

Demonstration Project Case Study

Project Title: Retrofitting NRW's operational assets with solar PV

Description

Natural Resources Wales is the regulatory body responsible for managing water resources in Wales. We monitor river and sea levels across Wales by collecting data from our measuring stations along rivers and coastlines. NRW's Hydrometry and Telemetry (H&T) operational teams manage a large number of remote assets that require power to monitor river levels and flow, rainfall and groundwater. This power supply has been historically provided through either a connection to the main grid or through the incorporation of batteries on site. The data from these sites is used for flood protection and warning, to manage water resources and minimise environmental damage from over abstraction, for decision making on key water quality policies, as well as many other internal and external customer requirements.

Although the sites are not as energy intensive as some other NRW assets, they do involve regular maintenance, whether to change batteries to ensure continued operation or to undertake replacement of these elements, which requires staff to travel to site. Although some maintenance can be carried out in a systematic way (reducing travel to individual sites), the nature of the network does not allow this regularly. The travel associated with maintenance of these sites is therefore is one of the largest sources of carbon from the operation of H&T assets.

To ensure our assets are as self sufficient as possible (requiring minimal power drawn from the grid to run them and reducing the amount of site visits needed to maintain them), solar PV has been used on assets for some years to power remote sites and with its use we should now be able to reduce the need for a battery change to once a year. This case study covers the installation of solar PV technology onto existing NRW operational H&T assets in our South East Operations H&T team and at Cilfrew gauging station near Swansea.

Solar PV was installed at 43 hydrometric sites in one year; greatly accelerating the programme of retrofitting operational assets and reducing the carbon emissions associated with the assets and the work of the teams. The installations aimed to reduce the carbon impact of the assets through self-generated renewable electricity to power it and reducing its reliance on mains electricity, whilst also reducing the number of visits required for maintenance at sites reliant on batteries.

An NRW hydrometry and telemetry station for river level monitoring



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Method

42 Hydrometric sites were identified in South East Wales that could:

- have older solar PV technology replaced to make the sites more efficient and increase their lifespan.
- have solar PV technology installed at battery only sites to reduce the frequency of site visits required.
- have mains electricity replaced by solar PV technology.

To enable this, the team procured 34 bespoke solar PV cabinets to house telemetry equipment, these replaced existing cabinets that had older solar PV technology in or none at all. The remaining 8 sites had solar PV panels installed on a pole next to existing infrastructure.

Approximately half of the kiosks were replaced by members of the H&T team, as they had the necessary skills and the installations require little infrastructure change. The other half required the help of the South Operations Delivery teams to install additional infrastructure to support the new kiosks and poles to mount solar PV on to. All sites were retrofitted by Spring 2018.

At Cilfrew gauging station, in South West Wales, four LG Neon 300W (1.2kW installation in total) roof mounted panels and associated equipment were installed to supplement mains power at NRW's Cilfrew flow monitoring station (also known as a gauging station).

Installation of solar PV generation equipment takes 1.5 working days to install a system of around 1kW, including the erection and removal of scaffolding. The work for the Cilfrew project was undertaken as part of more extensive construction work to refurbish the flow measurement structure.

42 South East assets: 2,394 kWh estimated generation per annum, yielding a saving of 670kgCO₂e¹ and £251² per annum.

Reductions in requirements to travel to sites are estimated to yield savings of 2,520km, 428kgCO₂e³ and 336 hours of staff time per year.

Cilfrew gauging station: 994 kWh estimated generation per annum, yielding a saving of 278kg CO₂e and £104 per annum.

42 South East Assets: £70,900

Cilfrew gauging station: £3,670

Total cost: £74,570

Established method/technology

Staff involved

Hydrometry & Telemetry teams (South East and South West Operations)
South Operations Technical Support Team
South Operations Delivery teams
Projects Delivery Team

¹ CO₂e savings based on the UK Government's 2018 scope 2 grid average electricity emissions factor for all gases combined of 0.28 kgCO₂e saving per kwh generated. Available at: <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018>

² Cost savings based on an average electricity unit price of 10.5p/kwh.

