nuClear news

No.113 December 2018

1. The RAB (C. Nesbitt) model for nuclear finance?

Hinkley Point C is expected to cost somewhere in the region of £20bn. But that is just for construction; it is not the whole picture. Remember you do not get a penny of revenue till the plant is up and running. That means financing those construction costs for up to 10 years, during which the debt is compounding away like rabbits, according to the *Financial Times*. Then you have decades when you are steadily servicing and paying down those loans. The cost of financing is so dominant that it can account for almost half of the costs of the project, according to the economist Dieter Helm. Which leads to a key conclusion, says the FT: if you want cheaper nuclear electricity you need to focus on driving down the cost of capital. (1)

One way of doing this would be to use the so-called Regulated Asset Base (RAB) model. (See 'Nuclear Finance' nuClear News No.110 http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2018/09/NuClearNewsNo110.pdf)

Emeritus Professor Steve Thomas explains that "*…the primary way to get a lower price of power … is for the public to take on even more of the construction risk. Lowering the risk to financiers will reduce the cost of capital, and thereby significantly reduce the consumer cost of power -- but only as long as things do not go wrong*." (2)

The RAB model means nuclear builders would earn a "fair" rate of return on the money invested as well as recovering their operating costs. This fair rate of return should be the rate of return earned by private-sector projects with a similar degree of risk and it should be reassessed every five to eight years. Currently, monopoly energy companies are allowed to earn a real rate of return of about 6%.

Under RAB companies would be allowed to start recovering their costs from consumers as soon as they start to invest. While this will be a major positive for investors, it places a major additional risk on consumers. One of the factors that allowed construction to start on the ill-conceived Vogtle and Summer AP1000 new-build projects in the US was the allowance by regulators for the utilities to start recovering their costs from consumers even before construction started. Consumers will be lucky to get much of the money they have spent on these projects back. The obvious questions to ask are who will pay if construction cost is more than anticipated and who will pay if plant reliability and costs are worse than expected.

Wylfa

Dr Dave Toke says the deal Greg Clark is hatching for Wylfa could lead to a stupendous loss for the taxpayer – perhaps £20 billion or more. What's really happening is not really a RAB model at all. It's a piece of brown-wash to obscure the reality of the Government offering a blank cheque to cover whatever it costs to build the nuclear plant.

That's because the whole plan hinges on the constructors being able to pass on cost-overruns onto the Government. And that's the point. Nuclear power stations being built in the west have

almost always tended to have large cost overruns. Recent ones have ALL suffered horrendous cost overruns - in the USA (4), France (1) and Finland (1).

Yet, some otherwise sensible, financial analysts seem to ignore this fact as they extol the virtues of RAB financing. They implicitly assume that Wylfa will proceed precisely on target, in which case, they say the Government will deliver the project at a 'cheaper' price than Hinkley Point C through the provision of Government loans with low interest rates. Sure, the headline price that will be paid by the electricity consumer, over 35 years, will be a bit cheaper. But that's likely to be at one hell of a cost to the taxpayer.

In fact, real RAB modelling as applied to nuclear power construction in the USA has actually bankrupted Westinghouse, and nearly bankrupted Toshiba who owned it. The model operates in the USA whereby consumers pay in advance for the power stations. They cover the costs while the power plant is being built through an addition to their electricity bills. That would be good for the company constructing the plant who is guaranteed to get their money back, provided of course, the project comes in at or below planned costs. But while that might work for other infrastructure, it doesn't work for new nuclear. Nuclear power plants often take longer to build than planned meaning that the workforce has to be kept on and paid and also extra interest charges accrue on loans - If a nuclear plant is supposed to be finished in 7 years, but takes 12, the costs double in that time.

But then Mr Clark is not considering the (real) US system - Hitachi would never buy into that because they don't want to go bankrupt. Instead the Treasury will take the hit on cost overruns. A very big hit, it's likely to be too. The 2.9GW Wylfa project is slated to cost £20 billion. If there is a 5 year construction overrun that means the costs will jump to £40 Billion. That means the Treasury will be on the hook to pay the extra £20 billion. (3)

Short of an extended 'no-deal' Brexit scenario it looks as though the UK will remain within EU state-aid rules for a long time to come, so Greg Clark's deal will have to get approval from the European Commission. Any application for state aid for Wylfa would be a tougher challenge than the Hinkley deal. Indeed the very proposal whereby the state will take at least a half equity share in the project and take responsibility for cost overruns is an action that in itself creates market failure if curbing carbon emissions is the objective!

The Government's cover story in 2013 was that support for Hinkley C was on the same level available for renewable energy since renewable energy schemes were also being offered CfDs (as well as very extensive loan guarantees that most renewable energy schemes could not get from the Government of course). But this time the type of support available for Wylfa is certainly not on offer to renewable energy schemes. Unlike the Hinkley C State Aid case this time voting could well be rather less favourable to the British application. The UK will have less insider influence, and there will be much less sympathy for Hitachi as a developer compared to EDF, the (French, state owned) developer of Hinkley C. (4)

Sizewell

The FT says the RAB mechanism has never been tried for a project as technically complicated and lengthy as a nuclear power station. This and other challenges mean any gains are not assured. EDF Energy is hoping to use the scheme to finance Sizewell C. This would allow EDF to

add chunks of the value of the partly built station to the regulated asset base (RAB) in stages during the risky construction phase. They could then charge an agreed regulatory return on that value to all UK electricity customers; a hypothecated amount designed to cover the project's interest costs. This would allow EDF to raise cash from pension funds that accept lower returns on investment. The aim would be to reduce the weighted average cost of capital (WACC) from the 9.2% on Hinkley to close to the 5.5-6%t achieved by the Tideway Tunnel. EDF says combined with construction savings this might deliver prices close to £60 per MWh.

