



The UK's V2X Innovation Programme: using EVs for energy flexibility

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Innovate UK

We are the UK's innovation agency

A key delivery body of the UK Government's Innovation Strategy

We support business-led innovation in all sectors, technologies and UK regions

Our Mission

To help UK businesses grow through the development and commercialisation of new products, processes, and services, supported by an outstanding innovation ecosystem that is agile, inclusive, and easy to navigate

EVs and Energy Flexibility

Electric Vehicles provide significant energy flexibility potential

- ✓ shift energy consumption to balance supply & demand
 - ✓ store renewable energy locally
 - ✓ export energy back to a system - grid, home, building, vehicle
- **Smart charging** – demand-side response (DSR), shifting EV charging to off-peak periods or periods of abundant renewables
 - **Vehicle-to-X technology (V2X)** – bidirectional smart charging, providing flexibility by enabling export of energy from an EV battery

The ambition:

- **Mid 2020s** - Smart charging becomes widespread in homes & workplaces
- **Late 2020s/2030** - Smart charging is the norm. Behind-the-meter and V2G services widely available for domestic & commercial EV users

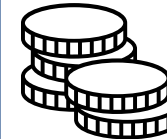
Benefits overview



Reduce network and generation costs, lowering prices for all consumers



Maximise use of variable renewables



Reduce cost of charging for EV drivers

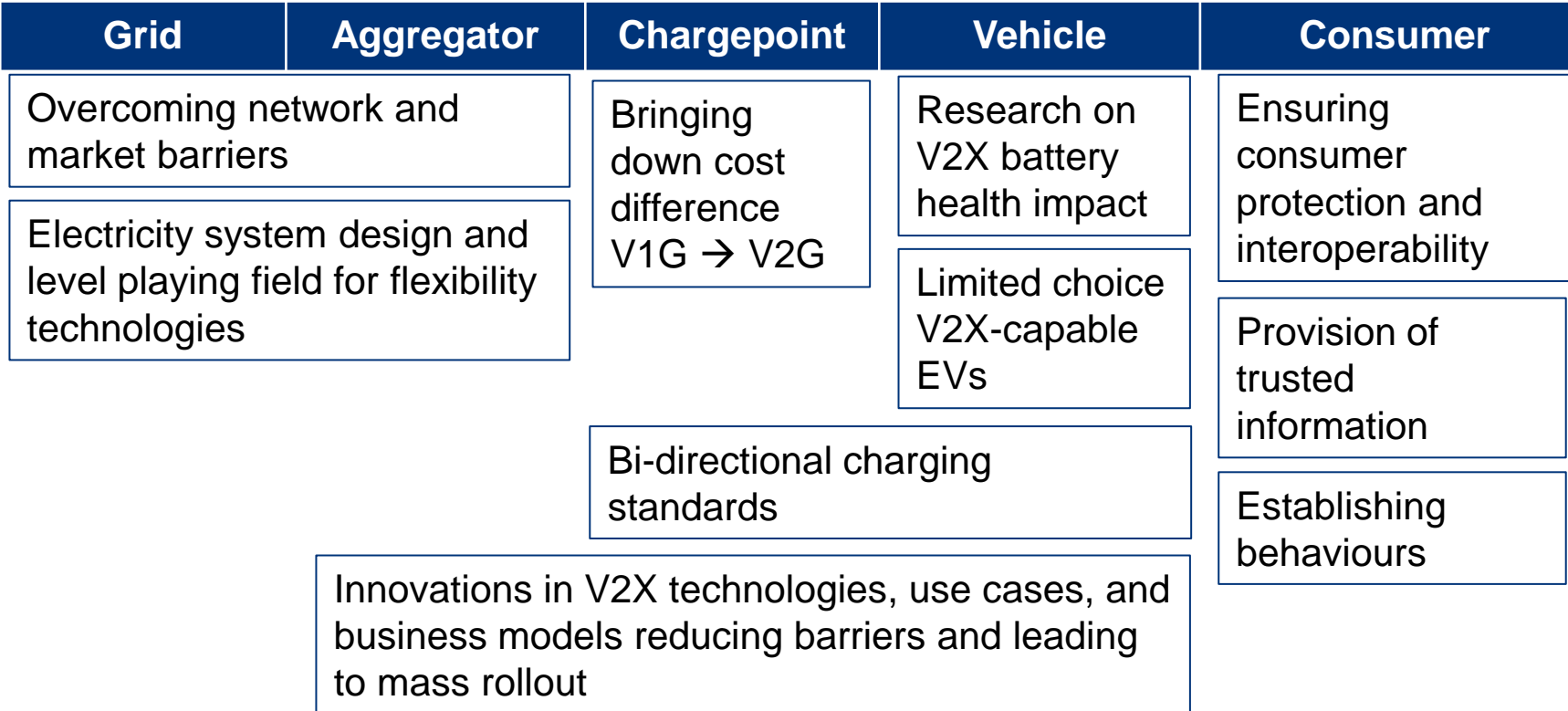
UK Policy

Electric Vehicle Smart Charging Action Plan

<https://www.gov.uk/government/publications/electric-vehicle-smart-charging-action-plan>



