

IMECH E Response to RSE Energy Inquiry

General

1. *How should Scotland provide for its energy needs over the next 5, 15, 30, 45 years, in the context of the likely UK, European and global energy environment?*

Scotland, with a population of c. 5m people, has only around 10% of total UK energy demand (population c. 56m) which in itself is a tiny proportion of the world's energy needs (current population c. 6300m). Consequently Scotland's, and even the UK's, energy needs will be totally determined by global energy needs and any meaningful energy policy for Scotland must start from this premise and not be considered in isolation. Various recent reports, including the Inter-governmental Panel on Climate Change (IPCC) 3rd Assessment Report (2001), suggest that global energy demand will grow from 10 Gt_{oe} to 50 Gt_{oe} during the course of this century. This enormous growth will be caused largely by the predicted growth in world population from 6bn to 12bn over the same period and the increasing standard of living aspirations from the developing countries. This level of growth will place unprecedented demands on the supplies of traditional fossil fuels, most forms of which are being depleted at a much faster rate than had previously been predicted (see, for instance, the Upsalla study of 2004). We believe that these global pressures will make it impossible for Scotland or the UK's energy needs to be met by current efforts. While it may be possible to continue with Scotland's current 'energy mix' in the very short term, any coherent strategy for 10 to 45 years' time will need to consider radically different ways of meeting Scotland's energy needs.

2. *Should Scotland aim to be self-sufficient in energy in general, and in electricity in particular, despite trends towards interdependence within Europe?*

This needs to be considered within the context of the UK's position as an island off mainland Europe. Most European countries have land borders with one or more of the other European countries, making energy interdependence more feasible. The present electricity and gas interconnectors with mainland Europe come onshore in the southern half of England because these involve the shortest physical distances. Scotland's only land border is with England and, as is well known, the electricity transmission connection between the two countries is not robust. This could, of course, be significantly strengthened, but only at relatively high financial and environmental cost. In terms of natural gas, the UK is already disadvantaged in national strategic terms by being at the end of the natural gas pipelines from Siberia and the Central Asian Republics. For Scotland to be dependent on gas supplied by this route would make it the 'end of the line' beyond England. A partial solution is the proposed direct interconnector with Norway but the overall economics of this are not clear. For these reasons, and the response to Question 3 below, the need for Scotland to become self-sufficient in all forms of energy supply is likely to become an absolute practical necessity rather than the more philosophical position implied by the question. In the electricity sector in particular, it must be recognised that if 40% is generated from renewables by 2020, then 60% is generated from conventional fossil and Nuclear plant. With all of Scotland's major power stations (Cockenzie, Longannet, Peterhead, Hunterston B & Torness) being scheduled to be decommissioned by around 2020, suitable replacement plant will have to be built before that time to ensure self-sufficiency.

3. *What are the possible implications and consequences for Scotland, and the UK, of becoming increasingly reliant on imported oil and gas for their energy needs?*

The UK government's PIU Energy Review of 2002 predicts that by 2020 the UK will become an 80% importer of natural gas, a large importer of oil and a large importer of coal, which clearly defines the government's own view of declining self-sufficiency in fossil fuels. In the case of oil and gas this lack of self-sufficiency has been brought about by exhausting the known British-sector reserves. In the case of coal this has been more as a result of political preference; substantial reserves of coal remain but much of the skills and experience in extracting these may have already been lost. The PIU Energy Review rather naively assumed that there would be no substantial increase in cost of importation of fossil fuels, which appears an unlikely scenario in the light of our response to Question 1. In sustainability terms, neither the PIU Review nor the Energy White Paper of 2003 takes any account of the embodied energy, environmental or societal costs of the importation of fossil fuels either. For all of these reasons, we see the consequences and implications of continuing to meet Scotland's energy demands from fossil fuels as unsustainable. In terms of any 'Triple Bottom Line' analysis, the continued importation of fossil fuels is not acceptable. We see the main solution to this is to maximise the use of Scotland's indigenous natural resources, probably in a combination of exploiting the remaining coal reserves, the offshore oil reserves through enhanced oil recovery with carbon capture and storage (EOR) and increasing the utilisation of renewable resources.

Energy Supply

4. *What are the feasibility, availability, reliability, sustainability, efficiency, capacity and risks of the different energy generation technologies?*

A competent answer to this question would in itself be a major report for which a commercial organisation would require a substantial fee. Any less comprehensive answer would be likely to reflect the bias of the author. We are not aware of any existing report which has produced an adequate comparison of the competing technologies and it should be noted that even the Royal Academy of Engineering Report of 2004, which attempted to make cost comparisons, has been repeatedly challenged and is considered by many within the RAEng to be deeply flawed. The Institution of Mechanical Engineers' position has for some time been that there must be balance to the 'energy mix' which will include 'clean coal' technologies, advanced CCGT, CHP, new nuclear (generation III and IV reactors), as well as an increasing level of renewables. Our comprehensive response to the Government's Energy White Paper can be found on our website at <http://www.imeche.org.uk/media/pdf/Energy%20Statement%20May%202004%20BR1.pdf> which explains our position in greater detail.

