Fig 2

can use the electricity produced or to pay for the incentive.

The lack of new build means we are approaching an "electricity cliff" as the older power stations are retired and not replaced. This will put our electricity supply in jeopardy for years to come.

To complicate matters further Governments of the past ten years have developed an obsession with wind generation which requires tweaking the National Grid to accommodate the intermittent and unpredictable bursts of small amounts of energy from wind farms. This is the tail wagging the dog. The National Grid is a major technical achievement built in the1920s and 1930s which allowed the national distribution of electricity to replace the previous inefficient and expensive system of local generation.

Wind energy has the superficial attraction of being "free", which turns out to be an illusion. When fully costed it is more expensive than the alternatives[1]. Wind energy has to be subsidised on a generous scale which is bad engineering and bad economics. This subsidy is consumers' money which could be better spent elsewhere. There is no economic case for wind energy.

Rain is also free but when water is collected, processed and delivered to the home and to industry in a usable form it has to be paid for. And water can be stored whereas electricity cannot be stored and needs to be generated to match the customer's demand.

The Government should change the focus of their electricity policy to encourage the building of a sufficient number of new large power stations with adequate capacity which will ensure security of supply.

There is one part of the Energy Bill which can be fully supported. The Bill does encourage us to reduce demand and use less energy – a solution which Punch proposed in 1868, Fig 2

Robert Freer is a chartered engineer

Reference

1 Ruth Lea Electricity Costs; The folly of windpower. Civitas January 2012

HELIUM

Why Recent Helium Shortages have Forced us to Temporarily Shut Down our Brain Research Centre

Dr Mark Stokes
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At the Oxford Centre for Human Brain Activity, we use magetoencephalography (MEG) to study the human brain in health and disease. MEG is one of the most advanced methods currently available for non-invasive brain imagining, allowing us to listen in on brain function by measuring tiny disturbances in the magnetic field around the outside surface of the head.

MEG is the centrepiece of our brain imaging facility, and provides researchers and clinicians from all over Oxford, and further afield, state-of-the-art technology for safe, painless and accurate measurement of human brain activity. Recently, we have been forced to shut down our facility on three separate occasions because of critical shortages in liquid helium supplies. We are all hoping for a better year in 2013, but the situation is far from guaranteed.

The superconducting quantum interference devices

. . . critical shortages in liquid helium supplies . . .

(SQUIDs) used to measure subtle variations in magnetic field operate at a temperature of near absolute zero. Only liquid helium can maintain this critical operating temperature, and any disruption in supply causes an immediate shut down of the facility. These shutdowns are obviously disruptive to our research programme, but warming up the cryogenic sensors also incurs significant additional overheads as restarting the system requires a costly and time-consuming re-tune of the entire system from the manufacturer's service engineers.

. . . disruptive to our research programme . . .

Although helium is the second most abundant element in the universe, supplies on earth are surprisingly limited. Helium inevitably floats off into space because it is inert and extremely light. Fortunately, the earth produces a very small amount of helium via slow radioactive decay. Most of this helium by-product also floats off into space more or less directly, but a small percentage is trapped underground. Over millions of years, helium has built up in recoverable quantities within a handful of reserves around the world.

The US Government has long appreciated the potential importance of helium for the national interest. Under the Helium Conservation Act of 1925, the US Government essentially seized control of helium supplies for military applications (eg airships). State control was relaxed by the Helium Act of 1937, which permitted helium sales to the private sector for other emerging applications, such as deep-sea diving. However, by the 1950s the strategic value of helium was reignited by the rocket industry that was to power the space race, as well as the closely related arms race that was fought out in parallel. To safeguard the supply for the national interest, the Helium Acts Amendments of 1960 established an active programme of buying up helium from the private sector to store in the Federal Helium Reserve. Inevitably, all this strategic hoarding came at a huge financial cost. It was thought that the proceeds from future sales would be used to repay the treasury loans, but the programme was in debt to the tune of $1.3 billion by the repayment deadline in 1995.

The Helium Privatization Act of 1996 was introduced to sell off the government stockpile and pay off the debt to treasury by 2014, assuming that the market will have established an alternative source by then. But this alternative market source has not yet materialised, partly because the 'fire sale' on helium seriously distorted global markets. Moses Chan, Professor of Physics at Penn State University, explains: "the price of federally owned helium, which is set not by current market conditions but by the terms of the 1996 Act, dominates, if not actually controls, the price for crude helium worldwide". The US selloff essentially crippled the market incentive to invest in infrastructure for collecting helium during natural gas extraction. Cheap helium also drives misuse. A staggering 8% of the world's helium supply is currently used for filling party balloons.

. . . crippled the market incentive. . .

To forestall disaster, Senator Bingaman has put forward a bill to Congress that would extend the Helium Reserve until all the remaining helium can be extracted. Other measures include more realistic pricing to correct the market distortion, and protections for US users. The immediate goal is to protect US medical, commercial and research applications from the serious supply disruptions we have experienced recently due to the rapid privatisation of the Federal Reserve. However, it remains unclear how this bill will affect global markets, and what will be the consequences for UK supplies.

What does the longer-term future hold? Helium demand will inevitably out-strip supply, and although the timescale of effective helium depletion cannot be predicted with certainty, current estimates suggest a 30-50 year timescale. For lighter-than-air usage, helium can be replaced with hydrogen, accepting the increased risk of explosion. It is a dangerous, but feasible alternative. For cryogenics, however, there is no substitute. Without helium, there will be no way to cool to near absolute zero. Our best hope lies in developing superconductors that can operate at higher temperatures. But even if we do manage to perfect higher-temperature super-conductivity in the future, who can predict what further need we may have for the super-cool properties of helium? Helium is a remarkable gas, with many unique properties – we will certainly miss it when it's gone.

. . . a handful of reserves . . .

. . . Helium demand will inevitably out-strip supply . . .

References:

S.2374 The Helium Stewardship Act of 2012 (http://www.govtrack.us/congress/bills/112/s2374)

Chan (2012) Up in the Air: The BLM's Disappearing Helium Program. Committee on Understanding the Impact of Selling the Helium Reserve, National Research Council of the National Academies. May 10, 2012 (http://www7.nationalacademies.org/ocga/testimony/Helium_Program.asp)

Cho (2012) Senate Bill Would Preserve Helium Supply for Research, ScienceInsider, May 11 2012 (http://news.sciencemag.org/scienceinsider/2012/05/senate-bill-would-preserve-helium.html)

McKie (2012). Helium stocks run low – and party balloons are to blame, The Observer, Sunday 18 March 2012 (http://www.guardian.co.uk/science/2012/mar/18/helium-party-balloons-squandered)

Nuttall, Clarke & Glowacki (2012). Resources: Stop Squandering Helium, Nature, 485, 573-575 (http://www.nature.com/nature/journal/v485/n7400/full/485573a.html)