SONE
Supporters of Nuclear Energy
Nuclear - The green route to secure and reliable power
January 2006

Briefing Note

This briefing note has been prepared for members of SONE as a handy reference for writing letters to the press and for use in preparing arguments. It will be updated from time to time. This first edition is dated January, 2006.

How is electricity generated in Great Britain?

Roughly by gas (40%), coal (33%), nuclear (20%), renewables, including hydro (4%), imports – i.e. nuclear (2%), oil (1%).

How is electricity consumed?

Roughly equally by the domestic sector (115.5 TWh), industry (117.8 TWh), services (107.4 TWh), with a small amount (9.7 TWh) required by the energy industries themselves.

How is energy (as distinct from electricity) consumed?

By transport (35%), the domestic sector (30%), industry (21%) and services (13%).

What is the most nuclear has generated in Britain?

About a third of total electricity.

How does the Government forecast nuclear will be run down?

To 18% by 2010; 10% by 2015 and 7% by 2020.

Other countries rely more heavily on nuclear power than the UK – France 83.4% (which plans to replace its capacity); Belgium 58%; Sweden 45%; Finland (which is building another reactor) 31%; Germany 29% and Spain 27%.

How many operational nuclear power stations are there in Britain?

Twelve, as compared with 441 world-wide.

What is the current forecast for nuclear power station closures, bearing in mind that operating lives can be extended?

Magnox (operated by British Nuclear Group in BNFL): Sizewell A and Dungeness A – 2006; Oldbury 2008; Wylfa 2010.

AGR (owned and operated by British Energy): Hinkley Point B and Hunterston 2011; Hartlepool and Heysham I 2014; Dungeness B 2018; Torness and Heysham II 2023.

PWR (owned and operated by British Energy) – Sizewell B 2035.

Are there any current plans to replace nuclear capacity?

No, but the Government is conducting a review of its energy policy.

Why is the Government reviewing its energy policy since it is only three years old?

It is true that the last Energy White Paper was published only in February 2003. It was widely derided at the time. Since then it has been seen to be failing on all counts –

* the development of renewables is lagging well below Government targets, calling for 10% of electricity generation by 2010 and 15% by 2015; there is an "aspiration" of 20% by 2020;
* in spite of energy conservation, electricity demand rises steadily by 1-1.5% a year;
* CO_2 emissions are rising and have done so for at least three years.

Continued over

- With the run down in coal, and nuclear-generated electricity, only natural gas can fill the gap. But latterly gas prices have soared and are likely to remain high because of demand. And increasing amounts of gas will have to be imported because North Sea gas (and oil) production is past its peak and is declining steadily. Strategically, we shall run very high risks in terms of security and competitiveness in relying, as is contemplated, on gas for up to 80% and possibly even more of our energy, especially when much of it will come from unstable areas such as Russia, the Middle East, Algeria and Nigeria. Russia's recent turning off of the Ukraine's gas supply shows it is prepared under President Putin to use energy as a political weapon.

Isn't energy conservation a potentially valuable element in the policy?

It is theoretically immensely valuable but the theoretical savings from cutting out waste are more easily identified than achieved. Every year scientists, engineers and technologists improve the efficiency with which energy is used. We get more work out of the energy we put in. Improved insulation and energy use controls also theoretically should reduce demand, and better insulation and controls have been pursued since the last energy crisis 30 years ago. But each year electricity demand grows by 1-1.5%. The problem with energy conservation is that the money saved from less energy use goes into buying new ways of using energy – and the self-same scientists, engineers and technologists each year satisfy the public's craving for new energy-driven gadgets of one kind or another.

Might the Government not rely on "clean" coal instead of nuclear?

Well, it might if by "clean" you mean CO_2-free. But clean coal technology at present means only scrubbing out sulphur (at very considerable cost) to avoid acid rain. The new idea is to remove CO_2 from fossil-fuel power station emissions and inject them into permeable strata in the oil and gas province under the North Sea. This would have the effect of recovering more oil and gas to create more carbon. But the collection and disposal of CO_2 from British power stations has not been proved and early estimates of the cost (assuming the undersea strata retains the CO_2) suggest it could double the price of electricity. Another drawback is that successful sequestration of CO_2 from power stations would still leave unhindered CO_2 emissions from much of the industrial sector and from the domestic and transport sectors which between them represent 70% of all UK CO_2 emissions.

So what commends nuclear's development?

Three things: security of supply at competitive cost and next to no carbon or other greenhouse gas output.

