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Renewables

Case study

Battery Buffered EV Charger

Key facts

The Centre for Alternative Technology (CAT), commissioned Dulas to design a battery buffered Electric Vehicle (EV) charging system with the purpose of limiting grid import by supplementing on site EV charging with battery power by utilising a smart Energy Management System (EMS).

We wanted to prioritise charging the battery using on-site renewable energy generation and solar power from a nearby local community energy scheme over mains electricity. The system has a nominal capacity of 72KWh and is now a key component of the site's integrated renewable energy infrastructure.

Background

Dulas and CAT share a partnership spanning several decades, making us the natural choice to deliver this complex project. Building on our ongoing research and development into battery-buffered EV charging systems, this initiative provided an opportunity to apply innovative energy storage and management solutions in a real-world setting.

The project plays a vital role in CAT's mission to educate students on renewable technologies whilst being as sustainable as possible. It also reflects a collaborative approach to local energy generation with Bro Dyfi Community Renewables (BDCR) supplying renewable electricity from its adjacent solar farm via a private wire connection.

Internal hardware and controls allowing safe access for visitors and students to learn.

> "It was a joy to be working with CAT again on such a groundbreaking project, helping Dulas to further develop and demonstrate our renewable energy linked containerised battery and EV charging solutions, whilst providing real benefits to the community, showing what is possible in grid constrained locations and providing an educational resource at the same time"
>
> **Ben Robinson**
> Business Development Manager and joint Project Manager

The arrangement benefits both parties, with CAT paying BDCR a higher rate than they would receive for exporting to the grid, while still paying less than the cost of importing from a traditional energy provider, thus creating a financially and environmentally sustainable model whilst realising Welsh Government's ambitions for locally owned energy generation systems.

The challenge

Dulas was tasked with designing a battery-buffered EV charging system that could manage complex energy flows and restrict grid import during peak site demand whilst working alongside an EMS to optimise onsite renewable energy usage.

CAT already had multiple generation sources, including three PV arrays and a 3kW Pico hydro turbine. In addition, the project required collaboration with BDCR to connect a 62 kWp solar array via private wire located 1 km away, and incorporate this into the EMS. Initially, the inverter was planned to be located at the solar array, which would have required a complicated wireless communication setup. After review, transmitting electricity as high-voltage DC proved more efficient and simplified the integration.

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Remote location, closed roads and difficult site meant complex logistical issues.

Key challenges included meeting tight funding deadlines, overcoming difficult site access issues for the containerised system, and creating a unified architecture from technologies of different ages and manufacturers. Interfacing these components within the EMS added further complexity.

Our solution

Our engineers began by analysing CAT's complex energy ecosystem to design a coherent EMS capable of integrating multiple generation sources and managing dynamic loads. This required working with an existing software platform and installing additional energy meters to monitor the older generation assets. For newer components, Modbus maps were obtained and integrated directly into the EMS.

A site adjacent to the LV switchboard was selected and local contractors prepared the ground and installed ducting for the containerised Battery Energy Storage System (BESS). The BESS and EV charging architecture were designed to meet strict specifications, with a control system ensuring the grid import limits could be maintained.

The final solution comprised a 72 kWh BESS paired with a smart EMS that prioritises charging from on-site generation over mains electricity. The system charges during periods of surplus renewable generation on site and discharges during high demand, reducing grid reliance and improving energy self-sufficiency. A minimum state of charge of 20% is reserved for peak shaving, enabling EV charging to continue at full capacity without breaching dynamic load management (DLM) thresholds.

Working in tandem with the EV charger's DLM system, the BESS smooths out demand peaks and keeps imports within pre-set limits. Once the battery capacity is exhausted the EV charger's DLM system ensures that charging capacity is limited, to ensure a hard limit in grid import.
Finally, a comprehensive monitoring and control system was implemented to provide intuitive energy flow management and serve as a valuable resource for postgraduate research and learning at CAT.

Impact

The system developed for this project delivers significant benefits to CAT and the wider community. Through the EMS, CAT can monitor site-wide energy usage, maximise consumption of locally generated renewable electricity, and minimise reliance on more expensive imported electricity. This approach not only reduces operational costs for CAT but also ensures BDCR can achieve higher revenues for their solar generation, creating a win-win model that strengthens local sustainability.

Beyond financial and environmental gains, the project fosters community engagement. By collaborating with TrydaNi community EV car share club, the system enables members to access charging facilities at CAT, supporting shared mobility and encouraging the adoption of EV's within the region.

In addition, the integrated monitoring and control platform provides a valuable educational resource for staff, visitors, lecturers and postgraduate students, offering real-world insights into renewable energy systems, battery technology, community energy, smart grid technology, and sustainable transport solutions.

Dual EV and E-bike pedestal chargers connected to the containerised battery in the tricky wooded location.

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