Application by Photovolt Development Partners (PVDP) on behalf of SolarFive Ltd for an Order Granting Development Consent for the Botley West Solar Farm project.

Written summary of oral submission given at the Hearings during the week commencing 12th May 2025.

Date Wednesday 14th May, Open Floor Hearing 2 (OFH2).

Name of speaker: David Rogers

I speak as a private citizen and also as a representative of a small community group of citizen scientists, SolarQ UK.

A colleague of mine – a physicist – once said that 'nothing moves faster than a bandwagon in a vacuum'. In the present instance, the vacuum is the Government's Net Zero policy and the bandwagon includes all companies involved in what has been called a 'Wild West' solar 'gold-rush', of which BWSF is one example.

Planning Inspectorate inquiries look at process rather than outcome, but I would like to push back briefly on 'outcome' because this part of the inquiry seems to be the only chance for members of the public to express their concerns over the possible outcome of this Inquiry and I would ask the Planning Inspectors to consider whether the planning gain here is worth the obvious pain that such a development would cause to a large part of rural Oxfordshire.

Consider a thought experiment in which nine square kilometres of Oxfordshire is covered with glass and steel solar panels for the next 40 years (the BWSF proposal). Under Option 1, that solar array produces its stated output of electricity, 840MWe, continuously, i.e. for 24/7. Under option 2, it produces nothing at all. In that thought experiment we have the same 'pain' in both cases (9sq. kms of Oxfordshire covered by solar panels), but very different 'gains'. Obviously, we would all prefer Option 1. In fact, in the UK, Option 2 is very much nearer the mark. At our latitudes, solar PV arrays produce their stated output for only *c.*11% of the time – or about 2.6 hours per day. This is called the 'Load Factor' and is documented for all UK renewable energy sources over at least the last decade by the Government's periodically updated Digest of UK Energy Statistics (DUKES)[1].

The developers claim that the BWSF solar installation, with an installed capacity of between 1200 and 1375MW (i.e. the 'number on the side of the tin'; the final installed capacity is yet to be decided within this range), will deliver 840MWe of 'clean electricity' to the grid. No solar farm without battery storage can ever deliver a fixed amount of electricity, continuously to the grid; thus, giving a fixed number for a solar farm output, such as '840MWe', is meaningless.

In fact, BWSF will never, ever deliver 840MWe of energy to the grid, even during the brightest day in an English Summer.

The European Commission's PhotoVoltaic Geographical Information System (EU PVGIS)[2] is a website into which one can put characteristics of any solar installation (geographical location, total capacity, type and angle of solar panels etc.) and get predictions of the amount of solar electricity produced by hour and month. The EU PVGIS allows two possible predictions. First is an estimate of the whole-system kWhours output for each month of the year, based on long-term monthly average irradiance values (watts/sq. m., the energy from the sun at ground level). The second is an estimate of irradiance (watts/sq.m.) for each hour of each day from January 2005 to December 2020. Using information from the first option that allows us to calculate solar PV efficiency (turning watts/sq. m.

[1] https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[2] [redacted] Accessed in June 2023, the input BWSF characteristics were: latitude 51.813, longitude -1.357 degrees; radiation database PVGIS-SARAH2 (the default); PV system capacity 1307000 kW (i.e. 1307MW); system losses 14% (the default); fixed slope of modules 15 degrees; orientation (azimuth) of modules 0 degrees (i.e facing due South). Non-default figures are from the BWSF website or Google maps (for latitude/longitude).

irradiance to watts/sq. m. electricity), it is possible to turn the second long-term time series of irradiance into a long-term time series of electricity produced by hour, day and year from 2005 to 2020; these figures can then be averaged to give figures for each hour of an average month over that period[3]. We would expect the predictions by the two methods to be similar, but not identical.

Each of the EU PVGIS's hourly/monthly predictions can be added up to estimate the total amount of electricity (kWh or MWh or GWh) generated per year, for comparison with the developer's own figure for the annual output from Botley West, which is 1,256,539,474kWh (a figure derived without much explanation on the BWSF website[4]) which, it is claimed, will power 336,784 households at the current annual household consumption of 3,731 kWh per year.

The EU PVGIS system calculates a total output per year of 1,239,633,833kWh p.a. using the first method and 1,244,618,927kWh p.a. using the second, figures that are 98.7% and 99.1% of the BWSF figure. The EU PVGIS figures are independently derived, using what appears to be a completely different method from BWSF, but are remarkably similar to the developer's own figure. It follows that the hourly figures of electricity predicted by the EU PVGIS system must be very nearly the correct ones (otherwise their annual totals would not match BWSF's).

