Scotland
and
Electricity Generation

Tucked away discreetly (perhaps for obvious reasons!) in the Sunday Herald issue of 21 Oct 2007 was an item about Scotland's total CO2 discharge for 2006. This article and reading between its lines to try to understand just what it meant prompted an attempt at a summary of where Scotland is at present in relation to electricity supply. The summary also tries to look towards the future and because power and fuels are so closely tied together it strays into other relevant areas.

○ Background

Scotland has 5 main electricity generating stations, Longannet and Cockenzie, both coal-fired, Peterhead which is gas-fired, and Hunterston and Torness which are nuclear. The more remote island groups presently rely on local, small-scale generation (usually diesel engine-driven) and we already have of course some renewables in the shape of windfarms and hydro power. Other generation sources, wave, biomass and landfill gas do exist but at this time they are relatively insignificant and amount to around 150Mw, less than 2% of the total. For the moment renewables and nuclear each amount to around 20% of the total generating capacity in Scotland, meaning that fossil fuel burn at the three named power stations has the potential to generate over 50% of Scotland's maximum capacity. The power stations' remaining operational lives are discussed later.

Scotland's last working underground coal mine closed in 2002 and Longannet's maximum requirement for 70,000-80,000 tonnes of coal each week is now met largely by imports through the former British Steel ore terminal at Hunterson in Ayrshire. The movement of this large volume of material causes serious congestion to the rail network in Central Scotland. This pressure on the rail system and rolling stock frequently leaves trains in the wrong place and other coal producers may then find they have no transport. Longannet also burns dried sewage (the legality of it doing this is disputed) and some gas/oil.

Some of this fossil fuel generating capacity had been lying idle while the nuclear power stations and the available renewables have been working hard in order to lower the country's total CO2 emissions. Demand and capacity are obviously different things and for a time demand has been somewhat less than the available generating capacity. In 2006 this seems to have gone dramatically wrong.

○ Scotland's CO2 and its main sources in 2006

The Sunday Herald report was based around SEPA's annual returns and their comments on the subject and made rather disturbing reading. Compared to 2005, Scotland's total CO2 discharge in 2006 actually went up by the amazing figure of 4.6Mt (this equates to a 10% rise), and it was stated that this was entirely due to added coal and gas burned for electricity generation! The SEPA report said this was the result of long-term outages in nuclear reactors at both Hunterson and Torness for emergency repairs. (Perhaps aggravated by age and over-utilisation?) The increase is effectively worse than 10% as several other major polluters (not generators) had made substantial savings in their CO2 discharges from 2005 into 2006.

Additional damage was also caused indirectly by the sharp rise in world gas prices (Russia now appears to dictate the price of supplies to the European gas market). The higher price of gas meant that, in order to contain costs, the extra power generation was mainly by coal burn, not by gas as used in the Peterhead power station, although even gas burn there eventually became essential. In coal versus gas for generation, coal is actually a far worse polluter. On top of this Cockenzie is an elderly and relatively inefficient power station retained only for strategic use in such emergency situations. Another small coal-fired power station has also been retained at Methil in Fife for the same strategic reasons. Methil's use is not mentioned in the SEPA report.

- **The problem for the Scottish Government**

Can you imagine the headache this scenario gives to any government reaching for the moral high ground and claiming to set an example for minimising global warming from greenhouse gases, especially as they are telling everyone that we don't need or want nuclear power? In order to deliver the non-nuclear promise for the future, the recently discussed 'clean coal' electricity generation, whereby the CO2 is captured and not discharged into the atmosphere, has to be much more than just technically feasible.

The problem of going for coal burn is that the global market price for coal, even if it is mined here, will be driven up in line with other fuel costs to a great extent as the cost of coal mined here and abroad is greatly affected by the price of oil. The main coal producers use opencast methods and the machinery used is largely diesel powered. The coal also has to be transported here by ship.

Applying 'clean coal' technology to reduce greenhouse gas (CO2) emissions is going to reduce power station efficiency as it requires a lot of energy to collect the CO2. The additional equipment will increase capital costs and add to operating costs. There is also the problem of developing a safe method of disposal for the captured CO2, and the cost of the disposal.

Electricity prices, from whatever generation system, will continue to rise dramatically in the coming years, due to fuel shortages, market pressures/demand and the introduction of new technologies. At present no-one is saying much about this but you do read frequent complaints about the artificially high price paid at the moment for electricity generated from renewables. In the not-too-distant future this price may well become the norm.

