

BUS2GRID PROJECT

Smart electrification for electric bus fleets



sse
Energy Solutions

For a better
world of energy



BUS2GRID BIDIRECTIONAL CHARGING

An innovative project delivered by an industry and academic partnership, Bus2Grid will deliver the UK's first e-bus to grid multi-megawatt demonstration at commercial scale.

The Bus2Grid project started in July 2018. Funded by the Department for Business Energy and Industrial Strategy (BEIS) and the Office for Zero Emission Vehicles (OZEV), with support from Innovate UK as a delivery partner, the project is designed to equip 28 state-of-the-art double decker buses, with technology capable of returning over 1MW of power to the grid.

The project partners consist of electric utility SSE Utility Solutions Limited (SSE Energy Solutions), bus manufacturer BYD, UK Power Networks and the University of Leeds. With support from energy optimisation technology provider Origami and hosted at bus operator Go-Ahead London's Northumberland Park depot where buses have already started transporting passengers around the city.

What problem are we solving?

The electricity system is changing. While the UK used to rely on large, fossil fuelled power stations, more renewables like wind and solar are fulfilling more demand than ever before. This means some fossil power stations are closing, and the services they used to provide for keeping the lights on need to be provided by other assets. This is where vehicle-to-grid comes in. Most of the value of a vehicle battery is in the transport it enables. If the battery can be used carefully by the electricity system when the vehicle is charging, then it becomes a low cost way to access 'flexible' power.

Vehicle batteries that can export power can do some of the jobs fossil power stations used to do, smoothing second by second and minute by minute fluctuations on the electricity grid.

Our Bus2Grid project is exciting because the Mayor of London has committed all London buses to having zero emissions at tailpipe by 2037. Currently there are 8 fully electric bus routes, with many more partially electric and 12 new low emission zones aimed at tackling air pollution in the most congested areas of the city.

If the entire London bus fleet of around 9,000 vehicles were to be converted with the technology being used in the Bus2Grid project, it could theoretically provide enough energy to supply more than 150,000 homes.

What innovation is needed?

Unlike other vehicle to grid trials we are working with 28 heavy commercial vehicles all connected on one site under one owner. Heavy vehicles such as these can charge at 80kW and discharge at 40kW meaning the volume of response from 28 buses can be more than 3MW with demand side response under certain conditions.

Rather than having to recruit hundreds of private vehicle owners through hundreds of electricity tariffs, this approach means one set of commercial parties can contract one significant volume of resource to the energy system operator. To do vehicle-to-grid at this scale though needs several strands of innovation to come together, both hard engineering and softer process and business model change.

IN PARTNERSHIP



UNIVERSITY OF LEEDS

IN COLLABORATION WITH



FUNDED BY



DELIVERY PARTNERS



HARD AND SOFT INNOVATION

On the hard engineering side, this volume of export power at one site means the bus garage needs to be treated more like a generator on the system.

