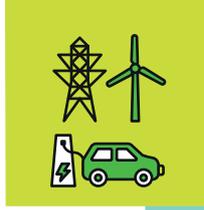


# CASE STUDY: VEHICLE-TO-GRID BRITAIN



*“A feasibility study to help the UK become a leader in low carbon vehicles.”*

## Introduction

Vehicle-to-Grid (V2G) technologies could play a key role in the decarbonisation of Britain’s transport and energy systems. Connecting millions of Electric Vehicles (EVs) and coordinating their charging and discharging could minimise the costs of EV charging, while allowing the grid to integrate high levels of variable renewable energy sources.

The Vehicle-to-Grid Britain (V2GB) project looked at ways to reward EV drivers who send excess energy from their car batteries to the power grid.

Energy Systems Catapult provided modelling support to a consortium – which included Nissan and National Grid – conducting a feasibility study to help stakeholders understand this area’s market potential.

## The challenge and opportunity

**Understanding the opportunities and constraints surrounding electric vehicle adoption:**

EV adoption is putting pressure on electricity infrastructure – UK trials have shown that widespread, uncontrolled charging could double peak loads on distribution networks. With EV sales growing 69% year on year, the grid is therefore facing challenges to stability and security. This could lead to expensive network upgrades – costs that would ultimately be passed on to customers and could become a roadblock for selling EVs.

However, EV fleets also represent a significant energy asset because of their storage capacity. When they’re plugged into two-way charging points, their batteries can feed power back into the grid, reducing pressure and helping networks operate more efficiently.

There are significant knowledge gaps when it comes to understanding the challenges and opportunities surrounding V2G. Vehicle to Grid Britain – one of 21 projects sharing nearly £30 million of funding from the Office for Low Emission Vehicles (OLEV) and the department for Business, Energy and Industrial Strategy (BEIS), in partnership with Innovate UK.



The V2GB consortium led by Element Energy, drew on the diverse expertise of members - Nissan Technical Centre Europe, Energy Systems Catapult, Cenex, Western Power Distribution, National Grid ESO and Moixa – to carry out a feasibility study looking at market drivers, revenue potential, risk factors, value chains and business models – to help the private sector and consumers adapt to system transformation.

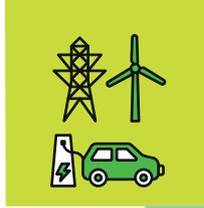
## Why Energy Systems Catapult?

Energy Systems Catapult was the partner of choice for modelling and providing insight on the range of complex scenarios due to our whole systems expertise and unique simulation capabilities.

The Catapult modelling established the energy system impacts of implementing V2G under a range of different vehicle uptake and electricity generation scenarios. We simulated a wide range of business models and technologies to explore both near term niches and enduring large-scale opportunities for V2G to play a role in the energy system in Great Britain – and how it could benefit both operators and consumers. The analysis drew on a vast range of complex data. National Grid and Western Power Distribution advised on electricity system operation, as well as network challenges and opportunities; Nissan’s European Technical Centre provided real-life data on driver behaviour, drawing on experience of delivering more than 500,000 EVs worldwide.



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Project findings show the value of V2G when offering grid services, the effect of V2G hardware cost and how to mitigate it and the whole energy system value and decarbonisation potential of V2G. Project recommendations include pathways to maximise revenues and enable and support adoption of V2G.

Thanks to these cutting-edge models, government and industry have an evidence-based way to see how V2G could work within the wider energy and transport systems.

## The outcome

- Residential V2G charging could be economically viable in the near term, but to do so will require a combination of high plug-in rates, reduction of the installation costs of high accuracy metering equipment for Firm Frequency Response (FFR), stacking of multiple revenue streams, and an agile model to move between revenue streams in a dynamic market environment.
- To achieve wider uptake and contribute to energy system decarbonisation, the industry must reduce V2G hardware cost significantly, develop viable commercial models to depreciate the assets over 10 years, and remove consumer concerns about range and battery impacts.
- A 7kW residential V2G charger could capture over £400/year in revenues, but only in ideal circumstances – a typical figure would be ca. £100/year.
- The cost premium for 7kW V2G needs to drop below £1000 by 2030 for continued viability.
- V2G could help to save £200m of cumulative distribution network investment by 2030.
- Smart Charging could generate GB energy system net savings of £180m/annum, and V2G could save additional £40-90M annually in GB by 2030.

## The impact

The analysis will enable policymakers, network operators and vehicle manufacturers to quantify the V2G opportunity, understand revenue prospects and create an environment that supports continued EV uptake.

The study provides industry insights of how V2G should be structured to be commercially viable and explored pathways for scaling up V2G to be able to support a flexible and efficient energy system.

It was the first time V2G was incorporated into a whole energy system model to show the long-term opportunities. This fills a gap in stakeholder understanding of the long-term viability of V2G, distinguishing V2G from other future sources of flexibility and evaluating the size of the opportunity across several scenarios.

## About Energy Systems Catapult

Energy Systems Catapult was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. The Catapult is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research. We take a whole systems view of the energy sector, helping us to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost.