Together Against Sizewell C

SIZEWELL C PLANNING APPLICATION INQUIRY (IP no. 20026424)

N CRUMPTON'S FOLLOW-UP COMMENTS FROM
ISH9 POLICY & NEED
Deadline 7 Submission

Written evidence by Neil Crumpton on behalf on TASC expanding on oral evidence given on Thursday 26th August 2021 to SZC agenda items 2 B and 4 A on 'Policy & Need'

2 D (scale & urgency)

i) it is clear from the latest IPCC and CCC (Climate Change Committee) reports that there is an increasingly urgent need to decarbonise UK energy use across all sectors preferably well before 2050, and preferably the electricity sector by 2035. Net 'zero' emissions targets by 2050 may require significant 'negative' emission technologies (Greenhouse Gas Removal GGR or DACCUS) to neutralise residual UK carbon emissions eg from land-use

ii) SZC (assuming commissioning and operation as forecast) would provide about 25 TWh/y of 'baseload' which is assumed currently to be 'low-carbon' ie 5 g/kWh or 5,000 tonnes per TWh. TASC contend that a similar amount of finance spent on an RE+CCS technologies (including stand-by generating capacity) over the same period could achieve the same 25 TWh/y of electricity by 2035 but with the added benefits of :

a) decarbonisation beginning sooner as smaller RE and BECCS projects can be constructed in shorter timescales and some power would very likely be generated before 2035 (and the earlier the reductions before 2050 the better)

b) providing 'dispatchable' power (as distinct to baseload power) which can better match power supply to future (difficult to forecast) Grid consumer demand (excluding electrolysis)

c) potentially partly comprising greater 'negative' emission electricity generating capability - emission reductions would also depend on using some additional but still low level of sustainable bio-energy (wastes residues and possibly some crops) than in the nuclear-inclusive scenarios eg in BECCS schemes (producing hydrogen for storage and dispatchable power).

iii) the Government's expressed 'need' for new nuclear generation (by 2035) in policies EN1 and EN6 in the EWP December 2020, is heavily based on a BEIS computer model (Dynamic Dispatch Model DDM) which compares many tens of scenario runs with varying inputs. It is clear that significant weight is put on the model by ministers (see minister Kwasi Kwarteng's evidence to the BEIS Select Committee in Jan 2021). BEIS has stated that the model is continually being updated so the 'need' as expressed as the weight given to policies EN1 and EN6 will be a function of the updates.

iv) One significant update will be the forthcoming incorporation of the Biomass Strategy expected in 2022. TASC contend that DDM Modelling 2050 without including bio-energy is non-sensical and highly likely to give unrealistic outcomes which benefit nuclear-inclusive scenarios - see 4A below. The amount of renewable bio-energy available for power generation in all DDM scenarios has implications for 'urgent' or priority emission reduction in the electricity sector.

For example, most bio-energy resources could be directed at bio-aviation fuels. However most flying is non-essential (tourism) whereas electricity production is essential across all sectors. Aviation fuels can be produced synthetically using CO2 captured from air (DACCU) and combined with Green or Blue hydrogen. The DACCU plants and electrolysers can use otherwise curtailed RE electricity (who's carbon emissions are already accounted for in the DDM). So only the emissions associated by the manufacture and construction of DAC plant, electrolysers, and synthesis site operations would be additional.

A Carbon Brief report *** states that : '*And because 80% of bioenergy used in the UK will need to be linked to CCS by 2050, the CCC says a "significant investment programme will be required, with construction of new bioenergy facilities with CCS occurring in the late 2020s and early 2030s, across multiple end-use sectors – transport fuels, hydrogen, manufacturing and power".*'

So the CCC recommendations indicate that 80 % of bio-energy is linked with (BE)CCS to generate strongly carbon-negative bio-hydrogen (about MINUS 0.4 mtCO2 per TWh thermal depending on wider LCA). Hydrogen can be stored at tens of TWh scale. IF used for electricity generation this strongly 'carbon-negative' bio-H2 could result in carbon-negative electricity with specific emissions of about MINUS 0.8 mtCO2 per TWh (assuming 50% HHV conversion efficiency ie 04 mt x 2).

v) Another significant event has been the publication of the CCC CB6 report indicating high 'low-carbon' hydrogen demand (over 200 TWh/y by 2045 and which include scenarios of 50% Green and 50% Blue hydrogen)**. The CCC's significant hydrogen demand estimate and recommendation was followed up very recently in HMG's 'Hydrogen Strategy' report ***(17th August 2021) estimating a massive hydrogen demand of between 250 to 460 TWh/y by 2050 (for comparison current UK electricity generation is around 340 TWh/y).

