits with one-second resolution. Furthermore, we must only pursue energy supplies that are sufficiently plentiful to satisfy our needs into the foreseeable future. We therefore need to add a further two categories to our multi-category scheme for a sustainable electricity grid:

4. Grid engineering and dispatch
5. Resource availability

(See references 1 and 2).

## Energy Landscape

*1 What are the most significant challenges to, and influences on, the energy landscape that any future energy strategy needs to take into account?*

The main challenge to overcome at present is the single criterion of CO<sub>2</sub> intensity that is being used to drive all policy decisions regardless of the harm done to the Scottish People and the Scottish landscape. Adopting a multi-criteria approach, that should rightly include CO<sub>2</sub> intensity, will lead to a very different set of policy decisions being made that will actually serve the Scottish people and the Scottish environment.

The second challenge to overcome is irrational fear of nuclear power, and to at least place the no-new nuclear policy under review. Nuclear power is the safest, most reliable and environmentally least intrusive means of generating electricity available to us today. It does not need to be expensive either. This is why Russia, China, India, The United Arab Emirates are all greatly expanding their nuclear power capabilities. Nuclear power meets all 5 categories listed above. Wind power barely meets 1 (Health). Several days can go by when the wind blows nowhere across the UK, this is not a dependable resource.

The third challenge is to resist extreme left wing policies that have no mandate from the Scottish People.

## Supply and Demand

*2 What will energy demand in Scotland look like in 2030, 2040, and 2050?*

To answer this question requires detailed knowledge of Scotland's population structure and demographics, future economic growth, technology developments and energy policies. This question is not easily answered.

On the policy front, Scotland should take steps towards electrifying heat and transport including electric cars. This is because both electric heating (heat pumps) and electric cars are more energy efficient than their fossil counterparts. Improving energy efficiency should be a guiding beacon since this reduces costs and environmental impact. I say 'take steps towards' as opposed to a headlong target driven rush.

The only way for Scotland to affordably and autonomously deliver the target of a 100% electrified energy sector is via extensive expansion of Generation III nuclear power generation.

*3 What are the biggest barriers faced to meeting the demand we will have for energy by 2030, 2040, and 2050?*

The only barrier to meeting demand for energy in 2050 is the current energy policy. While N Sea oil and gas reserves are depleted at the UK scale, they are still ample at the Scottish scale. Here, it is not necessary to consider the

independence question. Most North Sea oil and gas makes landfall in Scotland and this will provide the country with energy security for decades to come. Failing that, we are connected to the Norwegian pipeline system at several points. Norway will probably be the last man standing in Europe when it comes to gas supplies.

The electricity system is rather different where closure of Hunterston B in 2023 and the scheduled closure of Torness in 2030 create huge risks to the Scottish grid. This risk is currently managed by importing up to 2 GW (~40%) of electricity from England, which from my perspective is an unnecessary and unwelcome risk to carry where system reliability is outsourced to a third party.

This risk can be mitigated in two ways: 1) a review of the no new nuclear policy and 2) contingency plans to build 1 to 2 GW of new combined cycle gas (CCGT) power stations in the Central Belt, probably in the vicinity of Cockenzie and Longannet (the grid infrastructure is already there). Engineering design should ensure that these gas power stations have the capability to black start the Scottish grid should a nationwide blackout occur. An interim grid based on hydroelectric power, legacy nuclear and CCGT would provide Scotland with some of the lowest CO<sub>2</sub> intense electricity in Europe, grid reliability and affordability.

*4 Given the international nature of the energy market, how should acceptable quantities and origins of energy imports, and their associated energy security risks, be assessed?*

Given what I have said in my answer to point 3, I do not see this is a relevant question. New nuclear power stations make the question even more moot. We can import as much uranium from Canada and Australia as we want. (note that the cost of uranium represents only 2 to 3 % of the whole nuclear power cycle).

