Cassington Parish Council Response to the Botley West Utility Scale Solar Power Station

Response to the Photovolt Development Partners Pre-Planning Community Consultation Leaflet

Prof. Alex Rogers Ph.D., B.Sc.

Prof. Stewart Thompson Ph.D., B.Sc.

Graham Mills

Christopher Metcalf

Barbara King

Contact: cassingtonclerk@cassington-pc.gov.uk

The Need for Renewable Energy and the Nature of the Proposed Utility-Scale Solar Power Station in Oxfordshire

Climate change is one of two global emergencies on Earth being driven by human overconsumption of natural resources, the other being the biodiversity crisis. Average global surface temperatures have risen by approximately 1^{o}C, with some regions, such as the Arctic, suffering greater warming (IPCC, 2018). This is driving profound changes in natural ecosystems with negative impacts on both humankind and biodiversity (IPCC, 2018). Climate change is driven by a multiplicity of human drivers including the burning of fossil fuels, industrial activities (e.g. concrete production), agriculture and the degradation or destruction of natural ecosystems. The adoption of renewable energy is one measure amongst a wide range of actions necessary to address greenhouse gas emissions and global warming and other impacts, such as ocean acidification which arise because of them. The need for this energy transition is widely accepted and acknowledged by Cassington Village Parish Council.

The proposed development of an 840MW utility-scale solar power station in the largely rural landscape of west Oxfordshire is unprecedented in the UK. This would place this development in the top twenty largest solar power stations globally (Table 1). What is notable about the other utility scale solar power stations in the top 20 by size is that they are almost all located in desert or arid land which is characterised by high exposure to the sun, low rainfall and absence or low levels of other human activities such as agriculture. West Botley is one of only two utility-scale solar power stations that are sited on farmland, in this case good / moderate farmland (mostly Grade 3). We note that these figures are the best available at the present time and that the current pace of solar power stations proposed or being built is accelerating globally. We also note that many of the solar power stations listed cover much larger areas of land for a similar power generation potential than is noted in the Botley West Solar Farm Development (840 MW 1,400ha or 3,460 acres of land with 1,000ha or 2,471 acres of solar arrays). For example, the Copper Mountain Solar Facility requires

>1,600ha of land to generate 802 MW of energy. The Villanueva Solar Park generates 828 MW over an area of 2,750ha of desert.

Location	Size	Landscape
Bhadla Solar Park, India	2,700 MW	Desert
Longyangxia Dam Solar Park, China	2,400 MW	Desert
Huanghe Hydropower Hainan Solar Park, China (also known as Golmud Solar Park)	2,200 MW (given as 2,800 MW elsewhere)	Desert
Pavagada Solar Park, India	2,050 MW	Arid
Benban Solar Park	1,650 MW	Desert
Tengger Desert Solar Park, China	1,547 MW	Desert
Mohammed bin Rashid Al Maktoum Solar Park, United Arab Emirates	1,313 MW	Desert
NP Kunta Ultra Mega Solar Park, India	1,200 MW	Arid with approx. 40% under agriculture
Noor Abu Dhabi, United Arab Emirates	1,177 MW	Desert
Jinchuan Solar Park, China	1,030 MW	Desert
Danangouxiang Solar Park, China	1,020 MW	Semi desert
Kurnool Ultra Mega Solar Park, Andhra Pradesh, India	1,000 MW	Arid
Datong Solar Power Top Runner Base, China	1,000 MW	Uncertain (semi-arid?)
Yanchi Solar Park, China	1,000 MW	Desert
Delingha Solar Park, China	970 MW	Desert
Escatrón-Chiprana-Samper Solar Farm, Spain	850 MW	Arid
West Botley	840 MW	Arable farmland
Xuan Thien - Ea Sup 1, Vietnam	831 MW	Farmland
Villanueva PV Plant, Mexico	828 MW	Desert
Copper Mountain Solar Facility, USA	802 MW	Desert
Al Kharsaah solar power plant, Qatar	800 MW	Desert

Table 1. The world's largest solar power stations, data from https://largest.org/technology/solar-farms/ and https://en.wikipedia.org/wiki/List_of_photovoltaic_power_stations

The Botley West Solar Farm Community Consultation Leaflet distributed to homes in the vicinity of the proposed siting of the solar power station will generate an estimated 840 MW of energy. It is estimated that for every 5 megawatts (MW) installed, a solar farm will power 1,500 homes annually (based on an average annual consumption of 3,300 kWh of electricity per household according to Government Figures) and avoid emissions of 361,200 t CO_2 per annum or 14,448,000 t CO_2 over 40

years of maximum life of the installation. Roughly 25 acres of land is required for every 5 MW[1]. Therefore, by our calculations based on government figures for electricity consumption 840 MW will generate sufficient electricity for 250,000 homes.