Such high hydrogen demand forecasts have significant implications for the DDM modelling and the RE+CCUS scenarios particularly. The higher levels of curtailed electricity in the RE+CCUS scenarios can be used for electrolytic 'Green' hydrogen production rather than producing Blue hydrogen from Natural Gas with CCUS. Curtailed electricity could also be used to power GGR technologies or synthetic fuel production. Such technologies could lower the RE+CCUS sector emission levels to below that of nuclear-inclusive scenarios of equivalent cost - see 4A below.

* https://www.carbonbrief.org/ccc-uk-must-cut-emissions-78-by-2035-to-be-on-course-for-net-zero-goal
** https://www.carbonbrief.org/ccc-uk-must-cut-emissions-78-by-2035-to-be-on-course-for-net-zero-goal
*** HMG 'UK Hydrogen Strategy' August 2021
: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

4A Projections and Modelling

i) As indicated in 2D above, it appears likely that the high levels of hydrogen demand and the increasing urgency to achieve NET-ZERO emissions by 2050 or preferably much sooner (likely requiring GGR / BECCUS technologies) has significant implications for the BEIS DDM modelling. TASC contend that the DDM modelling which informs nuclear 'need' has significant scenario omissions and requires urgent updating to properly inform policy on what would be one of the highest cost construction projects globally ie SZC (and with significant security implications).

ii) the more low-carbon hydrogen that is required (for use within or outside the electricity sector) in a 2050 UK energy scenario, the more likely it is that the emissions-intensity of the RE+CCUS scenarios in the electricity sector falls comparatively more than in nuclear-inclusive scenarios. There are two main reasons for this.

Firstly, RE+CCUS scenarios generate relatively more 'excess' electricity (above instantaneous consumer demand on the Grid) over a typical year compared to nuclear-inclusive scenarios. This additional excess RE electricity is curtailed IF not utilised somehow. However, it can be used for Green hydrogen production via electrolysis ie 1 TWh electricity can produce about 0.75 TWh H2 (thermal). Green hydrogen production is forecast to be cheaper than Blue hydrogen by 2030-2040 (and Blue hydrogen is associated with potentially high fugitive emissions).

Secondly, the more electricity required for Green hydrogen production compared to that for suppling consumer demand, then the more likely it is that variable ('weather-dependent') instantaneous RE electricity supply is available to meet instantaneous consumer demand. Consequently, it requires relatively less dispatchable electricity over a year to match supply to consumer demand. As dispatchable electricity is much more expensive than RE (offshore wind and PV) supplied directly, the scenario costs reduce. The dispatchable electricity avoided would probably be NG+CCS, which has very high specific emissions.

The DDM model uses a figure of around 50,000 tonnes CO2 per TWh for NG+CCS. So for every 20 TWh per year of NG+CCS avoided the scenario emission reductions would be around 0.75 mtCO2per year after including the specific emissions of the offshore wind or PV which displaces the NG+CCS (which may be about 12,000 t/TWh). Note that the IPCC estimated LCA specific emissions for wind energy and nuclear power to be about the same at 11-12 g/kWh (BEIS use 5g/kWh for nuclear in the DDM and CCC use 6g/kWh for nuclear).

The BEIS Hydrogen Strategy demand estimate of between 250-460 TWh/y hydrogen (thermal) by 2050 could require anything from 330-615 TWh/y of low-carbon electricity for electrolysis (assuming 75% conversion efficiency) excluding hydrogen derived by other means. Low-carbon hydrogen could be produced from biomass gasification/pyrolysis, reformed (SMR) Natural Gas+CCS, or imported via H2 tankers or pipelines. The amount of sustainable biomass in 2050 is more likely to in the region of 30-60 TWh/y (thermal) ie roughly ten times less than the above hydrogen demand. Blue hydrogen also has higher specific emissions, potentially high fugitive emissions, and would lock the UK into fossil fuel use including Natural Gas imports.

