nuClear news

No.99 September 2017

1. Small Modular Reactors

Nuclear Free Local Authorities Briefing on Small Modular Reactors March 2015
http://nuclearpolicy.info/docs/nuclearmonitor/NFLA_New_Nuclear_Monitor_No37.pdf

Despite the fact that, as Matt Ridley writing in *The Times* put it: "*Almost nobody wants Hinkley to go ahead*", (1) and the *Financial Times* (FT) agreed, (2) the Government still seems pretty determined to go-ahead, not just with Hinkley, but the rest of the proposed programme too. According to the FT the Government has been stung by criticism of the Hinkley deal, but instead of scrapping the programme and going for cheaper renewables and energy efficiency it is re-thinking how to finance them. Ministers have held talks with Hitachi and the Japanese government about making Wylfa a public-private partnership, which could involve the British state injecting funds into the venture. This could, of course just be spin from New Nuclear Watch and, former chair of the Commons energy and climate change committee, Tim Yeo, who has been pushing the idea of making borrowing cheaper for the would-be nuclear builders. (3)

But it could also be the case that the Government is still seriously considering following the current programme of 18GW on large nuclear capacity with perhaps 7GW of small modular reactors by 2035, and a total nuclear capacity of up to 75GW by 2050. (4)

Rolls Royce has been complaining that Britain could squander its chance to become a world leader in small reactors unless it presses on with the competition launched in early 2016 to find the best design. The government said it would respond after the submission of designs by autumn 2016, but, so far, nothing has been announced. The apparent lack of action has raised industry fears that the project may have fallen by the wayside amid the political instability of Brexit and the general election. In May, a House of Lords report branded the Government's failure to publish the results of a competition for development funding as "*particularly alarming*". Rolls-Royce says the first country to licence a Small Modular Reactor (SMR) would set an international standard, giving those companies the chance to export their technology worldwide. "*Whoever moves first, globally, whoever gets a Small Modular Reactor up and running, licensed, commissioned, built, clearly has first mover advantage globally*." (5)

Now the Government has summoned major players in the nuclear industry to present their plans for the development of small modular reactors. NuScale and Rolls-Royce are among companies reportedly invited to talks with the government. Hitachi and Westinghouse have also been invited. (6)

History of a Nuclear Dream

In March 2013, the Coalition Government released its long-term nuclear strategy. (7) This envisaged making the UK a 'top table' nuclear nation, working in international partnerships leading the direction of future technology advances across the nuclear fuel cycle and being a key partner in commercialising new reactor types such as SMRs worldwide.

A nuclear research and development programme was sketched out which would give the UK the option of promoting a high-nuclear scenario for the country with up to 75GW of nuclear capacity in 2050 providing 86% of the UK's electricity supply. (8) This would require an eye

watering 30GW of new capacity to be built between 2030 and 2040 and another 30GW between 2040 and 2050, and newer fission technologies such as SMRs or Generation IV (mainly fast) reactors. Spent fuel reprocessing, fusion reactors and alternative fuel cycles (such as Thorium) might also be needed. While to most commentators this sounded like a nuclear fantasy, unfortunately the Coalition Government was not looking seriously at alternative non-nuclear energy strategies. (9)

In December 2014, the National Nuclear Laboratory (NNL) published a feasibility study which concluded that the UK had an opportunity "*to regain technology leadership*" in SMRs. It said there is a very significant market for SMRs in places where large reactors would be unsuitable and calculates the size of the market to be approximately 65-85 GW of new capacity by 2035, valued at £250-£400 billion, with demand in the UK of around 7 GW by then. NNL claimed that "first-of-a-kind" SMRs could be cost comparable with conventional nuclear build, with the potential to become more cost competitive as more are built. But said further evidence is required to make a policy decision or for business to make an investment. Paul Howarth, NNL managing director, said the feasibility report is "*an important step on the way towards recognizing the role which SMR designs can play and helping to capitalize on the opportunities offered*." (10)

In October 2015 the Energy Technologies Institute (ETI), a public-private partnership between the UK Government and energy and engineering companies, produced an 'insights' report on the future UK role of nuclear power. (11) The report explored the potential for SMRs. ETI argued that 21 GWe of these SMRs might be in place by 2050, compared to a 'theoretical capacity' of 63 GWe. However ETI only expects SMRs to be economically viable if there were a pre-existing district heating network at city-scale. SMRs could feed otherwise wasted heat from the nuclear reaction into this network – in addition to feeding electricity into the grid. But this network would already have to exist and have been paid for. The costs of adding this network to the costs of SMRs is, implicitly but clearly, enough to render SMRs economically unviable. There is no obvious reason to expect these multiple heating networks to be so conveniently available as a 'free good' to SMRs on so large a scale, if at all.

In November 2015, in his Autumn Statement George Osborne, outlined a commitment to kick-starting the SMR market in the UK and pledged £250m to support the development of the technology over the next 5 years. He said this would revive the UK's nuclear expertise and position it as a global leader in innovative nuclear technologies. This would include a competition to identify the best value small modular reactor design for the UK to pave the way towards building one of the world's first small modular reactors in the UK in the 2020s. He said detailed plans for the competition would be brought forward in early 2016. (12)

In March 2016, the government launched its competition to find a partner to help bring "mini nuclear reactors" into the UK energy market. More than 16 firms were expected to enter the competition to identify a preferred technology for SMRs. Companies were given until 6 May to put forward their designs and business cases. A decision on which companies would make the next round of the competition was expected in autumn 2016. The government said it would also publish an SMR delivery roadmap later in 2016 and allocate at least £30m for an "*SMR-enabling advanced manufacturing R&D programme*" to develop nuclear skills capacity. (13)

According to the *Telegraph*, the Government was also assessing suitable sites for SMRs, which could be built by 2025. Other than sites already included in the Government's National Policy Statement, Trawsfynydd in North Wales was the only site mentioned. (14)

