The Place of Nuclear Power in an Energy Portfolio
by
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"Are these the shadows of things that Will be, or are they the shadows of things that May be only?"
Charles Dickens, A Christmas Carol

In the heady days of the 1960s the residents of Seaton Carew in County Durham, UK demanded to know why they were to have a new coal-fired power station built close to their small town; "Why can't we have one of the new, clean nuclear stations?". Confidence in technology was high, the Americans were on their way to putting a man on the moon, the wishes of the residents of Seaton Carew were granted and an Advanced Gas Cooled Nuclear reactor was built on the site and is performing well to this day. But times changed and "events" intervened to undermine confidence in new technology and particularly nuclear power. Accidents at Windscale, Three mile Island, Chernobyl and, more recently, Tokaimura were highlighted in the media. All these accidents, incidentally, were the result of operator error with the exception of Windscale which was due to inadequate instrumentation.

Environmental pressure groups made emotional appeals to close down all nuclear stations, stop reprocessing spent nuclear fuel and leave it above ground in dry stores in, presumably, politically stable countries(sic), until something could, eventually, be done about it. Politicians, realising that there were only negative votes in nuclear power, either espoused the anti- nuclear cause or kept quiet about it. The nuclear industry, not noted for an articulate, pro-active stance, also kept quiet. But nuclear generating capacity continued to be built through the 70s, 80s and 90s, until today it provides 16 per cent of world electricity. During 2000 six new nuclear plants were connected to national grids, one in Brazil, one in the Czech Republic, three in India and one in Pakistan. Generating costs are higher than for coal and gas, but not much higher. Security of supply is good and, a further bonus, nuclear power puts almost no carbon dioxide into the atmosphere(1kWh of nuclear electricity puts 5g of CO_2 into the atmosphere, about the same as wind power; 1kWh of coal-fired electricity emits 1000g of CO_2).

World wide, nuclear power has reduced carbon dioxide emissions by around 8 per cent, about the same as hydropower. This environmentally friendly aspect of nuclear power has dumb founded the "green" anti-nuclear lobby, who find themselves unable to come to terms with the environmental arithmetic. Not so the Royal Commission on Environmental Pollution in its 1999 report, where the call to reduce carbon dioxide emissions in the UK by 60 per cent by a 2050 was made. This was necessary to limit the concentration of carbon dioxide in the global atmosphere to 550 parts per million, twice the pre- industrial figure. Nuclear power was expected to play a large part in two of the four scenarios presented. The report assumes no increase in energy demand over the 50 years in one scenario, a reduction of 36% in two others and a 47% reduction in the final scenario. This contrasts starkly with the doubling of energy demand anticipated in the Royal

Society/Royal Academy of Engineering report on Nuclear Energy published in the same year. The UK government is signed up to reducing carbon dioxide emissions by 20 per cent of 1990 values in 2010. Until recently it seemed on track to achieve this but recently carbon dioxide emissions have started to rise again, the result of higher gas prices causing more coal burn. Increased outage of ageing nuclear stations and the inexorable rise in the number of cars on the roads, have added to the problem. If the closure and decommissioning of all but two of the UK Magnox stations goes according to plan and they are replaced by gas-fired stations, carbon dioxide emissions will rise by 15 million tonnes. This is just about the savings anticipated from the climate change energy tax and associated measures introduced by the government. As the Red Queen remarked to Alice in "Through the Looking Glass", when they had been running very fast "Here, you see, it takes all the running you can do to stay in the same place, if you want to get somewhere else you have to run at least twice as fast as that". The carbon dioxide reduction of 20% is beginning to look fragile despite the rhetoric of government ministers.

Energy is the lifeblood of civilisation; without it society soon spirals down into anarchy. This is particularly true of the information technology-dependent developed countries of the West and Asia. A crash of the computer systems in the stock exchanges of the world, or at a major airport, or in the banking system shows just how vulnerable we all are. A power failure in the underground in London or New York at rush hour swiftly becomes intolerable. A foretaste of these dangers has arisen in California and Brazil, causing President Bush, in the US, to introduce a National Energy Plan. The Bush-Cheney plan strongly endorses nuclear power as part of a balanced generation portfolio. The thrust of the plan is to ensure "security of supply" rather than "protection of the environment". The European Union has recently published a Green Paper on security of energy supply with a plea that the nuclear option is not ignored. Nuclear power has also surfaced, albeit hedged around with caveats, in the UK. Prime Minister Blair announced, on the 25th of June, the setting up of an energy strategy review. "The aim of the review will be to set out the objectives of energy policy and to develop a strategy that ensures current policy commitments are consistent with longer term goals". The scoping note, which accompanies the announcement, emphasises security of supply and also, amongst other things, reduction in carbon dioxide emissions with a recognition of the important role nuclear power plays in reducing UK figures. The very mention of nuclear power is a political turn around for the Labour Party in the UK and a recognition, at last, of the reality of nuclear power's role.

