A BRIEF GUIDE TO SOLAR PV ON LARGE ROOFS.

INTRODUCTION

From an embryonic start, the solar PV industry has grown at a dramatic rate in the last three to four years. The industry has grown into a thriving market which now employs over 20,000 people in the UK. This expansion has initially been supported by government policy and incentives. In the last few years, this growth has been further fuelled by rapidly falling PV manufacturing costs and rapidly increasing conventional electricity costs. The combination of these three things means that solar PV continues to provide a very attractive return on investment.

TECHNOLOGY

Solar PV systems generally comprise of three main components, these are the solar PV modules, the inverter and the mounting fixtures.

Solar PV Modules:

The solar PV module uses sunlight to generate electricity. Obviously, as the level of sunlight fluctuates throughout the day or throughout the year, the amount of electricity produced will vary. The design, quality, pitch and orientation of modules are all critical to the performance delivered from a PV system.

A typical solar PV module that you would see on many houses is about 1m wide by 1.6m tall. The power output of a Solar PV module is rated in Watts-Peak (Wp). The majority of modules are 250Wp modules, which means they will produce 250W of power when exposed to a set level of light in laboratory conditions. Obviously the actual output of a module installed on a roof varies considerably depending on light levels. Four modules connected together will produce a 1 kWp solar array (4 x 250Wp). The biggest system that you would typically find on a house is a 4 kWp array comprising of 16 modules (16 x 250Wp each) but much larger systems are possible on commercial buildings.

The majority of solar PV modules are now manufactured in Asia. This has had the effect of dramatically reducing the cost of installing solar PV. Over the last five years, solar PV modules have fallen in price by over 50%.

It is important to note that not all modules are the same. Choosing the right module can be complicated and buyers should consider issues relating to quality, warranty and efficiency when making their choice.

Inverters:

The inverter is arguably the most important part of any solar PV installation. The inverter collects the power from all of the solar PV modules and converts it from D/C to A/C power. Once the electricity has been converted to the right frequency and voltage, power can then be used within the building or exported onto the electricity grid. The choice of inverter can make a big difference to the performance and reliability of a solar PV system. For this reason, inverters should be carefully matched to the type of solar PV module that has been chosen.

An average industrial size inverter is about the size of a domestic central heating boiler.

Mounting frame:

A huge variety of mounting brackets exist, thus enabling solar PV systems to be installed on almost any type of roof. On pitched roofs, most systems are screwed directly to the roof or to the structural steel work or timber underneath the roof covering. On flat roofs, it is common to use ballasted systems which simply use weights or aerodynamic forces to fix the PV modules onto the roof.

As mentioned earlier, Solar PV installations on domestic roofs are generally limited to 4 kWp, however industrial or commercial facilities can accommodate much bigger installations; potentially greater than 1000 kWp. Most industrial and commercial roofs can accommodate a system of 50 kWp and we have therefore used this as the basis of discussion for the rest of this guide.

SYSTEM SIZING & DESIGN

Compared to some renewable energy technologies, designing and sizing a solar PV system is a relatively straightforward process. This has become especially true in recent years, as engineers frequently use software programs to calculate system outputs etc.

An initial estimate of system size and orientation can often be made by looking at the building on Google Earth. Basics measurements taken from Google Earth can then be used to estimate the possible dimensions of a solar PV array. From this, the predicted power output and likely revenue, cost and carbon savings can also be calculated.

A 50 kW system, as mentioned earlier, would require some 200 solar PV modules. If mounted side-by-side on a pitched roof, this would require approximately 320 m² of roof surface. Modules work better when mounted at an angle from the horizontal plane and when facing approximately south. Solar PV mounting on a flat roof delivers a somewhat lower output per unit roof area, due to the need to space modules out in order to overcome shading issues and due to a reduced mounting angle. This is balanced with the opportunity to orientate modules on a flat roof to optimize power output.