We note several discrepancies between these figures and those delivered in the Botley West Solar Farm Phase One Community Consultation Leaflet:

- The land required for 840 MW we estimate is 4,200 acres, significantly more than stated by PVDP;
- CO_2 figures are for emissions avoided not carbon removed from the atmosphere as stated by PVDP. You have to divide a quantity of CO_2 by 3.67 to give a quantity of C (e.g. 1 tonne CO_2 = 272Kg of carbon);
- By our calculations PVDP has overestimated the number of houses the solar power station will provide electricity for by 80,000 households.

These discrepancies do not fill us with confidence in any figures provided by PVDP in the West Botley Solar Farm Community Consultation Leaflet.

Part of the justification for locating a utility-scale solar power station in rural Oxfordshire is because Oxfordshire is targeted for further investment in grid reinforcement and extension in response to the regions fast-growing economy. Another justification is that the solar power station will be close to grid connections. This point was also made by Dominic Hare from Blenheim Estates at the Cassington Parish Council Meeting on the 1st December, 2022, specifically that the main 400KVA cable route runs from the north of Oxford in close proximity to the proposed site. The implication of this statement was that electricity generation must be close to the grid and close to the site of use otherwise energy is wasted in transmission. This is presumably also part of the justification for stating in the Community Consultation leaflet that this power station will help meet Oxfordshire's transition to net-zero and could power every home in Oxfordshire. This contention was disputed by people at the meeting including representatives of District and the County Council. The point was made that with a national grid, electricity can be transmitted to most localities in the country at the speed of light with minimal losses in energy. In other words, it would be more realistic to state that the West Botley utility-scale power station would be supplying the grid and energy users nationwide, not locally. This would seem to undermine some of the implications/statements justifying the location of the solar power station in West Oxfordshire.

Further discussions at the Cassington Parish Council Meeting of the 1st December also pointed out that there may be issues with plugging into the grid at Botley, as substations may be unsuitable for the power station or do not have sufficient capacity. This is a problem which was raised during the planning process for the Noke Solar Array. Furthermore, obviously, solar power stations only generate electricity during daytime and when weather conditions are suitable (i.e. sufficient sunlight is being received). For this and other reasons, solar power is the least efficient of renewable energy sources (e.g. wind, hydro or tidal).

Alternative approaches to tackling climate change

Blenheim Estates have justified renting their land for the utility-scale solar power station as a necessary measure to avoid CO_2 emissions. We point out that allowing the land identified for the solar power station to return to grassland would sequester approximately 240 Kg carbon ha^{-1} (or 880.8 kg CO_2 ha^{-1}) per year (mean figure based on Ostle et al., 2009). If this figure is multiplied by

[1] According to figures at https://southhillcommunityenergy.coop/how-southill-solar-works

1,000 ha and then by 40 years the total carbon sequestered would total more than 35 million tonnes of CO_2, more than double the emissions avoided by placement of a solar power station on the land. Conversion to forest sequesters approximately 110 kg carbon ha^{-1} (or 403.7 kg CO_2 ha^{-1}) per year. Again, multiplying by 1,000 ha over 40 years yields over 16 million t CO_2, again exceeding the emissions avoided by the solar power station. Blenheim Estates would not earn rent with such schemes to sequester carbon which they will do by renting their land to PVDP.

It could be said that placing solar arrays over the land and allowing it to run to grass may give benefits through both solar energy and carbon sequestration via the land, but the solar park will be grazed by sheep or subject to other actions to control vegetation (see Biodiversity Impacts of Solar Farms below) and subject to changes in temperature and water supply which will mean it will not reach the potential of natural ecosystems or those managed to sequester carbon. Another alternative would be to adopt regenerative farming practices on land belonging to Blenheim Estates and Merton College. This also has significant potential to enhance carbon sequestration as well as many benefits for biodiversity, human health and overall sustainability of farming as well as earning rent via the tenured farms as happened in the past (see EASAC, 2022).

Questions

1. Cassington Parish Council would like to see a much more detailed appraisal of the specifications of the West Botley Solar Power Station showing how figures are derived for power generation, area of land required, including for associated infrastructure, what type of solar panels will be used (i.e. monocrystalline or polycrystalline silicon or thin film) and what the national contribution to energy will be.

2. We would also like to see a full Life Cycle Assessment (LCA) of the Botley West Solar Power Station including details of removal and waste handling once the 1,000 ha of solar arrays reach their end of life. Disposal of such a large number of solar panels is a significant consideration (e.g. whether they go to landfill, are exported overseas as e-waste or are recycled).

3. Given that 90% of the top 20 utility-scale solar power stations are located in deserts or arid regions in countries where high levels of solar irradiance are expected we would like to see justification for the adoption of such a scheme in the centre of a highly populated part of the UK on productive agricultural land. Why not invest in wind energy or another form of renewable energy which have a lower spatial footprint locally or in another geographic location?

4. We require more details of the suitability of the local grid and power substations to receive power from the West Botley utility-scale solar power station.