Table 1 shows the EU PVGIS figures in kWhours for each hour/month of the year and Figure 1 shows them by hour during an average day in July (red line) – the month of maximum output - and December (dark blue line) – the month of minimum output. The peak outputs in Fig. 1 are highlighted in red in Table 1, i.e. 627.4MW at mid-day in July and 217.0MW at mid-day in December.

Table 1. Output from BWSF predicted by the EU PVGIS facility by hour and month of the year. The totals at the bottom of each month column (i.e. total output per day in that month) contribute to the weighted yearly total shown in red, 1,244,618,927 (weights are the days in each month of the year; thus 31 for January, 28 for February, and so on), for comparison with the BWSF developer's estimate of 1,256,539,474kWh. The EU PVGIS predicted annual output is 99.05% of BWSF's own figure.

EU PV GIS system	Prefdicted BWSF power output at EU efficiency, kWper hour (N.B. none exceeds 840MW (840,000kw), the claimed output from BWSF)												
16.55364801	Time of Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.1655	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	1,828	35,418	55,001	40,161	7,795	0	0	0	0
	6	0	0	1,071	67,293	133,683	156,260	143,160	85,869	24,857	0	0	0
	7	0	0	68,130	196,330	257,135	286,201	270,852	205,627	139,039	48,051	0	0
	8	0	65,535	193,890	330,266	389,164	414,184	400,585	328,230	270,818	162,674	56,367	0
	9	95,834	169,997	305,767	459,809	493,928	511,921	506,070	435,872	373,447	241,633	148,709	81,894
	10	168,695	239,477	393,540	530,348	530,824	565,939	557,328	491,631	460,504	322,478	219,869	157,329
	11	215,118	284,231	442,095	587,048	593,189	601,771	610,356	517,107	492,208	347,226	265,835	210,314
	12	235,762	278,836	421,161	580,000	597,793	617,194	627,430	541,491	493,170	339,873	264,562	217,037
	13	211,303	295,654	429,604	556,089	559,991	584,385	606,706	522,738	471,881	316,910	235,979	187,479
	14	165,404	240,144	377,410	494,582	511,654	546,534	568,975	464,632	399,787	259,752	169,392	128,188
	15	102,691	187,514	312,932	417,235	448,706	480,230	505,531	429,606	343,125	195,920	104,005	55,238
	16	6,957	100,410	207,029	301,827	337,071	371,833	389,577	319,313	228,012	94,346	2,156	0
	17	0	3,190	85,708	170,996	217,229	252,745	259,274	194,457	100,042	4,226	0	0
	18	0	0	1,103	48,818	101,660	135,508	136,661	82,557	8,291	0	0	0
	19	0	0	0	0	18,512	41,608	37,284	8,435	0	0	0	0
	20	0	0	0	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0	0	0	0
	23	0	0	0	0	0	0	0	0	0	0	0	0
Yearly total , kWh	1,244,618,927	1,201,763	1,864,989	3,239,440	4,742,467	5,225,956	5,621,314	5,659,950	4,635,361	3,805,180	2,333,088	1,466,873	1,037,480
Hours per day		0.92	1.43	2.48	3.63	4.00	4.30	4.33	3.55	2.91	1.79	1.12	0.79
Load Factor		3.8%	5.9%	10.3%	15.1%	16.7%	17.9%	18.0%	14.8%	12.1%	7.4%	4.7%	3.3%
BWSF output, kWh	1,256,539,474												
EU PVGIS/BWSF estimate	0.9905												

