BNFL Response to the Royal Society of Edinburgh's Independent Inquiry into Scottish Energy Supplies

Introduction

Against a background of volatile oil prices, rising CO_2 emissions and increasing levels of gas imports, it is time for Scotland to take action in earnest to ensure its energy supplies for the future.

BNFL believes that there is a strong case for nuclear energy to remain a key part of the supply mix to meet Scotland's electricity needs. Nuclear energy currently provides over one third of Scotland's electricity – safely, reliably and with virtually no emissions of carbon dioxide or other greenhouse gases. However, by 2023 all of the nuclear capacity in Scotland is scheduled to have closed, and so key decisions must be made soon over the future shape and balance of Scotland's electricity supply mix over the coming decades.

We believe it is important to recognise that the overall environmental objective in respect of climate change is the achievement of substantial cuts in CO_2 emissions, rather than the deployment of any one specific low carbon technology. On that basis, we believe that whatever support is necessary to encourage investment in renewables should be part of a portfolio of investment to support all contributors to a low carbon energy supply.

Scotland has some of the best wind and other renewable resources in Europe, and has set ambitious targets for the deployment of renewable generating capacity. However meeting the target of producing 18% of Scotland's electricity from renewables by 2010 will be challenging. The longer term target for Scotland to produce 40% of its electricity from renewable sources by 2020 appears to be even more challenging.

A further consideration is the extent to which the UK and Scotland will become increasingly dependent on supplies of imported gas to fuel the electricity supply sector. Variability issues associated with the anticipated growth in wind energy also have to be taken into account in respect of reliability of electricity supply. The risks attached to such a future are difficult to quantify, but are widely expressed, and it is important to recognise the fact that nuclear power plants provide baseload power around the clock – with high confidence over the future availability of the uranium fuel.

The nuclear industry also offers significant employment opportunities in Scotland. The jobs are in general highly skilled and well paid which has a positive benefit to supporting the direct community. There is also a strong correlation with the skills that are employed in other aspects of industry in Scotland such as the off-shore oil and gas sectors. On the other hand, employment prospects from wind power are less clear – the technology is developed and imported from overseas with relatively few jobs generated in the local communities.

In looking to the future, Scotland also has unique experience in advanced nuclear technology that could attract the attention of the world's leading countries. Currently the US is establishing an international programme with nations such as Japan, France, Canada, South Korea, the UK and many others to develop nuclear reactor technology for deployment around the 2030 timeframe. Investment from countries such as the US, Japan and France could be greater than £500M per annum. Much of this investment is targeted at developing fast reactor technology and Scotland is one of the few countries in the world where fast reactor technology was successfully demonstrated (at Dounreay). There is a unique opportunity for Scotland to benefit from international cooperation in this area.

Nuclear energy offers safe, reliable and affordable electricity generation with virtually no CO_2 emissions. Urgent action by both the Scottish Executive and UK Government is needed in order to keep the nuclear option open. A low carbon energy portfolio is essential for Scotland, embracing nuclear and renewables, to ensure reliable delivery of the nation's energy requirements whilst providing the best possible protection for the environment.

Responses to Specific Consultation Questions

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 should show leadership in moving towards an energy future in which low-carbon energy is at the forefront. Scotland is well placed to do this – given its current substantial nuclear capacity, coupled with extensive renewable resources. A balanced mix of sources of electricity – including renewables, nuclear and fossil fuelled plant fitted with carbon capture technology – would leave Scotland well placed both to balance the different priorities of energy policy, and to lead the UK and Europe in doing so. Scotland is ideally placed to take forward a balanced energy mix given its experience in the oil and gas industry, the nuclear industry and the environmental resources for renewable technology. Scotland's ability to deploy a balanced energy mix using the above technologies could set an enviable benchmark for other countries.