"*What RAB financing does is transfer project risks to customers, who are least well placed to bear them*," said Martin Blaiklock, an infrastructure expert who likens the technique to "*being forced to pay for a meal at a restaurant before the restaurant has even been built, let alone served any food*". Consumers who paid up front for five to 10 years would run the risk that if the reactor were delayed, over-budget or ultimately not commissioned, the power savings would not materialise and they might suffer a total loss.

There are also legal question marks over whether the technique would be deemed an illegitimate subsidy under state-aid rules. "*A nuclear power station isn't like a sewer, a monopoly infrastructure asset*," said Peter Atherton, analyst at consultants Cornwall Energy. "*It competes with other private sector generators, which means legally it could be shades of grey*."

Lower costs may be necessary to get nuclear back on track, but most observers think they are not sufficient. "*Ultimately it comes down to whether you strategically think as a nation you should do nuclear*," says Dieter Helm. "*But if you do think you need it, then clearly it's right to seek to do it at the lowest cost.*" (5)

---

1. FT 18th Nov 2018 https://www.ft.com/content/b1f083ec-eb1c-11e8-8180-9cf212677a57
2. Steve Thomas, *In Perspective: UK Rab Model Will Shift Risks to Consumers,* Nuclear Intelligence Weekly, 28th September 2018 https://www.nuclearconsult.com/wp/wp-content/uploads/2018/10/NuclearConsultingGroup-ni180928.pdf
3. Dave Toke's Blog 11th November 2018 https://realfeed-intariffs.blogspot.com/2018/11/how-greg-clarks-hitachi-deal-could-lead.html
4. Dave Toke's Blog 14th November 2018 https://realfeed-intariffs.blogspot.com/2018/11/clarks-plan-to-underwrite-losses-on.html
5. FT 22nd Nov 2018 https://www.ft.com/content/f9a96304-e980-11e8-885c-e64da4c0f981

2. The impact of electric vehicles on electricity demand.

The UK Government's 2011 overarching National Policy Statement on Energy (EN-1) said (1) that "*electricity generation may need to more than double*" and so "*the government therefore anticipates a substantial amount of new generation will be required*." Hence the need for new nuclear power stations.

DECC's Director of Strategy at the time, wrote in a blog on DECC's website on 5th March 2012 that: "*All of our main scenarios for 2050 tell us that we need to plan to meet an increase in demand of between a third and two thirds, as transport and heating shift onto the electricity grid*." (2)

A new report from Redburn, a UK research and investment company, suggests the growing energy efficiency of Electric Vehicles (EVs) means that there may be a very limited increase in demand as a result of the electrification of transport.

An analysis by James Moore, partner in capital goods research at Redburn in London suggests that electrification of cars will not dent the established trends towards reduced electricity consumption because ever more energy-efficient lighting and motors will offset any increases in electricity consumption due to EVs.

According to Moore, roughly 60% of US electricity consumption comes from just four end uses:

- Lighting
- Heating, ventilation and air conditioning (HVAC)
- Machine drive
- Appliances

A closer look at these four categories reveals that the electricity-consuming component of HVAC, machine drive and some appliances – notably washing machines, tumble dryers and vacuum cleaners – is the motor.

In fact, Redburn's research leads them to conclude that motors are the world's biggest electricity-using product, ahead of lighting, accounting for an astonishing 30-35% of world's electricity consumption. Not surprisingly, as motors get more efficient, demand for electricity can be expected to fall, all else being equal.

Since Moore and his colleagues work in the capital goods division of Redburn, they know who makes the big motors – a handful of big players including ABB, Siemens, Schneider Electric and many smaller component manufacturers and suppliers.

It turns out that these manufacturers and their suppliers are confronted by ever more efficient standards forcing them to make their motors, particularly the big ones, more efficient. Aside from that, customers who know how much electricity is consumed by big motors are demanding more efficient ones.

New motors that save as much as 13% depending on the size of the motor will take roughly 15 years to replace the entire installed motor base, which will reduce global electricity demand by 0.7% per annum.

A similar scenario applies to lighting – currently accounting for roughly 22% of the global electricity demand. Here again, significant reductions in consumption can be achieved by switching to more efficient types of lighting, such as light emitting diodes (LEDs), which currently account for 20% of new global lighting unit sales. The savings can be significant.

With incandescent light bulbs expected to fall from the current 80% of the installed base to 20% by 2023, Redburn expects the global lighting electricity consumption to halve in the next five years. This alone should reduce global electricity demand by 2.3% per annum. The pattern is already obvious in falling electricity sales in many parts of the world. You don't need very many kWhs to enjoy many lumens of lighting.

Combined, these two end uses alone can reduce global annual electricity demand growth to roughly 3% below global real GDP growth in the coming five years. Of course, that is not the end of energy efficiency improvements.

EV electricity consumption

Won't the expected rise of demand from EVs more than offset the gains from energy efficiency? The short answer, according to Redburn is, not necessarily.

Examining several studies on the impact of EVs, Redburn expects average global electricity consumption of EVs to grow from around 8TWh in 2017 to 1,800TWh by 2040. While this is a massive increase, it represents only 5% of projected global electricity consumption in 2040 – not a huge percentage.

Why so little? The simple answer is that EVs are incredibly efficient, certainly compared to internal combustion engines (ICEs).

