15th June 2021

Renia Kotynia,
East Cheshire Council,
Westfields,
Middlewich Rd,
Sandbach
CW11 1HZ

cc. Kenny Dhillon, Dan Griffiths, Emma Williams, Andy Norton

Re: Alternatives Analysis for Leighton Grange Farm, Cheshire East, Crewe, CW1 4QQ, UK

Dear Renia,

In accordance with the scope, this letter outlines results of a preliminary lay-out analysis of requested alternative structural configurations and associated yield estimates for a proposed solar farm development located at Leighton Grange Farm, Cheshire East, Crewe, CW1 4QQ, UK.

Three scenarios have been simulated:

i) South facing fixed structures.

ii) East-West fixed structures

iii) East-West structure with tracking.

Our analysis is based on a PVSyst simulation of a block with 25 stringing inverters. We have calculated "packing ratios" (kWp/ha) for each option and extrapolated these figures to estimate total land requirement for a 6,664 MWp/5,000 MVA solar farm composed of each of the different configurations based on the available land, as provided in .kmz for by East Cheshire council. We have marked areas of obvious exclusion in a Block Plan appended to this letter, and have calculated a total land area of 14 ha with an available, usable, area at between 5.39 and 9.31 ha.

Recommended Component Specification:

The following represents the proposed principle components of the solar farm, which is in our experience represents the current best practice component selection for the UK market;

- Risen 595Wp RSM120-8-595BMDG Bi-Facial Modules.
- Huawei SUN2000-215KTL-H3 215kW 800V AC High Voltage string inverters
- A block is 5,000MVA with 25 inverters, 11,200 RISEN modules (consisting of 14 strings of 32 panels each), is connected to an STS-6000 transformer rated at 5,000 MVA.
- Total block capacity: 6,664 kWp/5,000kWn

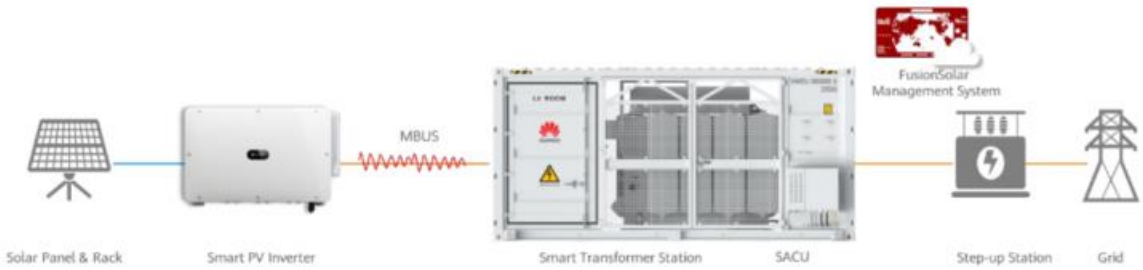

Figure 1 Huawei FusionSolar smart PV solution

Layout Arrangement Alternatives:

We have used the same distance between rows (10m) according to a shading limit angles 15.0 deg. This distance provides a minimal shading limit angle (15 degrees) by considering the inclination of the tables and the latitude of the location.

In all cases, the panels are configured in "2 in portrait". Each module is 1303mm x 2172mm. The tables are configured with 2 rows by 200 columns. This is in order to create a comparable analysis.

Layout drawings for each option can be found in Appendix C.

Alternative i) Fixed structure facing south.

The inclination of the structure is 22º. The annual yield will be 7,003 MWh with a specific yield of 1,051 kWh/kWp. The block occupies 9.31 ha, and the packing ratio is therefore 715,79 kWp/ha. The distance between rows is 10m and the shading limit angles 15.0 deg.

