22 DEMONSTRATION EVENT

NFUScotland

Cronan Farm:
Solar PV and Energy Management

Cronan Farm
Coupar Angus
Perthshire
PH13 9EX

Farmer: Mike McLaren
Date of visit 16th December 2015

Mike McLaren has installed two solar PV schemes totalling 250kW at Cronan Farm. They have also installed an energy management system to reduce their onsite energy use of their potato and broccoli chillers.

Background

The McLarens farm 2,600 acres in Strathmore. The farm consists of 650 acres of potatoes, 450 acres of broccoli and 1,500 acres of cereals.

Cronan Farm has cold storage for 6,500 tonnes of potatoes a year and chilling for up to 30 tonnes of broccoli per day. The McLarens have installed solar PV and an advanced energy management system in order to off-set the high energy cost of the chillers.

Solar PV

The two solar PV systems were installed by Forster Energy, part of the Forster Group. The first system installed in 2013 is 176kW with a second 74kW system installed in January 2015, creating a combined 250kW. They are situated on two cold store sheds, which are positioned 45 degrees off south.

As the roof is off south there is a reduction in the output of the system, however this reduction is estimated to be less than 10% compared to a due south system. The table opposite shows how panel pitch and rotation affect the average output of solar PV schemes for an average site in the UK.

The 174kW scheme was installed without fully considering the FiT banding. With hindsight a scheme of 150kW would have been eligible for a higher tariff. This is partly because a 200kW system was initially proposed, however there was insufficient roof space available.

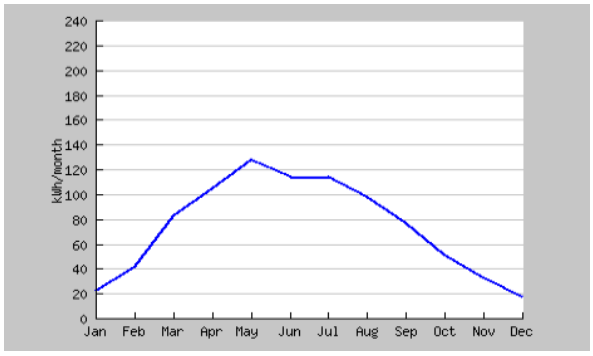
Impact of Pitch and Rotation on Solar Panel Output

TILT degrees	West										South								
	90	80	70	60	50	40	30	20	10	0	10	20	30	40	50	60	70	80	90
0	87	88	90	91	92	92	93	93	93	93	93	93	92	92	91	90	89	87	86
10	84	87	90	92	94	95	95	96	96	97	97	96	95	94	93	91	89	87	84
20	82	85	90	93	94	96	97	98	99	99	98	97	96	95	93	91	88	84	81
30	78	83	87	91	93	96	97	98	99	100	98	97	96	95	93	89	85	81	78
40	75	79	84	87	92	94	95	96	96	96	96	95	94	92	90	86	82	77	72
50	70	74	79	83	87	90	91	93	94	94	94	93	91	88	83	80	76	73	70
60	65	69	73	77	80	83	86	87	87	87	88	87	85	82	78	74	71	67	63
70	59	63	66	70	72	75	78	79	79	79	79	79	78	75	72	68	64	61	56
80	50	56	60	64	66	68	69	70	71	72	72	71	70	67	66	60	57	54	50
90	41	49	54	58	59	60	61	61	63	65	65	63	62	59	60	52	50	47	44

Source: www.solar-trade.org.uk

This year the PV array produced 220,000 kWh which means that the system achieved 880 kWh per kW of installed capacity. The diagram below shows how the ouput of a solar PV scheme will vary over a year in the Strathmore area.

Solar Output Estimates for Strathmore Area

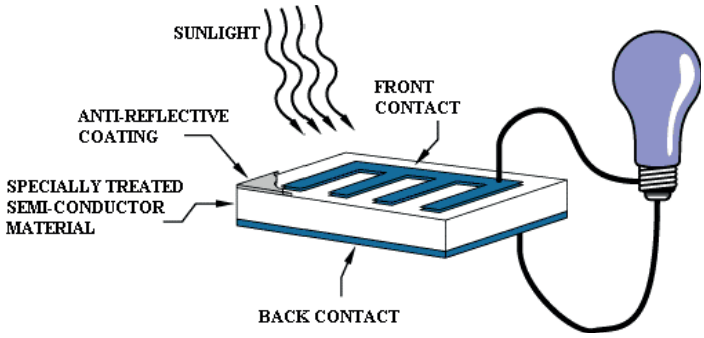


The Scottish Government

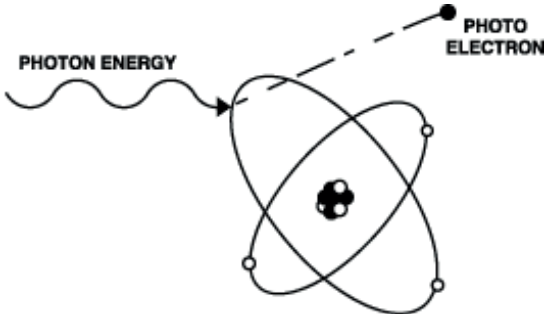
The European Agricultural Fund for Rural Development: Europe investing in rural areas

savills

How a solar panel works, in 100 words



"The diagram above illustrates the operation of a basic solar cell. Solar cells are made of semiconductor materials, such as silicon. For solar cells, a thin semiconductor wafer is specially treated to form an electric field, positive on one side and negative on the other. When light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor material (see diagram below). If electrical conductors are attached to the positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of an electric current - that is, electricity."



Source: http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/

Energy Management

Cornerstone Systems installed a renewable energy utilisation software package into the store temperature control system. The system controls the stores to achieve the desired temperature of the crop, it does this with either ambient air or refrigeration plant if required. The system pre-emptively cools the stores to the lowest allowed temperature if the local power generation has capacity to do so, thus maximising the use of the electricity form the solar PV system and reducing grid power requirements.

By using this management system the McLaren's have managed to maximise the return on the investment as they are using approximately 70% of the electricity generated from their solar PV systems. Since the PV systems were installed, the FIT has reduced significantly which impacts on the rates of return achieved. However as the FIT rate has decreased so has the cost of installing solar PV systems. As the FIT and installation costs have changed significantly since the McLarens' installed their system the table opposite details current scenario's that reflect the current market. The current generation FIT for a 250kW system is 9.21p/kWh with the generation tariff dropping to 8.89p/kWh from the first of January 2016. The government is proposing a further cut to the generation tariff, reducing it down to 2.64p/kWh for a 250kW system. This represents a 70% cut. This cut was initially proposed to be introduced on the first of January 2016, however it has been delayed and is expected to come into effect at the end of January. Based on a 250kW scheme being built from the first of January we have projected a simple payback period of 5.8 years. Even with the 70% cut to the generation tariff, a simple payback period of 8.6 years is projected. In the case of this example at Cronan farm the payback period is protected by the high onsite use of electricity from the solar PV system. A summary of our calculations are provided below.

System Summary	
Solar PV Capacity	250kW
Annual generation	220,000kWh/yr
Annual energy demand	440,000kWh/yr
Day time import (@12.5 p/kWh)	142,000kWh/yr
Night time import (@7.5)	142,000kWh/yr
PV self-consumption	156,000kWh/yr
PV exported	64,000kWh/yr

Item	Value under 1st January FiT rates (5.73 p/kWh)	Value with proposed FiT rates in consultation (2.64p/kWh)
Solar PV Capacity	250kW	250kW
Cost of solar PV system	£220,000	£220,000
Cost of control system	£22,000	£22,000
Electricity savings (@12.5p/kWh)	£19,500	£19,500
Generation FiT income	£19,558	£5,808
Export (@4.5p/kWh)	£2,880	£2,880
Total annual benefit	£41,938	£28,188
Simple Payback*	5.8 years	8.6 years

*Simple payback does not take account of tax, interest rates, operational costs, etc.

Future Projects (Batteries)

As part of engaging with the NFU Scotland on the Renewable Development Initiative, Mike McLaren has been looking at projects to further reduce energy costs on the farm. In considering energy storage an energy assessment of the farm was completed by Green Acorn. They found the payback of a battery system would be approx. 17 years. The long payback of the system was due to the energy use already being largely optimised. In a situation where the energy is not already optimised, Green Acorn believes the payback on the battery system could be as low as 7-10 years. The cost of battery systems are expected to drop considerably in the next few years increasing their viability.

"We only used professional companies, who do a good job."

Mike McLaren, December 2015