Will Cottrell

Brighton goes solar

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solar power
photovoltaic
alternating current
renewable energy

Brighton Energy Co-op recently installed Brighton's second-largest solar system on the roof of Shed 3a at Shoreham Port. Since May 2013, 800 panels have covered the two sides of this 3000 m^2 roof: half face east, the other half west.

The building itself is fairly simple: an industrial shed used by Shoreham Port to store imported timber. Yet compared to a typical domestic installation Shed 3a is huge, the equivalent of more than 100 average solar homes (typically 2 kW). This brings its own challenges.

The system is composed of 816 panels of 245 watts each, a total of 200 kilowatts. More than 5 km of cables connect the panels into the grid, and six inverters control the electrical flow.

Shoreham Port is a busy commercial harbour on the south coast of England, importing and exporting construction materials, timber and scrap metal.

Linking solar panels

Light from the Sun provides the energy needed to free electrons in the material of the photovoltaic panels. Once electrons start to flow in one of the panels, this current is combined with that of 20 other panels, and combined into a string. These strings then feed the electricity off the shed.

Solar electricity is direct current, DC, so it needs to be converted to the alternating current, AC, that we use every day. This is done via six inverters that are bolted to the side of the building at ground level.

The inverters direct the electricity to a distribution board which controls whether electricity is needed on site – mainly charging fork-lift trucks – or sent out into the national grid. A generation meter is also attached to this board to register the amount of electricity passing through it. Each night this meter texts data to our website so we can read daily output figures remotely.

If there's no usage in the shed then the distribution board sends the power through a 85 mm copper cable. This cable was a major sticking point: copper is expensive and the cable is 100 m long. Altogether it weighs just under 2 tonnes. Finding points to connect to the national grid can be a pricey business; if the connection point is a long way from the rooftop then not only do you have to buy the copper but you may also have to dig a trench to get it there, which is labour-intensive.

Metering the power

The last destination from our point of view is the electricity socket that plugs into the grid network – a metering point known as an MPAN. Every house and building with electric power in the UK has an MPAN where the electricity is metered as it enters; the network of MPANs around the country is the final destination for all the electricity producers. For renewable generation, however, we reverse the process and send electricity into MPANs.

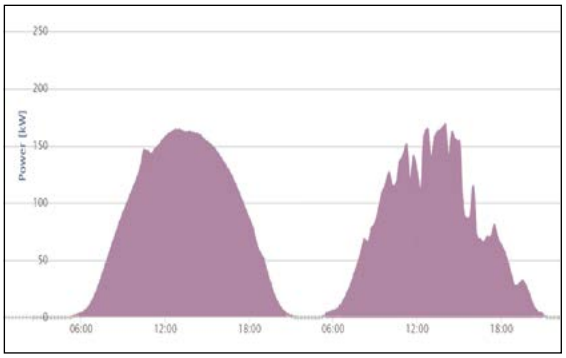
In Brighton, the local grid is run by a company called UK Power Networks. Before we could connect to the MPAN, they ran extensive tests to determine suitability before finally connecting our kit to their wider network. A second meter (an export meter) at the MPAN monitors the flow of electricity into the grid.

Daily output

Output varies with the weather. As the sun rises, voltage in the east-facing panels starts to increase, while the west-facing panels remain dormant until an hour or so later. The situation is reversed during sunset.

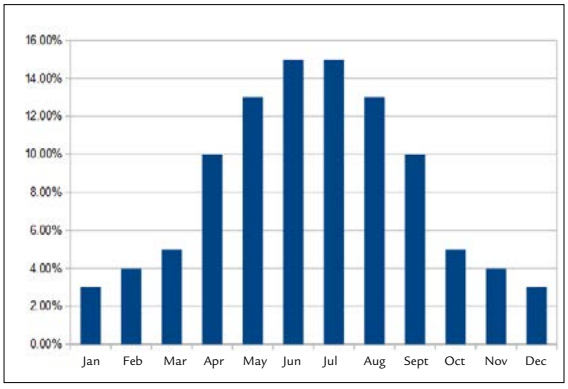
If it's a completely sunny day then output looks like a graceful bell curve: as the Sun approaches the horizon in the morning the output begin as to climb. As the sunlight strengthens output then climbs to a maximum around midday. For several hours output stays high as the sun passes through its zenith, then it drops rapidly, before gliding to zero as darkness covers the sky.

Other factors affect daily output. It dips significantly if a cloud goes across the sun, then picks up rapidly as the sun comes out. This makes output graphs look jagged and the passage of clouds across the sun can be clearly tracked by dips in the graph.



Electrical output from the solar panels varies through the day. (left) a sunny, cloudless day; (right) a day with intermittent cloud.

At peak times (midday) in July we can expect 160 kW output, some useful power. In winter, February produces barely 4% of annual output, with only around 30 kW around midday, barely anything at all.



We can expect the panels to produce 5 times as much power in June and July as in December and January.