In November 2016, the then Energy Minister, Baroness Lucy Neville-Rolfe, spoke to the Office for Nuclear Regulation (ONR) Industry Conference in Cumbria about exciting developments concerning SMRs which "*might allow us to bring down the costs of meeting our energy and climate change targets*." She said the Government had "*received an encouraging response from industry with over thirty eligible Expressions of Interest*". (15)

It is unclear why SMRs should have Government support says Philip Johnstone, Benjamin K. Sovacool, Gordon MacKerron, and Andy Stirling at Sussex University. There is no commercially operating SMR anywhere in the world. The cost is unknown and public acceptability untested. Pouring resources into "innovative" nuclear technology could be a damaging distraction. We must give balanced consideration to a full range of low carbon alternatives rather than focus uncritically on nuclear energy. (16)

By January 2017, there was still no announcement from the Government about the winners to the SMR competition. City AM reported that work on SMRs appeared to have slowed down, there was disappointment that SMRs didn't get a mention in the industrial strategy published that month. (17)

By May 2017, the nuclear industry was starting to panic. A House of Lords report warned the nuclear industry was being damaged by government dithering over plans for SMRs. The promised competition had suffered "*alarming*" delays owing to government indecision. Commercial interest in SMRs will wane unless ministers announce the initial results of the competition soon. (18)

The small reactors being proposed are not just small versions of the PWR – like submarine reactors. NuScale for instance has confirmed the suitability of its reactor to effectively dispose of plutonium. NNL confirmed that MOX could be used in the NuScale core with minimal effect on the reactor's design and operation. (19) GE Hitachi 's PRISM reactor is a type of Small Modular Reactor SMR - a 600 megawatt sodium-cooled reactor that could be built at Sellafied. Britain's Moltex aims to slash costs with a molten-salt design that uses a convection process, cutting corrosion and overcoming the sorts of metallurgy problems that have bedeviled past ventures. It too could in principle use up Sellafield's plutonium. (20) No mention, of course of the huge number of armed policeman that might be required to deliver the fuel to reactors around the country. These novel SMRs face daunting development costs, and mind-boggling technical uncertainties. Like all nuclear sites they inevitably involve high costs, the problems of expensive decommissioning, the risk of accidents and waste disposal.

Rolls Royce has been seeking to convince us of the socio-economic benefits of SMRs. John Molyneux of Rolls-Royce, says its primary market would be the UK where up to about 7 GWe of small units could be deployed, probably at existing nuclear power sites, "*but to really make them fly you have to look internationally so support from the UK government to international markets becomes really important*" requiring further long-term political commitment. Molyneux said he expects strong competition from Chinese, Russian and US offerings to mean that Europe and the Middle East would be more likely sales targets for Rolls-Royce. Should the UK succeed in

becoming a reactor vendor again, the socio-economic benefits are enormous, said Molyneux. Up to 40,000 jobs could be created in the years 2030-2050 and a total benefit to the UK economy of £188 billion spread across a century. Rolls Royce's reactor is actually 450MW – so larger than the normal definition of SMR. (21)

Safeguarding Nuclear Material will Become Harder

NuScale, which is majority-owned by Fluor, wants to build 12 of its 50MW SMRs at the Idaho National Laboratory. The U.S. Nuclear Regulatory Commission agreed to begin the formal process of reviewing the company's designs for the 600MW plant. That gives NuScale, based in Portland, Oregon, the inside track on building the country's first commercial reactors of this type. Many more SMR projects are coming or under way. There are around 50 designs or concepts in various development or planning stages around the world, according to the International Atomic Energy Agency. Four are already in advanced construction in Argentina, Russia, and China.

The company estimates that 12 SMRs would cost around $3 billion. ($5m/MWh), but "*the cost per megawatt-hour doesn't necessarily come down just because you're building a smaller plant*," says Ryan Fitzpatrick, deputy director of the clean-energy program at the think tank Third Way. Some players have reportedly already pulled back from SMRs, including Westinghouse and Babcock & Wilcox, at least in part because of competition from cheaper energy sources.

"*There have to be cost savings derived through other processes*," says Fitzpatrick. These could include things like shorter construction times and new design features that reduce regulatory expenses. But the key to driving down costs would be setting up factories to crank out a lot of reactors. That, however, may present a bit of a chicken-and-egg challenge: securing financing to build the plants will probably require a lot of orders, but it would be hard for a company to obtain those orders before it could reliably produce reactors cheaply. In addition, the Union of Concerned Scientists has raised separate questions about how safe and secure the plants will really be. Among other issues, the group noted that a widely distributed network of smaller but more numerous reactors could make it harder to safeguard nuclear material that, among other dangers, can be used to make dirty bombs. (22)

For earlier stories on SMRs see:

http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo72.pdf
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo79.pdf
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo82.pdf
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo84.pdf
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo87.pdf
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo96.pdf

1. Times 31st July 2017 https://www.thetimes.co.uk/edition/comment/britain-s-energy-policy-keeps-picking-losers-v2ctn5pcb
2. FT 4th Aug 2017 https://www.ft.com/content/b5840c4a-785e-11e7-a3e8-60495fe6ca71
3. FT 22nd August 2017 https://www.ft.com/content/c022f9a8-8327-11e7-94e2-c5b903247afd