According to Redburn: "While the 'peakiness' of fast-charging load profiles of EVs will need to be managed by utilities, we only expect EVs to add 3% to global electricity demand by 2035, the equivalent of 0.2% per annum demand growth. As such, while many players in the power industry talk about EV as the next big thing, we do **not** expect the electrification of the car to in any way dent the electricity consumption reduction caused by more energy-efficient lighting and motors." (emphasis added)

While Redburn's projections on EV sales are in line with many other main-stream studies, their prediction that massive EV sales will not have much of an impact on electricity sales – due to the offsetting impact of energy efficiency gains – is surprising, contradicting those who expect a much bigger rise in electricity consumption. (3)

Meanwhile Andrew Warren writes that despite the impending cap on energy bills the Government remains determined not to take into account the benefits of falling energy consumption in our homes. Over the past decade overall household expenditure on energy has fallen by £4bn. Fuel Bills for the average British household are now £140 lower in real terms

than they were in 2008. Since 2008 the amount of electricity and gas used by the average British household has fallen by 17% and 23% respectively.

Yet in a survey of 100 MPs two thirds thought erroneously that both energy demand and bills had increased since 2008. The second most popular answer was that demand had gone down, but bills had gone up. It is particularly surprising that energy ministers have been bashful about trumpeting the success of energy efficiency policies. (4)

---

1. Overarching National Policy Statement for Energy (EN-1) DECC July 2011 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf
2. Gurumurthy, R. Future consumers would not thank us for looking for an energy policy in the bargain basement, DECC 5th March 2012 http://webarchive.nationalarchives.gov.uk/20140403100311tf_/http://blog.decc.gov.uk/2012/03/05/future-consumers-would-not-thank-us-for-looking-for-an-energy-policy-in-the-bargain-basement/
3. Energy Post 6th November 2018 https://energypost.eu/the-impact-of-electric-vehicles-on-electricity-demand/
4. Energy in Buildings & Industry Magazine, November December 16th November 2018 http://www.energyzine.co.uk/

3. Hydrogen Update

Almost four million homes across northern England could be converted to use hydrogen gas for heating and cooking by 2034 under a £23 billion scheme. Boilers and gas cookers would need to be replaced or converted under the plan, which would add more than £50 to the annual energy bill of every UK home, according to three companies involved in gas supply. Tens of thousands of kilometres of existing gas pipelines could be used making the scheme cheaper and less disruptive than other "green" heating options. Burning natural gas for heating and cooking creates carbon dioxide, a greenhouse gas that causes global warming. Decarbonising heating, which accounts for about 30% of carbon emissions in Britain, is one of the biggest energy challenges facing the government. Options include switching to hydrogen gas, which produces only heat and water when burnt; installing electric-powered "heat pumps" or setting up local heat networks that send hot water to homes from a central renewable source.

The option of using hydrogen is being taken seriously by the government, which has already committed £25 million to funding projects to demonstrate that appliances can be run on it safely. A new report by Northern Gas Networks and Cadent, which between them own 168,000km of British gas distribution pipelines, and Equinor, the Norwegian company that supplies about 25% of Britain's gas needs sets out detailed plans for a switch to hydrogen. It is the most detailed plans yet which shows how the switch could begin in 2028 with a seven-year programme to convert 3.7 million homes and 40,000 businesses in cities including Leeds, Newcastle, York, Manchester and Liverpool.

The proposal is to build a series of facilities to convert natural gas into hydrogen and carbon dioxide. The waste carbon dioxide would then be pumped or shipped out to the North Sea and injected into saline aquifers in the seabed for permanent disposal. A new high-pressure gas transmission network would be built to carry the hydrogen between cities in the north of England but the existing low-pressure gas-distribution pipelines could be converted. Households would not have to pay up front for their new appliances, with the costs spread across all British consumers, the companies propose. The companies are calling for the government to split the cost of a £250 million engineering and design study to further develop the proposals. (1)

Currently the UK requires around 1,500 terawatt hours (TWh) of energy to support heat, transport and electric generation. Around 83TWh (Digest of UK Energy Statistics 2016) of this energy comes from renewable sources. This is 5% of net energy demand. Almost half of the energy consumed in the UK is to provide heat (760TWh). That is more than what's used to produce electricity or for transport. Around 57% of this heat (434TWh) goes towards meeting the space and water heating requirements of our homes. Great Britain's gas grid heats 83% of its buildings as well as providing almost all commercial and industrial heat.

According to the report bio gases, i.e. gases developed from a biological feedstock (such as bio-methane) can support decarbonisation of the gas grid in the context of short term carbon budgets, but they will always be limited by feedstock availability and competition for the 'bio' feedstock from the transport and electric sectors. Optimistically, bio feedstock may be able to supply up to 10% of net UK energy. This would be an incredible achievement at circa 150TWh.

However it falls significantly short of the energy required to decarbonise the entire UK gas network.

Dan Sadler, head of hydrogen technologies at Northern Gas Networks, told the Nuclear Free Local Authorities that he is very confident that Carbon Capture and Storage will work. He cites the Sliepner project in Norway as an example which has been in operation on the Norwegian side of the North Sea for 22 years sequestering 1Mtpa. Storing carbon has been undertaken in the industry for 40 years with 40 MTpa being used last year.

Sadler says power to gas (P2G) electrolysers are currently around 1MW, the North of England needs 12.15GW, in other words to rely on only P2G it would need 12,150 electrolysers. The wind farm off Cumbria (the world's largest) will produce an intermittent 3TWh of energy per annum. The North of England will require 85 TWh per annum i.e. 28 of the Cumbrian wind farms. If you take into account the efficiency loss it's more like 45 Cumbrian wind farms just for heat in the North of England. The ambition is to trade renewables globally giving them time to develop across the world and also giving the electroysers supply chain the time to scale up (in terms of size and output capability) - the later part of the century should see this happen then we can back out CCS. For a hydrogen economy CCS is an essential transitional step.