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

Scotland is currently a substantial exporter of electricity to the rest of the UK, but self-sufficiency need not be a pre-requisite for Scotland's energy future, provided that the risks associated with energy supply are well managed. A diversity of technologies for supplying electricity, coupled with diversity of fuel sources and assurance that the sources of fuel and their transit routes do not present an unacceptable political risk, should ensure a high degree of confidence in supplies, without the cost to the economy which full self-sufficiency could entail. As noted above, Scotland has the opportunity to take leadership in demonstrating the deployment of a diversified energy mix.

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 in general, and Scotland in particular, will experience a period of major change, as oil and gas supplies from the North Sea diminish, and increasingly come from overseas. The risk of interruption to supplies inevitably increases with the additional considerations of transport and political stability – both in source countries and those through which supplies must pass. In addition, recent experience has shown global oil and gas prices to exhibit both an upwards trends and significant volatility. The increased future dependence of UK and Scottish energy supplies on these imports therefore raises the prospect of higher energy prices for all users, and consequential impacts such as increased fuel poverty, reduced international competitiveness and the likelihood that energy intensive industry will be driven overseas. This latter point is particularly relevant when increasing UK and Scottish reliance on imported oil and gas is contrasted with other nations which will have a more balanced electricity portfolio, and are therefore less vulnerable to price rises in these commodities.

Energy Supply

What is the feasibility, availability, reliability, sustainability, efficiency, capacity and risks of the different energy generation technologies?

All generating technologies present a balance of advantages and negative features, across the various parameters outlined. In considering the different options, attention must be given to the benefits presented by diversity, as well as the features of individual options.

In summary, key features of the different options are as follows:

Coal stations provide reliable baseload generation, and coal supplies can be expected to be reasonably secure (either from domestic mining or imports) based on the track record of coal usage in the UK. Coal is an abundant fuel and relatively cheap. In addition, coal stations can respond rapidly to changing demand, thus providing essential flexibility to the supply side. However, current coal-burning technology leads to the emission of significant quantities of carbon dioxide, presenting a major challenge to environmental protection. Given the current priority accorded to preventing global warming, it is difficult to see a long term future for coal-fired generation until carbon capture technology reaches the point of being both technically proven and economically viable. Given the potential for significant deployment of coal generation in countries like China, there is an opportunity for Scotland using its existing resources and capabilities to take a lead in demonstrating sequestration technology. This experience could then be exported to support other countries.

Gas has been the fuel for most of the recently constructed power plants in the UK, on the basis of its low price over the past decade or so. However, the UK is now shifting rapidly from using domestic gas reserves from the North Sea to

relying on imports, as discussed elsewhere in this submission. Key sources of such imports are Norway, and in the longer term Russia, Qatar and Algeria. This carries risks in terms of supply security, as well as in terms of future costs, recognising the upwards trend and volatility of global gas prices. Raw gas costs account for around 60% of overall generating costs from gas power plants, and so power prices are strongly linked to the costs of gas. Furthermore, gas stations also produce CO_2, although only approximately half the emissions of a correspondingly sized coal station.

Renewable energy generally has no direct carbon emissions. However costs are currently uncompetitive without significant subsidy, and this needs to be overcome in the longer term if the proportion of power from such sources is to grow as hoped. Costs will come down with increased scale of deployment, but it remains to be seen to what extent these will become more competitive over time.

Whilst renewables generally have no issues attached to the delivery of fuel supplies to the power generation facilities, variability of the output has to be taken into account – in particular from wind farms. When the wind does not blow (or blows too strongly for turbines to operate safely) power must come from other technologies. The grid and other sources of power can provide this "backup" up to a certain amount of wind (typically 10 to 15% of all power production), but beyond that level additional plant would have to be built for this purpose. This is a particular issue in Scotland, where targets for renewable energy (primarily expected to be wind) are higher than the rest of the UK. Much renewable technology such as wind is already well developed with the main industrial companies based overseas.