4. Nuclear Energy Research & Development Roadmap: Future Pathways, DECC, March 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168043/bis-13-632-nuclear-energy-research-and-development-roadmap-future-pathway.pdf
5. Reuters 31st July 2017 http://uk.reuters.com/article/uk-britain-nuclear-smr-idUKKBN1AG1YO?rpc=401&
6. Utility Week 15th Aug 2017 http://www.utilityweek.co.uk/news/nuclear-players-to-present-smr-plans-to-ministers/1309792 and Telegraph 13th Aug 2017 http://www.telegraph.co.uk/business/2017/08/13/government-holds-crunch-talks-industry-giants-future-british/
7. Long-term Nuclear Energy Strategy, BIS & DECC March 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168047/bis-13- 630-long-term-nuclear-energy-strategy.pdf
8. Nuclear Energy Research & Development Roadmap: Future Pathways, DECC, March 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168043/bis-13- 632-nuclear-energy-research-and-development-roadmap-future-pathway.pdf
9. Guardian 26th March 2013 http://www.guardian.co.uk/environment/2013/mar/26/nuclear-freefuture-energy-strategy
10. Small Modular Reactors Feasibility Study, National Nuclear Laboratory, December 2014 http://www.nnl.co.uk/media/1627/smr-feasibility-study-december-2014.pdf (see also World Nuclear News 4th Dec 2014 http://www.world-nuclear-news.org/NN-National-Nuclear-Laboratory-urgesUK-investment-in-SMRs-4121401.html)
11. Energy Technologies Institute Nuclear – the role for nuclear within a low carbon energy system An insights report, October 2015 http://www.eti.co.uk/wp-content/uploads/2015/09/3511-ETI-NuclearInsights-Lores-AW.pdf
12. Spending Review and Autumn Statement 2015, HM Treasury November 2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/479749/52229_Blue_Book_PU1865_Web_Accessible.pdf
13. Nucnet 16th March 2016 http://www.nucnet.org/all-the-news/2016/03/16/uk-announces-plans-to-push-ahead-with-smr-development
14. Telegraph 2nd April 2016 http://www.telegraph.co.uk/news/2016/04/02/mini-nuclear-power-stations-inuk-towns-move-one-step-closer/
15. Baroness Neville-Rolfe speech 1st November 2016 https://www.gov.uk/government/speeches/baronessneville-rolfes-speech-at-the-office-for-nuclear-regulation-onr-industry-conference
16. Science 2nd Dec 2016 http://science.sciencemag.org/content/354/6316/1112.1
17. City AM 8th Jan 2017 http://www.cityam.com/256579/rolls-royce-launches-partnership-engineering-giants-amec
18. Times 3rd May 2017 https://www.thetimes.co.uk/edition/business/delays-over-nuclear-plandamage-uk-9wvgcp2m9
19. Power Engineering 20th Jan 2016 http://www.power-eng.com/articles/2016/01/uk-study-shows-nuscale-smr-can-use-mox-nuclear-fuel.html
20. Telegraph 29th May 2017 http://www.telegraph.co.uk/business/2017/05/29/brexit-has-forgotten-leaving-europes-nuclear-community-just/
21. World Nuclear News 13th June 2017 http://www.world-nuclear-news.org/NN-Rolls-Royce-elaborates-on-its-SMR-plans-1306171.html
22. MIT Technology Review 17th July 2017 https://www.technologyreview.com/s/608271/small-reactors-could-kick-start-the-stalled-nuclear-sector/

2. Bleak Outlook for New Nuclear

It sometimes seems like US and European nuclear companies are in competition to see which can heap greater embarrassment on their industry. August was the turn of the US side to generate ugly headlines when work was suspended on the VC Summer nuclear plant in South Carolina to stem spiralling costs. The decision by utilities Santee Cooper and Scana Corporation dealt another blow to Westinghouse, the US nuclear subsidiary of Japan's Toshiba, five months after it filed for Chapter 11 bankruptcy protection. VC Summer was one of two plants being built by Westinghouse in the US south-east using its new AP1000 reactor technology. A decision is expected soon from Southern Company on whether to go ahead with the other half-built and equally troubled AP1000 project at Plant Vogtle in Georgia. (For more on AP1000 reactors see http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2016/11/AP1000_reactors.pdf)

The US plants risk becoming an even bigger fiasco than the EPRs being built at Flamanville in France and Olkiluoto, Finland, which, although years late and billions of euros over budget, at least look likely to be completed in the next couple of years. Lower than expected growth in US electricity demand — because of increasing energy efficiency and sluggish economic growth — has further undermined the economic case for nuclear power since the Westinghouse projects were approved. (1)

The two VC Summer reactors have cost the utilities roughly $9 billion but remain less than 40% complete. Originally scheduled to come online by 2018, V.C. Summer has been plagued by disputes with regulators and numerous construction problems. Construction began before Westinghouse had finalized its AP1000 design, and several safety changes had to be made midway through the process. Engineers struggled with the complicated, novel project, as various components needed to be reworked. This year, utility officials estimated that the reactors would not begin generating electricity before 2021 and could cost as much as $25 billion — more than twice the initial $11.5 billion estimate. (2)

Jason Bordoff, director of the Columbia University Center on Global Energy Policy called the reactor suspension "*another powerful signal of just how bleak the outlook for nuclear in the United States is, a result of a hollowed-out nuclear industry, cheap gas, falling renewable costs and inadequate policies to account for the climate change costs of carbon emissions*". (3)

Tom Clements, Southeastern US Nuclear Campaign Coordinator for Friends of the Earth said the decision shows the project was a fool's mission right from the start. The damage that this bungled project has caused to ratepayers and the state's economy must be promptly addressed by the utilities and regulators and all effort must be made to minimize that damage. SCE&G and Santee Cooper must now take on a large part of the project's cost. Ratepayers are already paying 18% of the bill just to pay for project financing, it's time for money to be refunded as it was collected from them under the false pretence that advance payment for the nuclear project was sound. Warnings about potential problems with the project were raised in 2008 and repeatedly since then by Friends of the Earth and the Sierra Club but they were blindly ignored by both SCE&G and Santee Cooper as well as regulators. There was ample warning about the pitfalls that the project would face so it appears that regulators may have simply bowed to the will of SCE&G and rubber stamped decisions at every step of the way without proper review. Regulators have

so far not attempted to make a case that they provided proper oversight and the pressure is now on them to explain their actions that have led to this debacle. (4)

There was a slow exodus of construction workers who live in travel-trailers near the site at the beginning of August as they began pulling up stakes and heading home. An estimated 5,000 people were building two reactors (5)

The VC Summer cancellation adds to the growing number of tombstones for once championed "*milestones*" in an atomic power revival, says Beyond Nuclear. The inability to control the "*cost-of-completion*" and "*time-to-completion*" is the fundamental economic failure behind this recent collapse of the nuclear industry. In fact, these same reasons were featured in a 1985 Forbes magazine cover story "Nuclear Follies" describing the development of commercial atomic power as "*the largest managerial disaster in U.S. business history where only the blind and the biased can say the money was well spent*."

