

## **Understanding Renewable Energy, Okehampton, Phillip Bratby, Sept 19th 2014**

I will talk about four topics:

1. I'll start off with a bit of the history of our electricity supply.
2. General information
3. Wind power
4. Solar power

### **History**

You may have heard recently items in the news about the lights going out due to a shortage of electricity and that emergency measures are being implemented this winter - industry being paid to shut down and diesel generators brought into use. How has this come about when tens of billions of pounds have been spent on renewable energy (wind and solar)? To understand that we need to look at the electricity supply system.

Going back about 30 years, our electricity supply was completely run by the CEGB. It was designed, built and operated by power engineers. An equally competent Department of Energy (or Ministry of Power) oversaw the CEGB.

The system consisted of strategically placed power stations, the National Grid transmission system, the local distribution systems, right down to the meters in our home and our bills. The power stations were placed around the country to minimise the movement of electricity. Contrary to popular belief, the grid is not designed to move large amounts of electricity around the country; it is there to make the system robust against plant failure and to maintain a stable voltage and frequency. There is some net movement of electricity from north to south because it was more convenient to build coal-fired power stations near to the coal mines and thus move electricity rather than move coal. The power stations (known as synchronous generators) consist of turbo-generators weighing several hundred tons, all synchronously rotating at 3,000rpm to give us our ac electricity at 50hz (cps) and connected to the National Grid at very high voltage (max 400kV). The power stations are despatchable (controllable). The electricity flows by the line of least resistance from power stations to consumers via transformers until it arrives at our homes via the local network at 240V. The huge inertia of the generators, together with their control systems, ensure

the frequency is tightly constrained. At one time, grid frequency was not very important, but in the modern electronic era, it is vital, with lots of equipment only operating with the correct frequency. Also contrary to popular belief, most losses occur in the local network, not in the HV grid lines, because losses are inversely proportional to the square of the voltage.

The system was built with an excess capacity of about 20 - 25%, (nominally 24%, based on risk of blackouts) so it could cope with plant failure at the time of peak demand, which occurs during severe cold weather in winter. The system has never yet failed. Now the margin is down to 2% and suffering from plant failures and plant closures.

Following privatisation and the break-up of the CEGB, the Energy Ministry was virtually abolished and subsequently became a small part of various other ministries - it lost its expertise. No single Government body is now responsible for ensuring power stations are built to ensure that we have a secure, reliable and affordable supply of electricity and to ensure that we have a planned electricity supply. You might have thought that expertise would have come from Chief Scientific Advisors, but these tend to be academics with no real expertise - there is no Engineering Advisor. Everything in our society is dependent on there being plenty of energy (particularly electricity) at affordable prices, everything - so the Ministry of Energy should be the most important Government function - so why is it given such a low status and run by a succession of minor ministers?

Planning is now the responsibility of the DCLG. In fact, various planning policies (such as the defunct Planning Policy Statements (PPSs) and the more recent National Planning Policy Framework (NPPF)), coupled with the break-up of the industry, have had the effect of changing the electricity system from one carefully planned by power engineers to a totally unplanned system where generators are placed wherever land is available and is deemed suitable by local planning authorities and the Planning Inspectorate, who are totally unqualified to make such decisions. (Wind turbines and solar farms are often built where there is little wind or little sun, which shows how high the subsidies are). In 30 years we have gone from having a planned electricity supply to an unplanned system, which is leading to "the lights going out" and ever-rising electricity prices. It is amazing that the DCLG is responsible for where our electricity is generated, and by what means, rather than DECC. What expertise does DCLG have?

Experts in planning policy are making the decisions. Our future electricity supply is being decided by experts in planning law!

One result of this is that wind farms are appearing by stealth, with people finding themselves living in a wind farm - the beauty of the countryside is being destroyed by 'death by a thousand cuts'.

Existing power stations are being closed (due to age and EU regulations) and are not being replaced (can't compete with subsidised renewables). Even new CCGTs are being moth-balled as not profitable and industry is being paid not to operate at times of peak demand!