The Approach to Identifying Sites for Solar Energy Generation in Oxfordshire and the UK

The Community Consultation Leaflet for the West Botley Solar Farm states very clearly that access to the grid was a primary consideration for location of a utility-scale solar farm in southern England. This is at odds with an account of how the process of identification of the West Botley site was undertaken given by a representative of PVDP at the Cassington Village Consultation on the 25th November, 2022. Instead, it was stated that the process was initiated by PVDP sending land agents out across the south of England to identify large landowners who may be interested in offering their land for use for solar renewable energy. Schemes were then developed where land offered up was deemed as suitable for development of utility-scale solar power stations. Following planning consent

PVDP will go to “the city” to look for investors to invest in the scheme and presumably pay for the substantial infrastructure costs to build the power station. This appears to be a trawling exercise at a regional level to find private landowners willing to rent out their land for significant returns for solar energy. Should PVDP obtain planning consent for this or other utility-scale power stations there is no reason to believe they will not sell their interest in the development, making substantial financial gain for little risk. Such a land trawling exercise could be deemed as speculation, a situation which occurred in development of utility-scale solar power stations in the USA (Mulvaney, 2019).

Cassington Parish Council contends that such a trawling exercise is unlikely to come up with a coherent and strategically planned network of renewable energy generation in the south of England, a region already struggling with conflicting land use, high population density and inadequate transport and other infrastructure. Instead, a strategic assessment is required to identify:

- What renewable energy infrastructure is required in the UK including how much power generation is required, what type of renewable energy is appropriate (i.e. wind, solar, hydro, tidal, wave, other) and how it is best distributed via the grid?
- Given the above, this assessment should then determine where and how various types of renewable energy should be distributed given other societal needs
- After the above consideration can be given to what exact technologies can be applied so that they are sustainable and confer maximum benefit to the UK in terms of climate targets, economics, employment and other societal needs
- At a regional and local level, it would then be appropriate to tender for developers and landowners to cooperate with local authorities in delivery of a renewable energy solution for the UK

Such a top-down strategic approach would ensure that renewable energy development is sustainable with respect to society and the environment and delivers what is required through an appropriate national consultative process which is independent and equitable. This is almost the opposite to the process which has led to the West Botley utility-scale power station proposal which is based on private investors and landowners taking advantage of a national policy vacuum on renewable energy to place developments where it is convenient for them and with little consideration of the national situation in terms of renewable energy, other strategic needs for land as well as impacts on local communities.

Whilst we acknowledge that the current “investigative” approach to gauging opinion as to the acceptability of the solar farm has been adopted by the development proponents, this is an approach which we consider unsatisfactory. This development proposal will fall under both the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Regulations. As such, they should be applied from the outset of the plan-decision making process as it applies to this development. We note that “traditional” EIA, conducted at the individual project level, has proven unsatisfactory in dealing with the “bigger picture” impacts that developments of this scale generate. EIA has also failed to address cumulative impacts from multiple projects/developments and to protect the public interest. We therefore contend that the development should be considered at a more strategic higher-level, to guide policy-making and long-term planning by stakeholders in the renewable energy sector. SEA is now a well-established procedure that supports such plan-decision making, by ensuring that relevant alternatives are assessed that all environmental and social effects are evaluated and that stakeholder interests are balanced. With that in mind, we ask that the development proposal engages fully with the guidance available surrounding SEA and that, more importantly, it involves all relevant stakeholders (of which Parish Councils are one) in the

consultation process as soon as it commences, rather than their views being “bolted-on” after key debates and the decisions that emanate from them have taken place.

At a national level it is likely to be strategically more beneficial to develop other more efficient forms of renewable energy than solar power. Offshore wind is developing at great pace and legislation allowing development of terrestrial wind energy is being initiated. Tidal and wave energy offer the possibilities of continuous power generation. All of these are more efficient than solar energy, especially in a temperate country where the availability of sunlight is limited. Power transmission should not be an issue in supplying electricity to the grid from these forms of renewable energy. If we are to have solar power, then there are better ways to install solar arrays than via a massive utility-scale power station. For example, the German city of Freiberg is installing solar arrays on rooftops to generate large quantities of electricity taking advantage of Germany’s Electricity Feed-In laws (see https://www.greencitytimes.com/freiburg/). Why not install solar panels on all new build housing and existing non-listed buildings, including over car parks and other industrialised land across Oxfordshire? We suspect the answer to this question is that the large landowners involved in this scheme will not make significant financial gains.

Questions

5. Cassington Parish Council would like PVDP to confirm whether or not the process of land selection is as outlined by one of its representatives at the Cassington consultation meeting?

6. Do PVDP, Blenheim Estates and Merton College not agree that a better approach to development of national infrastructure in terms of utility-scale renewable energy plants would be through a strategic assessment and planning process which is consultative, independently carried out and equitable?

7. Other than land availability and statements about availability of the national grid (which are debatable in terms of their veracity have PVDP and the landowners considered the impacts and societal conflicts in locating the West Botley utility-scale power station in West Oxfordshire compared to other locations locally, regionally and nationally?