There is not one nuclear power project in the United States that has ever been built on budget and on time. The country is littered with the abandoned hulks of the 20th Century's "nuclear error" including Seabrook Unit 2 in New Hampshire, Shoreham in New York, Midland in Michigan, the "Whoops" reactors in Washington, Bellefonte in Alabama, Marble Hill in Indiana and Zimmer in Ohio. These sites stand as monuments to nearly 100 more cancelled construction projects. (6)

"*Let it be written*", says the Houston Chronicle, "*that environmentalists didn't kill the nuclear power industry, economics did*". It wasn't public protests that killed the VC Summer reactors, but the fact that the only way to pay for them was to overcharge customers or bankrupt both companies. The project has already bankrupted Westinghouse due to missed deadlines and costs spiralling out of control. (7)

Moorside

The repercussions of the decision to abandon the building of the South Carolina reactors will be felt across the Atlantic here in the UK, where three reactors of the same design were due to be built in Cumbria in the northwest of England. NuGen, the company that planned to build them, is, like Westinghouse, a subsidiary of the Japanese giant Toshiba. It was already reviewing its plans to build them before the VC Summer decision. Officially this is still the position, but it seems unlikely that the company would gamble on trying to build reactors of a design that could not be completed successfully in the US. (8)

Toshiba has been demoted to the second tier of the Tokyo Stock Exchange. The Japanese giant has also seen its share price drop following the move. It will no longer feature in the Nikkei 225 index of Japan's top public companies and faces the prospect of being delisted from the stock exchange altogether. This switch has happened because Toshiba's liabilities exceeded its assets by several billion yen following a write-off for its American nuclear division Westinghouse Electric. Toshiba is in discussions with other companies about selling its stake in NuGen, including South Korea's Kepco (Korea Electric Power Corporation). (9)

Toshiba has until March 2018 to resolve its debt issues. Analysts say it's hard to see how the beleaguered company won't face delisting soon - simply because trust in the firm's ability to

resurrect itself is at an all time-low and the company hasn't done much to infuse investors with confidence. (10)

With the implosion of Toshiba under the weight of the Westinghouse financial collapse, Moorside is under serious threat. If the South Koreans buy NuGen they will want to use their own reactor design. This will mean many more years of delay. By that time, nuclear energy will have become 100% redundant, as renewables, combined with energy efficiency, will have completely taken over. (11)

The decision by the newly-elected South Korean president, Moon Jae-in, to gradually phase out nuclear energy will affect both the domestic and export prospects of the Korean nuclear industry. Although the new Government says it doesn't plan to stop exports the phase-out will decimate South Korea's hope for exporting nuclear technology by undermining credibility, capability, and opportunity. In terms of credibility, it is reasonable to argue that when the Korean president has openly stated that nuclear energy needs to be phased out for the sake of public safety, it will be very difficult to convince other countries to import the exact same kind of technology from South Korea. (12)

The pro-nuclear GMB union is fighting on though. It says the "fiasco" over Toshiba's financial state "*highlights the folly of allowing foreign companies to be in control of the UK's critical future energy needs*". Justin Bowden, GMB's national secretary, said Government action was "*long overdue. The chaos at Toshiba must shake the Government out of its stupor of inertia and produce action to ensure the zero carbon electricity we vitally need is produced at Moorside*. (13)

---

1. FT 7th Aug 2017 https://www.ft.com/content/db592ce6-7b4e-11e7-9108-edda0bcbc928
2. New York Times 31st July 2017 https://www.nytimes.com/2017/07/31/climate/nuclear-power-project-canceled-in-south-carolina.html
3. Washington Post 31st July 2017 https://www.washingtonpost.com/business/economy/sc-utilities-halt-work-on-new-nuclear-reactors-dimming-the-prospects-for-a-nuclear-energy-revival/2017/07/31/5c8ec4a0-7614-11e7-8f39-eeb7d3a2d304_story.html
4. Ecowatch 1st August 2017 https://www.ecowatch.com/summer-nuclear-station-canceled-2467656474.html
5. The State 31st July 2017 http://www.thestate.com/news/local/article164659982.html
6. Beyond Nuclear 1st Aug 2017 http://www.beyondnuclear.org/home/2017/8/1/new-us-reactor-construction-collapses-because-its-prohibitiv.html
7. Houston Chronicle 3rd Aug 2017 http://www.houstonchronicle.com/business/columnists/tomlinson/article/Nuclear-power-as-we-know-it-is-finished-11727465.php
8. Climate News Network 4th Aug 2017 http://climatenewsnetwork.net/nuclear-revival-set-falter/
9. In Cumbria 2nd Aug 2017 http://www.in-cumbria.com/Cumbria-nuclear-backer-Toshiba-sees-stock-exchange-demotion-82f05225-a586-4022-adf6-90d8e015c62b-ds See also CORE 9th Aug 2017 http://corecumbria.co.uk/news/nugen-consultees-kept-in-the-dark-as-moorside-turmoil-increases/
10. BBC 10th Aug 2017 http://www.bbc.co.uk/news/business-40873088
11. Beyond Nuclear 10th Aug 2017 http://www.beyondnuclear.org/international-whats-new/2017/8/10/no-future-for-nuclear-is-not-breaking-news-it-was-ever-thus.html

12. The Diplomat 12th Aug 2017 http://thediplomat.com/2017/08/lights-out-for-south-koreas-nuclear-export-ambitions/
13. Telegraph 10th Aug 2017 http://www.telegraph.co.uk/business/2017/08/10/toshibas-88bn-loss-reignites-fears-cumbria-nuclear-project/

3. Energy Cost Review

At the start of August British Gas announced that it is raising its electricity prices by 12.5% and scrapping its dual-fuel discount, adding £76 to customers' average bills. The Company blamed policy costs for its latest price rise.

Several newspapers pointed the finger at "green taxes" reviving the long-running debate over energy bills and the impact of government policy. This debate typically ignores the significant savings that have resulted from energy efficiency policies to lower demand, focusing only on the smaller costs of supporting the development of low-carbon electricity. (1) *The Telegraph's* front page splash says: "*Green taxes adds £150 to home energy bill*", above an article that goes on to say: "*Green taxes will cost households almost £150 from next year, British Gas has claimed*." (2)

Between 2004 and 2016, the Climate Change Committee (CCC) says improved energy efficiency helped cut average bills by £490, with £290 of that saving coming since 2008. These numbers are rarely mentioned during the energy cost debate. Crucially, the CCC says there are still cost-effective energy efficiency savings available, worth an average of £150-£210 by 2030. These extra savings – which will only be unlocked with more ambitious energy efficiency policies – could more than offset an expected £95 increase in policy costs over the same period. (3)

A *Daily Mail* Editorial said "*British Gas claims* [green levies] *have added up to £98 to the average bill since 2014*." In fact British Gas says £14 of this £98 relates to network costs. The remaining £84 covers "*government mandates and policy*", a broad category that goes beyond what the *Daily Mail* calls "green levies" British Gas is referring to the cost of all policies, including carbon reduction, smart meters and fuel poverty, whereas the *Daily Mail* and *Telegraph* conflate this total with "green taxes".

The Department for Business, Energy and Industrial Strategy (BEIS) says: "*Policies driving energy efficiency improvements have more than offset the cost of energy policies and have resulted in lower energy bills on average for UK households, as independent reports have found, so it would be wrong to suggest they are increasing people's bills.*"

After Theresa May weakened her position on energy price caps after the snap General Election, things went quiet for a while. But the British Gas row with the Government has put energy bills firmly back on the political radar.

Keith Baker, Research Associate in Sustainable Urban Environments at Glasgow Caledonian University says a price cap won't work because the market is not only broken, it never worked in the first place. Incredibly high start-up costs mean energy is a natural monopoly, in which a small number of companies have been protecting significant investments in fossil fuels and nuclear power since the sector was first privatised. Markets encourage collusion and informal price fixing.

The belief behind a price cap is that up to 10 million "disengaged" Big Six customers could've been protected from price hikes if they'd switched supplier. This may be true, especially in the short term or if they'd switched away from the Big Six, but it conveniently ignores the fact that a common cause of price hikes is governments signalling their intent to intervene in the market,

which the Big Six respond to by putting up prices as soon as they can get away with it. Competition also means companies waste vast amounts of money paying staff to develop competing applications for different locations and technologies, when what is really required is a national strategy that sets out what is needed, and where, over the sorts of multi-decade periods energy suppliers need to justify investment.

Community ownership doesn't just help solve the energy problem, it also helps make people and communities more resilient. Towns and villages can't become energy cooperatives overnight - they need investment, technical expertise, and an awful lot of support to get up and running. The Labour manifesto included support for a publicly owned energy company in each region, and the SNP has proposed something similar. It's not a complete solution, but it's a big step in the right direction, says Baker. (4)

The Helm Review

We reported last month that Dieter Helm, an economist at the University of Oxford, has been asked by the Department for Business, Industrial and Energy Strategy (BEIS) to carry out a review of energy costs. He has been a vocal critic of the costs of both renewable power and nuclear in the past. The Conservative manifesto promised the resulting report would be the first step towards "*competitive and affordable energy costs*". Helm believes funding should be directed at next generation renewable technologies, such as more efficient solar panels. He also backs emerging technologies such as smart grids and battery storage. The new energy minister, Richard Harrington, has already said the government is still committed to a new generation of nuclear power stations, but Helm's review could provide justification for abandoning those ambitions on cost grounds. (5)

The study will examine how the UK can keep household bills down while also meeting its climate change targets. Helm says he will "*sort out the facts from the myths about the cost of energy*". But the study is expected to be finished by the end of October, so won't have much time to examine all the issues. (6)

Business and Energy Secretary Greg Clark said: "*We want to ensure we continue to find the opportunities to keep energy costs as low as possible, while meeting our climate change targets, as part of the industrial strategy*. *The review will consider how we can take advantage of changes to our power system and new technologies to ensure clean, secure and affordable supplies over the coming decades."* (7)

But the review won't look at gas bills, suppliers' profits and prices, smart meters or projects such as Hinkley Point, nor will it consider the option of capping energy prices, as promised by Theresa May before the election. (8)

Richard Black, director of the Energy and Climate Intelligence Unit, said: "*It is quite hard to see what Dieter Helm can say that hasn't been said before. Select committees have gone into this issue, so has the committee on climate change, and their reports are by their very nature weightier exercises than a short review by a single academic, however decorated*." Doug Parr, chief scientist at Greenpeace UK, said that he expected the review to "*draw on existing sources of evidence rather than creating new analysis*" and questioned why it would differ from studies by the CCC, the government's official adviser on the most cost-effective way to hit emissions targets.