[Icons from FlatIcon.com]

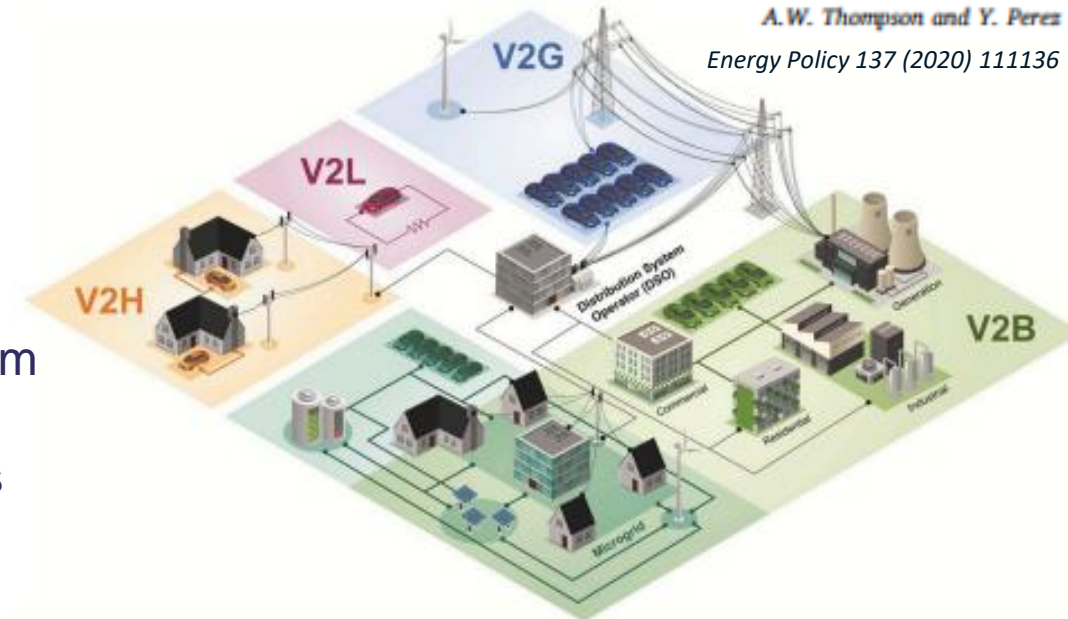


- V2G Programme (2018-2022)
- EV Smart Charging Regulations (2021)
- EV Smart Charging Action Plan (Jan 23)
- Call for Evidence: Gov't response (Jan 23)
- V2X programme (Sept 22-March 25)
- Secure Smart Electricity Systems programme

UK's V2X Innovation Programme (2022 – 2025)

<https://www.gov.uk/government/publications/v2x-innovation-programme>

- Programme Funding:** Up to £ 12.6 million
- Programme Timing:** September 2022 – March 2025
- Partners:** 58 organisations spanning ecosystem
- Phase 1:** 17 research & development projects
September 2022 - August 2023
- Phase 2:** Include a min. 6-month demonstration with real-world drivers in a real-world setting
Innovative V2X customer propositions for domestic & commercial use-cases
Using DC CCS, DC CHAdeMO and AC V2X protocols
Projects began October 2023



V2X Innovation Phase 1 R&D projects



Designing and developing to prototype stage new V2X components, sub-systems, hardware and software products & services, including business models



Which can reduce entry barriers for domestic or non-domestic use of V2X bi-directional chargers to provide energy flexibility services

Charging protocols

- AC
- DC CCS
- DC CHAdeMO
- Megawatt

V2X Challenges

- Cost reduction
- New technologies
- New use cases
- Improving the customer experience
- Energy barrier solutions

V2X Use cases

- V2H
- V2V
- V2B
- V2G
- Heavy freight
- Public spaces

V2X Innovation Phase 1 results - Hardware

AC & DC V2X charging products

- Product development in AC, DC CCS & CHAdeMO, multiple-sockets & cost reduction
- For V2H, V2B, V2V & V2G use cases
- For home & fleet consumers incl. heavy vehicles
- AC brings V2X charger cost closer to V1G & could accelerate V2X adoption