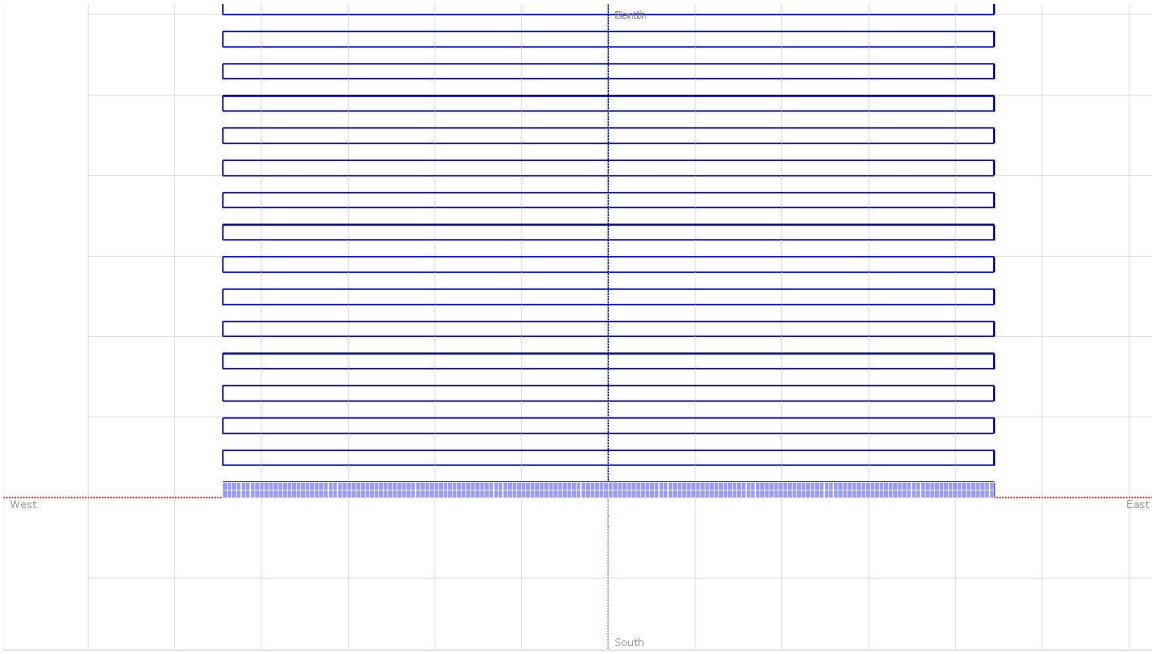

Figure 2 South facing fixed structures

Alternative ii) East-West fixed structure.

The inclination of the structure is 22º. There are the same number of panels facing east as west. The annual yield will be 5,881 MWh with a specific yield of 883 kWh/kWp. The block occupies 5.39 ha, and the packing ratio is therefore 1,236.36 kWp/ha. The distance between rows is 10m and the shading limit angles 15.0 deg.