Professor Helm has already written widely on the energy industry and has criticised renewable energy costs. Some issues on which he appears to be at odds with the government have been excluded from the review, such as the £11 billion smart meter rollout, which suppliers have blamed for rising bills. (9)

The full panel, chaired by Helm, will include: Terry Scuoler, chief executive of EEF, the manufacturers' organisation; Nick Winser, now chairman of the Energy Systems Catapult; Laura Sandys, now chief executive of Challenging Ideas; Isobel Sheldon, engineering & technology director of Johnson Matthey Battery Systems; and Richard Nourse, managing partner of Greencoat Capital LLP. (10)

The review prompted a mixed response from business groups and environmental campaigners, with some welcoming the opportunity to make the case for cost-savings that will be delivered by clean technologies and others concerned about Helm's track record of advocating for more gas capacity in the energy mix. Industry insiders also voiced fears the review had originally been conceived by former Number 10 joint chief of staff Nick Timothy as a means of supporting his previous argument that UK decarbonisation policies were undermining competitiveness. "*This review has been the one thing that has been keeping me up at night*," said one industry source, speaking on condition of anonymity. "*It originally felt like a 'let's overturn the Climate Change Act' job… But a lot has changed in the past few months. The market is on the side of renewables and it is starting to shift perceptions. The pragmatic line now has a lot of renewables in it, not because they are green but because they are cheap*".

Industry insiders said many of the experts on the panel were long-standing supporters of decarbonisation and clean technologies, while also noting that Helm himself recognised the huge opportunity to transform the power system through smart grid technologies, electric vehicles, and solar and battery systems.

Writing on Twitter, Greenpeace's Doug Parr argued the terms of the review were too narrow and should be extended to take a wider look at the cost of energy, including the need to decarbonise the heating system. "*The treatment of heat looks very cursory*," he wrote. "*How we decarbonise is seriously difficult question and whether through heat pumps, CHP, power-to-gas or a mixture it will have profound effects of the power system. Without thinking through the heat side this Review will be at best short-term, at worst taking us down wrong route.*" (11)

"A review by one man backed by an unpaid challenge panel and operating against a rushed timetable seems a way of simply finding out what Dieter Helm thinks," said Doug Parr "It is unambitious compared to the review we were expecting." He questioned why there was no consumer representative on the panel. The government has mandated that the review should consider only "system issues" and should not comment on the status of individual projects. Critics have queried the sense of this, given the technological choices the UK faces over pursuing a new nuclear fleet or enlarging the renewables sector. "How you can consider the cost issues facing UK energy without looking at the £20bn Hinkley Point reactor project defeats me," said an energy consultant. "We didn't want Prof Helm to spend two months simply arguing against the Hinkley project as that doesn't meet the task in hand," said a government spokesperson for BEIS, the business department. (12)

Dave Toke, reader in energy politics at Aberdeen University suggests six ways in which the energy costs review could reduce consumer costs and deliver green energy.

1. Encourage the French Government to reconsider the Hinkley C project e.g. suggest to them that it is not worthwhile putting more French taxpayers money into the project. If Hinkley C is not completed, then this will save UK energy consumers enormous sums of money since they are committed to paying (in 2017 prices) £100 per MWh for 35 years;

2. Instead issue power purchase agreements to onshore wind, offshore wind and solar pv for projects in the £60-£80 range, using 15-20 year contracts by the end of which costs of renewables will have fallen further;

3. Abolish stamp duty for houses which incorporate energy efficiency, solar power and storage technologies which involve buildings which can generate more energy than they consume;

4. Take the disastrously implemented 'smart energy meter' rollout out of the hands of the electricity suppliers and put it into the hands of the Distribution Network Operators who are now becoming Distribution System Operators.

5. Abolish price competition in the domestic retail sector and replace it with competition between suppliers to supply energy efficiency;

6. Identify new sites for offshore wind deployment as well as quickly bringing forward the issue of power purchase agreements to existing projects with planning consent. (13)

For more analysis see: Carbon Brief 8th Aug 2017 https://www.carbonbrief.org/depth-challenges-facing-dieter-helm-energy-cost-review

1. Carbon Brief 2nd August 2017 https://www.carbonbrief.org/factcheck-british-gas-and-daily-telegraph-make-confusing-claims-over-green-taxes
2. Telegraph 1st August 2017 http://www.telegraph.co.uk/news/2017/08/01/british-gas-says-green-taxes-will-cost-households-149-year-blames/
3. Carbon Brief 2nd August 2017 https://www.carbonbrief.org/factcheck-british-gas-and-daily-telegraph-make-confusing-claims-over-green-taxes
4. The Conversation 3rd Aug 2017 https://theconversation.com/electricity-is-a-rip-off-we-need-a-truly-radical-intervention-in-the-energy-market-77502
5. Guardian 12th July 2017 https://www.theguardian.com/environment/2017/jul/12/renewable-power-energycosts-review-dieter-helm
6. BBC 6th Aug 2017 http://www.bbc.co.uk/news/uk-40839433
7. Independent 6th Aug 2017 http://www.independent.co.uk/news/uk/politics/energy-price-review-lowest-in-europe-electricity-greg-clark-dieter-helm-a7878331.html
8. Times 7th Aug 2017 https://www.thetimes.co.uk/edition/business/energy-review-to-ignore-price-caps-profits-and-smart-meters-z2q6pdbd2
9. Times 8th Aug 2017 https://www.thetimes.co.uk/edition/business/academic-given-30-days-to-solve-problem-of-rising-energy-costs-xktbqfkz2
10. Edie 7th Aug 2017 https://www.edie.net/news/11/ieter-Helm-to-lead-cost-of-energy-review/

11. Business Green 7th Aug 2017 https://www.businessgreen.com/bg/news/3015180/helm-at-the-helm-government-confirms-independent-energy-cost-review
12. FT 14th Aug 2017 https://www.ft.com/content/45467caa-7e72-11e7-ab01-a13271d1ee9c
13. Dave Toke's Blog 14th Aug 2017 http://realfeed-intariffs.blogspot.co.uk/2017/08/six-ways-in-which-energy-costs-review.html

4. Energy Storage Systems

Emeritus Professor Dave Elliott has published a new book on energy storage systems. As renewable energy use expands there will be a need to develop ways to balance its variability. Storage is one of the options. Presently the main emphasis is for systems storing electrical power in advanced batteries (many of them derivatives of parallel developments in the electric vehicle field), as well as via liquid air storage, compressed air storage, super-capacitors and flywheels, and, the leader so far, pumped hydro reservoirs.