How could nuclear contribute to security of supply?

It is a safe and reliable method of continuous generation proved over 50 years during which there has been no death in the UK recorded from a radiation accident. There is no shortage of uranium available from stable countries and long-term supplies look to be more durable than oil and gas. What is more, the uranium (96%) and plutonium (1%) recovered from reprocessing can be used in the manufacture of new fuel, reducing the need for mining uranium ore; as the price of uranium rises, this becomes increasingly attractive. The price of uranium represents only a small proportion (i.e. 15-20%) of nuclear's costs. Nuclear power can be provided at a competitive price and is admirably suited to the generation of baseload power – say, 60% of peak load.

But opponents of nuclear say there is a shortage of uranium?

Nonsense. See separate note on uranium.

Where does nuclear stand in the competitive pecking order?

Nuclear is now the cheapest generating option, especially when environmental costs are taken into account. It is the only fuel that reflects in its current price (an allowance of some 4%) the estimated cost of decommissioning and waste management. This is probably a prudent conservative value for Magnox and AGR plants. For future reactors, a figure of 1-2% is more realistic, and even less than one per cent if the working life of the reactor is taken as 60 years.

Various studies confirm nuclear's competitiveness, even without taking account of its contributions to security and greenhouse gas reduction. These studies have been done by the OECD, IAEA, Scherer Institute of Switzerland, and the British Royal Academy of Engineering. Before the recent steep increases in the price of gas, the Royal Academy found that costs were: gas 2.2 p/kWh; nuclear 2.3 p/kWh; coal 2.5-3.2 p/kWh; onshore wind 3.0 p/kWh (but 5.4 p/kWh with back up); offshore wind 5.5 p/kWh (but 7.2 p/kWh with back up). Nuclear's competitiveness has also been confirmed by a survey by the World Nuclear Association of a range of comparative cost studies across the world.

In other words, wind power is anything from two to three times as dear as nuclear power. It is also intermittent and so has to be backed up by a similar amount of conventional power plant. This means that, given a turbine's capacity factor in the UK is only about 25% – that is, the amount of electricity it actually generates compared with its full generating capacity - it avoids the production of little CO_2, its main justification, because it has to be backed up by fossil-fuelled power stations.

If nuclear is competitive, why are nuclear power stations not being built in the UK?

So far the Government has been hostile to nuclear power and has done nothing to facilitate its development. Instead, it has subjected it to the climate change levy even though nuclear emits next to no greenhouse gases. The Government has made no known moves to license the use of new generation reactors, identify sites for new power stations or clarify nuclear's long-term access to the electricity market in view of the current short-term regulatory regime or the insurance framework. It also sees its forthcoming White Paper not as a policy document but as one requiring the fullest consultation. In the absence of such essential work (which only Government can do), likely investors are put off by the large initial costs of modern nuclear power stations. These are predicted to be from £1,100-1,400 per kW compared with gas-fired plants at £400 and coal £1,200-1,300 per kW. Nuclear power stations are likely to be immensely profitable over, say, a 60-year life but because of the high front-end costs it could take 10 years before they are in the black.

So nuclear wants a subsidy?

It does not. It wants fair play. It recognises that it will have to compete in the market and that the future generation of nuclear reactors will be built by the private sector, not by Government agencies.

Does nuclear have any other advantages?

Yes, a significant one in an overcrowded island where the Green Belt is under pressure. A modern 1000 MW nuclear power station requires the equivalent of only 10 soccer pitches whereas to generate a similar amount of electricity wind (when it is blowing) requires an area the size of Dartmoor; solar 1.5 times the size of Dartmoor; biomass – a forest the size of North Wales; bio-oil – a rapeseed field the size of the Highlands of Scotland; bio-alcohol – Devon given over to sugar beet or the whole of Yorkshire to corn; and bio-gas – 800m chickens on a farm a third the area of Dartmoor. To keep Britain going we need not 1000 MW but at least 50,000 MW – fifty power stations, not one. This is partly why renewables have only a marginal role to play.

So why did British Energy have to be rescued from bankruptcy?

Because the Government drove all electricity generators to the verge of bankruptcy. Only those with large retail arms survived by cross-subsidising their generating division. British Energy had no large retail arm. The agent for this bankruptcy was Ofgem, the Government regulator, with its short-term wholesale price regulatory regime. Now that gas prices have soared, British Energy is profitable, but those profits are being creamed off by the Treasury under the terms of the Government's "rescue". The company has effectively been re-nationalised on confiscatory terms.