The key outstanding evidence required to allow a policy decision on conversion is the quantified safety based evidence that a 100% hydrogen gas grid represents a comparable risk to the current natural gas grid and/or a town's gas grid. Two significant pieces of work are now underway which aim to provide this evidence by 2021. (2)

However, some environmentalists, such as E3G's Ed Matthew have expressed concern about the continued use methane with CCS saying it could still create significant carbon emissions at source. Matthews believes Hydrogen may have only a limited role.

A report on the future of gas published by National Grid said that, while a "combination of solutions" was expected to develop to decarbonise heat, hydrogen was "*gaining momentum*". A report by KPMG published in 2016 also put the cost of decarbonisation through conversion to a form of decarbonised gas (including hydrogen) at about a third of the estimated £300bn cost of full electrification. But whichever technologies are adopted, the cost will remain a challenge. Domestic electricity bills include a levy which subsidises renewables (and will subsidise nuclear power). Whether carbon-free heating can be paid for with a similar levy is still a matter of debate. (3)

In all of the indicative scenarios set out in the Clean Growth Strategy, heat networks are projected to meet 17% of heat demand in homes and up to 24% of heat demand in industrial and public-sector buildings by 2050, whereas they currently only supply around 1% of buildings heat demand. (4)

District heating networks could provide around 50-125TWh of heat by 2050. Energy efficiency measures could save around 130TWh. Biomethane produced by anaerobic digestion and BioSNG could provide around 183TWh. Power to Gas projects can continue to be developed. Any hydrogen generated using surplus renewable electricity for the electrolysis of water, can always be used to generate electricity or to power vehicles. Biomass heating from sustainable sources in off-gas grid areas also represents another low regret opportunity. (5)

Arno A. Evers, author of 'Hydrogen Society: More than just a vision' is described as "*one of the most convincing visionaries for the transition to a hydrogen energy system*." His book promotes the idea of producing hydrogen without the production of electricity in the first place. Alternative methods without the need for electrical power include: Photoelectrochemical hydrogen; Biological Photolytic Hydrogen; Conversion of Biomass and Wastes; solar thermal water splitting. (6)

---

1. Times 20th Nov 2018 https://www.thetimes.co.uk/article/37240fa4-ec42-11e8-bea1-693d823de728
2. Northern Gas Networks H21 Leeds City Gate film 1st Feb 2018 https://www.youtube.com/watch?v=dUKAMQ-c0Uc
3. . Future of Gas Report, National Grid, March 2018 http://futureofgas.uk/news/future-of-gas-how-gas-can-support-a-low-carbon-future/
4. Heat Networks Investment Project, BEIS 2018 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/691643/Heat_Network_Case_Study_Brochure.pdf
5. See nuClear News No.108 http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2018/06/NuClearNewsNo108.pdf
6. Arno A Evers, *Hydrogen Society: More than just a vision*, April 2010 http://www.hydrogenambassadors.com/the-hydrogen-society-more-than-just-a-vision.html

4. Progress on low-carbon hydrogen 'must begin now'

The Committee on Climate Change's latest report: "*Hydrogen in a Low Carbon Economy*" (1) concludes that hydrogen could replace natural gas in some otherwise hard-to-decarbonise areas such as a low-carbon fuel for heat in buildings and industrial processes, but progress towards deployment at scale "*must begin now*", if it is to play a role.

However, it is "*not prudent*" to rely solely on hydrogen to replace gas, it says. This would mean increased gas imports to produce the hydrogen and could mean greenhouse gas emissions remain too high. Hydrogen is "*not the 'silver bullet'*" it is often claimed to be by the gas industry. Hydrogen production from gas with CCS has a "*potentially important role*", but would only provide emissions savings of 60-85% relative to gas use in boilers, because of imperfect CO_2 capture and upstream methane emissions during gas extraction. As a result, a large-scale rollout of hydrogen from gas could mean the UK falls short on its climate goals.

The CCC's conclusions about where it is best to source hydrogen are disputed by some and German firms are already building relatively large-scale "power-to-gas" pilot plants. Mike Childs, head of policy at Friends of the Earth, says it is wrong to suggest that hydrogen produced from renewable power will always be too expensive. He adds: "*The same was originally said about solar power and offshore wind, but, with focus and innovation, prices have tumbled dramatically. Using natural gas to make hydrogen is still polluting and, therefore, doesn't have a future in a zero-carbon Britain.*"

One of the CCC's key recommendations is that we should roll-out of "*hybrid heat pump*" systems, where hydrogen boilers would provide backup for electric heat pumps to meet peak demands on the coldest winter days. Chris Stark, chief executive of the CCC, told Carbon Brief: "*They reduce the amount of natural gas that you use in your home by upwards of 80%. And that is remarkable. So we can now recommend the immediate roll out of hybrid heat pumps for the first time, as a really sensible step to first reduce the amount of natural gas that we're consuming in the home.*" This would mean far less natural gas would need to be decarbonised in the longer term – and allow the decision of whether or not to replace it with hydrogen to be delayed to the 2030s, the CCC says.

Hydrogen also has a part to play in reducing industrial heat emissions, the CCC says, especially in situations where the flame needs to come into direct contact with the material being produced, such as in furnaces. In addition, it could help to reduce more distributed sources of industrial CO_2 which would be difficult to capture at source, such as in the food-and-drink sector, the CCC adds.