In addition, new systems are emerging for hydrogen generation and storage, feeding fuel cell power production. Heat (and cold) is also a storage medium and some systems exploit thermal effects as part of wider energy management activity. Some of the more exotic ones even try to use gravity on a large scale. This short book looks at all the options, their potentials and their limits. There are no clear winners, with some being suited to short-term balancing and others to longer-term storage. The eventual mix adopted will be shaped by the pattern of development of other balancing measures, including smart-grid demand management and super-grid imports and exports.

Although storage systems are costly, we may want to use them nevertheless to meet system needs. Certainly large-scale storage can make economic sense if the cost of the input energy is very low and/or the price that can be charged for the energy output is high. The latter would be the case when variable renewable supplies are low but energy demand is high and no other sources are available. However, in most cases other sources are available, and are often low-cost, such as natural gas, which can be used in back-up plants when renewable inputs are low. So, the argument goes, electricity storage will never compete with cheap gas turbines, which already exist on the grid, especially if there is a need to store energy over significant lengths of time—many hours or days or even weeks, for example, due to long lulls in the wind.

New types of storage systems are beginning to make their mark in the wider energy system. They can offer useful system services, such as, for example, making it possible to use a wider range and type of energy sources and avoiding emissions from fossil fuel-fired backup plants. The most developed and widely used system is large-scale pumped hydro storage. However, there are limited sites available for large reservoirs, and additional storage systems will also have to be developed.

For large-scale relatively long-term storage (hours, days and maybe longer), in addition to pumped hydro, the options include compressed air energy storage (CAES) in large underground caverns and liquid air storage in cryogenic containers. Some advanced batteries, including new types of flow battery (in which two separate chemicals interact), also look promising for bulk power storage. There are some locational pros and cons. Liquid air stores and large battery stores can be sited wherever it is convenient, but in the same way that sites for hydro reservoirs are geographically determined, so are the sites for cavern-based CAES.

There is also a range of generally medium-scale fast-response technologies suited to dealing with day-to-day grid balancing, including the short-term variations in wind and solar inputs. The grid system deals with some variations in demand and supply by adjusting voltages and

frequency slightly over short timescales (seconds, minutes, sometimes hours), within tight regulatory limits, but some storage systems can help to limit this. Flywheel systems are one option, and some types of supercapacitors and batteries can also be used. At the smaller end of the scale range, battery systems can also play useful roles, such as, for example, storing the surplus outputs sometimes generated by rooftop photovoltaic (PV) solar arrays on houses and other buildings. Indeed, some look to an energy system in which both generation and storage are widely distributed.

It may often be the case that importing (increasingly green) energy from the grid would be cheaper than storage. And it may also be more economic, in system terms, to export any surplus for storage in larger more efficient energy stores. Independent home battery storage may thus not be that helpful in optimal system terms, but with the cost of both PV solar and batteries falling, self-gen/home storage is nevertheless becoming popular.

Battery storage may make more sense on a larger scale, but there are limits. The retail costs of grid electricity can at present range from roughly $0.1–0.2/kWh, sometimes less, sometimes more, depending on the sources and the country. For comparison, recent improvements in lithium ion batteries have brought their cost down to around $3–4000 for a 10 kWh rated storage system, such as that developed by Tesla, with stacks of these being offered for utility-scale use. If recharged, they each could deliver 10 kWh regularly, for maybe 1000 cycles over their lifetime (before their performance degraded), so the electricity would cost $0.3–0.4/ kWh.

The efficiency of different storage technologies varies – so the amount of electricity you can get back out of storage compared with what you put in varies – between 80% for pumped storage and 40% for hydrogen fuel cells. Clearly it would help if some of the efficiencies could be improved and costs reduced. So there is plenty to challenge physicists and engineers.

Elliott says it's helpful to classify these various systems on the basis of the basic type of energy conversion process used:

1. Electro-chemical systems, e.g. batteries.

2. Mechanical systems, e.g. flywheels, pumped hydro.

3. Thermal systems, e.g. heat storage.

4. Hydrogen-based options, e.g. electrolysis with cryogenic storage

In addition to large, utility-scale systems, domestic-scale lithium ion batteries are also now being widely used with rooftop PV solar. For example, it has been claimed that around 41% of all new domestic PV projects installed in 2015 in Germany included battery storage, and, with costs falling, take up can be expected to continue to grow there and elsewhere. The end result of all this is that the battery market, especially for lithium ion, is booming. This has been driven by dramatically falling prices for lithium ion, but also for flow batteries. This progress is likely to continue as new battery concepts emerge, some of them quite exotic.

Heat is easier to store than electricity, and heat stores can have high-energy storage densities. Hot water can hold about 3.5 times as much energy by volume as natural gas at atmospheric pressure and temperature. There are numerous mechanisms for producing heat, including by

direct capture of solar energy, biomass combustion, the trapping of geothermal energy, and, if all else fails, burning fossil fuels. It can be stored as hot water in insulated tanks or in larger pond or pit-type heat stores built into the ground with insulating walls and covers. Large heat stores are better than small stores, since the surface-area-to-volume ratio decreases with increasing size and it is that ratio that defines the heat losses. There are some very large partly solarfed interseasonal heat stores in Denmark for storing summer solar heat for winter use, fed into local district heating networks.

