



LIGHTSOURCE  
RENEWABLE ENERGY LIMITED

# PLANNING, DESIGN AND ACCESS STATEMENT

## SOLAR PHOTOVOLTAIC INSTALLATION



TRENCH FARM, RED HALL LANE,  
WREXHAM, LL13 0NA

DOC REFERENCE: Trench Farm

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## EXECUTIVE SUMMARY

- The proposal is for a 7.15MW solar farm, capable of generating enough clean electricity to power 1912 typical households.
- The solar farm would avoid 3250kg of carbon dioxide emissions associated with electricity generation each year, thus reducing the carbon footprint of Wrexham. This is the equivalent of removing 732 family cars from the road each year.
- The proposed solar farm will result in very few landscape or visual effects due to the well-established boundary hedgerows and trees which screen the site from most vantage points. Additional planting is proposed to fill small gaps in the hedgerow adjacent two Public Rights of Way. There will be no cumulative impacts with other developments.
- The site has the potential to support protected species, and therefore a number of mitigation measures are proposed during construction, whilst others have been incorporated into the layout design. Measures to improve biodiversity are also proposed, including new hedgerow planting to fill existing gaps, and the creation of grassland and wildflower habitats.
- There will be no impact on any designated heritage assets or known archaeological remains, and the potential impact on any unrecorded buried archaeology is assessed as being slight. In addition, the proposal would have no more than a slight impact on the Maelor Saesneg Historic Landscape designation, which will be mitigated by proposed planting.
- The site is located in Flood Zone A. The Flood Risk Assessment accompanying this application concludes that the proposed development of a solar farm at the subject site will not result in any discernible change to quantity or rate of run-off from the site. The development will not increase the risk of flooding on either the subject site, or the surrounding areas. Additional engineered drainage features were not considered necessary for this development proposal.
- The site is low grade agricultural land, being a mix of Grade 3b and 4, and an area of non-agricultural land currently used as a motocross track. Sheep will be grazed under and between the rows of solar panels, which allows for a dual productive use of the site, through the generation of renewable energy and the continued agricultural use of the land.
- At the end of the solar farm's life, the site will be decommissioned, with all infrastructure removed from the site, and the site restored to its original condition for future agricultural use.
- The majority of the components of the solar farm can be recycled or reused at the end of the solar farm's operational life.
- The proposed solar farm is consistent with national and local policy, and will contribute to the country's renewable energy generation targets.

# 1 INTRODUCTION

## 1.1 GENERAL

This planning and design and access statement has been prepared in support of a planning application for full temporary permission for the development of a ground mounted photovoltaic (PV) solar energy generation system (solar farm). The solar farm has been designed to accommodate sheep grazing on site, thus providing a dual productive function of renewable energy generation and agricultural production.

The site is located at Trench Farm, Red Hall Lane, Wrexham, LL13 0NA. The application area is 21.34ha in size. It is proposed to install solar modules covering approximately 4.64ha. The reason the proposed solar panels and associated infrastructure will cover only 22% of the site is that sufficient gaps must be provided between the rows of panels, to avoid one row shading another, and sufficient setbacks need to be provided from boundary vegetation, particularly on the southern boundary to avoid shading, in addition to this, buffers have been left around the ponds on site. The design of the proposed Layout Plan has been prepared to maximise energy production within the available area of land, taking into account the site specific constraints. The grassy avenues between the rows of panels, and the grass growing beneath the panels, will be grazed by sheep.

The purpose of the development is to convert daylight into electricity. This solar development will have a generation capacity of approximately 7.17 megawatts (MW), which is enough to power 1912 typical homes<sup>1</sup>, and save approximately 3250kg in CO<sub>2</sub> emissions per annum – the equivalent of removing 732 standard cars from the road each year.

## 1.2 APPLICATION STRUCTURE

This Planning and Design and Access Statement is accompanied by the following reports:

- Landscape and Visual Impact Assessment
- Ecological Assessment
- Archaeological Assessment
- Flood Risk Assessment
- Agricultural Land Assessment
- Construction, Decommissioning and Traffic Management Method Statement
- Statement of Community Involvement

The following plans are also enclosed:

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<sup>1</sup>The intensity and duration of daylight levels in any given location is steady and predictable when compared year on year (though obviously this fluctuates throughout the year). Therefore the annual daylight levels in a given location can be estimated relatively accurately without extensive prior monitoring (as required for wind turbines). Determining the number of typical households that a solar farm will generate electricity for is a simple calculation whereby the average yearly daylight yield is multiplied by the energy output capacity of the solar panels (minus expected losses, which varies around the country depending on the quality of the grid, but is typically around 10%). This number is then divided by 3,300kwh, which is the Ofgem stated national average for yearly electricity usage for a typical household in the UK.

We use the average number of households the solar farm is likely to generate power for annually as a representative figure to put the capacity in to perspective. Of course, the electricity will be used by a mix of residential dwellings, businesses, factories and farming operations depending on the demand from nearby energy users at any given time of day.

- Layout Plan and Panel Mounting Frame Elevations
- Topographic Survey
- Fence Elevation
- Inverter Elevation
- Transformer Elevation
- Switchgear Elevation
- Communications Building Elevation
- DNO Building Elevation
- Storage Building Elevation
- Auxiliary Transformer Elevation

### 1.3 THE NEED FOR RENEWABLE ENERGY IN THE UK

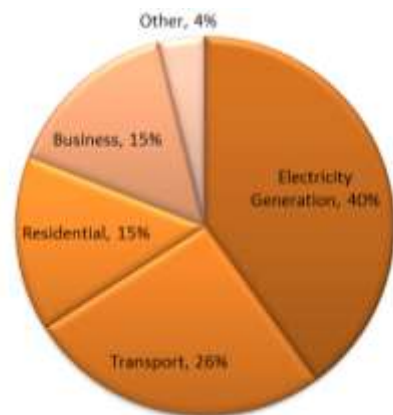
Energy generation is required to meet the electricity demands of households, businesses, factories and services in the UK. The availability of electricity is fundamental to supporting the modern way of life. Aside from the very few living off-grid, the majority of us require on-demand electricity both in our homes and businesses, and electricity black outs cause significant disruptions.

A significant proportion of UK electricity supply is generated from fossil fuels. Declining reserves of fossil fuels in the UK Continental Shelf are making the UK increasingly reliant on imports at a time of increased global demand.<sup>2</sup> Around a fifth of power stations in the UK are due to close within this decade as they come to the end of their operational lives or are deemed too polluting.<sup>3</sup>

With a large proportion of the UK's energy being generated from fossil fuels, we are exposed to potential energy security issues, including fluctuating international market prices and disruptions to fuel supplies through geopolitical conflicts.

Our reliance on fossil fuels also makes us one of the world's more prolific emitters of greenhouses gases and other pollutants. Based on 2012 figures, the UK is the 9<sup>th</sup> largest emitter of carbon dioxide in the world.

In 2011, the single largest contributor to these emissions was the electricity generation sector which creates 40% of the UK's carbon emissions, with the transport sector in second place at 26%.<sup>4</sup> The pie chart opposite shows the UK carbon emissions breakdown by sector.



