

# Ebbs and Flows of Energy Systems (EFES) Project

## PUBLIC DESCRIPTION

### What are we trying to do?

Electric vehicles (EVs) have the potential to transform the way we use energy on a daily basis. Power cuts and expensive peak demand tariffs could become a thing of the past.

- ✓ Could you power your house with your car?
- ✓ Could you power your car with your house?
- ✓ Would you like to be paid to drive your car to work and power your office block?
- ✓ What impact will EVs have on our electricity prices?

These, and more, are the questions we will be hoping to answer through this project.

### Why are we doing this?

The findings of this project will enable much more efficient use of the energy we generate, especially where we are generating local renewable energy, in order to make energy more affordable and reduce carbon emissions. It will also benefit electric vehicle owners to use the batteries of their vehicles as storage batteries to store energy and use it when it's more efficient to do so.

### How will we achieve this?

Partially funded by Innovate UK and the Engineering and Physical Sciences Research Council (EPSRC) the project seeks to manage, improve and reduce the electricity use of UK buildings, from single properties through to large commercial premises such as science and business parks. This will be achieved through development of three key technologies;

- ✓ **Virtual Power Plant (VPP)** - a cloud based 'power plant', capable of utilising electricity storage assets such as static batteries or vehicles through a software package, controlled by electricity providers.
- ✓ **Vehicle-to-Grid (V2G) Unit** – EVs will plug into this unit to provide both charging for the vehicle and enable it to act as a battery store, either to provide electricity directly to a building or to the National Grid using the VPP.
- ✓ **Vehicle to Grid Getaway** – this will provide the control functionality for the V2G unit, enabling the unit to communicate with both a building and the VPP to determine the most appropriate charging or discharging option.

Furthermore, the project looks to evaluate the impact the technology being developed has on our local energy systems through computational modelling, physical demonstration projects and engagement with the public. Specifically, research seeks to establish if there is a financial and environmental benefit to installing this equipment in the home and work place.

### How does it work?

Electricity demand across the UK varies depending upon the time of day and year. For example, peak electricity demand for the UK is between 4 and 7pm on a week day. This is because everyone has arrived home from work and turned on multiple appliances, causing a massive increase in electricity requirements to the National Grid. Currently this is supported by large fossil fuel power stations that run around the clock to anticipate any increase in the base demand.

However, this additional demand could instead be provided through utilising the excess electricity stored in an EV or battery storage asset, redistributing the electricity across the local network and as such reducing the requirements on traditional power stations.

### **What are the benefits to you?**

Any EV owner could be able to participate, signing up to a scheme offered by the VPP provider. The provider will then offer them a price for the electricity in their electric vehicle and if the EV owner agrees, will use the required amount. The BEMS unit will enable the vehicle user to specify where they will be travelling next and how much electricity they require, ensuring they are always able to use the vehicle whenever they need it. If you generate your own electricity from renewable sources you could get more out of a home solar system by storing the energy you generate in your car battery.

### **What are the benefits to our society and the environment?**

V2G technology is an innovation that can improve our lives and make the world a better world for present and future generations. A new era is expected where electric mobility becomes part of the domestic distribution grid. Specifically:

- ✓ By managing EV charging, utilities are able to reduce peak demand impacts, optimize intermittent renewable generation such as wind, and coordinate that generation with EV charging.
- ✓ EVs and renewable energy technology will benefit from one another's technical progress. V2G could play a role as storage for intermittent renewables, even when renewables become half (or more) of total electrical generation.
- ✓ Charging EVs solely by electricity from renewable generation would represent the ultimate in environmentally friendly, zero-emission transportation.
- ✓ V2G technology can help improve air quality problems in cities if EVs make an essential contribution in reducing CO<sub>2</sub> emissions in cities.