8. Can PVDP guarantee they will carry out the proposed development if it is approved through the planning process and not sell their interests as soon as permission is granted (if this were the case)?

Social justice

Cassington and the surrounding area has been occupied for at least 3000 years with evidence of Neolithic, Bronze Age, Saxon and Roman activities uncovered in archaeological investigations at Purwell Farm, Worton Farm, and even at the recent construction site of houses built by Blenheim Estates along the Cassington-Yarnton Road. The village was a part of a network of peasant farm villages in the area. Within its boundaries there is a Saxon Cemetery and much evidence of previous occupation. Despite the impacts of the building of the A40 and the extraction of gravel to the north and southeast of the village as well as new build, the centre of the village still retains much of its original character and old settlement pattern. This is why the centre of the village is designated as a Conservation Area with a high concentration of Grade 2 listed buildings including a 12th Century Church and significant boundary walls. The land around Cassington Village was subject to land enclosures over a period of several hundred years. The Inclosure Act of 1801 was particularly significant for the village when nearly 2000 acres of land were enclosed between 1801-1804, the great bulk of which went to the Duke of Marlborough (more than 1,300 acres), covering most of the land to the north and west of the village (Baggs et al. 1990). Blenheim set about a reorganisation of the roads, waterways and land surrounding the village following enclosure. The history of the land to

the north of Cassington is relevant because it is the seizing of land by the Duke of Marlborough through the morally questionable Enclosure act that has now placed Blenheim Estates as the dominant landowner to the north of Cassington.

West Oxfordshire is regarded as a special place which is highly valued by residents, and which should not be eroded by incremental decisions to accommodate local development (WODC, 2018 Para 1.2). Delivering new development that is needed to support economic growth that does not compromise the quality of life and the environment enjoyed by residents is therefore a key challenge (WODC, 2018 Para 1.2). Cassington is unusual in remaining a relatively small village close to Oxford. It is surrounded to the north, east and west by rapidly growing rural service centres including Eynsham, Woodstock, Long Hanborough (all West Oxfordshire District), Yarnton and Begbroke (Cherwell District). Significant major development has already taken place within the local area with the Eynsham / Cassington Ward being particularly targeted with the further expansion of Eynsham village to the west (approximately 1000 homes) on top of new estates built over the last 10 years to the east of the village and the plans for a further 2,200 homes in the Saltcross Garden Village lying on the northern side of the A40 opposite Eynsham, covering 531 acres of countryside with further options of expanding this development to the north. Woodstock has 300 homes currently being built and planning applications for a further 300 approved. Long Hanborough has new developments including 50 homes at Myrtle Farm, 25 at Oliver's Garage, 169 at Church Road, 120 at Hanborough Park, and 32 at Vanbrugh Meadows. North Leigh has also been subject to new development at Marlborough Gardens (50 houses), Shepherd's Walk (76 houses) and Bluebell Gardens (10 houses) and Freeland a further 41 houses at Oakland Grange. Cassington lies on the border of Cherwell District Council who are also considering controversial plans which include the loss of Green Belt land around Begbroke and Yarnton, fusing the villages and building approximately 4,400 new properties in the process. Further developments are in various stages of proposal or acceptance and the Local Plan is currently in revision. It may be the case that local developers are taking advantage of the current uncertainty over the Local Plan in pushing through additional windfall developments in the area.

These developments are materially relevant to the proposed West Botley utility-scale power station in several ways:

- Rapid development of rural centres and villages in the West Oxfordshire area is putting great pressure both on land, infrastructure and residents of the area. Without doubt this is already eroding the quality of life of residents through increased disturbance from traffic, pollution, access to amenities, availability of public transport and opportunity for exercise and experiencing the outdoors.

- Exposure to green space and the opportunity to exercise on locally available land have been demonstrated multiple times to have both physical and mental health benefits (e.g. Bowler et al., 2010; Shanahan et al., 2016; Cox et al., 2017). The main public rights of way used by the residents of Cassington village will be severely degraded in terms of their visual aspect, from one of open farmland to one of a largely artificial landscape dominated by solar panels.

- The aspect of open countryside currently enjoyed by residents of Cassington living on the north side of the village as well as residents of Jericho Farm will also be dominated by solar arrays, likely harming well being in terms of mental and physical health. Jericho Farm, in particular, will be almost completely surrounded by solar arrays running up closely to the boundaries of the properties there.

- The setting of Cassington, one of the few small villages in West Oxfordshire close to Oxford will turn from a largely rural aspect to one of being surrounded by industrialised land to the north (Mulvaney, 2019). This will have negative impacts on well-being for the majority of village residents.

We also note that in its pursuit of change in land use Blenheim Estates have, where they have been able, terminated the tenure of farmers on the land subject to the current proposal. This has caused great stress to some of the families involved and in one case has been suggested to have contributed to the death of one of the Parish's farmers (Cassington Parish Council Meeting, 1st December, 2022).