*5 What overall role should be played by various elements of the energy landscape, for example:*

- *Different sources of renewable energy;*
- *Offshore oil and gas;*
- *Unconventional oil and gas;*
- *Nuclear power;*
- *Energy storage;*
- *Others*

This question seems to be asking members of the public to design a future Scottish grid. I respectfully suggest that the general public are not qualified to do this.

My informed view, based on years of analysis of energy matters, is that we should begin with the 1.6 GW legacy hydro that we already have, but be aware that this never produces more than 1 GW base load because of water supply and operational constraints. We also need to be aware that hydroelectric power is

one of the most environmentally intrusive forms of power generation we have. But it provides very high quality electricity, by that I mean power that is available to us when we want to use it.

Scotland should aim to have 4.2 to 7 GW of new Gen III nuclear power by 2050 based on two sites at Hunterston and Torness (where there is already grid infrastructure ). This may provide for significant-electrification of heat and transport.

Some additional pumped storage may be an advantage, and the concept of electric vehicle to grid may come of age combined with nuclear power. This same concept is likely unworkable with wind power. The reason for this is simple. Nuclear power switches from surplus to deficit on a daily basis. Thus, car batteries can be charged at night, every night and may be used to supplement peak demand during the day, every day. Storage can be finely tuned to this highly predictable pattern. Wind on the other hand may produce oversupply for days on end, followed by no supply for days on end. The batteries of a vehicle fleet become discharged on day 1 and then the vehicles have to stand idle for days waiting for the wind to pick up.

As already discussed, a plan to introduce new gas powered electricity generation as an emergency stopgap measure to maintain the integrity and autonomy of the Scottish grid should be implemented without delay.

## Climate Change and Renewable Energy

*6 What action needs to be taken to ensure that Scotland fulfils its climate change obligations while also meeting demand; and what are the main obstacles to achieving this?*

The solution here is very simple. Abandon the existing energy policy, especially the no-new nuclear and the renewables targets parts of it and lay plans for Scotland to become a 70%+ nuclear powered nation. Going any other path may end in the destruction of the Scottish economy and landscape.

*7 What are the factors and risks which may impact upon the Scottish Government meeting the targets it has proposed on sustainable and renewable energy?*

As noted in the introduction, the current Scottish Government policy barely meets one of the five categories for sustainable electricity production. It is difficult to understand why anyone should believe that a high cost, environmentally destructive, unreliable and intermittent electricity system is sustainable.

At this point I should perhaps note that the late Sir Professor David MacKay, James Hansen and James Lovelock have all recognised that nuclear power is the only way to reduce CO<sub>2</sub> emissions whilst also preserving a functioning economy. The only reason the Scottish grid **appears** to work at present is because we are

connected to England that sends us dispatchable nuclear, gas or coal electricity when we need it most.

## Environmental Impact

*8 What are the environmental impacts of individual elements of a future energy mix, to what extent can these be mitigated, and how can any remaining waste products be dealt with?*

The environmental impact of the current high renewables path is there for all to see. Hills covered in wind turbines everywhere and a 90 MW power station planted in Aberdeen Bay just off Balmedie Beach. The external environmental costs are born by property owners, the tourist industry and every citizen who once enjoyed walking in our hills and glens.

The environmental impact of a high nuclear strategy would not be much larger than the existing impacts of Hunterston B and Torness. In advanced countries, nuclear waste will become the nuclear fuel of the future, burned in passively safe, fast breeder reactors, until with advances, all waste is consumed. This will provide humanity with energy for centuries.

## Ethics, Social Issues and Impact on Communities

*9 What account should be taken of the environmental and social impacts on those living elsewhere in the world, of the international energy supply chains on which we may choose to rely?*

The current renewables policy is taking us down a very unsavoury path. Most turbines installed in Scotland will have a high quantity of the rare earth element (REE) neodymium included as an alloy within the magnets in the electrical generators. This greatly improves the efficiency of the generators that allows a much higher power to weight ratio. Virtually all REE mining today takes place in China, not because it is the only country with REE mineral deposits, but because the chemical processes involved in recovering the REE from the host mineral causes immense environmental harm with a high cost to human health and China is the only country prepared to allow this. Some of this is anecdotal, but there are sufficient grounds for the RSE and Scottish Governments to conduct preliminary enquiries into health and environmental issues associated with REE mining and recovery since the RSE have chosen to bring this forward as an item for consultation.