Portable V2X products

- Technology & use-case development
- Energy support for vulnerable customers, non-grid tied sites, residents without off-street parking

Battery health monitoring

- To provide consumer SoH reassurance with repeated V2X cycling
- Including environmental & behavioural factors
- Benefits for second-hand EV market

TPS high-power
DC



Hanger19 AC
multi-outlet



Enstorel



Entrust DC V2H



V2X Innovation Phase 1 results - Software

V2X Optimisation

- Multiple use-cases – commercial fleets & domestic consumers requirements
- Tools developed considering wholesale energy prices, grid carbon-content, export revenue & self-consumption opportunities
- Consumer apps to enable decision-making

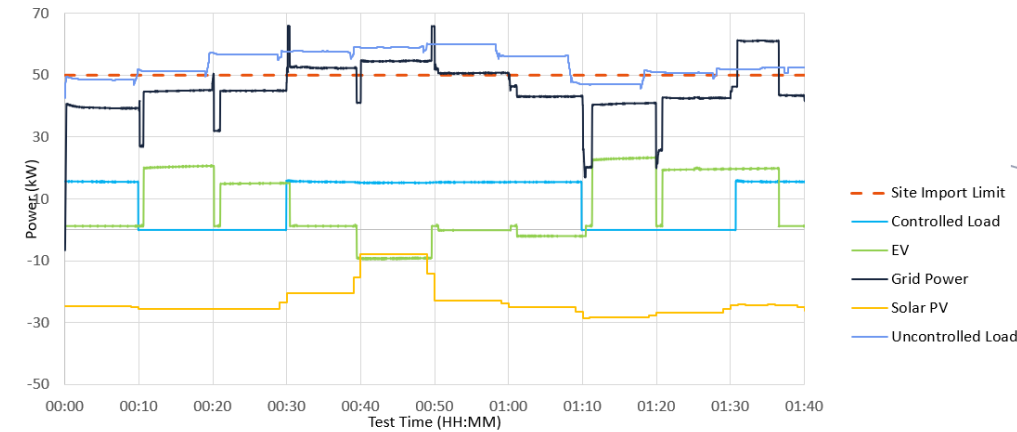
V2X Trading platforms

- Fleet flexibility platforms for day-ahead bidding

Smart energy integration with low-carbon technologies

- In line with UK energy policy for smart appliances
- Unified communication and coordination tools between appliances incl. V2X, on-site generation and storage
- Smart Systems Security by design
- HEMS & microgrids present a valuable opportunity to deploy V2X

V2X Local Network Fleet Solutions



LeasyV2H



V2X Innovation Phase 1 results – Business Models

Consumer attractiveness

- Consumer surveys identified barriers & how to max V2X value – cheap charger & energy tariffs, simplicity, reliability & flexibility
- Value of energy flexibility must be released from the start

V2X asset ownership models

- V2X charger leasing
- V2X bundled with EV & energy tariffs
- JVs across EV ecosystem could share upfront costs & risk

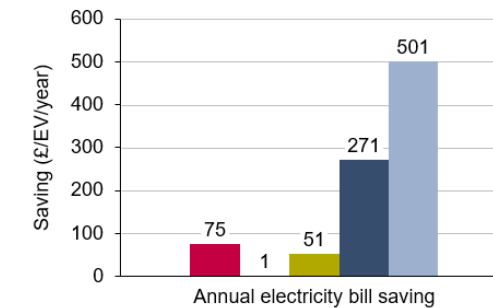
V2X value propositions

- Tested viability with fleet and domestic consumers
- Building energy management tool