³ CO₂e savings based on the UK Government's 2018 scope 1 medium diesel car emissions factor (per km) for all gases combined of 0.17 kgCO₂e saving per km saved. Available at: <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018>

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Outcomes

All 43 sites installed with solar PV have an expected lifetime of at least 20 years. The site at Cilfrew has an expected payback period of 16 years, based upon electricity cost savings and FIT payments only. For the 42 assets in South East operations, if costs for staff time, travel and electricity cost savings are taken into account the anticipated payback period is 7.6 years. However, both sites will require monitoring of estimated outputs to confirm the payback estimates.

42 South East assets:

Results at the end of the installations are expected to see a reduction of 670 kgCO₂e and £251 per year associated with electricity use from previously mains run sites.

There are also secondary cost and carbon savings associated with reduced travel requirements due to the installations reducing the amount of site visits needed to maintain remote H&T sites. We anticipate that sites will now only require a battery check once a year. Previous to this, batteries would have to be changed at least 3-4 times per year to ensure the sites were delivering timely and accurate data to the organisation. An estimated saving of 60km per site per year is anticipated, which is estimated to save a total of 2,520km, 428 kgCO₂e and £101⁴ per year.

In addition, there are savings associated with reduced staff time due to a reduction in required site visits. This has been estimated at approximately 8 hours per site per year, totalling 336 hours of staff time saved per year (worth approximately £9000⁵).

Cilfrew gauging station:

The installation at Cilfrew gauging station was larger than those of the South East installations and so is expected to save 278 kgCO₂e and £104 per year associated with electricity use previously drawn from the grid. The installation generated electricity as soon as it was commissioned and so began to reduce the carbon impact of the asset once operational.

Wider Benefits

- Hydrometry and telemetry assets are a valuable part of NRW's delivery of the sustainable management of natural resources (SMNR), supporting the monitoring and regulation of river flows and powering these assets using renewable energy further adds to our delivery of SMNR.
- There is potential to expand solar PV technology across NRW's monitoring stations, particularly where other civil works (especially roofing work) is underway. The installations in South East Wales demonstrated the potential for a method of bulk buy and installation of solar PV. Expansion of this method to our North and South West Wales assets could help to achieve wider benefits to communities

⁴ Based on an average cost per km in an NRW fleet vehicle of 4p per km (7p per mile).

⁵ Based on South Operations Delivery rate 2016-7.

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and habitats across Wales. We also recognise the potential for others to learn from this method for any part of an organisation that utilises maintenance heavy remote powered sites, or low use mains electricity sites.

- With Cilfrew gauging station, the use of an installation contractor based in Abergavenny allowed us to draw on their local knowledge and helps us to contribute to a prosperous Wales (Well-being goal). Expansion of this practice in future could further our contributions towards this and other Well-being goals.
- Improving power management at remote sites helps to make them more resilient and create a more robust hydrometric network that provides wider benefits and improvements to the flood warning service for Welsh communities and businesses.
- A decreased chance of loss of data (due to not using batteries) will also ensure that sites used for managing environmental protection can better enhance and protect the fluvial habitats across Wales.
- Due to a higher power capacity at sites, it may now be possible to install new monitoring technology that requires higher voltages to run (eg. Weighing rain gauges), further improving the service NRW can deliver.

Learning

- Similar solar PV installations have been added to other gauging stations successfully in the past, which have proved successful and reliable.
- The overall cost of installation is small, which means that there is a smaller financial risk if the benefits are not as great as expected.
- The roof mounted installations are unobtrusive and there are no wear and tear issues (which have been encountered with small wind generators in the past).
- A faster response time for approval of funds to deliver projects would ensure delivery of the projects within a financial year window.
- All requirements were set out in detail in the specifications at the outset of the two projects.
- The delivery leads met with the contractor or delivery staff on site prior to the works being undertaken to ensure the layout or installation at each site was agreed prior to installation.
- For Cilfrew gauging station, some challenges in organising the FIT payments were experienced due to a lack of previous experience in setting up FIT payments within the team.