Since weather varies from year to year it's difficult to predict exactly how much will be generated by the system over the course of one year. However, using weather data from the last 20 year we expect that the system will generate an average of 200 000 kWh a year.

The cost of solar

To pay for all this we raised £186 000 from the local community. Roughly half of that pays for the panels, the other half pays for inverters, cables, framing systems, labour, system design, transport and associated paperwork.

To raise the money we sold shares in our co-operative. We held various events, did public talks and lots of Facebook and Twitter work. Over a 6-month period more than 200 people joined Brighton Energy Co-op by buying shares. Some bought a few hundred pounds' worth, others £20 000, the maximum allowed for a co-op. Our members now range from students to retirees, some are professionals, some are just renewable energy enthusiasts. Our most distant member is a vicar in Northern Ireland. Members only have one vote irrespective of how much money they've invested.

As a co-operative we have the great advantage of being able to sell shares without government scrutiny. Regular companies must have a licence that can cost up to £50 000. Co-ops are exempt from this, so it's our organisational form that allows us to raise money in this way.

We are not a charity, however, and our members expect that they'll get their money back at some point in the future, plus interest. To pay for this, BEC earns money in three ways:

- Feed-In Tariffs, a government subsidy that pays renewable energy operators for each unit of electricity they generate.
- Selling electricity to our utility company Good Energy, who then supply home-owners and industry.
- Selling electricity to Shoreham Port, the owner of Shed 3a.

After covering our costs, we aim to pay 5% of a member's capital back each year, as well as 5% interest. This means they'll be completely reimbursed after 20 years – the lifetime of the FIT revenue stream. (The system itself will then be donated to Shoreham Port, and may continue long into the future.)

Will Cottrell on the roof of Shed 3a with Energy Minister Greg Barker and local MP Mike Weatherley.

Photovoltaic panels arrive at the site

Panels are lifted to the roof

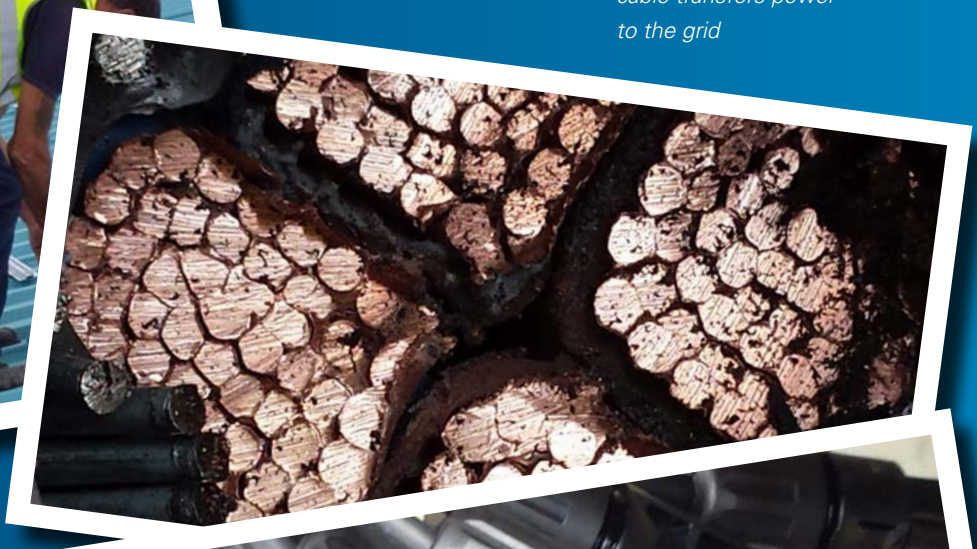
Brighton Energy Co-op has installed 200 kW of solar panels on the roof of a storage shed at Shoreham Port in Sussex, UK.