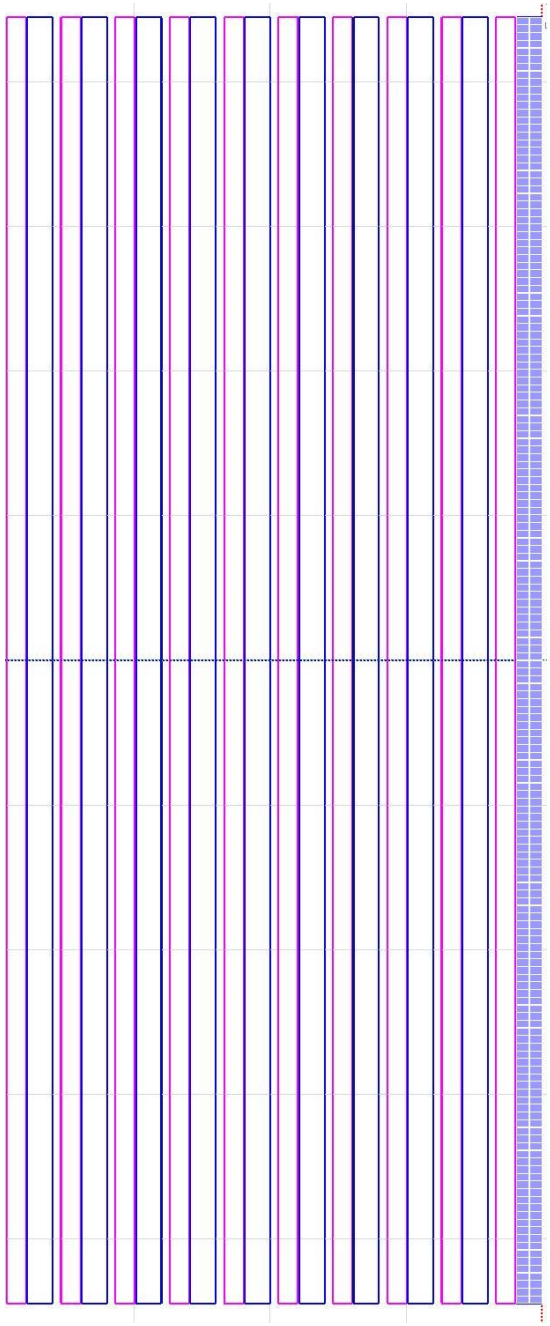

Figure 3 East-West fixed structures

Alternative iii) East-West structure with tracking.

The inclination of the structure is variable. The modules are oriented from east to west and rotate on a horizontal axis located from north to south. We have assumed a tracker manufactured by Ideematic. The maximum angles of inclination towards east/west is 60º. The annual yield will be 7,493 MWh with a specific yield of 1,124 kWh/kWp. The block occupies 8.93 ha, and the packing ratio is therefore 746.25 kWp/ha, the same as the south facing array. The distance between rows is 10m and the shading limit angles 15.0 deg.

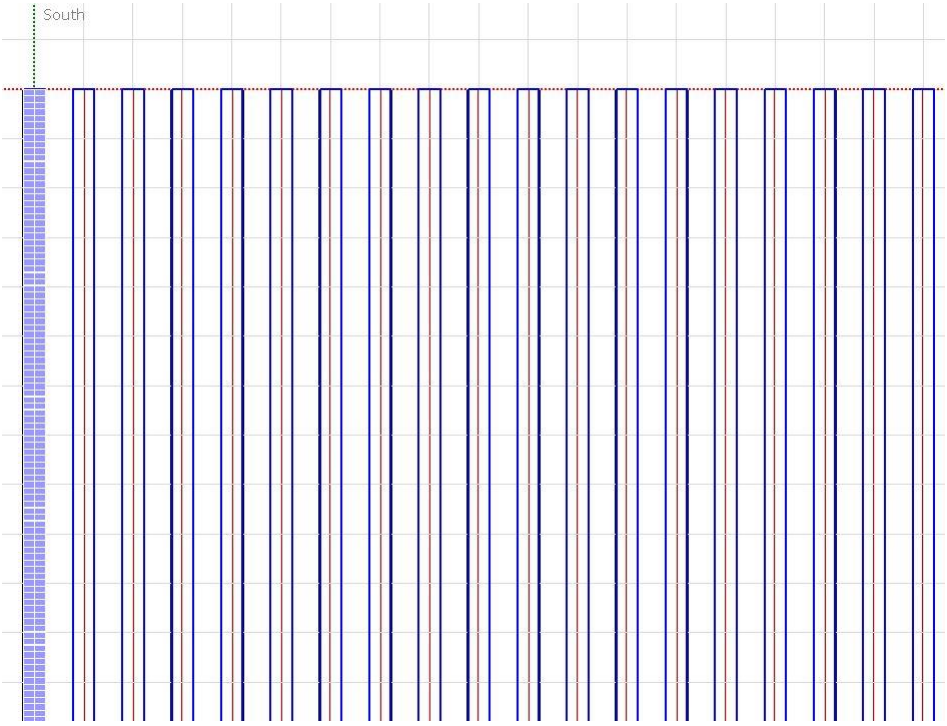

Figure 4 East-West structure with tracking

Summary Yield Results

System outputs for the projects have been modelled using PVSyst, industry-standard, validated modelling software. These estimates have been made based on the components specified. We have incorporated a degradation assumption into our models, however our experience over 10 years of operation at other sites is that this effect is minimal. We used PVGIS to generate half-hourly data profiles and scaled these to match the annual yields calculated by PVSyst.

We find that the modelled outputs are accurate subject to a sensible maintenance Planned Preventative Maintenance (PPM) regime. Modelled outputs are average yearly figures and may vary from year to year.

Inevitably, any estimates come with a degree of uncertainty and while we have used our best endeavours to provide accurate information, it is impossible to predict exactly what the output from the installation will be in any given year due to the natural variation in solar irradiation from one year to the next. Generally, the modelling is within +/-5% of actual output but the average generation over the life of the scheme should be highly accurate.