Anti-nuclear campaigners claim that nuclear is a "dirty" fuel – indeed, some say it is the dirtiest.

This is nonsense. The Government's Energy Technology Support Unit shows that nuclear is the cleanest per unit of electricity produced over its life cycle, taking into account everything from mining ore to decommissioning and disposal of waste. The figures have been broadly confirmed by the OECD. They are:

Nuclear	4 grams of carbon per kWh produced
Wind	8 g
Large-scale hydro	8 g
Small-scale hydro	9 g
Energy crops	17 g
Geothermal	79 g
Solar	133 g
Gas	430 g
Diesel	772 g
Oil	828 g
Coal	955 g

In other words, nuclear is cleaner than wind and other renewables, 100 times cleaner than gas, and 270 times cleaner than coal.

Anti-nuclear campaigners say nuclear power carries a radiation hazard?

This is how the average Briton is exposed to radiation:

	%
Radon seeping from the ground	50
Medical X-rays	14
Gamma rays from rocks	13.5
Cosmic – ie from the sun	12
Chemicals in our bodies	10
Fall-out from nuclear weapons	0.2
Occupational and largely indoor radon	0.2
Nuclear industry activities and disposal of radioactive materials – less than	0.1
Radioactive products – less than	0.1

In other words, nuclear medicine exposes the average Briton to about 140 times more radiation than nuclear power and natural radiation to 750 times more.

But what about the "unresolved problem" of nuclear waste?

The nuclear industry has been managing its waste for 50 years – ever since plutonium began to be manufactured for defence purposes and the first electricity was generated. It follows that part – but only a small part of some 2% of the current waste arises from military not civil use. High-level waste has been stored in ponds prior to vitrification. Intermediate level waste has been held where it arises, pending final disposal, while low-level waste (including that from industry and hospitals) has gone to a dump at Drigg, near Sellafield. Storage in ponds and in vitrified waste stores has allowed some of the heat to dissipate and the radioactivity to decay. If it could, the industry would send intermediate-level waste encapsulated in cement and cooled high level waste vitrified in glass to a more permanent longer-term storage. The only thing that stands in the way of doing this is a Government decision on a site for such disposal. The Committee on Radioactive Waste Management (CORWM) is due to recommend a method of disposal, but not a site, in July 2006.

The chairman of CORWM, Professor Gordon McKerron, has said that there is enough nuclear waste in Britain without any long-term strategy for its disposal to fill the Royal Albert Hall five times over.

First, we have to ask whose fault it is that there is no long-term strategy. The answer is that it is government's fault. Second, SONE has queried the five-Royal-Albert-Halls-full with Prof. McKerron since we can discover only enough to fill one RHA. He did not reply personally but a document sent by his office shows that he includes in his total waste that which is expected to arise in the future. This we regard as sharp practice. It devalues CORWM, which has suffered the loss of two scientists concerned about how it has gone about its work. Prof. McKerron has further devalued his position by lending his name to an article specifically setting out the case against nuclear in the Observer on December 4, 2005.

The highly radioactive waste in the current inventory could be contained within a volume of 30 cubic metres. This is about the size of an articulated lorry's body.

Anti-nuke campaigners say the waste disposed of would remain toxic for hundreds of thousands of years.

Another splendid exaggeration. The radioactivity would have decayed to relatively harmless levels found in nature – e.g. in the form of uranium – after 500-600 years. The only elements remaining toxic would be metals in the waste, in the unlikely event of their being eaten. Some of these metals are toxic like arsenic, mercury and lead but that has not stopped us from burying such metals in dumps that are far more accessible than nuclear repositories would be.

It is interesting that Bob Hawke, former Prime Minister of Australia, has recently said that Australia should volunteer to become the world's nuclear waste collector because its geology makes it ideal for the purpose as "an act of economic sanity and environmental responsibility".

How much highly radioactive waste does a 1000 MW nuclear power station produce in a year?

Only enough to fill a London taxi.

But what about the cost of decommissioning and waste management – the figure has been put as high as £66bn?