The UK Government is committed to meeting its legally binding targets for reducing the country's carbon footprint, and a key component of this strategy is increasing the levels of renewable energy generation in the UK. This will also have the benefit of insulating the UK from volatility in the global fossil fuel markets, by increasing our energy self-sufficiency.

<sup>2</sup> Department of Energy and Climate Change (2012) *Energy Security Strategy*, [www.decc.gov.uk](http://www.decc.gov.uk)

<sup>3</sup> Department of Energy and Climate Change (2012) *Energy Security Strategy*, [www.decc.gov.uk](http://www.decc.gov.uk)

<sup>4</sup> Source: Department of Energy and Climate Change (2012) *Statistical Release: 2011 UK Greenhouse Gas Emissions, Provisions Figures and 2010 UK Greenhouse Gas Emissions, Final Figures by Fuel Type and End-User*

These two key reasons (security of supply and carbon dioxide footprint reduction) for increasing our renewable electricity generation capacity are well recognised by both the UK Government and Welsh Assembly Government.

Solar PV is a proven technology<sup>5</sup> – having been in commercial production since the 1950s – and it has a significant role to play in increasing the capacity of our electricity generation from renewable sources.

## 1.4 ABOUT LIGHTSOURCE

Lightsource Renewable Energy Ltd (Lightsource) is the United Kingdom's leading solar energy generator. We are primarily focused on utility scale ground and roof mounted photovoltaic installations, which we maintain and operate, selling the electricity generated either for use on the national grid network, or directly to a specific high energy user. We have also installed solar panels on the roofs of over 100 schools across the United Kingdom, providing them with clean energy as well as a learning resource kit.

Lightsource are committed to the long term maintenance of our solar farms, we have internal Asset Management and Operations and Maintenance teams, with regionally based staff who manage all of our built assets.

For more information on Lightsource and our existing portfolio of solar sites please visit our website: [www.lightsource-re.co.uk](http://www.lightsource-re.co.uk).

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<sup>5</sup> It is sometimes quoted that solar panels have a low efficiency. What this is referring to is the ratio of actual energy produced versus potential energy generation if the sun stayed at the midday position 24 hours a day. Obviously daylight levels vary throughout the day, growing stronger toward midday, and weaker at sunrise and sunset – this does not mean that solar panels themselves are inefficient – it is just the natural limitation on the amount of energy they are realistically able to produce from natural daylight, compared to the amount they would be able to produce if daylight levels were always at their peak.

## 2 SITE DEVELOPMENT

### 2.1 SITE SELECTION

Site selection is critical to ensuring that an efficient, technically and economically viable solar farm can be developed without causing significant adverse environmental impacts.

Of the hundreds of potential sites we assess every year at Lightsource, we proceed to planning with less than 10% of these, with the other 90% either unviable technically, unable to achieve grid connection, or considered inappropriate from a planning policy and environmental impact point of view. The stages of our site selection process are detailed below.

#### 2.1.1 PHASE 1: DESKTOP ASSESSMENT

Our site selection process begins with a detailed desktop assessment assessing the following four critical criteria:

1. Technical suitability of the site for operating a solar PV system
  - Site size (minimum of 20acres)
  - Irradiation (daylight) levels and potential energy yield
  - Orientation and topography
  - Access point
2. Grid connection feasibility
  - Availability of grid capacity
  - Proximity of nearest overhead line (11/33kV)
  - Likely ease/difficulty of accessing grid connection point
3. Planning Issues
  - National and Local level designations (landscape, ecology, heritage)
  - Heritage assets
  - Flood risk
  - Agricultural land grading
  - Neighbouring land uses
  - Potential visual receptors
4. Site Availability
  - Landlord willing to rent/sell land for a solar farm development

At the desktop stage, the following area was assessed:



Based on the desktop assessment, it was determined that the site could proceed to a site visit stage to identify any risks or constraints.

### **2.1.2 PHASE 2: SITE VISIT**

For sites that pass the desktop assessment, we then undertake site visits to further assess the suitability of the site. A key focus for the site visit is assessing the potential a site has for unacceptable visual impact. Other criteria assessed on site include:

1. Technical suitability of the site for operating a solar PV system
  - Confirmation of site orientation and topography
  - On-site shading
  - Confirmation of appropriate access for construction traffic
2. Grid connection feasibility
  - Proximity of nearest overhead line (11/33kV)
3. Planning Issues
  - Actual visual receptors, and extent of site visibility
  - Potential for additional planting to screen views
  - Flora and fauna
4. Site Availability
  - Meeting with the landlord

The same area assessed at the desktop level was assessed at the Site Visit stage. Following the site visit, those fields toward the western edge of the area were discarded due to presence of footpaths (and subsequent views from them). Those fields to the south were also discounted due to proximity to dwellings and the fishing lake.

The remaining fields that passed the site visit stage are those subject to this application.



### **2.1.3 PHASE 3: PLANNING AND GRID APPLICATIONS**

Based on a favourable desktop assessment and site visit, the decision was made to begin preparation of the planning application, and to submit the grid application.

An appraisal of the subject site taken forward in this planning application is provided in Section 3.

## **2.2 PRE-APPLICATION ENGAGEMENT WITH THE COUNCIL**

Pre-application engagement with the Local Planning Authority was undertaken in the form of an Environmental Impact Assessment Screening Opinion, which was submitted in March 2013. The Council's Screening Opinion determined that an Environmental Statement was not required in this instance (Council ref: ENQ/2014/0063).

This application is accompanied by a Statement of Community Involvement, which sets out the pre-application engagement undertaken with the local community and other stakeholders.

## 3 SITE CONTEXT

### 3.1 SITE DESCRIPTION

The 21.34ha field is currently used for grazing stock. The site has the following characteristics:

- The site is flat, bounded in all directions by large trees and/or hedgerows.
- The site is within Agricultural Land Grading 3b and 4, as well as a small area of non-agricultural land.
- The site is primarily grassland, although the western-most field is currently a motocross track.
- A dense woodland lies on the northwest corner of the site, with strong belts of large vegetation running through the site separating each field. A number of ponds are located within the site and in its immediate surrounds.

### 3.2 LOCAL CONTEXT

The site is located within an agricultural setting. The local area has the following characteristics:

- The site is surrounded by agricultural land. To the immediate west lies a private airstrip, whilst to the immediate east of the site lies a redundant railway line.
- Red Hall Lane lies approximately 250m south; Grange Road (A528) lies approximately 600m west.
- The site is not located within any national landscape or other sensitive designations. The site is however located within a Special Landscape Area as identified in the Local Plan.
- There are no known heritage assets in the immediate surrounds.
- The nearest residential building is 200m south, on the same land ownership. There are a number of residential buildings and a number of industrial activities in Lightwood Green, approximately 400m north.

Detailed descriptions of the visual, ecological, and archaeological setting of the site are provided in the relevant reports accompanying this application.

