Comment on ExQ1-Q1.2.3. 40-year lifetime

The government recognises that NSIP solar farm applications are being submitted with an operational time limit [NPS EN-3 20.10.65]:

An upper limit of 40 years is typical, although applicants may seek consent without a time-period or for differing time-periods of operation.

It is not obvious why a solar farm would seek to have a fixed lifespan. A nuclear plant is a 'lifed' item because of the effects of neutron absorption and fission product decay. After time, the fabric poses a contamination risk and is decommissioned.

A solar farm, on the other hand, is well suited to evolution as technology advances. For example, in twenty years' time BOOM might well conclude that there is a business case for replacing the PV panels with more efficient units.

Apart from a speculative guarantee from the panel manufacturer, there is no intrinsic lifespan to a solar farm.

Previous government administrations have not slapped an order on this region requiring it to remain farmland for 40 years. Hence this examination is possible.
We, in turn, must allow future generations to make their judgements as to the best use of this land. They may wish to extend solar to 100 years; they may be faced with an urgent need for food production after 20; the owner may decide the farm is no longer viable.

Either way, we must let future decisions rest with future generations.

Comment on ExQ1-Q1.4.1. Electricity storage

Background

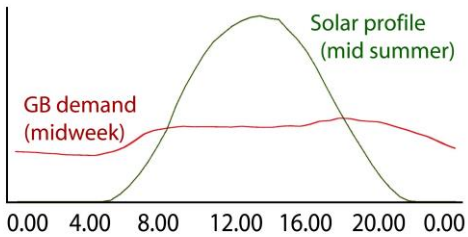
EN-1 (2024) draws attention to the need for electricity storage for solar PV. This will have come as no surprise to the 1.3 million[1] owners of domestic PV installations: up to half the cost of a rooftop PV installation is the battery. The battery stores the surplus solar energy (predominantly around midday) and redistributes across the 24 hours of the day as required.

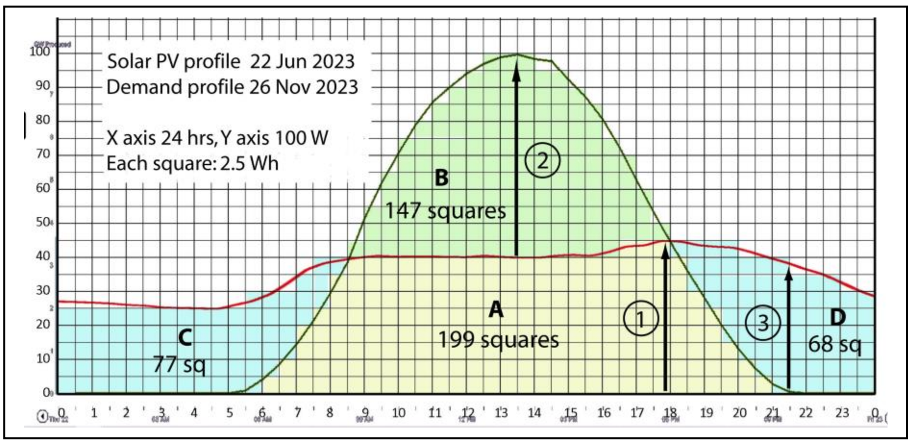
Grid-connected solar farms have no battery and operate under a different regime, thanks principally to natural gas electricity generators. Gas plants operate over a wide output range and are highly responsive (readily turned up and down). As the solar power comes online in the morning, the gas generation output is gradually reduced; this process is reversed in the afternoon.

As fossil fuels are phased out, this complementary regime too will phase out. In ten years' time, there will be no fossil-fuelled electricity generation to turn down. Grid solar will have to be coupled to battery storage, just as for the rooftop PV, in order to provide useable energy to the grid.

Battery capacity

Fortunately, this is easy to work out if you remember A Level Physics. Copy power profiles of maximum solar output (June) and grid demand from one of the websites that show graphical representations of published data. Superimpose the graphs and scale them such that they have equal area under the curves (= energy).





1 https://assets.publishing.service.gov.uk/media/6655a939d470e3279dd3328b/Solar_photovoltaics_deployment_April_2024.xlsx

In the bottom graph, the y-axis (power) is arbitrary assigned to 100 W, and hence each square on the paper represents 2.5 Wh. Area **A** is solar energy that can be fed directly to the grid, while surplus **B** is stored in the battery for subsequent discharge to **C** and **D**.

Measuring off the graph, the required battery capacity **B** (= **C**+**D**) is 367.5 Wh.