We certainly cannot look for any government we elect to shelter us from the constant price increases on the horizon as fossil fuels become scarcer. Oil prices are already at an all-time high and the price shows little sign of easing. Currency fluctuations make it difficult to assess this. With the fall in value of the dollar (and sterling) we may soon see the oil producing countries change from dollar trading to the euro for example. Similarly we are now being told that there will soon be a world shortage of uranium, so the price of that raw fuel will rise too, due to increasing demand and falling reserves. Other naturally occurring nuclear fuels do exist but may not be suitable for the existing power stations.

Electricity generation is clearly important, but in Scotland it has been stated that only 20% of the total power used is actually electrical. The vast majority of the balance is from fossil fuel (oil and gas), whether for heating, vehicle propulsion or industrial processes. The future seems set for a change to a hydrogen-fuelled economy, but the problem in this is the huge amount of electricity required to produce the raw hydrogen. To meet this challenge the figures suggest we might have to increase our electricity generating capacity five or six-fold if we want to manufacture our own hydrogen and not be dependent on imports.

- **What about renewable sources of energy?**

Renewable power sources can probably not safely meet Scotland's total electricity generation needs but they have already achieved the Scottish target for 2010. Scotland may soon go on to exceed that target but at the moment many planning applications for renewable power generation, mainly for windfarms, are bogged down in the planning system. The overall UK figure is however well behind target.

Other renewable power generation methods, aside from hydro, are in their technological infancy and are many years away from being capable of delivering a substantial contribution to power supplies. They will also have to clear the planning system's hurdles, whether that is at the application stage to build them, or to create the necessary grid system to collect power from possibly remote generating locations. Without a guaranteed grid connection no developer can afford to risk investing in a potential renewable energy site.

An example of the planning/environmental problem can be found when discussing wave/tidal power generation. At a recent conference in Dundee it was stated that Scotland had the potential for generating as much as 21.5Gw from wave and tidal sources (almost 9 x Longannet). However it was later added that an initial strategic environmental impact assessment and consultation had reduced this figure to between 1 and 2.5Gw. (Equivalent to 1 Longannet or less!)

With regard to hydro generation, a U.K. government report already admits that there is little expectation for further large developments due to their major environmental impacts, the time it takes to bring them into operation, and the huge capital outlay. The last planned scheme is currently under construction at Glen Doe in the Highlands. The same report adds that there is some scope for small-scale hydro systems, but only for limited local or individual property use.

- **Coal in Scotland**

Prior to WWII Scotland was achieving about 30Mt of coal mined in each year but during and after the war this figure fell sharply and after nationalisation the best output, in 1951, was 24.5Mt. The central area of Scotland was by then regarded as limited in potential and almost exhausted. The Coalfield Committee Report prior to nationalisation had estimated total Scottish reserves at around 8,000Mt. Much of what remains of that reserve today is in thin seams, in areas now sterilised by abandoned and flooded workings from closed collieries, or under built-up areas. What is economically accessible is currently being worked by opencast methods.

Today's remaining reserve is a fraction of that original optimistic figure but is still substantial. The worthwhile deep reserves lie in difficult situations, off the coasts of North Ayrshire, and under the Forth between Fife and Midlothian. There is also a largely unknown reserve under the border area between Canonbie and Carlisle but this is mostly under the English side of the border. The economically recoverable opencast reserve may have as little as 10 years of life remaining at present output. At this time the majority of the coal produced in Scotland is taken south to generating stations in Northern and Central England with some diverted to maintain a strategic reserve at Cockenzie or to top up Longannet's requirements. The cost of producing opencast coal is greatly dependent on the availability and price of oil, one of the largest cost factors in its production.

Scotland does not have the coal reserves to guarantee supplying Longannet (4.0 Mt per year when running at full capacity) in the long-term, let alone another two power stations of the same size if Hunterston and Torness are replaced by coal-fired power stations in the future. It has also lost the skilled workforce capable of doing the mining and it does not have the infrastructure to move the required volumes of coal any great distance from either mines or ports. If we are to rely on electricity from coal then new power stations will have to be built with adjacent deep-water port facilities to allow supplies to be fed from ships directly into the power station. Obviously they would rely on imported coal and at the moment Longannet is supplied mainly from Poland and Russia.