5. *What are the likely trends, and uncertainties, in the availability and cost of energy sources over the next 20/45 years?*

This question has, to some degree, already been answered. The price of imported fossil fuels is, and will continue to be, determined by market forces. Almost inevitably price will be driven up by increasing global demand. Just a few years ago, oil at US\$50/bbl would have been unthinkable. Now US\$100/bbl seems likely and it is impossible to project where the price may go beyond that. We expect prices for Natural Gas to broadly follow this trend. As soon as it becomes apparent that the UK has lost its skills and expertise in coal mining, we would anticipate similar increases in the price of imported coal. The price of uranium will no doubt also be subject to market forces, although the UK will benefit from a large indigenous stock of reprocessed fuel. On the other hand, most renewable energy sources are indigenous, are not subject to market forces and will remain cost-free.

6. *What are the economic issues of capital investment in the supply and distribution of energy that need to be considered?*

In sustainability terms we believe it to be inadvisable to consider economic issues and costs in isolation from environmental and societal issues and costs. However, even when making direct economic cost comparisons, it is extremely important to consider like with like, for example, the current popular comparison of the cost of electricity generated by a state-of-the-art, privately-funded, wind farm with that from a 40-year-old, fossil-fired, government-built, power station using cheap imported coal, is absurd. Whatever form of energy supply is considered, comparative financial, environmental and societal costs have to be considered for the whole lifetime of the fuel, including:

- raw material extraction,
- transport from source to use,
- material processing,
- plant construction,
- resource usage,
- plant decommissioning, and
- waste disposal, including transport.

7. *What are the key issues surrounding the development of Scotland's bulk electricity transmission and local distribution systems.*

The primary question to be considered here is whether the primary objective of “Scotland plc” is to become self-sustaining by supplying its own needs or intends to export substantial amounts of electricity to other countries, particularly to England. If the latter, then it is clear that the existing grid system connecting Scotland and England is inadequate and will have to be replaced at someone’s cost. If, however, Scotland is to become self-sufficient in energy terms, then we see no great need for substantial investment in transmission systems, other than possibly between the islands and the mainland. Indeed, the increasing utilisation of distributed and embedded generation schemes will mean that Scotland’s bulk transmission system will be adequate for many years to come. There will, however, be some reconfiguration and improvement of distribution networks required but this would have to be shown to be economically justifiable on a case-to-case basis.

Energy Demand

8. *What will the impact of energy availability and price be on the demand for energy by commerce and industry in Scotland?*

Precedent has clearly shown that the increasing price of oil, for example, over the past 30 years has not prevented the developed world from steadily increasing its energy demand year-on-year over the same period. What it has done, however, is make us much more aware of the need for reducing individual energy demand and increasing energy efficiency. This has largely driven developments in modern diesel and hybrid cars, use of lower-energy appliances and lighting, etc. The availability of energy, on the other hand, is a more politically-influenced field. There have been numerous studies to show that the whole world’s energy needs could be met entirely from renewable, sustainable resources. However, this will almost certainly not be the cheapest (in financial terms) option, which is why clear direction and leadership in this field are required from politicians and particularly the Scottish Executive. We see no reason why the impact of energy availability and price on commerce and industry should necessarily be negative. On the other hand, we believe that the opportunities presented by developing new, innovative ways of dealing

with energy supply and demand are massive and could have a major positive impact on Scottish commerce and industry.

9. *What are the likely trends in the domestic demand for energy for space heating and other purposes? What would need to be done to achieve major savings? What are the investment costs?*

Unless climate patterns change significantly in Scotland, demographic predictions suggest little change in demand for domestic space heating requirements. The increasing use of electrical and electronic appliances and 'quality of life' desires such as air-conditioning are likely to lead to increasing electrical loads. An obvious partial solution is to make it a legal requirement for all new house builds in Scotland to be of low-energy design. However, it is predicted that 80% of the housing stock in 2050 already exists and there are distinct limitations to the amount of energy efficiency measures that can be retro-fitted. Nevertheless, much can still be done to ensure that all existing homes are adequately insulated and equipped with double or triple glazing, conventional central heating systems are equipped with condensing boilers, together with increasing use of energy-efficient appliances and lighting. Rather more can be done for existing housing stock on the energy supply side, in terms of retro-fitting active solar thermal systems, ground source heat pumps (both well-developed technologies) or micro-CHP (close to market) technologies. These measures may well have to be legislated since simple financial pay-backs are rarely adequate to encourage investment.