Commenting on the new report, Dr Richard Lowes, a postgraduate researcher in energy policy at the University of Exeter, tells *Carbon Brief* that the call for a new heat strategy is welcome. However, he adds:

"*The three pillars of UK heat decarbonisation haven't changed since the previous 2013 government heat strategy: reduce demand with energy efficiency delivery; electrify heat with heat pumps; and grow heat networks in dense urban areas*." (2)

The Committee on Climate Change (CCC) spelt out the huge but necessary cost the country faces to switch to green heating. The cheapest scenario, it said, is a mix of electrifying heating and fitting hydrogen boilers, and will cost the UK £28bn a year, or 0.7% of GDP, by 2050. The public is largely unaware of the alternatives to gas central heating, said the report, and consumer understanding is "*far from where it would need to be*" before decisions on decarbonising heating are made in the 2020s. While householders can keep their radiators, the CCC envisages that in future they will need to live in much more energy efficient homes with heat pumps that use electricity to draw heat from the ground or air, running alongside gas boilers. Air-source heat pumps cost about £6,000-£7,000 but are expected to become cheaper as they become more mainstream. To meet the long-term goal of cutting carbon emissions 80% by 2050, gas boilers would eventually need to be replaced by hydrogen ones that provide backup heating at times. Chris Stark, the chief executive of the CCC, said the committee had previously been a "bit suspicious" of heat pumps but was now confident enough to recommend their rollout as a hybrid heating measure running alongside gas boilers, before a later move to hydrogen too. Despite the high costs of decarbonising heating, the CCC believes the total consumers spend on energy bills could stay similar to today, as it expects electricity prices to fall as more is sourced from wind, solar and nuclear, and costs of running a car to become cheaper owing to the switch to electric vehicles. (3)

---

1. Hydrogen in a Low Carbon Economy, Committee on Climate Change 22nd November 2018 https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf
2. Carbon Brief 22nd Nov 2018 https://www.carbonbrief.org/ccc-progress-on-low-carbon-hydrogen-must-begin-now-in-uk
3. Guardian 22nd Nov 2018 https://www.theguardian.com/environment/2018/nov/22/uk-hydrogen-heating-2050-emissions-targets-gas-boilers-electric-climate-change

5. Managing Radioactive Waste Update

A meeting planned for December between NGOs and the Nuclear Decommissioning Authority's Radioactive Waste Management Ltd (NDA/RWM) has been postponed until February 2019 due to a delay in BEIS announcing the next steps in the Geological Disposal Facility (GDF) process (originally scheduled for November 2018). Brexit is most likely to blame for this delay. (1)

Writing on the GDF Watch website before the cancellation, Roy Payne said "*there's no doubting the commitment in Whitehall to try and finalise GDF siting policy before Christmas. But if you ask about timing, you get the same silent stoic smiles revealing the lack of certainty across Whitehall about getting Ministerial decisions on anything at the moment*". He says it's likely that it will be many months after the policy is launched before we see any sign of active community participation. (2)

The Committee on Radioactive Waste Management (CoRWM) which advises BEIS on dealing with nuclear waste, has recently published a paper in response to calls during the most recent consultation exercise to select a site for a Geological Disposal Facility (GDF) based on the 'best geology'.

CoRWM says RWM, the UK's delivery body for a GDF, has developed generic environmental safety cases (gESC) for the three rock types: hard rocks (metamorphic and igneous rocks), soft rocks (clays and mudstones) and evaporites (salt deposits). CoRWM says the recognition that three very different rock types can provide for a safe GDF highlights the difficulty associated with selecting a 'best' geology as each rock type have their own advantages and disadvantages. For example, from the technical assessment carried out to support CoRWM's initial work:

"Strong indurated[1] rocks can provide repository concepts at depth that could provide long pathways and isolation from human intrusion. Weak indurated rocks could provide hydrogeological isolation but be constrained by depth limitations. Evaporites could provide hydrogeological isolation and low gas permeability. Excavations of some evaporites would be difficult to maintain over long time periods."

CoRWM concludes that geologic attributes or parameters cannot be compared across rock types, and the concept of a site which scores 'highest' on all parameters' simply cannot occur. The different and various roles played by geological settings proposed for GDFs across the world highlight this issue.

CoRWM says it recommended against geological screening in 2014 because the level of knowledge of the geology of much of the UK at the depths under consideration is too rudimentary to support a 'screening out/in' process. This position could only be changed by introducing, country-wide, a level of geological investigation, including investigative boreholes. This would clearly be unsupportable on both economic and public acceptability grounds. (3)

[1] Rocks hardened by heat or baking; also the hardening of sediments through cementation or compaction, or both, without the introduction of heat.

Cumbria Trust believes CoRWM's paper calls into question their independence. They are supposed to act as an independent body, but some of their recent actions suggest to us that they are too close to BEIS and failing to adequately perform their advisory function and to challenge poor decision-making. Cumbria Trust has written to CoRWM expressing its concerns. The letter says:

"*We feel that you are using an over-literal interpretation in responding to stakeholder consultation replies which advocated a search for the best geology, by taking this to mean the single best site in England and Wales. While a few stakeholders may have intended that in its very narrowest sense, which is clearly incompatible with voluntarism, we believe that the majority did not. By confining your response to this narrow interpretation, you have missed the opportunity to examine a more realistic and widely-held view. It is quite possible to combine the principle of voluntarism in site selection, which we accept, with some level of geological pre-selection. Cumbria Trust advocates actively seeking volunteers from areas which have promising geology, as recommended by many experts including the Lead Inspector of the Nirex Inquiry, Chris McDonald*."