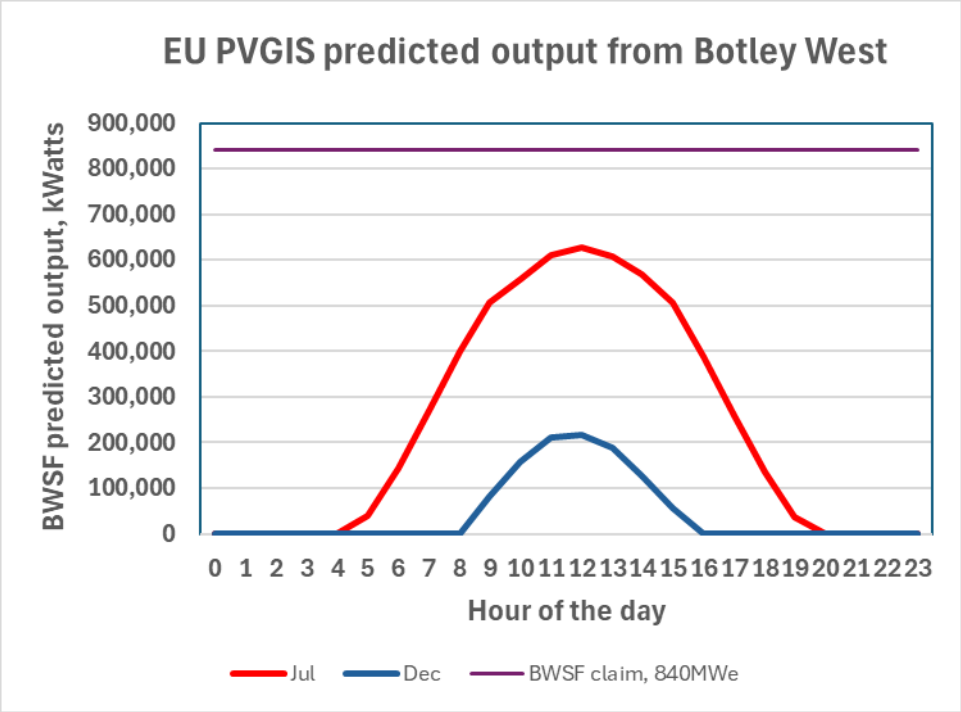
Figure 1 also includes a line showing the 840MWe output claimed by the developers. Obviously, it does not apply throughout the 24-hour day, but the actual output never even approaches this figure, even at the height of Summer.

[3] Details of the calculations involved are available in a SolarQ document available at https://www.solarq.org/supdemanalysis

[4] [redacted] In the FAQs select 'How did we calculate these numbers?'

The two last full rows of figures in Table 1, 'Hours per day' and 'Load Factor' give the number of hours-equivalent that the installation is working at its stated capacity and the Load Factor (i.e. hours per day/24, expressed as a percent). The average Load Factor throughout the year is 10.8% (i.e almost identical to the DUKES 2013-2023 long-term average figure of 10.6%) but Table 1 clearly shows the very poor performance in Winter, with Load Factors as low as 3.3%. Is all that pain worth so little gain, especially in Winter, when household energy needs are at their maximum?

Fig. 1. Hourly generation of electricity predicted for BWSF by the EU PVGIS facility for July (red) and December (dark blue). The BWSF developer's estimate (840MW) is shown for comparison, although will of course vary during the 24-hr cycle. But the actual output will never reach this figure, even at mid-day in July. Details – all hours of each month – are given in Table 1.



The total outputs claimed by the developers and estimated by the EU PVGIS facility are effectively the same, but the output from BWSF will go across the entire UK and cannot be restricted to, or imagined providing all the energy for, a specified number of houses. Those houses need electricity 24/7 and cannot be provided with all their needs by a solar PV facility without any battery storage. Claiming that the BWSF output will provide all the electricity needs of 336,784 households is again therefore disingenuous, as is the comparison of that number with the total number of households within the county, 288,000 in the 2021 census, implying, without actually claiming, that BWSF will provide all of Oxfordshire's household's electricity needs, or the 'equivalent' of those needs. It clearly cannot, and SolarQ's calculations show that less than half of the immediate needs of BWSF's 'target' of 336,784 households could be met by the output of the proposed BWSF. The remainder is met by generators elsewhere, while the periodic excess (for example near mid-day in Summer) of BWSF's electricity supply over those same households' immediate demands is exported across the national grid to be used elsewhere. Oxfordshire suffers all of the planning pain of BWSF but experiences very few of the planning gains of locally produced electricity that is, in fact, distributed nationally.

In the 'Supplementary Statement of Need' (PDB-014), dated May 2025, the developers point out that the draft updated NPS EN-3 states

"Solar energy is at the heart of our Clean Power 2030 Mission …"

It does indeed, but the same document[5] also states the ambition to triple both offshore wind (from 15GW in 2023 to 43-50GW by 2030) and onshore solar (from 15GW in 2023 to 45-47GW by 2030). Given that 1GW of offshore wind generates as much electricity as c. 4GW of solar PV (because the former's load factor is almost four times the latter's), it is clear where the emphasis lies – in offshore wind, not solar PV. The previous Government's ten-point plan for a green industrial revolution also emphasised wind almost to the exclusion of solar[6]. The word 'wind' appears 29 times in the 10-point plan document but 'solar' only once.