Overall, this builds a picture of an almost feudal approach to decision making on behalf of Blenheim Estates with little or no consideration of the enormous impact on health and well being of the proposed solar power station on the large number of people living on and adjacent to their land. It is a classic example of the "decide-announce-defend" approach undertaken by developers of utility-scale solar power stations elsewhere and is symptomatic of democratic deficit where local stakeholders are far removed from the decision-making process with respect to this development (Mulvaney, 2019). Given this project is of a scale that it is considered a national infrastructure project avoiding the usual local consultative planning process this democratic deficit is magnified.

This raises the prospect of compensation and/or benefits of the West Oxfordshire solar power station to those living in its vicinity. Whilst there is some mention of local employment, no details in terms of number or quality of jobs are given and there is no reason to believe there will not be extensive use of contractors from elsewhere for building and maintaining the facility. Sourcing of solar panels will presumably be from overseas so again, in terms of the life cycle of the plant it is unclear how local people might benefit directly from employment. Given the significant impact of such a large-scale solar power station on house values in Cassington especially, but also other villages immediately adjacent to the development, there is no mention of direct compensation. There is also no mention of discounted renewable energy for the village which might also compensate to some extent for economic and health impacts.

Finally, Cassington Parish Council would like to point out that it is and has over the last 18 months had to spend considerable time and resources (financial costs) in dealing with development proposals originating from Blenheim Estates or involving land that they own. This is time and money which should be being spent caring for the well being of the residents of Cassington by the Parish Council during a particularly difficult time in terms of escalating costs of living. If it is considered that other Parish Councils in the parishes surrounding Blenheim Estates, this begins to develop a very disturbing picture. As with a previous development proposal in Cassington the mode of operation has been to distribute a proposed plan of development without prior consultation of councillors at Parish, District or County Council (in other words "decide-announce-defend"). This puts more pressure on councillors who have to respond over short timescales to proposals, even if they are prior to official application. We believe there must be a better way for local councillors to work with Blenheim Estates and other developers. It is very clear that the current levels of development activity are causing excessive amounts of work for what are volunteers at local Parish level.

Questions

9. Have PVDP and the landowners involved in the West Botley power station considered the impacts on health and well being of their proposed development on farmers and residents on or adjacent to the land subject to proposal?

10. Have PVDP and the landowners considered the impacts imposed by the West Botley solar power station in addition to other development pressures in the immediate area?

11. Cassington Parish Council request details of employment and other benefits to residents of the village and surrounding area of the West Botley solar power station?

12. Have PVDP considered compensation for the residents for the negative impacts on their health and well-being?

13. Cassington Parish Council would like to invite PVDP and particularly the landowners to consider how they can work better with local councillors and provide relief from the current workloads they are imposing on local government bodies.

Environmental considerations of the West Botley Utility-Scale Solar Power Station

Drainage

Cassington is at low risk of flooding from the River Thames to the South and the River Evenlode to the west. However, the village is at risk from surface flooding events even at a 1 in 30-year event. Elm's Road appears to be particularly vulnerable from these events which result from surface water draining off the fields to the north of Cassington. This is consistent with flooding of properties on Elm's Road in 2007 (WODC, 2008). Foxwell Court, St Peter's Close, Horsemere Lane, Foxwell End and Reynold's Farm are also at risk of flooding from extreme surface water events (WODC, 2008). Outside the village Jericho Farm and Worton are also vulnerable to flooding and the road junction to Worton Farm was flooded over the winter of 2020/2021. Following the 2007 flood events action was taken to mitigate future surface-water flooding including the clearing of previously blocked drains and the building of a drainage pond behind the southwest corner of the playing fields. Since this time there have been no further property flooding events in Cassington village although the threat remains.

Studies of how utility-scale solar power stations impact hydrology are relatively few at present. However, the studies that do exist show changes in soil moisture content associated with solar panel arrays and also increases in surface water runoff (e.g. Pisinaras et al., 2014; Yavari et al., 2022). Alterations in hydrology also have the potential to increase soil erosion in some circumstances (e.g. Yavari et al., 2022). One aspect of solar array design which influences runoff of rainwater is the tilt angle and orientation of the solar panels at a given site (Yavari et al., 2022).

Given the flooding issues already experienced at Cassington, Worton and Jericho Farm resulting from surface water runoff alteration of hydrology on the hills to the north of Cassington is a significant concern for residents of the Parish. Any increase in surface water runoff would increase flood risks to properties particularly in Elm's Road, but also in Foxwell Court, St Peter's Close, Horsemere Lane, Foxwell End, Reynold's Farm, Jericho Farm and Worton.

Questions

14. Has the West Botley utility-scale solar power station been designed to a sufficient level for modelling of its effects on surface runoff to the north of Cassington to be estimated?

15. Assuming this has not been done can PVDP assure residents of the Parish of Cassington that such detailed modelling will be undertaken, accounting for local topography, soil mechanics and solar array design so the full impacts of the installation on water runoff be estimated.