In Scotland, the SHEAP district heating project on the Shetland Isles supplies heat from a waste-to-energy incinerator to 1100 customers. Surplus heat during the night is fed to a 12 MWh thermal store, with an expansion planned to link 6.9 MW of wind generation to a 135 MWh capacity heat store with immersion heaters, capable of providing five days' extra heat.

Heat storage does not have to just be in water. UK company Isentropic has developed a gravel filled heat store system linked to a heat pump that upgrades the heat flow. They claim the round-trip efficiency is 72%–80%. Molten salt can also be used to store heat, as is widely used with concentrating solar power plants, and there has been interest in using sand as a heat store medium. Crushed rocks or bricks, with hot air blown through, have also been used for some solar heat stores and Siemens has been reported to be looking at rock-based storage systems for use with wind turbines.

Hydrogen can be produced by steam reformation of methane (natural gas) or, as noted earlier, by electrolysis of water. It is flexible fuel, useful for power generation, heating and transport. There are many systems being developed for hydrogen storage, as a gas under pressure or cryogenically as low-temperature liquid, or chemi-absorbed in metals, with a graphene-based system also being considered.

Perhaps the cleverest hydrogen option is the so-called power to gas (P2G) approach, which is basically a utility-scale extension of the ideas above of using wind or solar generated electricity to make hydrogen for later use to make electricity again when it is needed. In this case, however, it is surplus renewable electricity that is used—electricity that would otherwise be wasted, unless of course, it is stored is some other way. The P2G concept opens up a range of options for producing storable fuels (methanol and ammonia have also been suggested) from variable renewables, turning their variability from a problem into a solution. As renewables expand it is likely that surpluses will also expand, since, to ensure that the average level of demand can mostly be met, despite the variations in output, extra capacity has to be installed, the output of which will not be needed when demand is low. But, with P2G that does not matter; the surplus energy can be used later to meet demand when there are major wind or solar lulls or above average demand peaks.

1. Elliott, D *Energy Storage Systems*, IOP Science 16th July 2017 http://iopscience.iop.org/book/978-0-7503-1531-9

5. Further Reading

Chinese investment in UK nuclear

"*It is not clear China wants to go ahead* [they] *increasingly realise that the Hinkley design is a dead end, as costs escalate and delays grow*."

Ridley, M. *Britain's energy policy keeps picking losers,* Times 31st July 2017
https://www.thetimes.co.uk/edition/comment/britain-s-energy-policy-keeps-picking-losers-v2ctn5pcb

Kidd, S. *Nuclear in China – why the slowdown?* Nuclear Engineering International 10th August 2017 http://www.neimagazine.com/opinion/opinionnuclear-in-china-why-the-slowdown-5896525/

EDF Finances

Stop Hinkley Letter to EDF 12th February 2016 (Lists EDF's financial problems with references)
http://www.stophinkley.org/PressReleases/pr160215Letter2EDF.pdf

Pagnamenta, R. *Sparks to fly as EDF Board faces critics over Hinkley*, Times 26th May 2016
https://www.thetimes.co.uk/edition/business/sparks-to-fly-as-edf-board-faces-critics-over-hinkley-point-8wtzch2gq

Dorfman, P. *EDF facing bankruptcy as decommissioning time for France's ageing nuclear fleet nears,* Ecologist 16th March 2017
http://www.theecologist.org/essays/2988748/edf_facing_bankruptcy_as_decommissioning_time_for_frances_ageing_nuclear_fleet_nears.html

Toke, D. *Could latest delays in Hinkley C presage bankruptcy of EDF and more British bailouts?* Dave Toke's Green Energy Blog 27th June 2017 http://realfeed-intariffs.blogspot.co.uk/2017/06/could-latest-delays-in-hinkley-c.html

Loan guarantee conditional on Flamanville having "*completed the trial operation period*" by December 2020. Forston, D. *New threat to Hinkley power plant cash*, Sunday Times 31st January 2016 https://www.thetimes.co.uk/article/new-threat-to-hinkley-nuclear-plant-cash-gzntmz5jlln

Latest on Flamanville – currently scheduled for start-up in 2018. (Commercial operation later)

EDF may need to replace Flamanville reactor lid in a few years. Reuters 26th June 2017
http://uk.reuters.com/article/edf-flamanville-nuclear-idUKL8N1JN2OC

Roche, P. *Hinkley Cost to Consumers Rockets to £50bn,* nuClear News No.98, August 2017
http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo98.pdf

Toshiba/Westinghouse

Toshiba delivers long-awaited earnings, BBC 10th August 2017
http://www.bbc.co.uk/news/business-40873088

Troubled Toshiba could spark a meltdown, Sunday Times 7th May 2017 Times 7th May 2017
https://www.thetimes.co.uk/edition/business/troubled-toshiba-could-spark-ameltdown-rt8sm77d8

South Korea

Phuong Nguyen, V *Lights Out for South Korea's Nuclear Export Ambitions*, The Diplomat 12th August 2017 http://thediplomat.com/2017/08/lights-out-for-south-koreas-nuclear-export-ambitions/

Hitachi

Hitachi scrambles to divest UK nuclear risks after Toshiba fiasco, Nikkei Asian Review 9th June 2017 https://asia.nikkei.com/Business/Companies/Hitachi-scrambles-to-divest-UK-nuclear-risks-after-Toshiba-fiasco

Roche, P. *ABWRs – one of the least reliable reactors in the world*, nuClear News No.77 September 2015 http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo77.pdf

Renewables

…just keep getting cheaper. See Gandolfi, A. *The Wind and Solar Boom*, Goldman Sachs, July 2017 http://www.goldmansachs.com/our-thinking/pages/alberto-gandolfi-wind-and-solar-boom.html