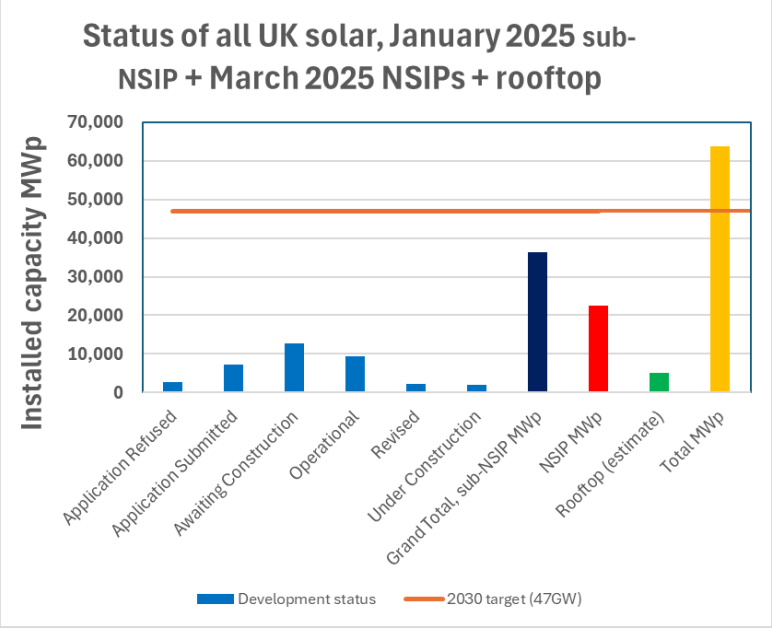
During the Inquiry to date, no-one has asked how near are we to achieving any of our renewable targets? The commonly held belief is that we have a very long way to go; thus installations like BWSF are essential to speed up progress towards these Net Zero targets. But if we are already near those targets, do we really need BWSF?

SolarQ's analysis has shown that we have already exceeded the 2030 solar targets at both the national and county-levels, and by quite a margin.

National targets exceeded

The January 2025 version of the Department for Energy Security and Net Zero's (DESNZ's) Renewable Energy Planning Database (REPD)[7] shows that there is a total of 36.24GW of ground-mounted solar PV of <50MW capacity (i.e. 'sub-NSIP' size) at various stages of viable development. Here, 'viable' means 'Application Refused' (2.8GW) (which might go to appeal), 'Revised' (2.3GW), 'Application Submitted' (7.2GW), 'Awaiting Construction' (12.7GW), 'Under Construction' (1.9GW) and 'Operational' (9.3GW). In addition, there is a total of 22.5GW of ground-mounted NSIP-scale solar at various stages of the planning process, and approximately 5GW of rooftop solar, making a grand total of 63.75GW of solar PV against a CP 2030 maximum target of 47GW. We are already 36% in excess of our 2030 solar PV target nationally (Fig. 2).

Fig. 2. Capacity of UK solar PV, January to March 2025 from the REPD (sub-NSIP data) and SolarQ's database of NSIP installations. The various developmental stages of sub-NSIP installations are shown to the left in blue histograms, their total as the dark blue histogram. The NSIP proposals are shown in red. The green histogram is an estimate of the nation-wide rooftop installations. The final yellow histogram is the sum of all three types and exceeds by a wide margin the national Clean Power 2030 target of 47GW, shown as the thin red line.



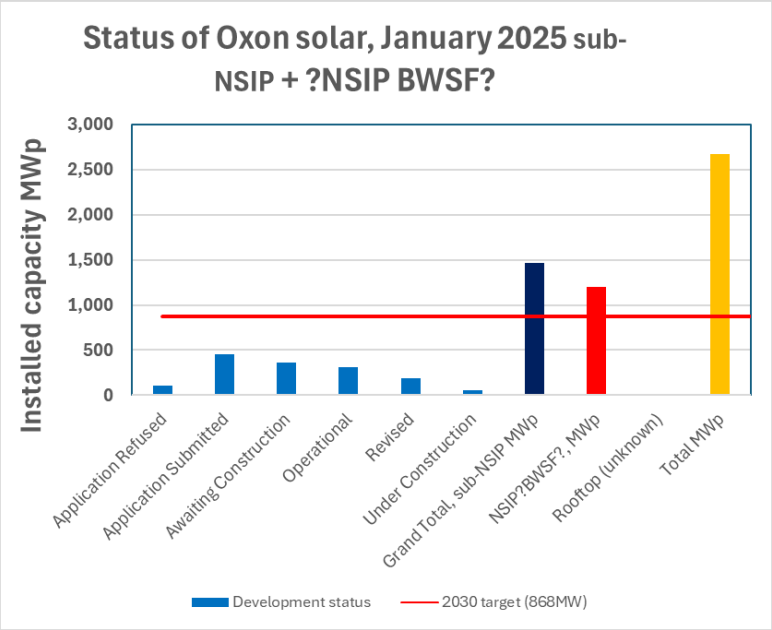
[redacted]