Panels cover most of the shed roof

Catalyst

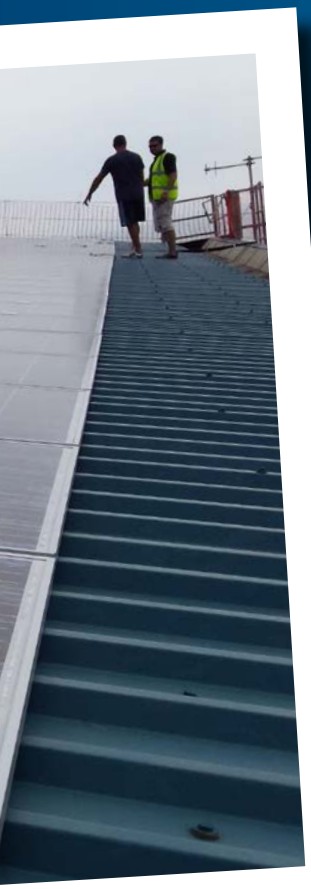
www.catalyststudent.org.uk

Preparing the roof fixings

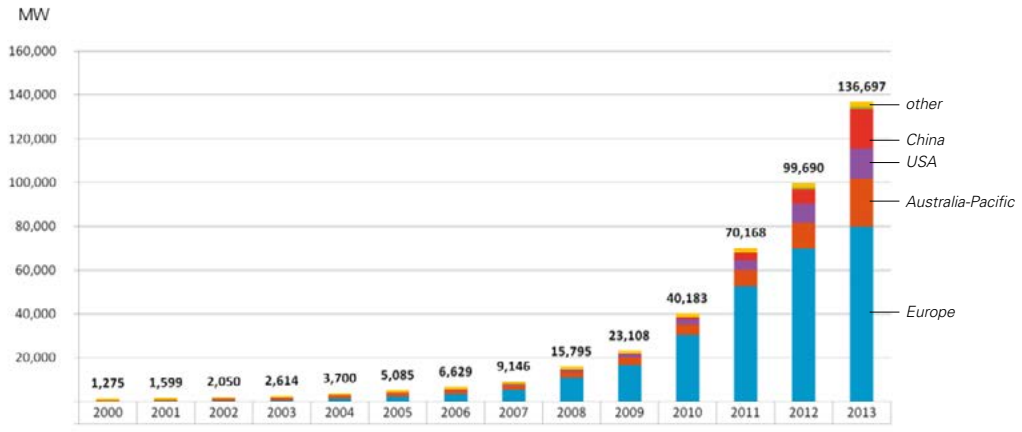


An 85 mm copper cable transfers power to the grid

Connectors bring power from the panels



Inverters convert power from DC to AC



The installed capacity of solar power stations is increasing rapidly around the world. Source: EPIA

Why can this be done today but not ten years ago?

The UK solar marketplace was revolutionised four years ago by the introduction of Feed-In Tariffs (FITs). Previously, renewable projects were a very specialist subject. The technology was expensive and consequently so was the electricity they generated. So it remained the preserve of a few enthusiasts. FITs have revolutionised renewable energy because people can now make money from solar.

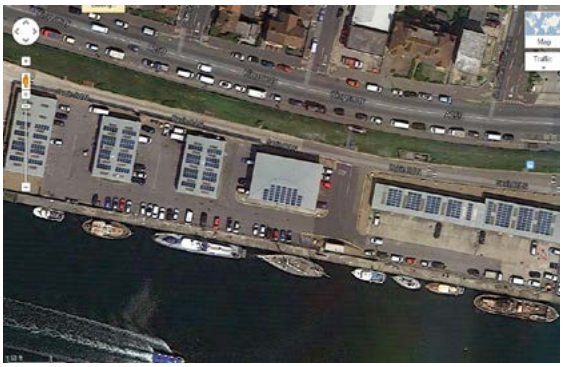
FITs are a subsidy that will disappear. As more projects get off the ground, so prices fall because there's more demand. The price of UK solar, for example, has fallen 70% in the last four years. Eventually the idea is that the technology becomes so cheap that no FIT subsidy is required.

Looking ahead

Brighton Energy Co-op will continue to develop new solar projects. We've several megawatts of new rooftop solar in development, and plenty of appetite from our community to invest in our schemes. We've also got some other new technologies under consideration, particularly anaerobic digestion.

In terms of the wider energy picture it's only going one way. The price of fossil-fuelled electricity will continue to rise as the costs of extraction go up because we've already drilled all the easy oil and gas. Meanwhile the price of renewables will continue to come down as the huge roll-out going on all over the world continues to reduce prices. Renewable energy is already big and it's going to be much bigger – and it's exciting to be in the centre of it.

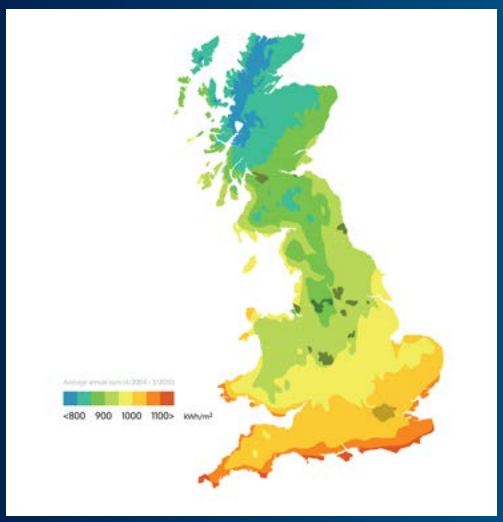
Will Cottrell is chairman and founder of Brighton Energy Co-op. www.brightonenergy.org.uk



Solar panels on the rooves of Hove Enterprise Centre, another Brighton Energy Co-op project.

UK Solar – where next?

The map shows how the available solar energy varies across the UK. Latitude and cloud cover are both important, so the south of England receives about 50% more energy per square metre than the north of Scotland. A 'solar farm' must cover a large area if it is to provide significant amounts of electricity.



Average annual energy per square metre of solar panel varies across the UK.

The map shows that Cornwall is one of the best counties for investing in solar power. Because the Wheal Jane solar farm is located on the site of an old tin mine, it does not use up valuable agricultural land.