Heavy fleet opportunities

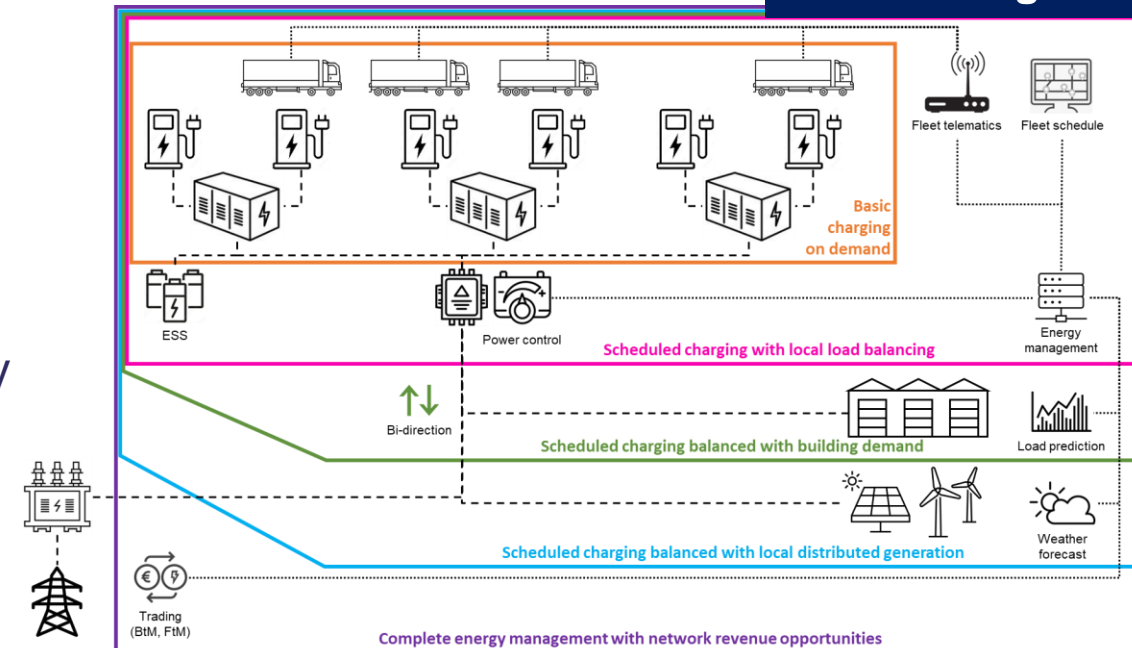
- Microgrids can mitigate grid reinforcement costs & eHGV total costs can be comparable with diesel within 10 years

Total savings in annual electricity bill (£/EV/year) using V2B compared to smart charging^{1,2}



V2Build

MW microgrids



V2X Innovation Phase 2 demonstration projects

Project	Brief description
Electric Vehicle Fleet Bi-directional Charging (FLEXET)	Demonstrates Otaski Energy Solutions' bi-directional EV charger containing its multi-input multi-output (MIMO) DC-DC converter, integrated with Syselek's telematics system and fleet energy management systems to enable fleet EV operators to access energy flexibility and the prosumer market. The DC converter is designed to be cost and energy-efficient while offering high adaptability to variable loads, increasing grid reliability, resilience and stability. With partner University of Leeds, FLEXET will demonstrate V2X benefits including reduced carbon footprint and improved energy efficiency, whilst addressing the limitations of smart charging for EV fleet operators.
Wireless V2G for fleets (V2Geasy)	Wireless charging company Electric Green will convert 20 delivery vehicles to bi-directionally charge and discharge inductively and then conduct a comparison between wired and wireless bi-directional charging at a Royal Mail depot. The solution addresses depot space constraints, accessibility and safety concerns, whilst facilitating higher connection times and maximising monetisation for back-to-base fleets. QEnergy will analyse fleet duty cycles, vehicle battery and state of charge data mapped against grid capacity and flexibility market revenue potential, whilst Royal Mail drivers and fleet managers will add their feedback to investigate the practicalities of both systems.
Papilio3 DC V2X FastHub Demonstration	Demonstrates an integrated bidirectional EV charging hub for medium dwell-time workplaces, destinations, return-to-base fleets and delivery depots. The solution is based on 3ti's mini Solar Car Park: Papilio3, a pre-fabricated single-box solution using recycled shipping containers, designed to rapidly deploy 12 EV chargers with a solar canopy and energy storage battery. The project integrates DC charge points, battery and solar to a common power bus, delivering 30 kW bidirectional charging, lower capital costs and lower operating costs using a high efficiency microgrid. 3ti leads a consortium combining research expertise in EVs, energy systems and infrastructure (Cenex), with pioneers in bidirectional charging technology (Turbo Power Systems) and innovative grid flexibility aggregator (GridBeyond).
V2VNY - optimising AC bidirectional charging	Demonstrates a unique AC-V2G solution, a three-socket bi-directional charger designed by Hanger19 enabling V2G, V2B and V2V applications. CrowdCharge's patented optimization tool will maximise the energy benefits on site including between vehicles, whilst GridBeyond's open flexibility markets will be used to maximise value from grid services. Jaguar Land Rover will provide test vehicles to complement the Hyundai, Kia and MG EVs already proven as compatible. The diversity of trial sites provided by Drive Electric, Oxfordshire County Council and Electric Corby will enable testing of multiple use-cases and propositions for fleets and generate user feedback.



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Thanks for listening

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<https://www.v2g-hub.com/>



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