Evidence & information

An internal Environment Agency Wales Report, a detailed study focusing on larger scale arrays, was consulted by teams to identify any opportunities or recommendations for these projects. It's recommendations included the need to consider solar when refurbishing H&T gauging stations in favourable locations.

Previous operational experience at Capel Dewi and Redbrook gauging stations were also used to inform installations. At Capel Dewi gauging station, located on the River Towy, in 2011, a 2000Kwh solar array was included in a more general refurbishment of the gauging station building. By building installation of solar PV into an existing project, the team were able to use already arrange access methods and project management support to deliver it making the extra cost relatively small in comparison to a direct, dedicated retrofit. The process proved to be relatively straight forward and learning has been applied to other suitable locations since.

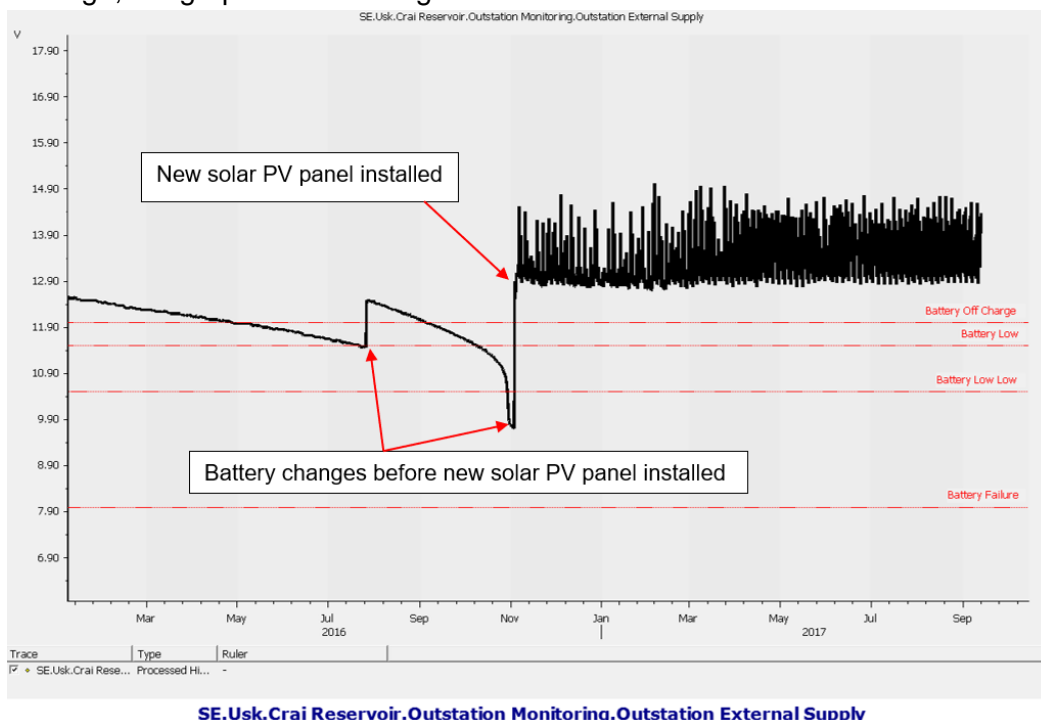
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Illustrations

Cray Reservoir rain gauge and river level monitoring station – an example of a new site layout, which includes a large solar panel on a pole. This will power the site all year round and reduce site visits.



The graph below shows voltage patterns before and after a solar PV panel installation. Before the installation, the graph shows voltage dipping over time as the battery begins to run out. After the installation, where there is now a constant charge, the graph shows voltage is much more stable.



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Michaelchurch flood warning station

An example of an old style kiosk with bolt on solar PV panel, which is no longer fit for purpose and requires multiple battery changes each year.



An example of a bespoke solar telemetry kiosk, which will provide a higher voltage output and reduce the need for site visits by NRW operations staff.



Cilfrew gauging station – photo of the gauging station following the installation of solar PV. Four new solar panels can be seen mounted on the roof of the building.

