# Making vehicle-to-grid a reality:

# V2G DEVELOPMENTS IN THE UK

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Innovate UK

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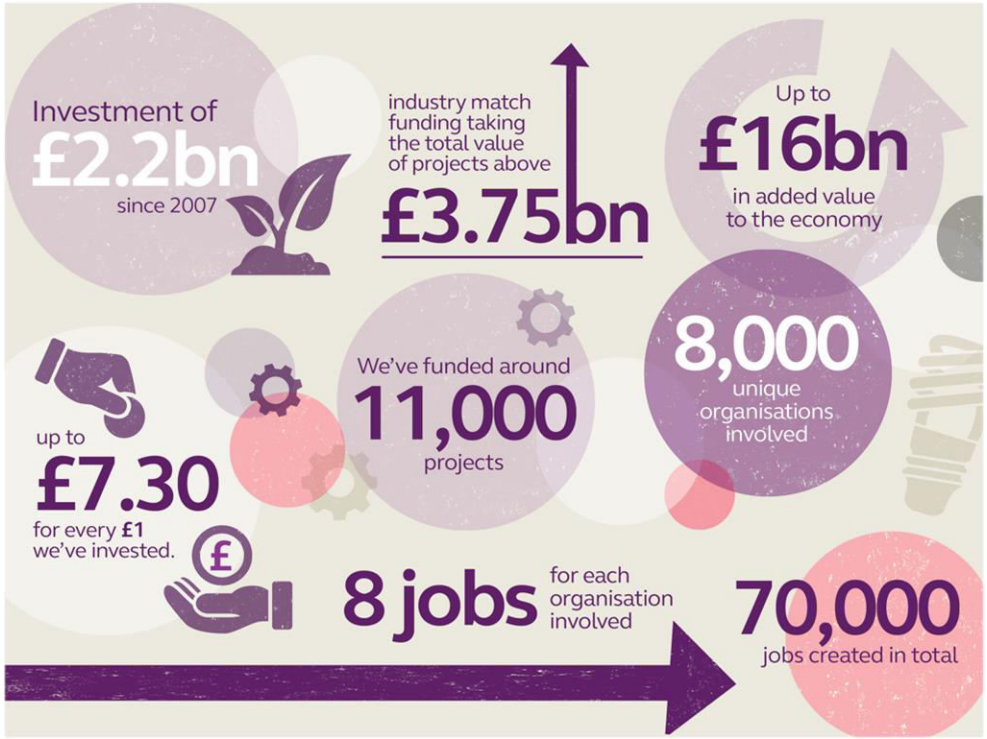
Innovate UK is part of
UK Research and Innovation

# Outline

- Innovate UK
- Drivers for V2G developments in the UK
- V2G opportunity and market value
- Innovate UK V2G programme
- Takeaways
- UKPN & V2G

# Innovate UK

Innovate UK drives **productivity and growth** by supporting businesses to realise the potential of new technologies, develop ideas and **make them a commercial success**



# The Innovate UK V2G programme at a glance

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**20**
projects

**72**
individual parties

**£30m**
public funding

**£46m**
whole projects value

**2700**
V2G installation on test

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# UNMANAGED EV CHARGING WILL REQUIRE NETWORK REINFORCEMENTS

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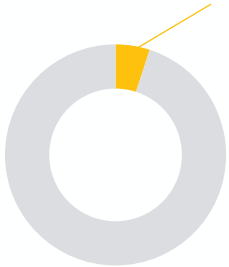


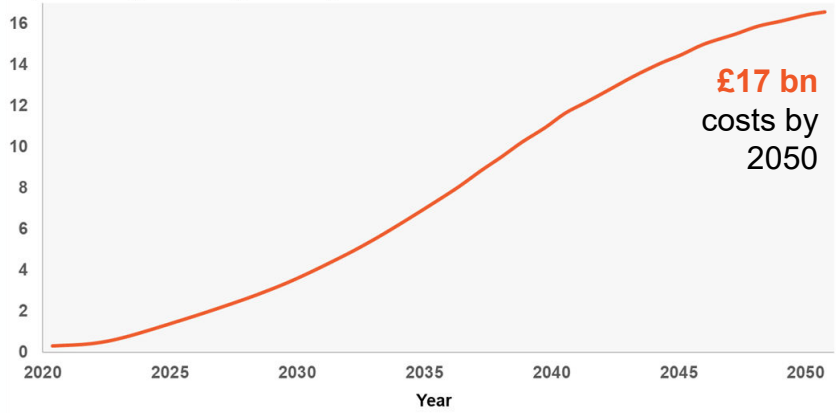
Global electricity consumption from EVs **5% of total** in 2040

[Source: Bloomberg New Energy Finance Electric Vehicles Outlook 2017]


**Additional peak demand**
without managed charging

[Source: National Grid Future Energy Scenarios 2017]