10. *What are the likely trends in the demand for energy for transportation in Scotland? What is the likely time-scale and scope for substituting other power sources for fossil fuels? What are the likely investment costs?*

Other than in the Central Belt, Scotland's population is widely dispersed and public transport is not a practical solution for most people. Even within the Central Belt, many suburban rail lines and tramway systems were closed during the 1950s and 60s and are difficult and costly to restore. Only the Greater Glasgow area has anything approaching an integrated transport system and this is far from perfect. Few of Scotland's railways are electrified, and in any case the source of electric power has to be analysed for sustainability. This has led to a high dependence on cars for personal transport and HGVs for freight. Large improvements have been made recently in the efficiency of diesel engines and hybrid cars, although take-up of the latter has been relatively low in the UK. In any case, diesel engines and hybrid vehicles are still reliant on fossil fuels. Until recently, Scotland was still so well-supplied with fossil oil that there was little incentive, relative to most countries, to develop alternative fuels. There is a great opportunity here for Scotland to develop bio-fuels based on energy crops and agricultural residues (many technologies for which are close to market), but this may require some 'kick-starting' from the Scottish Executive. In the longer term, it is possible that further developments will be made in energy storage devices and vehicle fuel cells although the latter are currently still mainly reliant on fossil fuels. In this respect it should be noted that there is not yet any commercially viable method of producing hydrogen other than from fossil fuels. The investment costs will entirely depend on the technologies used and the size of the plant(s).

Environmental and Social Issues

11. *What are the environmental concerns that need to be taken into account, in terms of the impact on ecological and other natural resources, as well as waste management and impacts on the landscape?*

There must be a much clearer understanding of the potential conflicts between the genuine needs of Scottish society in order to be able to function properly and effectively, and the wants of that

society in terms of the increasing interests in outdoor pursuits. For example, should what some people (but by no means all) regard as the visual intrusion of wind farms in the landscape be given a greater weighting than the need of all society to combat global warming? Environmental impact assessment needs to be very broad-based in line with our response to Q.6 and to include “whole-life analysis” to establish the sustainability of a project in direct comparison with other alternative forms of energy. Proper implementation of waste management is crucial to sustainability in Scotland and the current ways of handling most forms of waste will require significant review. There is also a need for an urgent re-definition of ‘waste’ – for example, forest and arboricultural residues cannot continue to be regarded as waste when they are clearly such an excellent biomass resource. Municipal solid waste (MSW), as well as industrial/commercial waste, also needs to be viewed as a resource rather than a problem and we encourage the building of advanced-technology Energy-from-Waste (EfW) plants to utilise this valuable resource as a fuel.

12. *Can the objectives of environment improvement and economic growth both be met without a major increase in energy costs? What steps should be taken to enable an informed debate on the issue?*

It is our view that energy costs will rise inexorably over the next few decades, particularly for imported fossil fuels (see answer to Q.5), as reserves dwindle and global demand increases exponentially. Early support for and development of indigenous fuel sources and innovative conversion technology will safeguard Scotland against inevitably increasing international energy costs and will lead to significant economic growth in the nation while simultaneously improving the environment. There is a salutary lesson from which we must learn: as recently as 1990, wind turbine technology in Scotland (J. Howden & Co) was as well developed as in Denmark and Germany. Because of a lack of a domestic market for the turbines or any other kind of local support, the Scottish technology was lost while Danish and German companies went on to firmly establish themselves as the world market leaders in this field. Although Scotland is unlikely to be able to claw its way back into wind energy technology in any meaningful way, other renewable, sustainable technologies in wave, tidal, marine currents and biomass are again being developed in Scotland and the opportunity to turn these into world-class businesses must not, this time, be lost. As a Learned Society, we believe that we have been holding ‘informed debate’ on these issues for some years now, but we are growing concerned that both Scotland and the UK will continue to lose ground against international competitors if action does not quickly start to replace debate.

13. *What are the social values and consequences of energy generation and distribution on employment opportunities, health, and energy affordability?*

We believe that there has to be substantial re-education of the entire UK population to understand the consequences of the end of the ‘cheap energy’ era. Energy, in all its forms, must, in future, be regarded as one of our most precious commodities and not something to use or waste at will. There also needs to be some re-education of Government, which will also have to cease regarding energy as a ‘cash cow’ to provide ever-increasing tax and duty revenues to be spent on non-energy-related issues. As previously stated, there are numerous renewable, sustainable technologies which are being developed in Scotland which, if encouraged, can provide large new employment opportunities creating genuine wealth for the Scottish economy.