Papilio3 DC V2X Fast Hub Demonstration Project

V2X Innovation programme: bi-directional charging demonstrations

3ti Energy Hubs Ltd 2026

Authors/Acknowledgements

This report has been prepared through the collaborative efforts of the project partners, led by 3ti Energy Hubs Ltd as Lead Partner.

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Summary

The Papilio3 DC V2X Fast Hub Demonstration Project was funded as part of the V2X Innovation programme: bi-directional charging demonstrations, which was part of the Net Zero Innovation Portfolio. The programme was run by Innovate UK on behalf of the Department for Energy Security and Net Zero. The funded project demonstrations concluded in September 2025.

Project Overview

The Papilio3 DC V2X Fast Hub Demonstration Project was established to design, develop and evaluate a deployable, commercially scalable DC microgrid system capable of supporting multi-vehicle bidirectional EV charging. The project was led by 3ti Energy Hubs, in partnership with Turbo Power Systems (TPS), Grid Beyond and Cenex. Its objective was to generate robust evidence on the technical performance, operational feasibility and commercial value of containerised V2X energy hubs for workplace, fleet and destination charging environments. The system was deployed at UTAC Millbrook, a representative mixed-use commercial setting with fleet, staff and prototype vehicle activity.

System Delivery

The project successfully delivered and commissioned the Papilio3 V2X (P3-V2X) system, integrating 12 × 30 kW DC bidirectional chargers, 280 kWh of battery storage, 20 kWp of solar generation and a single 240 kW Distribution Grid Inverter (DGI) onto a shared DC bus. This represents a first-of-a-kind deployment in the UK. The prefabricated architecture enabled rapid installation with minimal civil works, demonstrating the suitability of containerised systems for short-lease or grid-constrained sites. Despite the late-stage relocation required for the trial, the system was successfully installed and prepared for operational testing.

Technical Performance

The commissioning phase provided important technical evidence. Measured component-level efficiencies demonstrated strong performance of the DC microgrid approach, including:

- Battery → External Grid: up to 98.8%
- External Grid → Battery: 98.2%
- Battery → Vehicle (CCS): 92.3%.

Bidirectional operation was successfully demonstrated using a CHAdeMO vehicle (Nissan Leaf MY2015), confirming the operational capability of the V2X infrastructure. During commissioning, the system exported energy both to the adjacent building and, at times, to the

wider UTAC site, validating multi-asset energy flow paths. Although solar generation was not fully integrated early on, PV performance modelling aligns with expected annual output of approximately 18 MWh in UK conditions.

Intended Use Case and Trial Design

The trial was designed to investigate a range of V2X use cases relevant to commercial sites, including behind-the-meter optimisation, peak shaving, solar-aligned charging, vehicle-to-building (V2B) support and vehicle-to-vehicle (V2V) transfers. UTAC Millbrook offered multiple user archetypes, including fleet vans with predictable duty cycles, staff vehicles with regular 9-to-5 dwell times and OEM prototype vehicles. A V2X-enabled user interface was developed for PAX IM30 payment terminals, supporting RFID and contactless authentication. Although the full operational trial could not proceed due to commissioning delays and the absence of Combined Charging System (CCS) - V2X based V2X vehicles in the UK market, the required digital and physical infrastructure was prepared.

Commercial Insights

The project provides several insights relevant to commercial deployment. The DC microgrid model appears capable of materially reducing installation costs and grid-connection requirements compared with traditional AC-tied systems, offering benefits such as lower G99 footprint, reduced harmonic contribution and streamlined protection design. Higher one-way energy efficiencies improve the business case for PV self-consumption, battery cycling and potential flexibility participation. However, the absence of ISO 15118-20 compliant CCS bidirectional vehicles remains the dominant constraint on near-term V2X commercialisation. In addition, the value of grid services is highly dependent on-site location; with Millbrook outside a grid-constraint zone, the attainable flexibility revenue was limited.

Policy Implications

Several policy considerations emerged from project delivery and analysis.

- Mandating interoperable implementation of ISO 15118-20 (AC and DC) for all new EVs, ensuring consistent support for V2X communication, SoC reporting and plug-and-charge.
- Establishing streamlined planning and compliance pathways for prefabricated microgrid charging systems to accelerate deployment.
- Reforming export-eligibility frameworks (e.g., MCS requirements) so that standalone V2X and microgrid systems can receive export payments.
- Encouraging OEM participation in enabling DC V2X functionality and avoiding closed, OEM-specific implementations that inhibit interoperability.

- Supporting the development of open standards and reducing barriers to participation in flexibility markets for small-scale distributed energy resources.

Conclusion

Although a full participant trial was not conducted, the project has delivered the UK's first deployable DC microgrid V2X hub and generated new technical, commercial and policy insights. It has demonstrated that containerised DC microgrid systems are technically feasible, capable of high-efficiency energy flows and suitable for a wide range of commercial use cases.

The system will remain at UTAC Millbrook for further testing and potential future research projects. These findings contribute to the growing evidence base for V2X and provide a strong foundation for future innovation, particularly as CCS-based V2X capability becomes available in the UK market.

Figure 1. The Papilio3 V2X (P3-V2X) system





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