Nuclear energy provides reliable baseload power around the clock, and produces virtually no carbon dioxide. It therefore makes a major contribution to both supply security and carbon reduction. The raw uranium fuel comes from politically stable countries such as Canada and Australia, and in any case requirements are low, and the costs of the uranium are only a small proportion of overall costs, so uranium price variability is not a key concern. In fact the economics of nuclear power generation are dominated by the relatively high capital cost of building the plant, and associated financing costs. Even so, recent studies[1,2] show that the costs of electricity from nuclear stations are competitive with those from alternative sources.

Waste volumes from modern designs of nuclear plants are substantially less than from some existing reactor technologies, and so would represent only a marginal addition to existing waste volumes over the full lifetime of a fleet of new plants. For instance 10 new reactors across the UK would add less than 10% to existing UK waste volumes over a 60 year operating lifetime.

As noted above, Scotland has a unique history and capability in advanced nuclear technology which is attracting international attention. Fast reactor technology such as that at Dounreay, whilst initially demonstrated, was not progressed once the North Sea gas fields were discovered. However many

[1] For instance *"The Cost of Generating Electricity";* Royal Academy of Engineering; 2004
[2] and *"Projected Costs of Generating Electricity";* OECD / NEA / IEA; 2005

nations such as the US, Japan, France, South Korea and China are now revisiting fast reactor technology in recognition of limited and finite fossil fuel resources. From a research perspective, Scotland could have a significant role to play.

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

It would be difficult to predict either availability or cost with confidence on these timescales, however it is clear that there are new issues attached to both in relation to imported gas – likely to be the mainstay of the electricity supply sector on these timescales. As noted above, the shift from domestic production to imports can only increase the risks of supply interruptions and of gas price rises, which will lead inexorably to increased electricity prices for domestic and industrial consumers. The cost of nuclear electricity is however well defined. The generation cost is dominated by capital cost with ongoing fuel and operations costs only making a modest contribution. Fuel costs are also stable and therefore the cost of electricity from nuclear power stations over a lifetime of several decades is well defined and unlikely to vary significantly.

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

Investment is a key issue in relation to the supply side of the electricity sector. A number of potential technologies, including nuclear and tidal projects, are likely to be long term and relatively capital intensive, yet offer the potential to deliver both reductions in carbon emissions and improvements in security of supply. Given their low-carbon benefits, it is important that the market framework is such that these projects can be feasible, as well as shorter term, less capital intensive technologies such as CCGT and wind.

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

Scotland is currently a significant exporter of electricity to the rest of the UK. However, around 50% of Scotland's generating capacity has either recently closed or is scheduled to close within the next decade (the Chapelcross nuclear plant has already closed, and the nuclear station at Hunterston together with the coal plants at Cockenzie and Longannet are expected to follow over the coming 5 – 10 years). Unless this capacity is replaced promptly, this implies a major shift from exporting power to becoming an importer.

This change comes in parallel with the projected growth of renewable capacity – particularly wind farms - at a disparate range of locations where grid capacity is currently weak or absent.

All of this change in the shape of power generation across Scotland brings a need for substantial investment to re-shape the transmission network. It seems inevitable that this will ultimately be funded by electricity consumers, so heightening the importance of keeping the generation component of overall costs as low as possible. Other risks of power price rises (for the reasons discussed elsewhere in this submission) must be seen against this backdrop.

Energy Demand

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

Whilst demand, price and availability are all inter-related issues, it is important not to allow demand to be constrained by availability or overly governed by price. Economic growth will be the main driver of energy demand. If Scotland's energy demand cannot be met cost-effectively – for whatever reason – then economic performance will suffer. If problems in these areas were to persist (or to be seen to be at risk of doing so) then it is likely that industry would look to invest elsewhere, and existing businesses would consider re-locating.

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?

The issue of energy efficiency is a complex one, and merits a more detailed analysis than is possible here. However, a number of points should be noted. Energy efficiency measures and initiatives are not new –indeed they have existed over many decades. Yet all the evidence shows that they do no more than slow the rate of growth in demand. Rarely, if ever, has there been a sustained reduction in demand which was caused by efficiency improvements rather than economic recession.