The Trust also refers to a statement made in 2013 by Professor Yardley, who subsequently became RWM's Chief Geologist, in which he pointed out that due to the UK's extensive programme of spent fuel reprocessing there is a significant amount of carbon-14 present in the UK inventory. This poses a particular risk to a GDF project and increases the need for an effective gas barrier to prevent radioactive methane, amongst other gases, from escaping. This is a further reason why a clay host rock may well be preferable for the UK. (4)

1 in a million

CoRWM also points out that:

A Geological Disposal Facility must isolate the waste it contains from people and the environment such that the risk levels to individuals that are most susceptible is kept within 1 in 1 million (10^{-6}) into the very distant future. This is assured by developing a Safety Case which models the behaviour of the repository system.

The Environment Agency (EA) has set a limit on the risk that may be caused by the burial of radioactive wastes of 10^{-6} (i.e. one in a million). (5) However, the NDA Disposability Assessment Report for waste arising from new EPR reactors states:

"*…a risk of 5.3 x 10^{-7} per year for the lifetime arisings of a fleet of six EPR reactors each generating a lifetime total of 900 canisters is calculated*" (6)

This is more than half the total risk of 10^{-6} allowable for a GDF for 9.6GW of new capacity. If the Government succeeds in persuading the nuclear industry to go ahead with 18GW of new capacity clearly this will exceed the risk targets set by the EA.

Two ways round this have been suggested. Firstly there could be two repositories, but although both dumps might share the same access shaft, there would be a sufficient distance between two separate groups of disposal chambers so that you have in effect two dumps giving a potential dose to two different populations.

The second excuse seems to be that if the probability of such an outcome is very low then the Environment Agency may allow a risk higher than 10^{-6}. This kind of 'make-it-up as you go along' technique of risk assessment will not go down well with communities surrounding a proposed GDF.

CoRWM reviewed

GDF Watch writes: The publication of the tailored review on CoRWM sets out some revised principles for the Committee's future role. While the review says that the Committee's role and objectives needs updating, and that these should be set out in a new framework, the Government says little about what that role might actually be. However, one specific area of activity under review is the extent to which, and on what basis, CoRWM more actively participates in public and community engagement. The July appointment of Sir Nigel Thrift as CoRWM's new Chair underlines the Government's awareness of the need to shift priority as the siting process relaunches. Sir Nigel is a human geographer, a social scientist. This is a marked shift from CoRWM's historic technical/scientific foundations, and a recognition that the issues are increasingly social rather than technical – civics not science. The minutes from CoRWM's recent public plenary sessions indicate that the Committee itself has been examining whether and how it should become more active and more visible. Those who gave evidence to the Committee, including GDFWatch, were in agreement that a revamped CoRWM could have a critical role in building public trust in geological disposal and the siting process. (7) (8)

Former CoRWM member Pete Wilkinson said "*CoRWM should perform the role of building public trust. The only – big – problem is that all CoRWM members are basically in favour of and supportive of government policy so their role in building public trust will inevitably be biased towards enabling policy to be enacted. The first CoRWM's role was largely in this public engagement domain and its PSE programme was full and comprehensive*."

However, following the Swedish Land Court's rejection of the Nuclear Waste Company SKB's applied solution for nuclear waste disposal and revelations that the Swedish regulator SSM tried to withhold crucial information regarding copper corrosion from the court, it would not be surprising if some people were nervous about relying solely on the UK regulators to scrutinise the science. (9)

Meanwhile, the regulators – the Office for Nuclear Regulation and the Environment Agency – have published a report on their findings and recommendations on RWM's 2016 generic Disposal System Safety Case. (10)

The Regulators say "*we have not identified any fundamental regulatory issues that would prevent RWM developing a safety case in the future to address our regulatory requirements. However, our position is subject to some reservations that we present in this report. We note that there is a significant amount of work for RWM to do to develop a comprehensive, site-specific safety case, and that many aspects can only be fully evaluated when a site is selected and specific designs are produced. We advise RWM to continue the constructive dialogue with us and take steps to address our feedback as it progresses this further work*."

1. Bloomberg 19th Sept 2018 https://www.bloomberg.com/news/articles/2018-09-19/brexit-hasbrought-britain-to-a-standstill
2. GDF Watch 28th Oct 2018 http://www.gdfwatch.org.uk/2018/10/28/what-will-a-new-siting-process-look-like-issues-hurdles/
3. CoRWM Position Paper: GDF Should only Target Best Geology 25 October 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/753945/3468_O_Best_Geology.pdf
4. Cumbria Trust 11th Nov 2018 https://cumbriatrust.wordpress.com/2018/11/11/has-corwm-lost-its-independence/
5. Environment Agency (February 2009) Geological Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation, page 46 para 6.3.10 http://publications.environment-agency.gov.uk/pdf/GEHO0209BPJM-e-e.pdf
6. NDA (22nd Jan 2010) Generic Design Assessment: Disposability Assessment for wastes and spent fuel arising from operation of the UK EPR. Part 1 Main Report. para 5.4 page 97
7. GDF Watch 28th Oct 2018 http://www.gdfwatch.org.uk/2018/10/28/a-new-corwm-possibilities-for-the-expert-committee/
8. Report of the tailored review of the Committee on Radioactive Waste Management (CoRWM) 2017 to 2018. *BEIS 22nd Oct 2018* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/750127/corwm-tailored-review-2018.pdf
9. See MKG 11th Oct 2017 http://www.mkg.se/ssm-har-morkat-risker-med-slutforvaret-till-domstolen and MKG 13th Oct 2017 http://www.mkg.se/yttrande-om-ssms-interna-kapseldiskussioner-lamnad-till-domstolen and MKG 6th Feb 2018 http://www.mkg.se/lackt-dokument-fran-ssm-visar-pa-intern-kritik-till-slutforvarsbeslutet
10. Pre-application advice and scrutiny of Radioactive Waste Management Limited: Joint regulators' assessment of the 2016 generic Disposal System Safety Case, November 2018 http://www.onr.org.uk/documents/2018/2016-gdssc.pdf

6. Sellafield – a misuse of public funds

The House of Commons Public Accounts Committee (PAC) says while the Nuclear Decommissioning Authority (NDA) and Sellafield Limited have made progress with reducing delays and expected cost overruns on 14 major projects at Sellafield, with a combined lifetime cost estimate of £6 billion, there is still a long way to go.