16. Should such modelling show an elevated runoff and flood risk to Cassington will PVDP alter the solar array design to mitigate excess runoff or in the event mitigation is not possible, exclude the slopes to the north of the village from the planned power station?

Food security

The West Botley utility-scale solar power station middle site area is proposed to be built on farmland which is mostly Grade 3. We have been told that most of the land to the north of Cassington is Grade 3b. Mr Dominic Hare has stated at two meetings (Bladon Parish Council Community Meeting, 28th November, 2022; Cassington Parish Council, 1st December, 2022) that Grade 3B land is "pretty poor" farmland. This was contended at the Cassington Parish Council meeting (1st December) and as can be seen from Table 2 below is materially incorrect. Indeed, Grade 3B land has a moderate yield for cereals and is good for producing grass for grazing and harvesting. This fits with historical records which indicate that villages like Yarnton were locally famous for producing excellent hay. Several of the farmers who have farmed the land subject to this proposal have reported to the parish Council that their yields have been very good. The repeated claims from a representative of Blenheim Estates that this farmland is "pretty poor" would appear therefore to be an example gaslighting the residents of villages which will be affected by the West Botley utility-scale power station. Designation of Grade 3B land for solar energy generation has been controversial and the current government has switched positions from considering whether or not to review Grade 3B land as whether it may or may not be used for solar energy generation.

Generalised Description of the Agricultural Land Classification Grades

Grade & standard colour notations	Description of agricultural land	Detail
1	Excellent quality	No or very minor limitations on agricultural use. Wide range of agricultural and horticultural crops can be grown. High yielding and consistent.
2	Very good	Minor Limitations on crop yield, cultivations or harvesting. Wide range of crops but limitations on demanding crops (e.g. winter harvested veg). Yield high but lower than Grade 1.
3 (subdivided)	Good to moderate	Moderate limitations on crop choice, timing and type of cultivation, harvesting or level of yield. Yields lower and more variable than Grade 2.
3a	Good	Moderate to high yields of narrow range of arable crops (e.g. cereals), or moderate yields of grass, oilseed rape, potatoes, sugar beet and less demanding horticultural crops.
3b	Moderate	Moderate yields of cereals, grass and lower yields other crops. High yields of grass for grazing/ harvesting.
4	Poor	Severe limitations which restrict range and/or level of yields. Mostly grass and occasional arable (cereals and forage), but highly variable yields. Very droughty arable land included.
5	Very poor	Severe limitations which restrict use to permanent pasture or rough grazing except for pioneering forage crops.

Table 2. Definitions of different grades of agricultural land (Welsh Government, 2017).

Farming is a critical element of food security for the UK especially in world where political, economic and climate shocks are becoming more frequent. UK farming currently uses about 17.2 million hectares of land (71% of the UK land area) distributed across 216,000 farms (DEFRA, 2022). Since 2009/2010 profitability of farming has not changed significantly, rising food prices have generally reflected rising costs (e.g. for fertilisers; DEFRA, 2022). Cereal farms, such as those to the north of Cassington have the best economic performance on average with outputs 43% higher than inputs

(DEFRA, 2022). Intensive agriculture can lead to greenhouse gas emissions (e.g. from loss of soil organic carbon and from livestock methane production) and other environmental impacts.

The question arises as to whether landowners involved in the West Botley utility-scale solar power station could undertake alternative actions to curb CO_2 emissions or sequester carbon. As pointed out above, converting the land to grassland or forest could sequester more carbon than the power station could avoid in emissions. However, as there is clearly a significant profit motive for landowners in this scheme such actions may not be attractive. An alternative might be to engage in regenerative farming practices where agricultural activities are maintained but managed to reduce CO_2 emissions and to improve soil condition and organic carbon content. Another alternative may be to adopt a mixed land use approach, scaling back the current proposal considerably but maintaining agriculture, forestry and may be other activities appropriate to a rural setting. Finally, we point out that agriculture is an activity that has shaped Cassington and which still contributes to the village economically and in terms of the well-being of its residents (see above).

Questions

17. Have the landowners investigated the potential of regenerative agriculture to maintain the rural aspect of the land to the north of Cassington but to also benefit wildlife, reduce emissions, increase carbon sequestration and maintain or improve the amenity value of rights of way?

18. Could a mixed use of land (agriculture, solar, other rural activities) provide a compromise solution that delivered equivalent contributions to fighting climate change (through emissions reductions and carbon sequestration) but not have such a devastating impact on the landscape, amenity value and well being of the residents of Cassington and other affected villages?

Biodiversity impacts of solar farms

Habitat loss.