## 4 PROPOSED DEVELOPMENT

### 4.1 PROPOSED USE

Lightsource proposes to install and operate an array of photovoltaic (PV) solar panels on the site, as shown in the accompanying Layout Plan, to convert daylight into electricity. The PV panels will have an energy generation capacity of approximately 7.17MW, and will output electricity equivalent to the power requirements of 1912 typical households per year. The energy generated will be fed directly into the local power grid network for use by the nearest points of demand.

The solar farm will be a temporary, medium term, use of the site. At the end of its operational life (approximately 30 to 35 years), all equipment associated with the solar farm will be removed from the site, and minor remediation works undertaken to backfill any excavated areas.

### 4.2 AMOUNT, SCALE AND APPEARANCE

The solar farm will be comprised of the following components, shown in the Layout Plan and Elevations, all of which are designed and warranted to last at least 25 years.

**Solar Panels:** Solar PV panels, with a combined energy generation capacity of approximately 7.17MW, will be installed. The panels will be approximately 1.650m x 0.946m x 0.05m.

The mounted solar panels will have a maximum height of 2.277m above ground level, and at the lower end will be 0.6m above the ground, allowing for sheep to graze the grass beneath the panels.

The glass surfaced panels are coated to maximise daylight absorption, and thus minimise glare potential.

**Mounting Frames:** The panels will be attached in a 4 in landscape configuration to mounting frames at an angle of 20 degrees, to optimise daylight capture. The panels are fixed in place and will not move to 'track' the sun. The mounting frames will be made of either galvanized aluminium or steel and will have a rough matt finish, rather than a polished finish.

The mounting frames are pile driven into the ground, and no concrete foundations are required. The base of the frame piles are thin 'H' or 'Z' shapes, thus they have very little impact on the ground and do not require any prior excavation. The frames are driven to a depth of approximately 1.5m. At the end of their operational life when the site is decommissioned, the frame piles are simply pulled out from the ground causing minimal ground disturbance.



Howbery Solar Farm, South Oxfordshire



Frame structures prior to attachment of panels

**Inverters:** The panels generate Direct Current (DC) electricity which must be converted into Alternating Current (AC) before being feed into the local electricity grid network.

Central inverters are housed in a cabin like structure of approximately 2.9m high x 4.4m long x 1.5m wide and painted green. The Central Inverter is mounted on a concrete base. A total of 6 inverters are required, as shown in the Layout Plan.



**Inverter Building, Hatchlands Solar Farm, Devon**

**Transformers:** The transformer transforms electrical energy from one circuit to another, and allows for the energy generated to be fed into the local grid network. The transformer is housed separately from the Inverters, in a green cabin approximately 6m long x 2.5m wide x 2.8m high. A total of 3 transformers are required as shown on the Layout Plan.



**Inverter (centre), Little Trevease Solar Farm, Cornwall**

**Switchgear Substations:** Substations are the onsite point of connection from where electricity flows into the grid network via the connection cable. The substations house the site switchgear which acts as a safety mechanism to protect the solar farm from any fault in the grid network and vice versa. It disconnects electrical circuits if there is a fault in the system, much like a household fuse box.

Two sets of switchgear are required, one to shut the grid off from the solar farm (referred to as the DNO Substation) and a second to shut the solar farm off from the grid (referred to as the Client Side or Customer Substation).



**DNO Substation, Little Trevease Cornwall**

The DNO requires a security light to be affixed to the exterior of the DNO substation for health and safety reasons – if an emergency repair crew is required in hours of darkness the light allows them to safely access the substation to undertake the repair work. The motion sensor light only activates when the substation is approached; it will not be illuminated on a permanent basis. No other site lighting is required or proposed.



**Customer Substation, Tavells Farm, Hampshire**

**Perimeter Fence:** A 2m high agricultural timber and wire fence will be installed around the solar farm. This fence type has been selected for its appropriateness in a rural setting, and its visual permeability.

The purpose of the fence is to deter theft or vandalism, and prevent unauthorised access to the solar farm. The solar farm will be an unmanned site, and whilst solar farms are safe and we regularly take educational tours through our operational sites, it is important that unauthorised or unaccompanied access is prevented in case there is a fault in the system that presents a health or safety risk.



**Fence at Tavells Solar Farm, Hampshire**

**Security Cameras:** In order to monitor the site and detect any unauthorised access, motion sensor CCTV cameras will be erected around the site perimeter on poles of approximately 2.4 metres in height as shown on the Layout Plan. The cameras are directed into the solar farm, avoiding impinging on the privacy of nearby properties, and employ infrared technology so no lighting is required.



**CCTV camera in left hand corner of above photo.**

**Communications Building:** A communications building is required to enable 24hour remote monitoring of performance and security. The monitoring equipment rapidly identifies any faults, as well as relaying security camera footage. The proposed building will measure approximately 3m in length x 3.6m in width and 2.5m in height. An aerial of satellite dish may be affixed to the cabinet if reception issues necessitate it.



**Communications Building, Little Trevease, Cornwall**

The rows of the panel arrays will form a regular pattern, and the grass growing between the rows of panels will help to green the appearance of the site. The intention is to minimise views of the scheme such that it blends into the landscape. Although solar farms consist of built infrastructure mixed with natural elements, they are not necessarily unattractive, and can form features of interest.

Visual montages showing “before” views and “after” visual simulations of what the proposed development will look like are included with the accompanying Landscape and Visual Impact Assessment. The below photos show examples of some of Lightsource’s operational solar farms, to show what solar farms look like. Lightsource is happy to take Council staff and Councillors to visit one of our operational solar farms should they wish, so that they are able to see one close up and gain an appreciation for what the proposed development will look like once constructed.



**Higher Pirzwell Solar Farm, Devon**



**Barton Solar Farm, Devon**



**Sandhill Solar Farm, Somerset**



**Benbole Solar Farm, Cornwall**

### 4.3 LAYOUT

The proposed Layout submitted with this application has been prepared by Lightsource's in house Technical Team to make the most efficient use of the land available, whilst taking into account on site features such as underground services, existing vegetation and ecological constraints, such as badger setts.

If planning permission is granted, then Lightsource will engage a specialist Engineering, Procurement and Construction (EPC) firm to prepare the final detailed design layout and construct the solar farm, and will also finalise details with the Distribution Network Operator for their substation. The proposed Layout and elevations are based on informed assumptions of the most likely options for equipment and their positioning, however it may be that availability of equipment, or specific site requirements, mean that the final detailed design differs in some minor respects from the proposed layout. To address this, Lightsource proposes a Condition as outlined in Section 4.6 of this report.

The total area of the development will be 21.34 hectares, with the area of ground covered by the rows of solar panels and associated infrastructure totalling 22% of the site area; the remainder of the site being grassed land constituting the gaps between the rows of solar panels, and between the fence and the solar farm.

The plans accompanying this application include:

- Layout Plan and Panel Mounting Frame Elevation
- Fence Elevation
- Inverter Elevation
- Transformer Elevation
- Switchgear Elevation
- Communications Building Elevation
- DNO Building Elevation
- Storage Building Elevation

- Auxiliary Transformer Elevation
- CCTV Camera Elevation

#### 4.4 LANDSCAPING

The site was selected for its well screened nature. It is proposed to retain the existing hedgerows, and to undertake limited infill planting of new hedgerow to fill in gaps in the boundary vegetation in the vicinity of footpaths. These will be planted in the first planting season following completion of the solar farm.