Most major projects at Sellafield are still significantly delayed, with expected combined cost overruns of £913 million. The NDA has not systematically reviewed why these projects keep running into difficulties, or analysed properly the constraints it says prevent them from making faster progress.

Until this work is completed, the Committee will remain sceptical about the long-term strategy to decommission Sellafield. And despite this Committee's recommendation nearly five years ago, the Department for Business, Energy & Industrial Strategy has still not decided what to do with the plutonium stockpile currently stored at Sellafield.

Given the scale and unique challenges at Sellafield, the NDA must have a firm grip of the work that takes place on the site. This was not the case with the NDA's recently failed contract to decommission its Magnox sites.

PAC Deputy Chair, Sir Geoffrey Clifton-Brown MP said:

"*The Government's oversight of the NDA's performance could and should be much better, particularly on projects at Sellafield that cost a considerable amount of public money. BEIS needs to seriously get a grip on its oversight of nuclear decommissioning in this country*."

The Committee's findings make yet more dreary reading for the UK taxpayer says Cumbrians Opposed to a Radioactive Environment (CORE). The costs described as 'a misuse of public funds' by a spokesman for the report's authors the Government's Public Accounts Committee (PAC). The PAC report pulls few punches in its criticism of the way the NDA is managing many of the major projects needed to clean up Sellafield.

The site currently receives some £2bn of public money every year and, over the next 100+ years of decommissioning is expected to cost a total of £91bn. In a slight but revealing departure from the pattern of previous reports, PAC raises the spectre of the UK's plutonium stockpile (40% of the world's global stock) and the latest thinking by Government on its long-term plutonium management options. CORE says an update on its plutonium plans is currently being finalised by the NDA and could be published soon.

The PAC report reveals the following:

- Major projects are expected to cost over £900 million more than originally budgeted and be subjected to delays of over 13 years.
- The NDA has cancelled three projects since 2012 after spending £586 million of taxpayers' money on them.

- Two of the above projects – the silo direct encapsulation project and the box transfer facility were cancelled after the NDA projected a combined cost increase of £2.1 billion and a combined delay of nine years.
- The NDA's programme to deal with the plutonium stockpile in the near term is late and its costs are increasing.
- The concerning discovery last year (NAO report 20.6.18) that some plutonium canisters have been decaying faster than expected is made worse by the fact that the NDA's project to repackage these canisters is at least two years late and expected to cost over £1.5 billion, £1 billion more than it first expected.
- The series of contingency arrangements to manage these decaying canisters are short-term fixes for a long-term problem and BEIS has yet to set out clearly what its strategy is and the associated costs to the taxpayer.
- BEIS has still not decided between the two plutonium management options available – its long-term storage prior to final disposal as waste in a geological disposal facility (GDF) that has yet to be located or constructed, or its reuse as fuel in new nuclear power stations – but has told the PAC Committee that 'it is not comfortable with any of the potential options for managing plutonium other than disposing it in the GDF' (2)

Meanwhile the controversial Thermal Oxide Reprocessing Plant (THORP) at Sellafield has started work on processing its final batch of waste fuel after operating for only 24 years. (3) THORP opened in 1994 to reprocess spent fuel from the UK's newer reactors – like Hinkley Point B - and overseas customers. Reprocessing is a chemical process which separates out plutonium and unused uranium from spent nuclear fuel.

There are strong parallels between THORP and the proposed £20bn Hinkley Point C nuclear power plant. Powerful arguments were put forward against the construction of both plants, but the Government and the Nuclear Industry continued to stubbornly pursue these massively expensive and dangerous projects. This Stop Hinkley Campaign briefing asks whether there are any lessons we can learn from the THORP experience to help us to evaluate the merits of continuing to build Hinkley Point C.

Currently, the ground-works for Hinkley Point C aren't even finished so, in theory, it should be straightforward not to go ahead with the project, if it looks like full construction and operation would be a mistake. In fact not going ahead with the plant could save electricity consumers between £27bn and £50bn over the 35 years that the plant would have operated. (4)

The construction of THORP was very controversial and was the subject of a Public Inquiry in 1977, which ran for one hundred days. It was argued that the Inquiry would be a way of rationally weighing up all the evidence in order to come up with the correct decision on whether or not to give the plant the go-ahead. However, Professor Brian Wynne has argued that the Inquiry was in fact a charade, meant only to give the impression of rational decision making. (5)

At the Inquiry it was argued that THORP would be needed to supply plutonium for a new type of reactor – the Fast Breeder Reactor. Justice Parker, the Inquiry Inspector, concluded that THORP should go ahead and the Government agreed. It was built in the 1980s and switched on in the 1990s. Within a week of THORP starting up, the prototype Fast Reactor at Dounreay in the north of Scotland was shut down – ending the whole UK Fast Breeder programme. (6)

By 1992 the original rationale for THORP had all but disappeared before it even opened so the Government decided to commission the consulting firm Touche Ross to examine the financial implications of THORP's operation or abandonment. It concluded that the economic benefit of operating THORP versus not operating it were £1.81bn for BNFL and £950m for the UK (7). In 1994, after a long and agonised debate, the Government decided to allow the plant to operate and the first waste spent fuel was 'sheared' - the outer cladding taken off - as the first step in the reprocessing process, in March of that year (8).