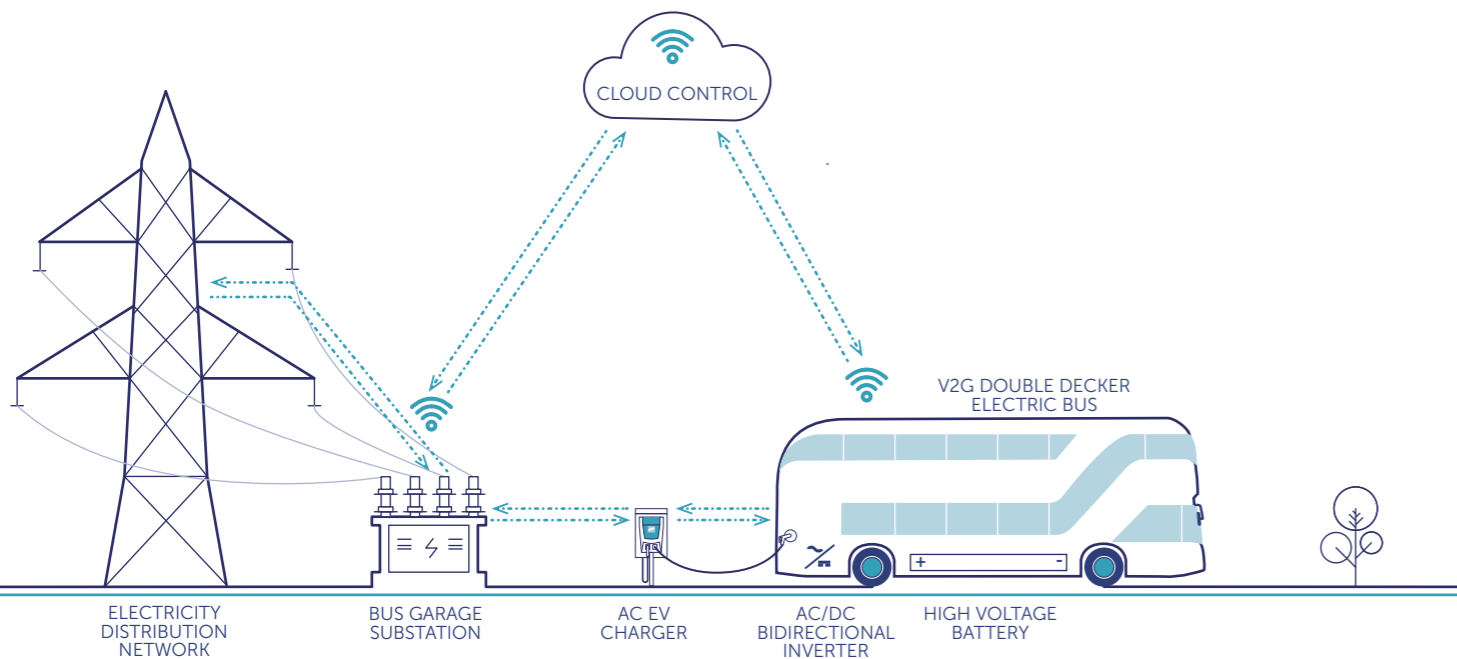
Hard innovation

The buses need to make sure their power export is safe, and reliable enough to protect the surrounding power grid. This means the substations and infrastructure around the garage need upgrading to handle a larger power import and have the hardware in place to deal with a two-way power flow.

The costs associated with this work needs to be set against the revenues that can be made from participating in the energy market. Further, work needs to be undertaken on the power characteristics of the buses and ensure they are compliant with 'G99' standards, a certification used for connecting generation projects.

This requires the bus manufacturer to design systems to the standards of power generation as well as transport services.

At the interface between the buses and the site's power supply there needs to be a charging management and vehicle telemetry system capable of recognising and responding to signals from a third party. Here Origami is working with BYD to integrate their own energy router technology with BYD's 'BAFAS' on bus telemetry system and the depot's existing charging management software. The protocols that need to be developed must integrate systems functionality and do so in a way that allows all chargers and buses to respond to signals in under 10 seconds to service some parts of the energy market.



Soft innovation

On the softer side of innovation there is a need for new types of partners to work together and find new business models and value sharing principles. The project has facilitated a process of learning between the transport led and energy led stakeholders in the project. Here the needs of the vehicle owner Go Ahead, must take precedence.

Each bus needs to be at a set state of charge to leave the depot in a morning and run the routes contracted by Transport for London. The primary role of most of the on-site hardware is to fulfil this need. After this, the site needs to remain within limits set out by the grid provider, UK Power Networks, in the site connection agreement. Once these conditions are satisfied, and the hardware development and installation is complete and tested, Origami's systems can be used to enable SSE to bid into the Electricity System Operator to fulfil energy services.

Observing the constraints above it is possible to calculate the available flexibility window. When it is clear what this flexibility window looks like, then BYD can model the impact on the battery and power handling equipment on the buses that may result from servicing this market, and ensure a risk sharing agreement is in place between manufacturer and buyer.

In a business model development workshop in May 2019 run by the University of Leeds, the project partners identified no fewer than nine commercial contracts are affected by this process, moving from standard electric buses to vehicle to grid capable buses.

Each of these contracts has varying lengths and covers existing commercial activities. In this way the hard and soft innovation elements need to co-evolve, making communications and project management as important an element of innovation as the development of new software or power handling equipment.

Benefits from success

By reducing the volume of fossil fuelled power stations that satisfy energy system flexibility, we reduce greenhouse gas emissions from the UK power sector. The bus operator is able to offer more competitive contracts and could ultimately lower costs for passengers because they are benefiting from energy contracts they can make some revenue from.