#### 4.5 ACCESS

Access to the site will be obtained directly off Red Hall Lane as shown in the below aerial map.



Access was not seen as a contentious issue through the community consultation process, nor was it raised through the EIA Screening response. The exact route has not yet been finalised, however will likely be from the south of the access point, via the A528. The final route will be confirmed upon engagement of a construction contractor, and secured through a condition.

**Construction Traffic:** This application is accompanied by a Construction, Decommissioning and Traffic Management Method Statement which provides detail on levels of construction traffic, how the site will be accessed and how construction traffic will be managed.

It is considered that the relatively low levels of traffic to be generated during the construction period will not result in any material adverse impact on traffic safety or traffic flows in the surrounding roading network.

**Operational Traffic:** Traffic generation during the operational life time of the solar farm will primarily be restricted to maintenance visits, including:

- 2-3 grass cuts a year (if sheep grazing does not keep grass sufficiently short).
- 2-4 visits per year to wash panels – this will involve bringing in a water cube on the back of a flatbed 4x4.
- Up to 20 visits per year to undertake maintenance activities – this will be in a transit van or 4x4 type vehicle.
- 4 visits per year to read the electricity meter – this will be in a transit van or 4x4 type vehicle.

As solar farms are still relatively new in many areas of the UK, Lightsource also occasionally undertakes educational tours of our operational solar farms. To date this has primarily been for small groups of Councillors or Council staff who have not previously had the opportunity to visit a solar farm.

**Decommissioning Traffic:** Decommissioning of the site will take approximately half the time that construction takes, and will require similar levels of traffic as the construction phase to remove infrastructure from site. Further detail is provided in the Construction, Decommissioning and Traffic Management Method Statement.

#### 4.6 RECOMMENDED CONDITIONS

As detailed in Section 4.3 above, the final detailed design for the solar farm, as prepared by the EPC we engage to construct it, may have some minor differences from the proposed layout, though we always endeavour to keep these to a minimum. To ensure Council approval of the final detailed design layout and elevations prior to construction, Lightsource proposes the following pre-commencement condition:

*“Prior to commencement of the development, full details of the final locations, design and materials to be used for the panel arrays, inverters, transformers, control room, switchgear substations and CCTV cameras shall be submitted to the local planning authority and agreed in writing.”*

Alternatively, the Council may wish to attach a condition listing the approved plans, thus allowing for a Variation of Condition to be sought to amend the plans as required based on the final detailed design, for example:

*“The development hereby permitted shall be carried out in accordance with the following approved plans, unless otherwise agreed in writing with the local planning authority:*

- *Layout Plan*
- *Mounting Frame and Panel Elevation*
- *Fence Elevation*
- *Inverter Elevation*
- *Transformer Elevation*
- *Switchgear Elevation*
- *CCTV Camera Elevation”*

In order to condition the removal of the solar farm as part of the planning permission, Lightsource recommends the following condition wording:

*“Within 6 months of the cessation of energy generation from the development, all infrastructure associated with the solar farm will be removed from the site.”*

Although solar farms have low operating costs, they are relatively expensive to develop, therefore if the Council requires a specific time bounded condition for decommissioning, then Lightsource requests that this be 30 years and 6 months from the date that construction starts on site. This will provide for 30 years of electricity generation, and 6 months for later decommissioning. We recommend the following wording:

*“Within 6 months of the cessation of energy generation from the site, or a period of 30 years and 6 months following completion of construction, whichever is the sooner, all infrastructure associated with the solar farm will be removed from the site.”*

If the later condition is used we recommend including an additional condition requiring notice to be given to the LPA of the start of construction, for example:

*“Written notice is to be given to the LPA at least 5 days prior to construction starting on site.”*

## 5 ASSESSMENT

### 5.1 BENEFITS OF PROPOSAL

#### 5.1.1 RENEWABLE ENERGY GENERATION AND SECURITY OF SUPPLY

As discussed, increasing the capacity of renewable electricity generation in the UK is critical for reducing the country's carbon emissions and for improving our energy self-sufficiency to avoid the volatility in the global fossil fuel market.

A range of energy generation methods are required to ensure security of supply on the national grid network, and all options have their advantages and disadvantages. A comparison of solar farms with other energy generation options is provided in Appendix A.

#### 5.1.2 BIODIVERSITY ENHANCEMENT

The RSPB's 2013 'State of Nature' report found that approximately 60% of British wildlife is in decline, much as a result of agricultural intensification and subsequent habitat loss.<sup>6</sup> The RSPB and Natural England have both identified the opportunity that solar farm development presents for providing substantial wildlife gains, due to the extent of the unutilised area between panel rows and bordering the installation, combined with the low levels of disturbance from humans or machinery within the sites once operational.<sup>78</sup> Wildlife habitats can be provided in these areas that will boost numbers of bees and other pollinating and predatory insects, and provide enhanced feeding opportunities for birds and small mammals.<sup>9</sup>

In managing these habitats, nutrient input to the land and watercourse will also be significantly reduced in comparison to arable use. Soil health is essential for long term sustainability of farming, and solar farms could play an important role by resting soils through the life of the solar farm, allowing soil nutrients to restore naturally, without the need for regular use of fertilizers.<sup>10</sup>

Measures proposed to enhance the biodiversity values of the site include the planting of new, native hedgerow to infill gaps in the existing boundary vegetation, as well the creation of grassland and wildflower habitats in the area between the fence and hedgerow (i.e. the area that will not be grazed by sheep).

The first solar farms in the UK were constructed in 2011, and a recent study of a selection of these by an independent ecologist identified numerous biodiversity gains when compared with agricultural fields used as controls in the study.<sup>11</sup>

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<sup>6</sup> State of Nature Partnership (2013) *State of Nature: The State of Nature in the UK and its Overseas Territories*, [www.rspb.org.uk/Images/stateofnature\\_tcm0-345839.pdf](http://www.rspb.org.uk/Images/stateofnature_tcm0-345839.pdf)

<sup>7</sup> Natural England (2011) *Solar parks: maximising environmental benefits*, Natural England Technical Information Note TIN101

<sup>8</sup> State of Nature Partnership (2013) *State of Nature: The State of Nature in the UK and its Overseas Territories*, [www.rspb.org.uk/Images/stateofnature\\_tcm0-345839.pdf](http://www.rspb.org.uk/Images/stateofnature_tcm0-345839.pdf)

<sup>9</sup> RSPB (2011) *Solar Power*, RSPB Briefing March 2011

<sup>10</sup> BRE (2014) *Biodiversity Guidance for Solar Developments*, Eds G.E. Parker and L Greene

<sup>11</sup> Parker, C and McQueen, C (2013) *Can Solar Farms Deliver Significant Benefits for Biodiversity?*, Preliminary Study July-August 2013, Unpublished Report



Flower colonisation of Tavells Solar Farm, Hampshire



English Partridge at Wilburton Solar Farm, Cambridgeshire

### 5.1.3 FARM DIVERSIFICATION AND SUPPORT

Around half of all UK farms undertake some form of activity that is outside of the core business of farming in order to support farm operations – this is farm diversification. Diversification can result in a more productive use of part of the farm estate and can provide a constant form of income to the farm as a balance to the traditional fluctuations in farm incomes; this can then be reinvested in farming activities.