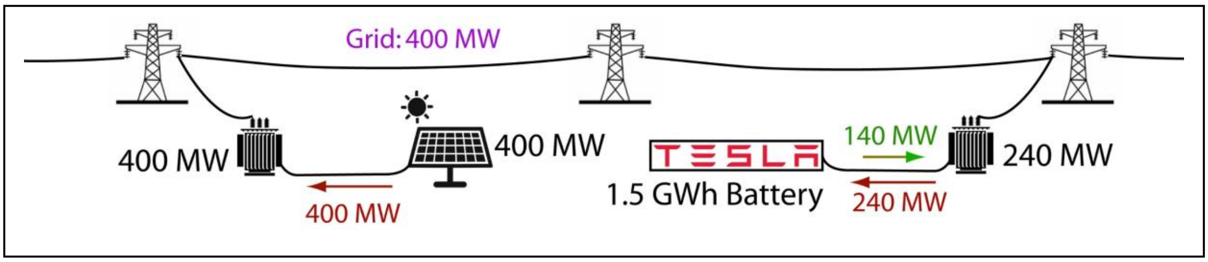
Scaling up to a 400 MW PV system (measured at inverter output), this represents a battery capacity of 1470 MWh (1.47 GWh).

This is a theoretical value, of course. You may want to increase it to avoid running lithium cells above 90% or below 10%. You may want to decrease it on economic grounds, as for undersized inverters. Tracker systems of the same installed capacity produce lower peak power but a broader power profile, so a slightly smaller battery will suffice.

A 1470 MW Tesla Megapack will set you back $524m (Dec 2023 prices).[2]

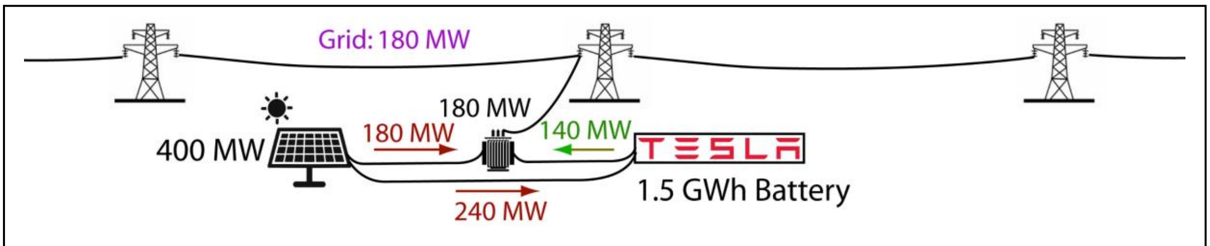
Battery location

Reading off the graph again and scaling up for a 400 MW system, the peak charge rate (arrow ②) is 240 MW and the peak discharge rate (③) is 140 MW. For an installation with a remotely located battery, the system design looks like this:



The full 400 MW from the solar array/inverters is sent to the grid via a 400 MVA transformer. The battery substation requires a 240 MVA transformer (max charge rate).

The design is a lot simpler when the battery and solar array are co-located:



The peak output power is now 180 MW (① in the graph), so a single 180 MVA transformer is all that is required. More significantly, you can give the overstretched National Grid the good news that you now need only 180 MW grid entry capacity.

Again, this is theoretical. I think the Megapack needs 480V 3ϕ interfacing, so there's another transformer.

[2] The Megapack website no longer shows pricing. Other battery manufacturers are available (and cheaper).

Observations

According to published data, daily energy yield in December is around 5% of what it is in June (0% if snow settles on the panels). Solar power is predominantly a summer activity. In winter the battery can be for marginal grid support by trading in the wholesale energy market. A comparable grid exit capacity contract will be required.

Unlike grid frequency stability batteries, charge/discharge rate (MW)) specifications for solar batteries are not important. They are on a 24-hour cycle. Nevertheless, of the minority NSIP pipeline proposals that include a battery, the typical specification is 200 MW, which is both too small and the wrong units. Sunnica alone went with 2.4 GWh.

For compatibility with the government's 2035 energy targets and beyond, a battery is the central component of a solar farm installation. However, they are expensive. A solar farm without a battery will produce excellent performance figures for a few years.

Comment on Q1.4.2 – Single Axis Tracker (SAT) configuration

<u>Q1.4.2(b)</u> Mixed FSF/SAT. This option in the Statement of Need is probably moot. ES-The Scheme [Table 2-1] specifies just SAT, and ES-Alternatives [3.9.6-7] states that FSF was discounted prior to the Statutory Consultation (May 2023). Although the Statement of Need was published in Nov 2023, it was presumably written earlier.

<u>Q1.4.2(a)</u> The use of SAT in UK utility-scale solar will be unique. Is this a bold decision or a risky one? Has everyone else in the UK got it wrong?

Whereas conventional fixed south-facing (FSF) panels only generate maximum output at midday (when they face directly at the sun, and the sun has maximum irradiance), SAT follows the sun to increase output at lower sun elevations.