Note also that Green hydrogen production would produce very large quantities of oxygen gas during electrolysis, some of which could be used to re-oxygenate the UK's largest rivers eg Thames.

As Green hydrogen produced using curtailed RE has likely competitive cost and emission advantages over Blue hydrogen by around 2035, then the amount of electricity required for Green hydrogen could rise sharply. Assuming no or low H2 imports, electrolysis demand could range from 300 TWh/y to over 500 TWh/y by 2050 even if most biomass is also used for hydrogen production.

Consequently, UK electricity demand could easily reach or exceed the current DDM 'high-demand' scenario of 672 TWh/y in 2050. Indeed, assuming 300 TWh/y for Green hydrogen production could result in a UK electricity demand of well over 700 TWh/y (eg 350 current electricity use + 100+ for electric vehicles + 300 electrolysis = 750 TWh/y). Electrolysis demand could comprise a huge 40 % of 2050 electricity demand (300/750).

The BEIS Modelling 2050 report does some analysis of using otherwise curtailed electricity for hydrogen production in scenarios and shows that cost-effective, low-emission (<5g/kWh) RE+CCUS scenarios do exist even in their bio-energy excluding modelling. Figure 5 indicates that RE generation scenarios above 670 TWh/y electricity would require no new nuclear (ie 5GW nuclear = HPC + SZB). The high level of CCUS **generating capacity** indicated as 30 GW would be mostly Green hydrogen fired (

and includes carbon-negatively produced bio-hydrogen) and used to supply peaks in consumer Grid demand

There is some discussion of using curtailed RE for hydrogen production in Section A5 page 34. Figure 10 on page shows RE curtailment for 5GW nuclear scenarios (ie no new nuclear) in the '5g/kWh, high demand, WITH hydrogen' scenarios ranging from 103 to 297 TWh/y (ranging from 20 to 90 TWh/y more curtailment than in 10 GW nuclear scenarios). For scenarios below 5g/kWh sector emissions the additional RE curtailment (between 5 and 10 GW nuclear) would rise proportionally more and there is a case for the electricity sector to be carbon-negative to achieve UK net-zero by 2050. The additional excesses of RE electricity could also be used for GGR carbon-reducing schemes (DACCUS) to lower sector emissions even further (below nuclear scenarios).

BEIS essentially says in the Modelling 2050 report in **Section 5 'Conclusions /Next Steps'** (page 25) that it has '*NOT presented any analysis on the production of hydrogen by electrolysis*' ie above the 20 TWh/y electricity selected (which would require around 40 TWh/y H2 thermal energy). It goes on to state that : '*However, if the economics of hydrogen production more generally favoured electrolysis then higher volumes could be demanded from the power sector which could in turn impact the relative cost of different generation mixes (see figure A6).*'

Essentially BEIS itself is indicating that its 2050 DDM modelling analysis and current outcomes could change significantly if or as it further models RE curtailment and Green hydrogen production in its 'Next Steps'. The inclusion of bioenergy, particularly with CCS ie BECCS, would also significantly impact all scenario modelling, further displacing higher emission NG+CCUS dispatchable electricity. The inclusion of biomass probably benefits RE+CCUS scenarios relatively more than in new nuclear scenarios because bio-derived electricity is dispatchable and biomass can be stored at scale avoiding the need to construct additional large-scale hydrogen storage eg sub-sea caverns.

In summary (2D and 4A)

BEIS needs at least to update its DDM model in light of its very recent Hydrogen Strategy and the forthcoming Biomass Strategy before HMG makes multi-billion pound decisions on a SZC project. Even HMG's December 2020 Energy White Paper is already looking dated not least because it is heavily informed by the BEIS 'Modelling 2050' DDM analysis. The DDM updates, which are likely to result in significant changes in scenario outcomes, give weight or not to policies EN1 and EN6 and have implications for Habitat's Directive (ie IROPI) regarding a SZC project.

Updated scenarios should include : full use of otherwise curtailed RE electricity for Green hydrogen production and GGR (DACCU) emission-reductions; synthetic fuel production; and bio-energy with CCS (BECCUS). The modelling of such advanced net-zero or negative energy technologies befits a technologically leading nation.