Diversification into renewable energy will increase farm income security, reducing the farm owner's vulnerability to agricultural subsidy cuts and commodity price changes. Moreover, it can serve to protect the farming tradition by removing the incentive, seen increasingly often on farms, to sell parcels of land to maintain income for the benefit of the remainder of the holding. In this instance the solar farm represents an opportunity to provide a dual use of the site, harvesting the sun's energy to generate electricity, and agricultural production through the grazing of sheep.

#### 5.1.4 COMMUNITY BENEFIT

The local area will benefit from a reduction in their carbon footprint. The electricity generated by the solar farm will enter the local grid network and will be utilised at the closest points of demand, meaning that more of the electricity used by the Overton Community will be from a clean renewable source, as opposed to from the burning of fossil fuels.

There are likely to be work opportunities generated for local contractors during the construction and on-going operation of the solar farm. The specialist Engineering, Procurement and Construction firms engaged by Lightsource to undertake detailed design and construction of our solar farms, typically employ local contractors as part of their work force during the construction period. As part of the community engagement process Lightsource has specifically sought to develop a database of local suppliers and contractors whose services could be engaged during and post construction.

Lightsource also typically engages local contractors to undertake general maintenance activities on site, as well as employing regionally based Operations and Maintenance staff to manage the operational solar farms.

#### 5.1.5 HEALTH

The electricity generation sector is the single largest contributor to CO<sub>2</sub> emissions in the UK through the burning of fossil fuels. An increase in our renewable, zero and low carbon energy generation capacity will result in a reduction not only in our carbon emissions, but also in the other air pollutants that are emitted during the burning of fossil fuels. Prolonged exposure to elevated levels

of air pollution affects the human respiratory and inflammatory systems. The emissions associated with energy generation through fossil fuel burning, including sulphur dioxide, nitrogen oxide, and carbon dioxide, as well as fine particulates, are particularly problematic for people with lung or heart conditions. Whilst the impact of this particular solar farm alone is unlikely to result in a measureable impact on air quality or people's health – the cumulative positive impact of a growing zero and low carbon energy sector will reduce air pollution, and thus reduce the risk posed to human health.

## 5.2 USE OF AGRICULTURAL LAND

The proposal involves the development of a solar farm within 16.6ha of Grade 3b and 4 agricultural land, and 5.9ha of non-agricultural land. The use of agricultural land will not jeopardise food production in the UK. Meeting the UK Government's target of 10GW of solar energy generation solely through ground-mounted systems would require the use of less than 0.01% of all agricultural land in the UK.<sup>12</sup>

The solar farm will be a passive installation, harvesting the sun's energy to generate electricity for human consumption – aside from the obvious visual difference, the outcome is little different to growing crops of rapeseed, poplar and willow for biofuel rather than food, and in fact solar PV requires significantly less land for the same energy output as biofuel crops, with even the most efficient biofuels requiring 29 times the land area as solar PV<sup>13</sup>.

The use of agricultural land for solar farms can actually be a positive, providing opportunities for a dual productive use of the site – clean energy generation combined with agricultural production through grazing. There are also significant opportunities for habitat and biodiversity enhancement, as discussed later in this report.

In the case of the proposed solar farm, the design specifically provides for an ongoing agricultural use of the site through sheep grazing. Lightsource has found sheep grazing to be beneficial in the operation and maintenance of our solar farms, as it largely avoids the need for mowing between and beneath the rows of panels.

The site includes 16.6ha of land classified as Agricultural Land Grading 3b and 4, which is not the 'Best and Most Versatile' agricultural land.



Sheep grazing at Trevemper Solar Farm, Cornwall



Lamb underneath array at Newlands Solar Farm, Devon

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<sup>12</sup> Based on 'World Bank Indicators – United Kingdom Land Use statistics', and assuming total installed capacity of 10GW of solar farms.

<sup>13</sup> Greyer, R et al (2013) 'Spatially Explicit Life Cycle Assessment of Sun-to-Wheels Transportation Pathways in the US', *Environmental Science and Technology*, 47(2), pp 1170-1176

The proposed development will be a temporary use of the land. Solar farms do not involve the introduction of large areas of hard surfaces, and all infrastructure can be easily removed at the end of the solar farm's operational life, followed by a return to sole agricultural production.

### 5.3 LANDSCAPE AND VISUAL IMPACT

The main impact associated with solar farms is the visible change to the site within which it is built. The Landscape and Visual Impact Assessment which accompanies this application concludes that the scheme will result in very few landscape or visual impacts, with these primarily being contained within the site boundary. The mature trees and hedges adjoining the site screen it completely from most vantage points. The exception is two Public Right of Ways (PRoW) which adjoin the site boundary, for the most part the boundary vegetation screens the site from these PRoWs except where there are short gaps in the hedgerows. It is proposed to fill in these short gaps with new hedgerow planting in order to further reduce the visual impacts.