This is ideal near the equator – the panels face directly at the sun throughout the hours of daylight. But as you move further north or south, this geometrical advantage diminishes – the panels are facing vertically up at midday, but the sun is not directly overhead. It may still be effective in Australia (35°S), but Yorkshire is at 54°N. Surely the minimal advantage at dawn and dusk is cancelled out by the reduced output at midday?

BOOM will have used one of the simulator packages created for utility solar designers, in order to compare the power profiles of different configurations. (RatedPower looks like the popular one.) Can they show some print-outs and yields to back up their decision? The free on-line ones suggest no more that 2% energy difference between SAT and FSF at 54°N. The Statement of Need [APP/7.1, 6.5.12a] says that *SAT requires more land per MW(p) but has the potential to generate more MWh/MW(p) than FSF*. Where's the data?

The Scoping Report [ES Appendix 1-1] refers to an Australian solar farm with SAT operated by the applicant's parent company. Which farm? Which parent? Is there any data yet on how this is performing?

The overwhelming attraction of solar PV as an energy source is that it has no moving parts, and hence requires virtually nil maintenance for decades, apart from the occasional wash.

The overwhelming disadvantage of SAT is that it presumably uses hundreds of motors and sensors, thousands of bearings, miles of additional electrical cables and a central control station, all of which have failure rates. Will BOOM be purchasing a 40-year inventory of spare parts?

It is difficult to comprehend that a marginal (if any) difference in energy yield can justify the monumental additional complexity.

Supplementary related questions:

Why is BOOM intending to clean the panels using a tractor with the trackers in the horizontal position [Framework Operational, APP/7.8, 2.6.3]? I occasionally wash my car and I can report that the roof is impossible to wash off without a hose. Surely, tilt them over like the Google pictures of other PV-cleaning tractors show. Has this been thought through?

If the ExA is querying content in the Statement of Need, could its author (Humbeat Ltd) be asked for an opinion on the wisdom of solar farms in the UK? He – Humbeat Ltd is Mr Simon Gillett[1] – has contributed enthusiastic Statements of Need to numerous (all?) solar NSIP applications, yet his website expresses the opposing view.[2] 'Power system fundamentals'[3] is a worthwhile introduction to the issues of power generation, but it reports that North-West Europe has "low solar generating potential" (page 9).
The article is a few years old: recent developments in the UK solar sector may have effected a change of opinion.

[1] Gillett has university degrees in both Mathematics and Nuclear Power Safety, he tells us in every submission.
[2] Credit to the Cottam (et al.) action group 7000Acres for drawing attention to this anomaly.
[3] https://www.humbeat.uk/home/resources/

Comment on ExQ1-Q3.0.7. Climate Change – Annual energy yield

ES Climate Change quotes 922 kWh/kWp/yr as both the minimum yield [6.4.5] and the typical yield [6.7.30]

A more meaningful expression of the units would have been kWh/yr/kWp, because they are describing annual energy (kWh/yr) per kWp of PV panel.

For comparison, the government publishes measured solar PV Load Factors[1]. The most recent available value is 11.4% for 2022 (excluding PV connected during 2022). The figure is based on Installed Capacity, but includes some estimates so may not be entirely accurate. Many UK solar farms are several years old now, so the newer ones should actually have higher LF figures. All (?) use fixed south-facing panels.

11.4% equates to 999 kWh/yr per kW installed. (24 x 365 x 11.4%)

[1] https://assets.publishing.service.gov.uk/media/64c132501e10bf000e17cf7f/DUKES_6.3.xlsx

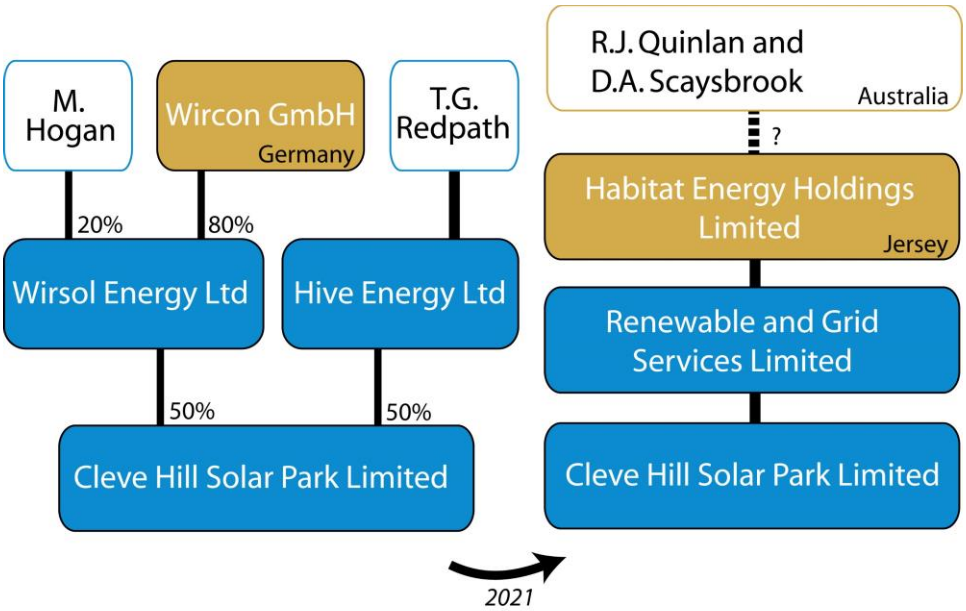
Comment on ExQ1-Q5.0.10. Arts. 35 and 47 – Transfer of the Order