Moreover, the most effective means of improving energy efficiency are those installed in new build properties. Retrofitting to existing properties is much less cost-effective, and is unlikely to be able to deliver the same level of benefit. The rate of improvement is therefore governed by the turnover in property, which is measured in the order of decades, if not longer. Therefore, whilst there is much potential for improvement, substantial changes cannot be expected on a short, 5-10 year timescale.

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?

Over the medium term, demand for energy for transportation seems likely to increase steadily in Scotland – as in the rest of the UK and indeed most other countries in the world. Whilst much work is being done on alternatives to fossil fuels, it is unlikely that major change in this area (for road and air transport at least) will be seen for some decades to come.

Over the coming decades therefore the focus should be on reducing fossil fuel usage in those areas where there are alternatives available (such as in the electricity sector), whilst awaiting the global developments in transport technology which may drive a shift away from fossil fuels in this area.

Even if alternatives do become available –such as hydrogen fuelled vehicles – it will be important to understand the full-cycle impact of these changes. For

instance, if the hydrogen used in future transport systems is itself produced from fossil fuels (either directly, or using electricity from fossil fuelled power stations) then there may be no net saving in carbon emissions. Any electricity used in hydrogen production must itself be carbon-free if the shift to this technology is to play a part in reducing CO_2 emissions.

Environmental and Social Issues

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?

All forms of electricity generation have their own impacts on the environment. Fossil fuels emit carbon dioxide which contributes to global warming, onshore wind turbines have a visual impact which alters the landscape where they are situated, and other renewables such as wave, tidal and hydro plants impact on the surrounding natural environment and impact on the local wildlife.

In the case of Scotland, it is important to pay particular regard to the impact of any scheme on the tourist industry, which forms a valuable sector of the overall Scottish economy. Particular care should be taken to avoid undue detrimental impact on the unspoiled and highly prized Scottish landscape.

Although nuclear power stations produce radioactive wastes, the volumes concerned are very small in the context of wastes from other stations, and such wastes are managed safely and securely to ensure there is no impact on the environment.

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?

Improving the environment need not imply substantial increases in the cost of electricity, provided that advantage is taken of the most cost-effective options for delivering that environmental improvement. Recent studies have shown that low-carbon nuclear energy is competitive in terms of overall generation cost with other technologies, and is less expensive than most renewables. In particular, a recent study by Oxera[3] showed that the costs of delivering reduced carbon emissions through the use of nuclear energy were substantially less than the corresponding costs to the taxpayer of achieving the same benefit through renewable sources. These studies are based on today's expectations of future fossil fuel prices. As noted earlier, if these prices increase more than expected in the future, then the benefits of nuclear energy, in terms of preventing electricity prices from rising too sharply, become more significant.

Achieving an informed debate will require specific action to encourage a move away from mindsets of the past, leading to understanding and acceptance of other possibilities. Action should include providing ready access to reliable

[3] *"Plugging the Carbon Productivity Gap";* Oxera; 2005

data and up-to-date assessments from industry, academia and independent analysts alike. As an example of this the nuclear industry has sponsored the development of a new website (www.energy-choices.com) aimed at putting nuclear energy in the context of other energy sources. This website should therefore be able to make an effective contribution to informed debate on our energy choices for the future.

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

Reliable and affordable supplies of energy are vital to much of today's society – from keeping transport systems running and businesses operating to underpinning hospitals and providing power for communications and leisure activities. Even short interruptions in power supplies can lead to disruption which can last for hours or even days, with a vast range of associated problems. A modern 21st century society, such as Scotland's, virtually takes for granted that energy supplies will be reliable and affordable for all. If this ceases to be the case, then as well as the immediate effects arising from a loss of power, the longer term effects such as declining economic prosperity and loss of investment must be considered.

BNFL

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