Construction of solar farms and their associated infrastructure may require large-scale removal of vegetation and surface grading (e.g. Turney and Fthenakis, 2011; Murphy-Mariscal et al 2018). This results in habitat loss, degradation and fragmentation, leading to a reduction in species richness and density (e.g. Turney and Fthenakis, 2011; Murphy-Mariscal et al 2018). These impacts are exacerbated as the solar farm proposed will be situated on agricultural land which provides the landscape and habitat for an ever-dwindling group of plants and animals. Today in the UK the loss of "agri-wildlife" is well documented, with the majority of species and habitats associated with low-intensity agriculture showing catastrophic declines post World War 2. As a result, many of those species associated with agricultural habitats are afforded protection at the very highest levels. Whilst much is made of reinstating elements of the habitat lost post solar farm construction, most notably hedgerow systems, emphasis must be placed upon the fact that we are losing a long-established, biodiverse habitat with a brand new one. This new creation will take many decades to come anywhere close to the biodiversity of its predecessor, this at a time when agri-biodiversity continues to be lost apace.

During the operation of the solar farm, vegetation will be significantly lost or altered as they require some form of vegetation management under, and in the gaps between solar panel arrays. The vegetation is managed via a variety of options - using herbicides, covering the ground with gravel, mowing or grazing. For the proposed solar farm there is a strong suggestion that the land between the arrays will be sheep grazed. Given the extent of the solar farm proposal, if the entire footprint

were to be sheep-grazed, then this would require a significant number of livestock with which to achieve this, numbers which are unlikely to exist in reality. It is therefore likely that alternatives will be employed, such as mechanical mowing or use of herbicides, both of which have high negative biodiversity impact. In temperate areas such as the UK it has been shown that plant species diversity, coverage and biomass are reduced below solar panels compared to reference and panel interspace areas (Armstrong et al., 2016; Yavari et al., 2022).

Soil microclimate

Soil microbial biodiversity is vital to the well-being of the above ground vegetation and all that depends upon it. Solar panels result in a large proportion of the overall footprint of the solar farm effectively being put in the shade with reduced exposure to rain, severely diminishing soil microbial activity as a consequence of alteration to the immediate microclimate. This will result in an inert growth medium for plant life with a cascading effect upon the wildlife that directly or indirectly depends upon it. Solar panels also alter the temperature and evapotranspiration of soils, tending to keep them warmer during winter and cooler during the summer (e.g. Armstrong et al., 2016).

Barrier effects

Access to suitable foraging and breeding territory will be lost. Many agri-bird and mammal species require large, uninterrupted tracts of suitable breeding and feeding habitat with which to complete their life cycle. Solar farms result in large-scale losses of these vital components and as a consequence, species already demonstrated to be in significant decline (brown hare, harvest mice and several species of passerine birds including linnet, yellowhammer, corn bunting and tree sparrow for example) will be further negatively impacted. It is also useful to note that if the land between the solar arrays is to be sheep-grazed, then the surrounding field perimeter will require stock-proof fencing in order to contain the grazing livestock. This fencing will function as a barrier to movement (resulting in an inability to access/maintain breeding and feeding territory) for several mammal species, notably badger and those species of deer typically found in agricultural settings.

Several species of migratory bird rely heavily upon large tracts of agricultural land and their associate hedgerows, particularly in the late autumn/winter period. Species of note here are winter thrushes (redwing and fieldfare), starling, and several species of geese and swans. In addition, passerine birds such as wheatear, yellow wagtails and redstart, “stop-off” on agricultural land in order to re-fuel on passage to their nesting grounds. As such, loss of these sites, accompanied by a reduction/removal of their ability to provide food sources, constitutes a significant concern to the overall impact to biodiversity.

Bird/bat/insect strike.

Solar panels present a significant strike risk to bird and bat species, especially if the surfaces are vertically oriented and/or reflecting light (e.g. Visser et al 2019; Smallwood, 2020). Birds and bats are attracted to the panels for a variety of reasons (e.g. Smallwood, 2020). The panels themselves attract the principal prey items of insectivorous animals, which the birds/bats seek to consume, thus colliding with the structures in doing so (e.g. Smallwood, 2020). Water birds have been demonstrated to collide with the panels as they mistake them for waterbodies and effectively try to land on them (Jenkins et al., 2015; Mulvaney, 2019). This is a particular concern in relation to this proposal as there are a number of large water bodies both within the footprint of the proposed development and in close-proximity to its boundaries. We also note that some aquatic birds such as mute swans and geese also feed in fields proposed to be covered in solar arrays around the village of Cassington. Bird mortality at solar arrays in the US caused a mortality of 11.61 birds and 0.06 bats per MW/year (Smallwood, 2020). Translating such a figure to the West Botley utility-scale solar power station would cause a mortality of more than 390,000 birds and 2,000 bats over a 40-year

operating time. Obviously impacts on US bird fauna are likely to be different to those in Oxfordshire but this gives an idea of the potential scale of impact of an 840 MW power station on birds and bats in the area. Aquatic insects are attracted to the polarised light reflected by solar panels, again displaying maladaptive behaviour, mistaking the panels for water surfaces.

Questions

19. Will PVDP undertake baseline environmental and biodiversity surveys in the area subject to proposal with sufficient areal coverage and accounting for temporal variation in land use by wildlife to produce a realistic picture of the current biodiversity value of the affected area of the West Botley utility-scale solar power station?

