

# **Crichton Castle photovoltaic system upgrading**



## **Integrazione estetica**

The panels were mounted on the roof of the castle. Due to the parapet of the ruin still being quite high, the panels could not be seen from the ground. Historic fabric was not affected by the installation that resulted unobtrusive and respectful to the aesthetic values of the monument.

## **Integrazione energetica**

Generated power is used for the building needs only as Crichton Castle is not connected to mains utilities. At present, the castle's power consumption is dominated by heating and lighting. The card reader and fax machine are active for brief periods only, so they will be excluded from the following calculations.

The old panels generate a maximum of 1,000W when the sunlight is at its brightest. The less sunshine falls on them, the less power they will generate. By comparison, the new panels generate a maximum of 1,800W.

## **Integrazione tecnologica**

The panels were mounted on the roof of the castle, mechanically fastened to a modern flat roof.

## **Processo decisionale**

The power demand during operation times was modest, but not being met by the PV panels put up in 2005, and a generator was occasionally required. Upgrading was needed. The cabling required from the roof down to the ticket office was low power.

The new PV modules achieve a market-leading 22.2%. Combined with a slight increase in the total area of the array, we have been able to increase the power output to almost double what it was before.

As part of the upgrade project, we have also installed new batteries with a larger capacity. This means more power can be stored for longer, and the extra output from the new panels won't be wasted.

Thanks to this extra power, we now have several options that we didn't have before. We could:

- Use the extra power to run the heating system, which would mean much less reliance on the petrol generator\*. We are planning to make some changes to the heating system that will enable us to keep our staff warm without using so much energy; these would synergise well with the upgraded solar installation.
- Keep the current lights on for longer without having to run the generator, even when it's too dark to get any solar power.
- Install additional lighting across the site to improve the visitor experience and bring more of the building to life.
- Provide power to a computer or electrical cash register in the office.

Furthermore, the new panels will last much longer than the old ones. Even after 25 years, until 2044, the panels we have installed today should still be producing 87% of their nominal output.

## **Lesson learnt**

At present, Crichton Castle is the only ancient monument in the Scottish HES estate that is fitted with solar panels. Since HES have made it an explicit goal to get more of its energy from renewables, Crichton Castle represents a vital proof-of-concept that will hopefully serve as a model for other sites, so that its carbon savings can be replicated elsewhere.

The old panels, which have been at Crichton Castle for 14 years, and the old batteries, which are around 4 years old, are still in good working order. HES is going to keep hold of them and, if possible, re-install them at another site. The roof space at Crichton Castle is very limited, and the lack of mains supply means that every kilowatt-hour we can squeeze out of the solar array is one we don't have to get from the petrol generator. At other sites, with more roof space and pre-existing mains connections, this is less of a concern, so the old panels can still make a useful contribution.

We've also taken steps to minimise the amount of waste produced by the upgrade project. For example, we modified and re-used the old battery cabinet, and kept most of the existing electrical cables between the roof and the batteries. These items were still in perfectly good condition, so it would not make sense to throw them away now.

#### DATI EDIFICIO

<b>Tipologia progetto</b>	Riqualificazione
<b>Destinazione d'uso</b>	Pubblico
<b>Sistema di integrazione</b>	Tetto piano opaco
<b>Indirizzo</b>	Pathhead, Scotland, UK

#### DATI SISTEMA BIPV

<b>Tipologia moduli</b>	Moduli standard
<b>Tecnologia FV</b>	monocrystalline silicon solar cells modules
<b>Potenza nominale (STC) [kWp]</b>	1.8
<b>Dimensione sistema [m<sup>2</sup>]</b>	5
<b>Dimensioni moduli [mm]</b>	1427x652x35.7
<b>Orientamento</b>	Southwest
<b>Inclinazione [°]</b>	25

#### COSTI SISTEMA BIPV

<b>Costo totale [€]</b>	-
<b>€/m<sup>2</sup></b>	-
<b>€/kWp</b>	-

## DATI PRODUTTORE

<b>Produttore</b>	KYOCERA Europe GmbH - Solar Technical Service Center
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- 1.
2. © Historic Environment Scotland
3. © Historic Environment Scotland
4. © Historic Environment Scotland
5. Incline of the panels to facilitate runoff and self cleaning © Historic Environment Scotland
6. Installation of the PV panels using a crane © Historic Environment Scotland
7. Free-standing setup for PV associated infrastructure, © Historic Environment Scotland