Why renewables? Tony Blair signed up to EU Renewable Energy Directive to get 15% of our energy from renewable sources by 2020 (meant to be 15% of electricity). No evidence that they reduce CO<sub>2</sub> emissions due to carbon footprint and backup.

### **Renewables in general**

The main general considerations for renewables in general:

- 1 Low energy density - hence large facility for small amount of energy.
- 2 Asynchronous generators - liability to grid - Grid Code.
- 3 Intermittent and largely unpredictable - unreliable, harm energy security.  
Cannot store the fuel, so cannot control the output.
- 4 Between 2 and 6 times as expensive as conventional - not "free" sources of energy. (EREOI very low; not sustainable).
- 5 Jobs - subsidised, low productivity - destroying jobs in the real economy and destroying wealth.
- 6 Most feed into the LV distribution network, so the electricity is trapped and losses are high.
- 7 huge grid capacity wasted (1/CF).
- 8 Foreign manufactured.
- 9 Short lifetime, degrading performance.
- 10 They do not reduce the emissions of CO<sub>2</sub> (carbon footprint, backup).

## Wind

Capacity factor 20 - 25%, i.e. on average produce about 20 - 25% of the stated output. Waste 3/4 of grid capacity. Degrade as they age (maybe not noticeable). Harsh environment, bearings, gearboxes (20years max).

Output is largely unpredictable, especially when high winds.

Can almost guarantee they will produce no electricity at peak demand - winter when cold.

Hence need just as many real power stations.

Subsidised by 2 to 6 times (ROC & FiT). Cannot repay capital cost without subsidy.

50kW cost £300k, electricity worth £100k, subsidy 22.2p (x4.5), income £400k;

500kW (derated - scam) cost £1.5M, electricity worth £1.1M, subsidy 19.2p (x4), income £4.2M. Consumers pay - vast wealth destruction.

Noise - three types. Normal (mechanical + aerodynamic), EAM, infrasound (latter two have been covered up by Governments, not included in ETSU-R-97). Health effects. Wind industry has its own noise regulations because it can't meet standard industrial limits.

Kill birds and bats.

Devalue houses. Report by Owen Paterson at Defra has been blocked by DECC for over a year. Paterson now sacked.

Industrialise the countryside, bad for tourism.

*Exploiting the "free" power from the wind is a very expensive exercise.*

## Solar

Large area of land (~5acre/MW), other infrastructure, inverters, transformers, security fence and CCTV cameras (Industrialise the countryside).

Efficiency 11-16%; say 15%, hence 85% of sun's energy is reflected or heats the panels and the air, hence wasted.

Capacity factor ~10%, i.e. on average produce about 10% of the stated output. Thus at 5 acres per MW installed capacity, need about 50 acres to produce an average of 1MW. 90% of grid capacity wasted.

Work best at 25°C. Degrade by ~1% per year (maybe not noticeable).

Ground underneath is cold and shaded - good for growing weeds - need strimming.

Noise: inverters and transformers - usually ignored.

Subsidised by 2 to 5 times (has been 10 times). Likely to be changed for big (5MW) solar farms due to Levy Control Framework exceedence - consultation ongoing. No solar power when demand is highest - in winter, early morning and evening. Peak in summer around lunchtime when demand is low. New solarPV strategy Oct 2013 and April 2014 (why now, not before plans and policies put in place?): Move to stop ground-based solar farms and put on roofs etc. Not greenfield land, not Best and Most Versatile (BMV) land. But applications still coming in to put on farmland.

## **Conclusions**

Our society is totally dependent on copious amounts of cheap energy. Before the Industrial Revolution, the country was totally dependent on renewable energy - mainly food crops for manpower and horsepower and wood for heating and cooking.

The Industrial Revolution was built on plenty of cheap energy and the development of the steam energy and everything that followed - internal combustion engine, electricity etc. Energy gives us the ability to do work. And that's what the cheap and plentiful energy did - we did more work, were more productive and generated vast amounts of wealth.

An attempt to return to using renewable energy is bound to lead to reduced productivity, the destruction of wealth and an increase in poverty. That is where the renewable energy policy is leading us and it is happening now.

***Renewable energy was never an engineering decision, an economic decision or an environmental decision; it was purely a political decision.***