20. What mitigation measures will be put in place to prevent damage to biodiversity, in particular species of conservation concern, especially birds and bats?

21. We note that a biodiversity and amenity offset scheme is suggested along the flood plane of the River Evenlode to the west of Cassington. During the consultation meeting at Cassington it was suggested a footpath would be built in the fields adjacent to the river to enable use of the footpath during winter when the route is flooded. Has PVDP considered that this area is already generally set aside from agriculture because it is flood land and the impacts of building a causeway on existing biodiversity and flood management for the river?

22. What measures will be put in place to mitigate against landscape fragmentation caused by fencing for wild animals (e.g. deer, foxes, badgers, hedgehogs and other animals).

23. Have land management practices been considered in terms of reducing impacts on wildlife?

24. How will biodiversity management plans be monitored post installation?

References

Armstrong, A., Ostle, N.J., Whitaker, J. (2016) Solar park microclimate and vegetation management effects on grassland carbon cycling. *Environmental Research Letters* 11: 074016.

Baggs, A.P., Blair, W.J., Chance, E. Colvin, C., Cooper, J., Day, C.J., Selwyn, N., Townley, S.C. (1990) 'Cassington: Economic history', in *A History of the County of Oxford: Volume 12, Wootton Hundred (South) Including Woodstock*, ed. Alan Crossley and C R Elrington, pp. 44-48. *British History Online* http://www.british-history.ac.uk/vch/oxon/vol12/pp44-48 [accessed 15 June 2021].

Cox, D.T.C., Shanahan, D.F., Hudson, H.L., Fuller, R.A., Anderson, K., Hancock, S., Gaston, K.J. (2017) Doses of nearby nature simultaneously associated with multiple health benefits. *International Journal of Environmental Research and Public Health* 14: 172.

Bowler, D.E., Buyung-Ali, L.M., Knight, T.M., Pullin, A.S. (2010) A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health* 10: 456.

DEFRA (2022) Agriculture in the UK Evidence Pack: September 2022 Update. DEFRA, London, UK, 56pp.

EASAC (2022) Regenerative agriculture in Europe**:** A critical analysis of contributions to European Union Farm to Fork and Biodiversity Strategies. Report by the European Academies Science Advisory Council, Halle, Germany 58pp + Appendices.

IPCC (Intergovernmental Panel on Climate Change) (2018) Global Warming of 1.5° C. *An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Edited by V. Masson-Delmotte, P. Zhai, H.O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, et al. Geneva: IPCC.

Jenkins, A.R., Ralston, S., Smit-Robinson, H.A. (2015) *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa.* Birdlife South Africa, 62pp.

Mulvaney, D. (2019) *Solar Power: Innovation, Sustainability and Environmental Justice.* University of California Press, 329pp.

Murphy-Mariscal, M., Grodsky, S.M., Hernandez, R.R. (2018) Solar Energy Development and the Biosphere. In: Letcher, T.M., Fthenakis, V.M. (Eds.) *A Comprehensive Guide to Solar Energy Systems: With Special Focus on Photovoltaic Systems.* Academic Press, New York, USA, pp 391-405.

Ostle, N.J., Levy, P.E., Evans, C.D., Smith, P. (2009) UK land use and soil carbon sequestration. *Land Use Policy* 265: s274-s283.

Pisinaras, V., Wei, Y., Bärring, L., Gemitzi, A. (2014) Conceptualizing and assessing the effects of installation and operation of photovoltaic power plants on major hydrologic budget constituents. *Science of the Total Environment* 493: 239–250

Shanahan, D.F., Bush, R., Gaston, K.J., Lin, B.B., Dean, J., Barber, E., Fuller, R.A. (2016) Health benefits from nature experiences depend on dose. *Scientific Reports* 6: 28551.

Smallwood, K.S. (2020) Utility‐scale solar impacts to volant wildlife. *Journal of Wildlife Management*. 86: e22216.

Turney, D., Fthenakis, V. (2011) Environmental impacts from the installation and operation of large-scale solar power plants. *Renewable and Sustainable Energy Reviews* 15: 3261– 3270

Visser, E., Perold, V., Ralston-Paton, S., Cardenal, A.C., Ryan, P.G. (2019) Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa. *Renewable Energy* 133: 1285-1294.

Welsh Government (2017) *Agricultural Land Classification Frequently Asked Questions*. 8pp.

WODC (2008) Parish Flood Report Cassington November 2008. West Oxfordshire District Council, 20pp.

WODC (2018) West Oxfordshire Local Plan 2031 Adopted September 2018. West Oxfordshire District Council, Witney, Oxfordshire, UK, 322pp.

Yavari, R., Zaliwciw, D., Cibin, R., McPhillips, L. (2022) Minimizing environmental impacts of solar farms: a review of current science on landscape hydrology and guidance on stormwater management. *Environmental Research Infrastructure and Sustainability* 2: 032002.