[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf
[7] https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

Local targets exceeded

All of the Oxfordshire Local Authorities have signed up to the solar targets set for the county in the 2021 Pathways to a Zero Carbon Oxfordshire (PAZCO) report[8] by the Environmental Change Institute in the University of Oxford. This report identifies a need for 728 – 868MW of solar capacity within-county by 2030. In the same edition of the REPD (see above), Oxfordshire in January 2025 had a total of 1469.3MW of sub-NSIP ground-mounted solar capacity at various stages of viable development (totals of 106MW, 188MW, 451MW, 359MW, 56MW and 310MW in the same categories as the national figures above, respectively). Thus only 21% (310/1469) of Oxfordshire's solar capacity is currently operational but there is a great deal more in the 'pipeline' that will be built out by 2030. Oxfordshire's ground-mounted solar therefore already exceeds its own 2030 target by a minimum of 69% (1469MW/the maximum PAZCO target of 868MW) without Botley West at all! Adding in the total capacity of Botley West (and taking the lower, conservative figure, of 1200MW capacity for it) would take Oxon's ground-mounted solar capacity to 2,669MW, or 307% of PAZCO's upper target of 868MW (Fig. 3). Roof-mounted solar was excluded from that comparison but would obviously increase the 'over-capacity' of Oxon's solar still further.

Fig. 3. Capacity of Oxon solar PV, January 2025 from the REPD (sub-NSIP data) and the possible BWSF NSIP installation. The various developmental stages of sub-NSIP installations are shown to the left in blue histograms, their total as the dark blue histogram. The BWSF proposal is shown in red. There is no estimate of rooftop solar in Oxfordshire at present. The final yellow histogram is the sum of the sub-NSIP installations and the BWSF proposal. Even the sub-NSIP installations alone exceed by a wide margin Oxfordshire's PAZCO target of 728-868MW of solar by 2030, the upper target (868MW) shown as the thin red line. Adding BWSF would make the total exceed the target more than three-fold.



The dangers of solar over-capacity at both national and local levels are highlighted in Varun Sivaram's book *'Taming the Sun'.* There is the possibility of 'too much' solar, all producing maximum electricity at more or less the same time of day, when domestic day-time needs are at their lowest value (near mid-day), and then all falling to zero towards the end of the afternoon just as domestic demand begins to rise towards a peak in mid-evening. Bringing in other supplies as solar activity falls in the afternoon creates difficult balancing problems for the network operator. The more solar, the greater the mid-day peak, the larger the afternoon fall in electricity generated and therefore the greater the sudden demand on any balancing supply. Fluctuating supply from solar and demand from

[redacted]

households threatens system stability and can lead to the sorts of blackouts that occurred over parts of Europe earlier this year.

We simply cannot go on adding solar capacity without limit. We have Net Zero targets, both nationally and locally, but without a roadmap of any sort to reach them.

Aiming for any Net Zero targets beyond 2030 seems pointless until we have sorted out our near-term targets. Renewable technology is changing rapidly, and new solutions will become available for longer term goals.

There would therefore seem to be very little gain – both nationally and locally – to the development of BWSF.

Referring back to the start, the 'Wild West' rush to solar in the UK is neither planned not balanced. Solar installations are being put up more or less at random, where a willing landowner meets a solar developer; not where, spatially, they would serve the country best, because there is, at present, no spatial plan of any sort for land-based renewables in the UK.

In determining the planning balance, and whether or not the 'exceptional circumstances' of Net Zero over-ride Green Belt protection or the preservation of productive farmland in our rural landscape, I would ask the Inspectorate to consider the cumulative impact of sub-NSIP and NSIP scale solar both nationally and locally. If the proposed Botley West Solar Farm is approved, it would contribute to nationwide over-shoot of the 2030 Net Zero targets (Fig. 2) and result in more than three times over-capacity of Oxfordshire's own renewable target (Fig. 3).

Is the planning gain really worth the planning pain so clearly expressed to you by members of the public who have been allowed to speak in these Hearings?

Professor David J. Rogers MA, D.Phil. (Oxon)

04/06/25