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"Security of Energy Supply""

by Professor Ian Fells

"Electricity is the lifeblood of civilisation, without it we spiral down into anarchy and barbarism"

In 2003 there was a spate of "brownouts" in N America, UK, Italy, and Scandinavia. Auckland was blacked out in June 2006 with a loss of $52m, in S Africa there were rolling blackouts last year because of lack of investment in new plant. Eskom are now desperately trying to raise capital for new build.

The blackouts in 2003 lasted about 12h. and were mostly due to faults in the creaking distribution system rather than lack of generating capacity. Consequential loss in New York was estimated by the mayor at $2bn and in London at £700m. The underground stopped, lifts stopped, communication of all kinds including mobile phones stopped, computer control of heating and ventilating systems, traffic lights etc. all stopped, the lights went out, petrol pumps and tills at supermarkets ceased working and people stole food from the shelves. If blackouts continue for 48h sewage accumulates as pumps stop. Criminals stalk the streets. See "What if the lights go out?" BBC2 TV, 2, March 2004.

Could it happen here again as a result of complacency or design (terrorism)?

Over the next decade we lose one third of our electricity generating capacity as coal and nuclear stations are retired (many over 40 years old), ie 23GW rising to 35 GW by 2025. Currently gas provides approximately 40% of our electricity generating capacity, coal 35%, nuclear 15% and the rest is hydro, wind 1.5%!!, and nuclear imports from France equivalent to one power station.

By next year gas imports will have risen to 50% of requirements as North Sea gas declines; this comes mostly through pipelines from Russia and Norway, and as Liquefied Natural Gas(LNG) by tanker from Qatar, Algeria and Iran. There is talk of a gas Troika being formed, consisting of Russia, Iran and Qatar. UK also imports one third of its coal from Russia.

Europe imports 55% of its energy, mostly oil (for transport) and gas, some coal, and the figure is rising. This makes Europe, and particularly the UK which has very little storage capacity for gas, vulnerable to political threats to cut off supplies.
Europe will have to replace some 450GW of generating capacity by 2020. Germany is opposed to nuclear and will need a massive new build of coal stations unless it goes for the default position which is to build new gas stations. Hungary is building a 2.4GW gas-fired station.
In the UK there are 5GW of gas-fired stations on the stocks and some more planned, coal is stalled for environmental reasons and new nuclear stations, now embraced by the Government having been spurned in the White Paper of 2003, take 10 years to be up and running (although the actual build time is only 45 months; planning etc takes up the rest of the time). New nuclear power is endorsed by Malcolm Wicks in his report to the Prime Minister, where he says 40% nuclear will be required by 2030. He has also made the surprising remark that the market will not deliver what we require.
The UK Government seems fixated on the most expensive and unreliable solution to future electricity generation, wind power, in particular 30GW of new offshore wind by 2020. Apart from the cost and huge subsidy (£30bn for subsidy alone by 2020), because wind power is intermittent (for three weeks over Christmas 08/09 the wind did not blow over the UK and wind provided less than 0.1% of electricity) it has to be backed up by coal or nuclear to the tune of 90% according to E.ON who have some 15GW of wind in north Germany. This means, with a load factor of 30% (which is very optimistic), 30 GW of offshore wind will only produce, on average, 10MW, even if it can be built and installed in time, which is very problematical.
All this means there could well be blackouts in the UK by 2014/15 or even earlier if the economy picks up.
The Government in an annex to its Low Carbon Strategy Plan(July '09) predicts shortfalls in 2017 and 2025.

A more general global problem is the voracious demand for more energy from developing countries such as China and India. There is now good evidence that we are approaching a global peak in both oil and gas supply, in the case of oil a peak of 100m barrels of oil per day (currently 85m bbls/d) and then a steady decline of 2% per annum.

What to do?
Build some gas-fired stations but concentrate on coal, with or without carbon capture and nuclear power as quickly as possible; also build the Severn Barrage, which is mature technology and will provide 5% of renewable and predictable electricity, rather than attempt to build huge offshore arrays of wind turbines. If an additional series of tidal stations are built up the west coast, Solway, Morecombe Bay, Mersey, Dee, using standard technology, some 12% of electricity from tidal power could be generated.

Nuclear power will play a crucial role in the longer term. There seems no problem about uranium supplies, particularly as we move to the Generation 4 designs of reactor which use uranium 60 times more efficiently than today's reactors. This effectively multiplies world energy reserves tenfold. Russia has been operating the BN600 breeder reactor at Beloyarsk since 1980 with a claimed availability of over 70% and is building a BN800. In Kazakhstan the BN350 provides 150MW of power and the rest goes to operate a desalination plant. Nuclear power stations which also desalinate water, could be crucial to the survival of some Middle Easton countries, as water, as well as energy, shortages begin to bite.
Nuclear power is under our own control, even now, if supplies were cut off for whatever reason, we carry enough uranium to run for two years using current stations.

Looking further ahead, reactors can also be built using the thorium cycle where Th_{232} transmutes to U_{233}; there are huge reserves of thorium and the cycle has the added advantage that it is extremely difficult to make nuclear weapons using decay products from this reaction. It does not require expensive enrichment and thorium fuel could already be used in reactors like CANDU. There is now renewed interest in thorium in Russia and Norway, as well as India, which has large reserves. However the cycle is nothing like as well developed as the uranium cycle.
The Pebble bed reactor, still under development and based on the UK Dragon reactor of the 1960s, is an attractive possibility for smaller and developing countries, with its proposed output of only 165MW. However it will be very difficult to process the spent fuel so that it will be a once-through cycle.

A programme of this kind will need finance and a trained work force of engineers and technicians. There is currently an acute skills shortage; the company Areva is seeking to employ 20,000 skilled workers in Europe alone and other companies are doing the same.

Fusion power will be an important, secure form of energy post 2040/50 and, curiously enough, there is a possible resource problem with supplies of Li_6, which converts to tritium for the D-T fusion process. Lithium largely comes from Southern Bolivia and Chile. If the world's cars are to switch to electric traction using lithium-ion batteries a huge demand for lithium will gradually build up.

Risk

The current UK Energy Policy which has relied on the market to provide a secure supply of clean energy is flawed and has led to the impending crisis. But in addition there is the threat of political interference with trade in energy and also the possibility of terrorism.
The infrastructure, that is, grid lines and oil and gas pipelines is vulnerable to attack. Liquid Natural Gas (LNG) carriers present a target for both terrorists and pirates. The same will be true if we ever get to using huge solar power station arrays in countries like Libya and Saudi Arabia, where power lines will have to be laid to the power-hungry, industrial countries of Europe.

Transport is particularly susceptible to shortages of hydrocarbon fuel. In World War II Germany had to develop the Fisher-Tropsch process to manufacture diesel and gasoline from coal to support its armed forces. Shortages of fuel for military aircraft and ground forces would be disastrous. It would be wise to build the new aircraft carriers with nuclear-powered propulsion. The Russians are building large rafts, each carrying two nuclear power reactors (submarine reactors of 35GW), which can be towed to where power is needed for both civil and military use. Trade in portable diesel generators is building, the Scottish company Aggreko is supplying 100MW of equipment to Kenya, where serious power shortages are impending.

The UK should be connected up into the EU grid network with new submarine cables to Norway, Germany, Denmark, the Netherlands and another line to France. This would add valuable security to our electricity supply.

A secure and robust energy supply is essential if the UK is to grow its economy and play its part in combating climate change. The prospects of black outs, all too possible at the moment, should be a matter of deep concern