Along similar lines, a main constituent of Li Ion batteries is the element cobalt (Co) the principal source of which is the Democratic Republic of Congo. Again, anecdotally, child slave labour is locally employed in unpleasant mining operations. Most Scots today carry at least one Li Ion battery in their pocket.

The nuclear plan I favour places dependency on Canada or Australia for U fuel and on England / the UK for fuel enrichment and manufacture, waste storage and reprocessing. My preferred vendor for nuclear reactor technology would be the S

Korean company KEPCO and their APR 1400 Gen III reactor. Most of the construction work would take place in the UK / Scotland. Scotland should actually position itself to gain UK-wide, high-end engineering contracts as part of the planned expansion of nuclear south of the border.

*10 What actions can be taken, and by whom, to ensure that energy is accessible to all at an affordable cost for those on low incomes; and that any changes in energy provisions and associated tariffs are understandable and acceptable?*

The answer to this falls into two parts. There are international energy spot prices for oil and gas that we have virtually no control over, one good reason for electrifying transport and heat too. The second part is government policy that has sought to make electricity expensive via a system of tariffs paid by cash strapped consumers to fat cat wind energy developers and via inventing an unsustainable generation system that requires ever more costly interventions to maintain such as backup, more grid and storage. As already stated, this system of supporting high cost, environmentally destructive power generation that doesn't work needs to end.

*11 What are the particular advantages enjoyed, and challenges faced, regarding energy; and what lessons can be learned on a national scale from community energy schemes undertaken by:*

1. *a) Rural and remote communities*
2. *b) Urban Communities*

Community energy schemes are usually prohibitively expensive and subsidised by the majority. They are, therefore, not scalable to a national level.

## **Regulation and Governance**

*12 To ensure that energy is successfully sourced for, and delivered to, the people living in Scotland, how can different levels of government best cooperate:*

*a) With one another;*

*b) Internationally;*

*c) With existing energy generators, network operators and retailers?*

Scotland should be autonomous and self-sufficient in energy. This dispenses with the need for any form of international cooperation or dependency. The historic symbiotic relationship with England where Scotland was a near-permanent exporter of electricity could and should be maintained.

## **Informed Debate**

*13 How can we best encourage objective, evidence-informed debate around energy while also acknowledging the differing perspectives and priorities held by businesses, civil society and government?*

I would hope that every arm and colour of government, industry and society can unite behind the objectives of an energy system that delivers on:

- Low cost;
- Health;
- Environment;
- Grid integrity;
- Resource availability.

Any evidence-based debate needs to be confined to those technical experts who understand the thermodynamic and economic consequences of a variety of different system configurations.

## Skills

*14 How can Scotland ensure that it retains, and develops, the necessary workforce of skilled professionals needed to meet its energy needs?*

The oil and gas industry will look after itself with collaboration from institutions like The Robert Gordon University and Heriot Watt University.

If a nuclear path is chosen then these same institutions plus Strathclyde University, in collaboration with the nuclear industry – which at present means EDF, Rolls Royce and large construction firms - should plan to establish the appropriate courses in nuclear engineering, civil engineering and electrical engineering.

## Meeting the Challenge

*15 What issues arise regarding innovation for Scotland's energy future; how might this interact with an industrial strategy for Scotland?*

Scotland needs to shake off the developing world aspiration of becoming a major exporter of energy and resources. Instead it should use the fundamental right of cheap and reliable electricity to free up fertile young minds to genuinely innovate. Terra Bits of knowledge are far more powerful economic drivers than Terra Watts of intermittent electricity.