I share the ExA's confusion over the need for this provision, and in particular the reason for dispensing with the Secretary of State's authorisation in the exceptions to Art. **35**(3).

Companies are routinely transferred within a hierarchical structure (holding company, subsidiary etc). Because the DCO remains with the company "East Yorkshire Solar Farm Limited," the issue of a 'transferee' does not arise. Indeed, the company may be sold to any other parent company, UK- or foreign-registered, without requiring an explicit transfer of the DCO benefits.

The transfer issue arises, it would seem, if a parent company wants to convert a UK entity into a foreign-registered entity, such as "East Yorkshire Solar Farm GmbH." This would require a DCO transfer. But this is not what happens in practice. Foreign companies register a UK holding company (e.g. "ABC UK Holdco Ltd") and place their UK assets under this.

Cleve Hill is a good example. Its DCO was awarded in 2020. The following year Wirsol and Hive sold the company (with DCO) to Quinbrook. Cleve Hill Solar Park Limited retains its name, UK company status and DCO. It is owned via UK and offshore holding companies.



The small print

The ancestry of the East Yorkshire DCO can be traced back to Cleve Hill.[1] They have similar transfer articles (**35** and **5**, respectively) and use "undertaker" throughout the DCOs as the authorised exerciser of the DCO powers.

What looks like a slip-up probably renders the earlier transfer provision unenforceable:

"undertaker" means Cleve Hill Solar Park Limited (company number 08904850);

Pinsent Masons have corrected this:

"undertaker" means East Yorkshire Solar Farm Limited (company number 14103404) and any other person[2] who for the time being has the benefit of this Order in accordance with article 34 (benefit of the Order) or article 35 (consent to transfer the benefit of the Order);

Recommendation

Whether the transfer provision adds any value to a DCO is debatable. The ExA should draw the attention of the SoS to the article and let him/her decide if exclusion of the Whitehall veto is desirable. The SoS might wish to consult a legal practice that specialises in company law.

---

[1] via West Burton, based on the multiple (now deleted) DCO references to the river Trent.

[2] Curious use of language: is East Yorkshire SFL a "person" in legal parlance? And, shouldn't "benefit" and "consent" in the parentheses be "Benefit" and "Consent"? If Pinsent Masons reads through the DCO with a little more care, it will find (at least) one further stipulation that neuters the transfer mechanism.

Comment on ExQ1-Q5.1.4. Sched. 2 R18 – Funding of Decommissioning

The Framework Decommissioning Management Plan [APP/7.9] is understandably noncommittal:

The specific method of decommissioning the Scheme at the end of its operational life is uncertain at present as the engineering approaches to decommissioning will evolve over the operational life of the Scheme. [2.1.3]

There is no suggestion as to how this will be funded. We have to assume that in the closing years, profits will be diverted into a Decommissioning Account. Hopefully, BOOM's grandchildren will inherit the commitment to responsible governance.

But this is far from certain. Indeed, a subsequent owner might resort to the traditional business model of selling off everything that is not nailed down and filing for insolvency, leaving the council to clean up the mess.

Furthermore, there is no guarantee that East Yorkshire Solar Farm will remain viable for 40 years. It may be forced into receivership prematurely.

The solicitor observed at ISH1 that laws exist to protect against misuse of funds. True. But if the money's gone – as is often the case – it's gone.

Other infrastructure (most notably nuclear power stations) include a decommissioning fund from day one for this purpose. The holding of deposits in landlord–tenant contracts has the same function. A similar plan for solar farms would be appropriate.

The capital held in reserve could be reviewed periodically at the Applicant's or SoS's request.

The Applicant should compile an itemised list of decommissioning expenses for ExA approval. BOOM's current intention of sending the PV panels for recycling is commendable, but for the purposes of costing, landfill estimates should be permitted. (Recycling of 20,000 tons (?) of PV is probably not currently possible and likely prohibitively expensive.)