Another raison dêtre for THORP was quickly found, with construction work of the Sellafield MOX Plant beginning a few weeks later in April 1994. This was meant to produce plutonium fuel for ordinary reactors rather than Fast Breeders. The Sellafield MOX Plant was expected to generate £400m; instead it cost £2.2 Billion.

THORP was originally expected to reprocess 7,000 tonnes of spent fuel in its first ten years of operation. By the time it closes it will probably have reprocessed around 9,300 tonnes of spent fuel. If the plant had been working to its design capacity it should have completed 9,300 tonnes ten years ago in 2008 (9). THORP's throughput was never reliable, nor to specification

The cost of building THORP steadily rose from £300m at the time of the public inquiry in 1977 to £1.8bn on completion in 1992. With the additional cost of associated facilities this figure rose to £2.8bn. The operator at the time – British Nuclear Fuels Ltd (BNFL) received advance payments from its customers of £1.6bn which largely covered the construction costs. The net result, according to BNFL was that over the first ten years the income would not only cover all building operating and future decommissioning costs, but would produce a profit of £500m. One economic analysis in 1993 pointed out that at a projected profit of only £50m per year, the economics of the project looked extremely vulnerable to unforeseen events, and British electricity consumers would be paying £1.7bn more than necessary to have British spent fuel reprocessed at THORP (10). This analysis turned out to be prophetic - there have certainly been plenty of unforeseen events since 1994. With THORP operating around a decade behind schedule, any notional profit originally expected must have long since been completely wiped out.

A report for the Government by management consultants Arthur D Little predicted in 2001 that the Sellafield MOX Plant would earn the UK more than £200m in foreign currency by exporting MOX fuel to Japan and several other countries. After the plant opened it was plagued by production problems due to its faulty design and layout. Instead of producing 120 tonnes of MOX a year, it managed less than 14 tonnes in eight years. The plant was closed in August 2011. (11) The plant is thought to have cost British taxpayers about £2.2bn in capital, operating and decommissioning costs since it was built. An internal report concluded that the facility was "not fit for purpose" and its performance over a decade was "very poor". (12)

The economics of THORP and subsequently the Sellafield MOX Plant (SMP) depended on the constructors and operators being able to build and operate the facilities according to the specification. But nuclear facilities being built in the west have suffered from delays and almost always tended to have large cost overruns. Recent ones have ALL suffered horrendous cost overruns – in the USA (4), France (1) and Finland (1). Yet otherwise sensible, financial analysts have, in the past produced reports to justify building facilities at Sellafield and Hinkley which seem to ignore this fact and assume construction and operation will proceed precisely on target.

The prospects of avoiding a Sellafield-scale financial disaster with Hinkley Point C do not look good. As Emeritus Professor Steve Thomas has pointed out: "Hinkley Point C would use a technology unproven in operation – the EPR – which has run into appalling problems of cost & time overruns in the 3 projects using it. It would be supplied by Areva NP, which is in financial collapse and might not be saveable and has been found to be falsifying quality control records for safety critical items of equipment for up to 50 years – a bizarre situation."

Time to cancel Hinkley Point C now while the cancellation costs are relatively low. Leaving things any longer risks yet another Sellafield-scale financial disaster.

---

1. Public Accounts Committee 31st Oct 2018 https://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news-parliament-2017/nuclear-decommissioning-authority-17-19/
2. CORE 31st Oct 2018 http://corecumbria.co.uk/briefings/spendthrift-sellafield-wayward-governance-and-the-latest-plutonium-view/?doing_wp_cron=1541014253.9727599620819091796875
3. North West Evening Mail 26th October 2018 http://www.nwemail.co.uk/news/17009882.residents-urged-to-have-their-say-on-sellafield-review/ and Environment Agency 26th October 2018 https://consult.environment-agency.gov.uk/cumbria-and-lancashire/sellafield-rsa-major-permit-review/ In Cumbria 14th Nov 2018 http://www.in-cumbria.com/news/nuclear/Thorp-reprocessing-ends-at-Sellafield-788459cb-b779-45f7-863d-1827a6800d17-ds
4. Time to Cancel Hinkley? By Professor Steve Thomas, Emeritus Professor of Energy Policy University of Greenwich September 2017. http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2017/09/Time-to-Cancel-HinkleyFinal.pdf
5. Rationality and Ritual: Participation and Exclusion in Nuclear Decision-making, by Brian Wynne, Earthscan, 2011.
6. A Guide to Dounreay, NDA & DSRL. April 2008 http://webarchive.nationalarchives.gov.uk/20120405092238/http://dounreay.com/UserFiles/File/Publications/PR%20First%20time%20Visitors%20Booklet%202.pdf
7. Walker, W. Nuclear Entrapment: THORP and the politics of commitment, IPPR, 1999, page 87.
8. Forwood, M. The Legacy of Reprocessing in the United Kingdom, International Panel on Fissile Materials, July 2008 http://fissilematerials.org/library/rr05.pdf
9. Commercial Operations at Sellafield, CORE's Evidence to the Public Accounts Committee 18th October 2013 http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2014/02/CommercialOperations-at-Sellafield.pdf and CORE Press Release 12th Nov 2018 http://corecumbria.co.uk/news/sellafields-thorp-reprocessing-plant-an-epitaph-never-did-what-it-said-on-the-tin/
10. Aubrey, C. THORP: The Whitehall Nightmare, Jon Carpenter 1993

11. Guardian 3rd August 2011 https://www.theguardian.com/environment/2011/aug/03/sellafield-mox-plant-close
12. Independent 9th June 2013 https://www.independent.co.uk/news/uk/politics/revealed-2bn-cost-of-failed-sellafield-plant-8650779.html