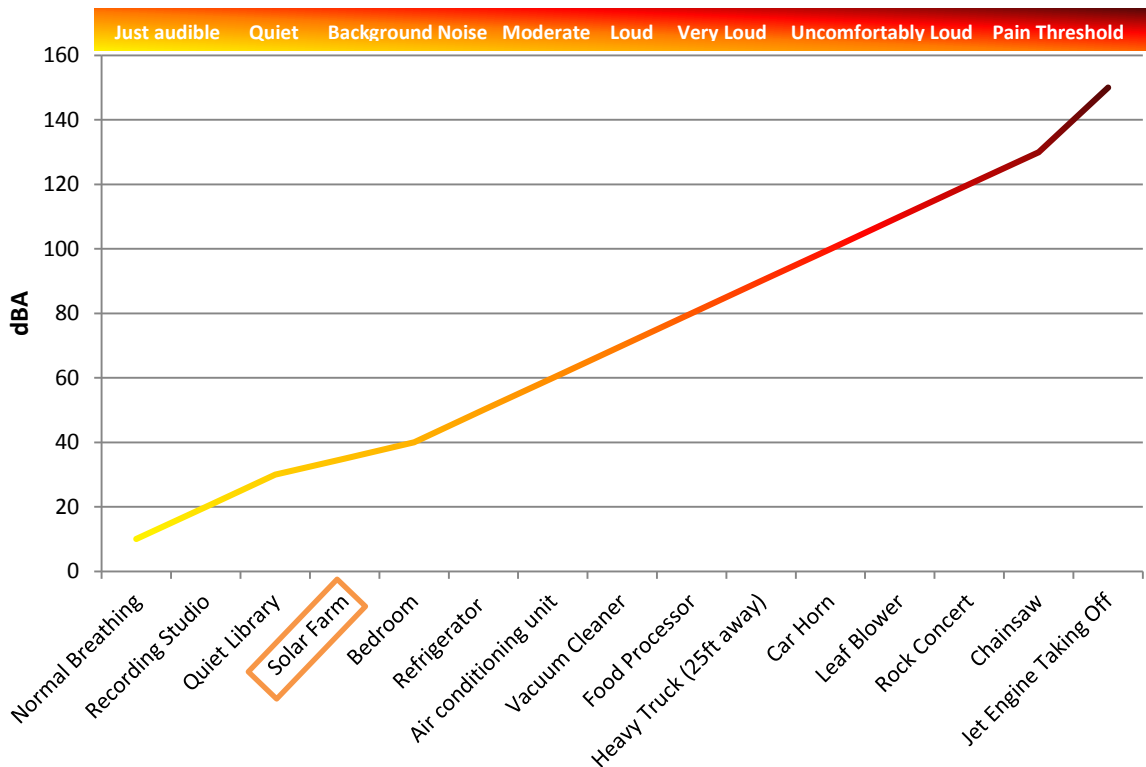
### 5.4 NOISE

Solar farms are not noisy developments. The PV panels, which comprise the main feature of solar farms, do not generate any perceptible noise.

The inverter cabinets are fitted with cooling fans, which generate a small amount of noise whilst the solar farm is operating during the day. However, the cabinets trap the majority of noise generated. Solar farms only operate during daylight hours, thus there is no noise generated at all in the evening, night and early morning, when ambient noise levels are typically lowest.

Lightsource has strict conditions relating to noise within the contracts we have with the specialist Engineering, Procurement and Construction (EPC) firms that we use to construct our solar farms. These conditions require that a maximum noise level of 35dBA is not exceeded at the site boundary. What this means in practice, is that there will be no audible noise beyond the site boundary once ambient noise is taken into account. To put the figure of 35dbA into perspective, a normal conversation typically ranges between 44 and 65dBA.

The graph below shows some typical noise levels as a comparison.



## 5.5 GLINT AND GLARE

There is sometimes a misconception that PV panels might result in significant adverse glint and glare effects, with reflected sunlight creating a nuisance or even a safety risk for planes or traffic. This is not the case. The glass used to make the panels is not like window glass; it is specifically designed to absorb as much daylight as possible to convert to electricity, and therefore has a low level of reflectivity when compared to surfaces such as window glass, water or snow. Less than 9% of total incident visible light is reflected by PV panels, whereas normal glass reflects about 17%.

The potential for glint and glare from a solar farm is much lower than the potential for glint and glare from other man-made structures such as poly tunnels and glass houses, as well as natural features such as water or snow.

Glint refers to a specular reflection, produced as a direct reflection of the sun off of a surface. Glare refers to a continuous source of brightness, being the general reflection of a bright sky rather than a direct reflection of the sun.

In summer, once the sun reaches sufficient height in the south eastern sky, sunlight will fall directly on the panels and there may be a slight chance of glint occurring, however, the reflected beam will be directed back into the sky toward the south west. During the winter, the location of the sun in the sky means light would be reflected back into the sky toward the west-southwest. Because most of the reflections from the panels will be skyward, the solar farm will not create a traffic hazard, or nuisance to residential properties.

This skyward reflection does not create a safety hazard for aeroplanes. In Germany and the USA it is common for PV systems to be installed on airport terminal buildings, or within airport grounds, and in 2012 solar panels were installed on the terminal buildings at Birmingham and Gatwick Airports in the UK.

## 5.6 ECOLOGY

The Ecological Phase 1 Assessment concludes that the site and surrounding land has the potential to support protected species, and the wider area offers some possible foraging and roosting habitat for bats and birds. A number of mitigation measures are set out in the accompanying ecological assessment including:

- Birds: Either ground works to take place outside of bird breeding season (March – Sept), or an ecologist should check any vegetation to be removed prior to its removal.
- Bats and Dormice: Retain and enhance the existing boundary hedgerows.
- Badger and other small mammals: Small mammal gates will be incorporated in the fence to allow for continued access through the site.
- Amphibians and Reptiles: all ponds on site will be retained, and buffer zones have been incorporated into the layout design, and a series of Reasonable Avoidance Measures (RAMs) will be implemented during construction to avoid adverse impacts on Great Crested Newts.

Overall, it is considered that with appropriate mitigation measures in place, there will not be an adverse impact on ecology. Proposed habitat enhancement features are also proposed to improve biodiversity and habitat values within the site.

## 5.7 CULTURAL HERITAGE

The Archaeology and Cultural Heritage assessment submitted with this application assesses the potential for the proposal to impact on heritage assets. There are no recorded heritage assets located within or adjacent to the site. Within the 5km search area assessed six Schedule Monuments, two Grade 1 listed buildings, and 13 Grade II\* listed buildings were identified. Within 1km of the site 4 Grade II listed buildings were identified.

The heritage assessment concluded that no designated heritage assets will be physically impacted upon by the proposed solar farm, and that the potential for impacting on unrecorded buried archaeology is slight. There will not be any significant adverse setting impacts, with the potential impact on the registered Maelor Saesneg historic landscape being assessed as slight. The proposed planting to fill in gaps in the hedgerow will mitigate this impact.

## 5.8 FLOOD RISK

The site is located in Flood Zone A. The Flood Risk Assessment accompanying this application concludes that the proposed development of a solar farm at the subject site will not result in any discernible change to quantity or rate of run-off from the site. The development will not increase the risk of flooding on either the subject site, or the surrounding areas. Additional engineered drainage features were not considered necessary for this development proposal.

## 5.9 VIBRATION

The solar farm does not involve any moving components; therefore there is no potential for any vibration impact.

## 5.10 EMISSIONS

The development will not result in any emissions. To the contrary it will in fact help to reduce the level of CO<sub>2</sub> emissions in the UK associated with electricity generation.

## 5.11 WASTE

The solar farm will not produce any waste, therefore no onsite waste storage or waste collection is required during operation.

## 5.12 CONSTRUCTION

The Construction, Decommissioning and Traffic Management Method Statement accompanying this application provides detailed information regarding the construction activities associated with developing the proposed solar farm. It is considered that any adverse effects on the surrounding area arising from the construction period will be minor and temporary only in nature.

## 5.13 DECOMMISSIONING

PV modules have an operational life of over 30 years, with most Tier 1<sup>14</sup> panels still working at 80% of the original capacity after their 25 year warranty period, thus it is not anticipated that many will need to be replaced over the life of the system. Once the panels reach the end of their life, or earlier if a term is imposed through planning conditions, the site will be decommissioned, all infrastructure removed, and the site restored to its original state.

The Construction, Decommissioning and Traffic Management Method Statement accompanying this application provides detailed information regarding the decommissioning process.

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<sup>14</sup> Lightsource only use Tier 1 panels in their solar farms. 'Tier 1' refers to the top 20% of panels in terms of the efficiency, performance, and longevity.

## 6 PLANNING POLICY

### 6.1 EUROPEAN POLICY

The UK has signed up to the EU Renewables Directive, under which our legally binding target is for 15% of total UK energy consumption to be generated from renewables by 2020, with this target rising to 80% by 2050.

The UK's Renewable Energy Strategy (RES) sets out how the UK will increase its renewable energy generation and reduce greenhouse gas emissions. The RES is based on a scenario of 30% of electricity, 12% of heat and 10% of transport being generated from renewables by 2020. In 2012 UK electricity generation from renewable sources was 11.3%, an increase of 1.9% from 2011.<sup>15</sup> A substantial increase will be required in order to achieve 30% by the end of this decade.

### 6.2 NATIONAL POLICY

#### 6.2.1 NATIONAL ENERGY POLICY

The UK Government is committed to meeting our renewable energy targets, which are set out in national policy through the Climate Change Act of 2008. Section 13 of this Act states that there is a duty for the Secretary of State to prepare proposals and policies for meeting carbon reduction targets. These obligations fall to Local Planning Authorities.

In 2011 the Department of Energy and Climate Change published the UK Renewable Energy Roadmap, which was updated in 2013. This presents the framework for the delivery of renewable energy deployment in the UK; it reiterates the UK Government's commitment to meeting our renewable energy targets. 2013 also saw the publication of the UK Solar PV Strategy Roadmap which states that "*Solar photovoltaic (PV) technology is a mature, proven technology and is a reliable source of renewable energy with an important role to play in the UK energy generation mix.*" Paragraph 13 of this Strategy notes that presently solar PV accounts for 12% of renewable electricity capacity in the UK.

The Welsh Government Energy Policy Statement (March 2010) provides key policy direction on renewable energy schemes, by setting a target of being in a position where almost all local energy needs can be met by low carbon energy production.

#### 6.2.2 NATIONAL PLANNING POLICY

Planning Policy Wales (Edition 6, Feb 2014), sets out the land use planning policies of the Welsh Assembly Government, and is supplemented by a series of Technical Advice Notes (TANs). Planning Policy Wales and the relevant TANs are material to decisions on planning applications.

#### Planning Policy Wales (Feb 2014)

As set out in paragraph 4.2.2, the Welsh planning system "*provides for a presumption in favour of sustainable development.*" Section 4.3 details the core principles which underpin the approach to planning policy for sustainable development, these include:

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<sup>15</sup> Department of Energy and Climate Change (2013) *Digest of UK Energy Statistics*

- *Engagement and involvement, ensuring that everyone has the chance to obtain information, see how decisions are made and take part in decision-making;*
- *Respect for environmental limits, so that resources are not irrecoverably depleted or the environment irreversibly damaged. This means, for example, mitigating climate change, protecting and enhancing biodiversity, minimising harmful emissions, and promoting sustainable use of natural resources;*
- *Tackling climate change by reducing the greenhouse gas emissions that cause climate change and ensuring that places are resilient to the consequences of climate change;*

The proposal for a solar farm to generate energy from a renewable resource (daylight) without generating greenhouse emissions, and the community engagement work undertaken pre-application, are consistent with these core principles.

Section 4.4 sets out the sustainability objectives that the Welsh Assembly Government seeks to deliver through planning policies, decisions and proposals, including:

- *Support the need to tackle the causes of climate change by moving towards a low carbon economy. This includes facilitating development that reduces emissions of greenhouse gases in a sustainable manner, provides for renewable and low carbon energy sources at all scales and facilitates low and zero carbon developments.*
- *Contribute to the protection and improvement of the environment, so as to improve the quality of life, and protect local and global ecosystems. In particular, planning should seek to ensure that development does not produce irreversible harmful effects on the natural environment and support measures that allow the natural heritage to adapt to the effects of climate change. The conservation and enhancement of statutorily designated areas and of the countryside and undeveloped coast; the conservation of biodiversity, habitats, and landscapes; the conservation of the best and most versatile agricultural land; and enhancement of the urban environment all need to be promoted*

The proposal for a solar farm is consistent with the above objectives.

As noted in paragraph 4.5.1, tackling climate change is considered to be a “*fundamental part of delivering sustainable development.*” The Welsh Assembly Government has set out a commitment to tackling climate change and reducing the carbon footprint of Wales.

Paragraph 4.5.2 sets out the Welsh Assembly Government’s goal of achieving at least a 40% reduction in all greenhouse gas emissions by 2020 (against a 1990 baseline). The approach to climate change is two-fold, focusing both on the reduction of emissions to avoid the worst impacts of climate change, and preparing for the consequences of climate change. As noted in paragraph 4.5.7, actions to minimise climate change include facilitating the delivery of sustainable forms of energy.

Paragraph 12.10.1 sets out the matters that local planning authorities should take into account in determining applications for renewable energy developments:

- *The contribution a proposal will play in meeting identified national, UK and European targets and potential for renewable energy, including the contribution to cutting greenhouse gas emissions;*
- *The wider environmental, social and economic benefits and opportunities from renewable and low carbon energy development;*
- *The impact on the natural heritage, the Coast and the Historic Environment;*

- *The need to minimise impacts on local communities to safeguard quality of life for existing and future generations;*
- *Ways to avoid, mitigate or compensate identified adverse impacts;*
- *The impacts of climate change on the location, design, build and operation of renewable and low carbon energy development. In doing so consider whether measures to adapt to climate change impacts give rise to additional impacts;*
- *Grid connection issues where renewable (electricity) energy developments are proposed; and*
- *The capacity of and effects on the transportation network relation to the construction and operation of the proposal.*

The site has been chosen due to its location in close proximity to a viable grid connection, as well as its well-screened location. Due to the surrounding woodland and hedgerows, there is little potential for visibility from public areas or private residences. In addition, the proposal has been designed to avoid impacts on ecological resources, and precautionary construction practices will be utilised to minimise any construction-related impacts on the local ecological resource.

The proposal will contribute significantly to local and national renewable energy generation targets, whilst minimising any potential adverse effects on the surrounding environment.

#### **Technical Advice Note 8: Planning for Renewable Energy (July 2005)**

With regard to the TANs, TAN 8: Planning for Renewable Energy, is focused on delivering renewable energy targets through the planning system and is therefore of particular relevance to this proposal. In paragraph 2. 1 it is recognised that the planning system has an important part to play in achieving the Welsh Assembly Government's commitment to enable the development of all forms of renewable energy.

The Tan was prepared in 2005, and as such does not consider large scale ground mounted solar installations which were not yet an established development form in the UK. Therefore, it is important to also take into account more recent guidance from the Welsh Assembly Government regarding large scale solar.

#### **Practice Guidance: Planning Implications of Renewable and Low Carbon Energy Development**

The Guidance document was produced in February 2011 to assist local planning authorities in determining applications for renewable and low carbon energy developments. The guidance summarises the key issues for consideration when determining an application for a solar array:

- Landscape and visual impacts
- Glint and glare
- Ecology
- Historic environment
- Agriculture
- Hydrology and flood risk
- Cumulative impacts

Each of these matters are addressed both within this report, and the accompanying technical assessments.