Structural Configuration	TIC (MWp)	Land Area (ha)	Estimated Yield (MWh/y)	Specific Yield (kWh/kWp)
South fixed structure	6.664	9.31	7,003	1,051
East-West fixed structure	6.664	5.39	5,881	883
East-West structure with tracking	6.664	8.93	7,493	1,124

PVsyst model has been prepared for each site scheme option, the model, a summary of these models has been annexed to this report in Appendix B.

Annual Generation Analysis

The basis for an accurate analysis is a half-hourly (HH) demand profile and the superposition of the modelled solar generation. A half-houly data profile for the Compost plant has been provided. The average yearly electrical demand figures for day and night, are as follows;

Structural Configuration	South Fixed	EW Fixed	EW Tracking
Existing Grid Import (MWh/y)	2,238	2,237	2,237
Solar Generation (MWh/y)	7,003	5,881	7,493
Renewable Self-Consumption (MWh/y)	1,021	1,022	1,029
Solar Export (MWh/y)	5,982	4,858	6,463
Residual Grid Import (MWh/y)	1,216	1,215	1,208

Due to the fact that the solar capacity is significantly over sized in relation to the compost plant demand, the analysis shows that there is little difference between the renewable self-consumption figures of each option.

Financial Modelling

Cost Estimates

The capital and installation costs in our estimate have been built up from component level and broken down to; modules, inverters, access costs, DC cable, AC cable, powered equipment costs, skilled labour, electrical switchgear, transportation, travel, testing, commissioning, our company overhead and margin. These are budgetary estimates and require confirmatory site visits by our mechanical and electrical engineers. Our estimate assumes are based on a fully inclusive, turn-key delivery of the solar project.

The cost estimates are fully inclusive of design work, and includes any detailed design to be shared with the DNO including, single line diagrams, site layouts, cable calculations, including protection coordination studies and all equipment specifications etc.

Commercialisation Analysis

Due to the opportunity for a “behind-the-meter project”, the return on investment is significantly higher than selling electricity directly to the grid due to the high off-set price obtainable by offsetting on-site generation at the Compost Plant. The use of solar “behind the meter” allows “renewable self-consumption” at an energy cost which is lower than the high cost of purchasing electricity from the grid. This "self-consumed" electricity off-sets what would otherwise be bought from the grid. The grid price of electricity includes both commodity and non-commodity costs (we have assumed Hitachi are paying £150/MWh but this will depend on their supply agreement which we have not seen) - it is this unit cost (multiplied by the MWh of self-consumed generation) which would be saved (offset) by the installation of PV. The financial analysis computes the full-value cash-flows of the project and does not consider the value of a potential Power Purchase Agreement (“PPA”) that might be negotiated between the Council and the Compost Plant – this can be analysed at a later stage.

We have modelled the value of electricity that can be sold back to grid at £55/MWh under the Smart Export Guarantee (“SEG”) to Suppliers such as EON or Npower which is applicable for projects <5MW capacity.

A discounted cash flow model has been prepared for each site scheme option, the model, a summary of these models has been annexed to this report in Appendix A.

Financial Analysis	South Fixed	EW Fixed	EW Tracker
Cost (£m)	3,332	2,998	3,998
Cost/kW	500	450	600
IRR	12.9%	11.6%	11.4%
NPV@5%d.r. (£m)	3,097	2,368	2,906
Payback	8.64	9.22	9.31

Conclusions and Recommendations

The available land area is sufficient for a 6.664 MWp solar farm capacity for all options. The south facing and east-west tracker options both require around 9ha, whereas the east-west fixed structure option requires around half that land area (5 ha). The highest specific yield is obtained by the East-West tracker option (1,124kWh/y) which is around 27% greater than that of the East-West fixed structure option.

The financial modelling analysis demonstrates that the South Fixed option is preferable, however although not considered as part of the scope of study, we would expect a significantly higher return on investment for a smaller size of solar farm of around 2-3MWp.

East Cheshire council should decide on the basis of the analysis, which of the alternative designs should be taken forward to full planning design, taking into account the drivers for the project including carbon abatement targets, land area and financial return.

Yours sincerely,

Jonathan Bensted MEng (Oxon) CEng MIMechE

SSWUK Ltd

Managing Director