That figure includes £10bn for disposing of reprocessed uranium and plutonium, which could be used as new nuclear fuel and hence become income instead of a cost. We have a year's supply of electricity in the form of plutonium stocks. It would be economic madness to dispose of these stocks when we could usefully burn them up. That shows you how figures for decommissioning and waste management are gold plated. This leaves the Nuclear Decommissioning Agency's (NDA) £56bn bill for cleaning up after military and civil nuclear operations. SONE has formally protested against the NDA's draft strategy because it is based on the assumption that nuclear operations are to be run down and many sites returned to greenfield status. It is nonsense to suppose that all nuclear operations – military, medical, industrial and electrical power – will cease. There is also a use for existing nuclear sites – as the sites for new generation nuclear power stations. There is no sense in returning sites required for a new generation of nuclear power stations to greenfield status. Incidentally, new, safer and more efficient designs of nuclear reactor would produce a tenth of the waste generated by current reactors.

In short, the oft-quoted massive clean up costs for the nuclear industry have no credibility. What is more, electricity consumers have already contributed – and continue to contribute – towards the cost of decommissioning and waste management through the current price of electricity.

What about terrorism?

Terrorists pose a threat the world over and security at nuclear sites is crucial. But nuclear power stations are not bombs waiting to go off. Their systems are entirely different from military weapons. And why should terrorists try to acquire highly dangerous and difficult to handle radioactive materials when they have global access to a vast array of weapons? Nuclear reactors are operated within robustly thick concrete containment vessels designed to withstand massive impact. In fact, in computer simulations an aircraft flown into a nuclear power station containment at 500 mph evaporated but the containment was undamaged.

And what about proliferation?

Clearly, the effective operation of international anti-proliferation treaties is necessary and so far those protocols have worked pretty well, with UN agencies as active watchdogs. In Britain nuclear materials in nuclear installations and in transit are safeguarded using methods tried and tested over 50 years. The threat of proliferation cannot – and will not stop the development of nuclear power in a world hungry for electricity and concerned to combat global warming. The important thing is to promote the responsible peaceful use of uranium as a means of generating electric power: to make sure that an element – uranium – with no other peaceful use other than to generate electricity is put to the service of man and so extends the availability of other fuels. The late Prof. J H Fremlin, a leading radiophysicist, in his book, Power Production, said: “I can see no way in which the building of further nuclear power stations in Britain can make the probability of proliferation of weapons elsewhere either greater or smaller”.

Interesting facts

What is the average annual household consumption of electricity?

Total annual domestic energy consumption is 48m tonnes of oil equivalent (mtoe). Given there are 25m households and that 1mtoe is equivalent to 11.63 TWh (a TWh is (a) 1,000,000 MWh or (b) 1,000,000,000 kWh), this works out at an average annual domestic energy consumption of 22,239 kWh.

Different households have different mixes of energy use. One SONE member, for example, uses 3,705 kWh of electricity a year in his centrally heated bungalow and a further 19,849 kWh as heat in the form of gas. The electricity bill for a typical 4-bed house is £400 a year, which at 5 pkWh works out at 8000 kWh.

So how do we relate the average household consumption of electricity to other activities?

A London-Glasgow express: this works at an average rate of 1,000 horse power = around 750 kW. If the journey takes four hours it consumes 3,000 kWh. So the annual consumption of the SONE member's bungalow would power not much more than one single journey. The annual consumption of the average semi-detached at, say 6,000 kWh, would just enable it to get to Glasgow and back.

Heathrow: this is equivalent to a town of 50,000 people, or 20,000 households. Assuming that the average semi-detached house annually consumes 6000 kWh, then in a year Heathrow would consume 120m kWh. But you have to allow for 24 hour (multiply by 2) operation and its intensive energy use (multiply again by 1.5). On this basis Heathrow consumes energy at 60,000 times the rate of a typical household. So the annual supply to a typical household would keep Heathrow supplied for a mere 8.75 minutes (24 x 60 x 60 x 365 divided by 60,000).

Great Ormond Street Hospital and London Zoo, on a rough back-of-the-envelope calculation, would consume the annual electricity demand of a typical house in 19 hours and 26 hours respectively.

What are the chances of a member of the public being killed by radiation from a nuclear power plant in Western Europe?

Theoretically, between 1 in 10m and 1 in 100m – roughly equivalent to the chance of being killed by lightning or a dangerous dog. This compares with a 1 in 10,000 to 1 in 100,000 chance of being killed in a car accident or in an accident in the home. In other words, the risk from a nuclear accident is anything from 1,000 to 10,000 times LESS THAN the risk from an accident on the road or in the home. It should also be pointed out that members of the public (as distinct from workers and emergency service personnel) represent only a small minority of the death toll of 56 at Chernobyl where the only nuclear disaster has occurred. That disaster occurred in an RMBK reactor, a type in use only in the former Soviet Union. Since the accident, they have all been modified to make them safer.

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