## 6.3 LOCAL PLANNING POLICY

The relevant local planning framework is made up of the Wrexham Unitary Development Plan, adopted in 2005. The Wrexham Unitary Development Plan 2 is currently under preparation, with a preferred strategy currently being formulated. Currently, this Plan is not expected to be adopted until 2016, and as such no weight has been applied in this instance.

### 6.3.1 WREXHAM UNITARY DEVELOPMENT PLAN 1996 - 2011

The following District-wide Strategic Policies are considered relevant to the proposal:

**Policy PS2** *Development must not materially detrimentally affect countryside, landscape/townscape character, open space, or the quality of the natural environment.*

**Policy PS3** *Development should use previously developed brownfield land comprising vacant, derelict or underused land in preference to the use of greenfield land, wherever possible, particularly so where greenfield land is of ecological, landscape or amenity value, or comprises agricultural land of grades 1, 2 or 3a quality.*

**Policy PS11** *Encouragement will be given to proposals which improve the biodiversity value of sites and to the establishment of local nature reserves where the nature conservation and landscape interest of the land will be protected and enhanced.*

**Policy PS12** *Proposals for the generation of energy from renewable sources will be supported provided that the wider environmental benefits are not outweighed by any detrimental impacts of the proposed development (including any electricity transmission facilities needed) on the landscape, public safety, and the local environment.*

This framework sets the presumption in favour of renewable energy developments, provided any adverse effect associated with them is not unacceptable. This is consistent with National Policy. The site has been located and designed so as to be minimal in terms of its visual impact, so will have a negligible impact on the character of the countryside and surrounding natural environment.

The proposal incorporates a number of ecological/biodiversity enhancement measures, which will enhance the overall ecological resource on site. As discussed in section 5.1.2 above, solar farms are now well documented as to their potential for biodiversity gain, and the measures proposed seek to ensure this is applicable to this proposal.

Finally, the site is located on a mixture of Agricultural Grade 3b and 4 land, as well as a small area of non-agricultural land, thus ensuring that the best and most versatile land is avoided from development and retained for agricultural use.

In addition to the above, the following policy is also relevant to the proposal, being located within a Special Landscape Area:

**Policy EC5** *Within Special Landscape Areas, priority will be given to the conservation and enhancement of the landscape. Development, other than for agriculture, small-scale farm-based and other rural enterprises, and essential operational development by utility service providers, will be strictly controlled. Development will be required to conform to a high standard of design and landscaping, and special attention will be paid to minimising its visual impact both from nearby and distant viewpoints.*

The proposal has been sited and designed so as to minimise its visual impact on the surrounding environment. Given the flat nature of the site and well established boundary screening, there is little potential for adverse effect on short and long distanced viewpoints. Accordingly it is considered that the proposal would not adversely affect the character of the Special Landscape Area in this instance.

#### **6.4 GRID CONNECTION LEGISLATION**

This planning application does not include the works or infrastructure associated with the connection to the grid network except for the onsite substation/switchgear.

Works required for the underground cable to connect the solar farm to the electricity grid network are undertaken by the Distribution Network Operator as a Statutory Undertaker under Part 17, Class G(a) of the General Permitted Development Order.

## 7 CONCLUSION

The Trench Farm solar farm will increase the UK's sustainable, locally generated, energy supply, by providing enough clean energy to power 1912 households. Growing our renewable energy generation capacity will both reduce our carbon emissions and enhance security of energy supply by lowering our reliance on volatile international fossil fuel markets.

There is strong policy support for the development of large and small scale renewable energy developments, provided that the environmental impacts of individual proposals are acceptable, or can be made so through mitigation strategies.

It is considered that the impacts of the proposal will be acceptable, given the proposed design and site characteristic, including the extensive boundary vegetation which screens the site from most vantage points. Where potential environmental impacts have been identified, detailed assessments have been undertaken and these accompany this application.

Consultation has been undertaken with the LPA, local Community Council and local community, and issues raised during this engagement process have been addressed as detailed in the accompanying Statement of Community Involvement.

The proposal has been shown to comply with the relevant planning policy framework therefore, planning permission should be granted.

## APPENDIX A – COMPARISON OF ENERGY GENERATION OPTIONS

| Energy Generation Method                                                                                          | Comparison with Solar Farms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Wind Farms</b><br>            | <ul style="list-style-type: none"> <li>• A 1MW turbine is typically 80m high to the hub, with a ground to blade tip height of 120m, thus they have a much wider reaching visual impact than solar farms.</li> <li>• Solar farms are very quiet, and do not create noise and vibration issues for local communities, as wind farms sometimes can.</li> <li>• Solar farms are static and passive with no moving parts. Thus they do not draw attention through movement like turbine blades, and pose no threat to birds.</li> <li>• Wind turbines only produce energy when the wind is strong enough, but not too strong. Solar panels produce electricity during all daylight hours.</li> <li>• Wind turbines do produce a large amount of energy based on the small ground area that they require.</li> </ul> |
| <b>Hydropower</b><br>           | <ul style="list-style-type: none"> <li>• Hydropower is limited by the availability of large rivers.</li> <li>• The creation of the dam lake destroys the local habitats in the areas that are flooded, as well as impacting on downstream river ecosystems by altering the river flow.</li> <li>• Hydropower can produce large volumes of energy throughout the day, so long as water is available.</li> <li>• Effects of dams are significant in comparison with the low impact nature of a network of comparatively small solar farms.</li> </ul>                                                                                                                                                                                                                                                            |
| <b>Anaerobic Digestion</b><br> | <ul style="list-style-type: none"> <li>• Whilst biomass energy production results in lower carbon emissions than fossil fuel energy generation methods, the operation of solar farms results in zero carbon emissions.</li> <li>• Solar farms do not emit any air pollutants or odours.</li> <li>• Anaerobic digestion plants require less land than solar farms; however, they still involve large industrial style buildings.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Nuclear</b><br>             | <ul style="list-style-type: none"> <li>• Nuclear power has the benefit of being able to generate large amounts of electricity at any time of day.</li> <li>• Nuclear power stations are large buildings, with much greater visual impacts on the local surrounding area than a network of comparatively small scale solar farms.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <ul style="list-style-type: none"> <li>• Nuclear waste is highly toxic and expensive to dispose of.</li> <li>• Uranium is mined in large scale open cast mines, impacting significantly on the country of origin.</li> <li>• New nuclear power station developments require far higher subsidies than those provided for renewable electricity generation options.</li> </ul>                                                                                                                                                                              |
| <p><b>Fossil Fuels</b></p>  | <ul style="list-style-type: none"> <li>• The burning of fossil fuels to create energy is currently cheaper than renewable energy methods; however it results in significant carbon emissions, and other air pollutants.</li> <li>• Fossil fuels are a non-renewable resource, and the UK is often at the mercy of global price fluctuations.</li> <li>• Extraction of fossil fuels including mining, fracking, and oil wells can have significant adverse impacts.</li> <li>• Solar panels have a lifespan of over 30 years, whereas coal can only be burnt once.</li> <li>• Solar farms do not emit any air pollutants or odours.</li> </ul> |