Because the diesel to electric switch becomes more attractive, city dwellers benefit from better air quality. Finally, by bringing together engineering, commercial, manufacturing and software innovation, this trial builds the capacity of the UK to maximise the benefits of a smart energy revolution.

These benefits have been estimated at over £40bn in Great Britain by 2050. These savings to the UK economy come from reducing need for traditional heavy engineering solutions, maximising the use of renewable energy, and combining smarter systems with better forecasting and system planning.

Bus2Grid is part of 21 V2G projects awarded in 2018 by Innovate UK in a globally significant £30m innovation trial. By the end of the project, London and other UK cities will be in pole position for developing and expanding the benefits of vehicle to grid technologies.

SMART DISTRIBUTED ENERGY INFRASTRUCTURE SOLUTIONS

Designed to meet local energy needs and drive Net Zero.

SSE Energy Solutions is part of SSE plc, a UK based FTSE 100 company with 75 years' experience operating in the fast-changing energy industry.

SSE Energy Solutions plays a major part in the emerging consumer-led energy system, and provides key services to enable users to benefit from new ways to optimise and manage their low carbon energy use.

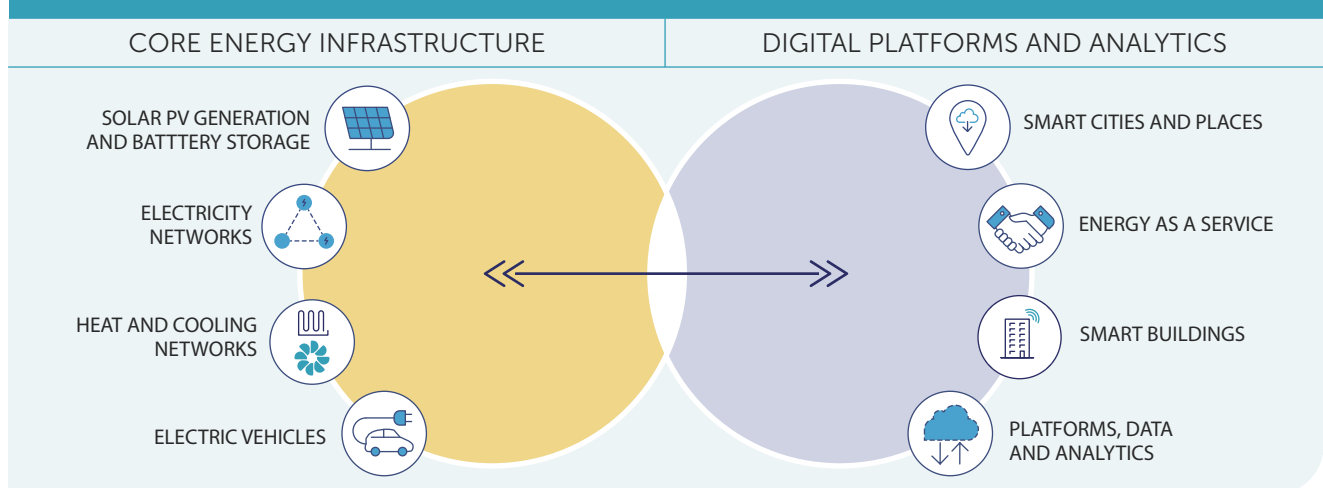
Our Distributed Energy business teams adopt a whole system approach by investing in, building and connecting your localised, flexible energy assets to accelerate your path to net zero and create a more resilient energy system for the long-term.

Right now, your decision to pick SSE Energy Solutions, part of an established renewable energy company investing in all our futures, will be the right choice for you and for our environment.

Our energy solutions include:

- Electric vehicle infrastructure for public transportation and vehicle fleets
- Local electricity infrastructure including building, owning and adopting private HV networks
- Heating and cooling networks for residential, commercial and industrial consumers
- Local energy generation, including funded offsite/ onsite solar PV
- Energy storage solutions, including battery storage
- Optimising building energy consumption and use
- Data platform services to support smart buildings, places and cities
- SSE Enhance, our aggregation and trading platform for small energy assets
- A growing suite of green energy supply solutions, including corporate power purchase agreements.

WHOLE SYSTEM THINKING – ACCELERATING THE JOURNEY TO NET ZERO



FOR A BETTER WORLD OF ENERGY

Get in touch with our team to find out how we can help you
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