ABOUT GOVERNMENT INCENTIVES

In order to incentivise the installation of more renewable energy technologies, the Government has introduced two incentive schemes aimed at supporting technologies such as solar PV, wind power and anaerobic digestion. Solar PV systems above 50kWp can subscribe to either system, however the use of the Feed In Tariff system (FITs) is more common on smaller systems.

Feed In Tariff: The smaller of these incentive schemes is called the **Feed in tariff scheme (FITs).** Under this scheme the owner of the solar PV system would receive two payments based upon the number of kilowatt hours generated by the plant. The first of these payments is a *generation tariff* which rewards the operator purely on the basis of the number of kilowatt hours generated, irrespective of who consumes the power. A second payment is also made for any electricity which is exported onto the electricity grid and this is known as an *export tariff*. The operator of the solar PV system has the opportunity to forego the export tariff and to use the power themselves or sell it to a third party via a Power Purchase Agreement (PPA).

At the time of writing (June 2015), solar PV schemes between 50kWp and 150kWp receive 9.98p for each kWHr generated and 4.85p for each kWHr exported to the grid. These figures are continuously under review by the Government, and we reflect this in any proposals or business cases that we prepare.

Renewable obligation scheme (RO). In order to meet the U.K.'s National renewable energy targets, the UK Government has also placed obligations on the UK's major electricity producers to deliver an

annually increasing percentage of the U.K.'s electricity from renewable sources. The major utility companies have the option to discharge this obligation directly themselves by constructing renewable energy installations. Alternatively, these obligations can be met by supporting others who generate renewable energy. Under the Renewable Obligation, an independent generator of renewable electricity can sell their electricity on the open market based on a price per kilowatt hour. In addition to the income from the sale of electricity, the generator also receives something called a Renewable Obligation Certificate (ROC). The certificates may then be sold by the generator in the open market in order that larger utilities can purchase these certificates so they can meet their own obligations.

THE BUSINESS CASE

The cost to install a quality 50 kWp PV system is currently in the range of £55,000 (June 2015), although larger systems can cost less than this. The most profitable installations are those which consume most of the power generated, thus minimizing 'bought-in' electricity costs. Therefore, buildings such as retail outlets, offices and manufacturing facilities often result in better business cases.

At the time of writing, a 50kWp system based in the south of the UK, would typically provide financial benefits in the region of £6,700 per annum** (that's an annual index linked generation subsidy of about £4,500 plus an export tariff of £2,200) ... depending on roof orientation, system details and how much power a site uses each day.

Once in place, the system will generate power for 25 years with little maintenance.

IS MY ROOF SUITABLE?

If you are interested in finding out more, we would be very happy to assist in the preparation of the initial business case. Before doing this we would first recommend that you consider the following points:

Building ownership. Obviously the installation of solar PV is a long-term investment. Very often buildings may be leased on a short-term basis and it is always worth considering if a lease agreement may be an impediment to you hosting a solar PV scheme.

Roof orientation and shading. The best roofs for a solar PV installation are south facing roofs or flat roofs that are free of any significant shading. Power outputs from north facing roofs are much lower, thus weakening the financial business case.

Power consumption: if you have a number of buildings, it is often best to start with those buildings which consume the most power. Whilst surplus power can be exported to the electricity grid at 4.85 pence per kilowatt hour (June 2015), it is much more beneficial to use the electricity, thus avoiding the purchase of electricity at anything from 8p to 1p per kilowatt hour.

Capital cost: many businesses prefer to finance their own solar PV installation. If a business has the available capital this is a good option. If this is not possible, we can provide fully financed solutions which allow the installation of a solar PV scheme at no cost to your organisation. In such instances, we sell reduced price electricity to the building users in return for the use of the roof.

WANT TO KNOW MORE?

If you are interested to learn more or would like us to prepare an outline business case for your organization, please don't hesitate to contact us using the details below:

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*** Figures based on a first year yield of 900kWHrs per kWp per annum, a 9.98p FIT generation tariff, 4.85p kWHr export tariff. Also assumes all power is exported rather than consumed on site.*