Due to the still sizeable reserves of coal remaining in the ground in Scotland there may be a case for the use of 'in situ' coal gasification (ISG) with the gas generated fed into the existing distribution network for domestic use, possibly also as a fuel in power stations. This system of gas generation might allow even the thinnest of seams to be utilised. Again this is a technology at an early stage, despite having been discussed for 40-50 years. Until full scale testing is tried and proved successful it cannot be relied on. Its effects on the ground, particularly in urban areas, have not been established. Much of Scotland's remaining coal reserve, where mining was previously carried out, is now built over.

- **What can we do to limit greenhouse gas emissions and our vulnerability?**

Assuming that we want to continue to comply with limiting the emission of CO2, it would seem that all we can really do is try to build a reasonable mixture of modern, clean generation systems, a mixture which must limit our dependence on fuel imports. We should also try to avoid having all our eggs in one basket, whether it's nuclear, renewables or coal. To **minimise** pollution we need renewables for use when the winds, rains, tides, waves or whatever are suitable and fossil fuel or nuclear for the base load and when these renewables might have inadequate output. The use of gas for power generation is questionable.

To be nuclear-free is an admirable goal, but until clean-coal technology is up and running **and** we build another two coal-fired power stations the size of Longannet (to replace both nuclear power stations and Peterhead) with a secure long-term fuel source for them, we will continue to need both nuclear and coal. In addition to this there are questions over the remaining useful life of Longannet itself. This rough estimate of two power stations is based on the present situation and assumes demand will remain constant. As our need for electricity rises, total generating capacity will have to rise accordingly and still contain a safe percentage of over-capacity for security.

- **Summary**

Recently BP announced the loss of 350 jobs at its Aberdeen North Sea headquarters. This was blamed on both the falling output from the oilfields there and BP's own annual results as they try to introduce economies. Immediately after BP's announcement Shell also gave similar indications due to its impending results. The UK's oil production from North Sea fields peaked in 1999 and has already fallen to 50% of the 1999 figure. We are told by some studies that world production has now peaked too, in 2005 or 2006, but the world's demand for oil is still rising. We are also told that world oil production could fall to 50% of the current level by 2040.

Gas production from the seas around the UK is also falling in parallel with oil production with only small reserves still to be brought ashore. Exploitation of new reserves of both fuels in the much deeper waters off the west coast of Scotland remains problematical due the extremes of conditions challenging developers. Some of the locations are also the subject of litigation by other countries who clearly want access to these reserves for themselves. It will happen but it will not be on the scale of what came from the North Sea.

Another recent report, in the Guardian, refers to there being only 20 years of proven oil reserves left **based on present demand!** The actual figure seems to vary from 20 to 40 years according to which report is being used. Some of these reports clearly contradict each other in detail but they all point in the same general direction. The UK's Department of Business and Enterprise reacted predictably to these claims saying that in the short term world oil production would actually grow and outstrip demand! It did not comment on the price of oil, or the life of the world's remaining reserves! If their statement was correct then why is the price at a record high?

The technology now exists to propel smaller vehicles by means other than fossil fuel (the hydrogen fuel cell) but not yet for larger HGV types of vehicle, shipping or aircraft we use for business and holidays and take so much for granted. Unfortunately it takes a **lot** of electricity to create these gases. Add that and our increasing need for electricity to the present level of demand and our electricity requirement is actually going to rise sharply in the coming years.

As well as our taken-for-granted personal transport we have all kinds of essential industries relying on oil at the moment, food production and distribution, pharmaceuticals, hospitals, police, fire service, public transport, and most manufacturing industries in general. Very little is being said or done publicly to enable these services to continue operating when oil becomes scarce. It would seem that events are conspiring against the western world's dependence on a constantly increasing need for fossil fuels and electricity supplies.

All five main power stations in Scotland come to the end of their economic or safe lives in the near future. Longannet is already 35 years old, Cockenzie is almost 40 years old, Peterhead is 25 years old (but was renovated in 2000), Hunterston is over 30 years old and Torness is almost 20 years old. There is nothing definitive regarding the ultimate life of the fossil fuel power stations but the nuclear power stations have a design life of 35 years and anything planned beyond that is the subject of very careful scrutiny. Torness and Hunterston are both recently showing signs of unreliability.

It took ten years from start of construction to commissioning for Longannet Power Station. For how long before that was the project in planning? It was built in the 1960's (1962-1972) when the planning system and construction rules were more favourable for developers! If it has been decided that 'clean coal' is to be our base-load generating fuel for the future then hopefully someone is already drawing up plans to build replacement power stations now, at Hunterston or somewhere similar, where a deep water coal handling facility already exists and where there is an established grid system which can take the power to the consumers.

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