The two-pronged approach in the in the UK strategy study suggests a possible future role for nuclear power in reducing dependence on imported gas from Russia and the Middle East (as much as 80% of UK electricity could be generated using imported gas by 2040 if coal and nuclear stations are closed) and keeping carbon dioxide emissions low. If this strategy is found to have merit we could see a resurgence of nuclear power in the UK. Similar realisations may develop in Germany, Sweden and other nuclear averse countries. The US is driven by the awful prospect of lights going out

elsewhere than in California; as for natural gas, supplies are running out as prices quadruple although demand is predicted to rise by 50% by 2020 and, in twenty years time, the US will be importing two out of every three barrels of oil. So it's coal and nuclear power to fuel the future, or is it?

Renewable energy technology is still in its infancy, other than hydropower, that is. A huge increase in renewable energy is strongly advocated by some environmental groups such as Friends of the Earth who call for a doubling of the 10% renewable electricity target for 2010 in the UK, for example. But energy arithmetic reveals the difficulty , if not impossibility, of such proposals. If all the wind farms currently operating in the world were all concentrated, say, on the South Downs in the UK, they would only supply 10% of ***United Kingdom electricity***. Or, to replace the two nuclear power stations that supply 50% of Scotland's electricity would require 10,000 of the newly installed wave power generator on the island of Islay. The World Energy Council's most optimistic scenario for renewable energy suggests it could provide just 20% of world energy by 2050.

By far the biggest renewable source, other than firewood, which is now running out in Asia and Africa, is hydroelectric power, which provides around 19% of world electricity, cutting carbon dioxide emissions by about 8%. Expansion of this resource is possible, although environmental groups have pronounced large scale hydro as unsustainable. They object particularly to the 18,000MW Three Gorges Dam now being built in China. There is an air of unreality about some environmental groups' plans for the future. How can renewable energy replace nuclear power and dwindling fossil fuel resources and, at the same time, provide double the current energy demand in 2050?

But if there is to be a resurgence in nuclear power, with life extension and new build and not just a "silly season" brief flowering of interest before the idea withers on the vine, how will it be achieved?

The industry has been developing a new generation of "inherently safe" designs, primarily light water reactors, building on the very successful current technology. The Westinghouse AP600 (already licensed in the US) and the larger AP1000 are ready to go; there is the EPR built by Siemens/Framatome, the ABB Boiling Water Reactor and a number of Japanese designs, some of which will use mixed oxide fuel. Looking further ahead, the Pebble Bed Modular Reactor of Eskom/BNFL/Exelon and other high temperature reactors using helium as coolant will become available. In Russia there is the prospect of the BS800 Fast Reactor based on the long operating BS600.

It has to be appreciated by politicians eager for a "quick fix" that nuclear stations take, in general, 10 years to build and a medium length strategy has to be adopted. The same is true of expansion of renewable power generation. But that means starting new programmes in the next couple of years to achieve security of supply and carbon dioxide emission control post 2010.

As always, public perception of the acceptability of nuclear power, and , for that matter, the real but limited role that renewable energy can play, must be

appreciated. A universal carbon tax would make a profound difference here and show real commitment to containing carbon dioxide emissions.

The Achilles heel of the nuclear industry is the problem of radioactive waste management, widely perceived as being unsolved. Although the engineering of both the reprocessing route and the dry store method is well understood, the identification of dry, geological structures, which can contain the waste, is still not in place. In the US continuing arguments over the Yucca Mountain site and in the UK the suggestion that there is no hurry and that waste can be stored safely for 50 years above ground whilst a suitable site is found, are unacceptable. Finland leads the way with the approval of the construction of an underground rock facility at Olkiluoto and the near ordering of a new nuclear station.

The delicate, green shoots of “new build” will have to be carefully nurtured if they are to grow into a healthy, second generation nuclear building programme.

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