**Cumulative network reinforcement costs in UK (£bn)**
[Source: Energies Technologies Institute]

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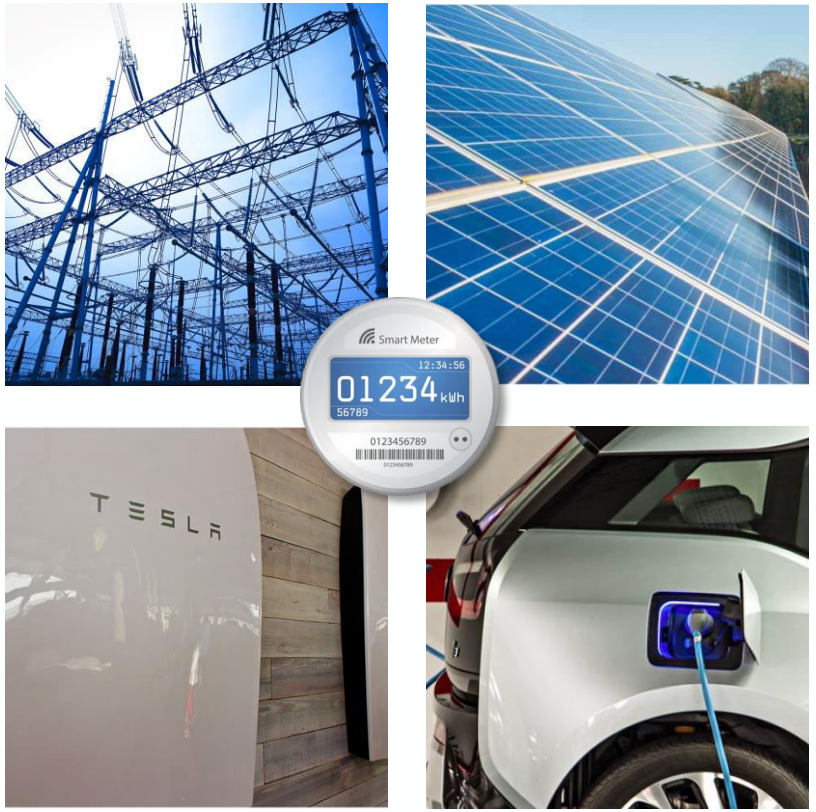
# A Smart Energy System supports V2G

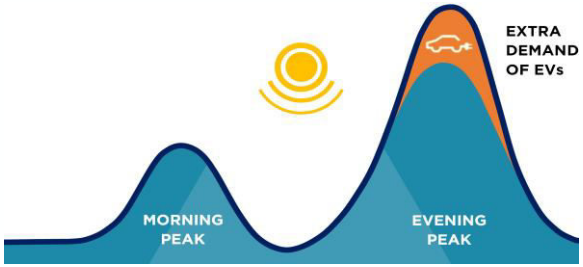
An Electricity System ready to adapt to new consumers and generators, and business models is necessary for V2G to be viable

- Local Generation
- Electrification of heat
- Time of usage tariffs
- Aggregators and Smart Energy Services
- Open and simplified flexibility markets
- Distribution Network Operators (**DNOs**)
  - Distribution System Operators (**DSOs**)



# EV BATTERIES AS DISTRIBUTED ENERGY RESOURCE

**Vehicle to Grid (V2G)** includes all technologies and systems that achieve a more tight integration of EVs with the Power Grid:

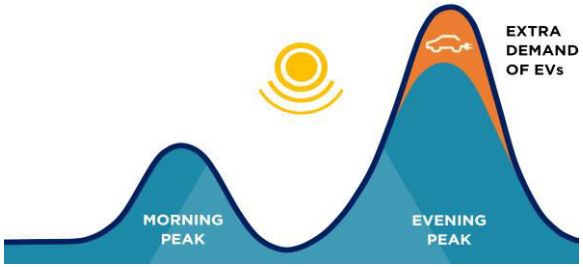



UNMANAGED EV CHARGING

# EV BATTERIES AS DISTRIBUTED ENERGY RESOURCE

**Vehicle to Grid (V2G)** includes all technologies and systems that achieve a more tight integration of EVs with the Power Grid:

- EVs act as **controllable loads**, to smooth demand peaks



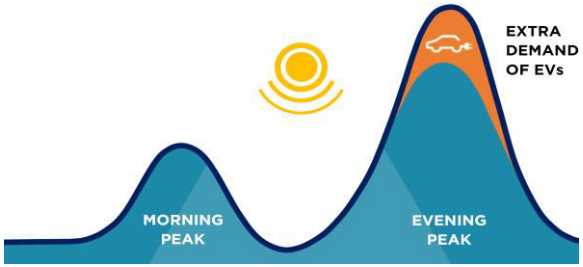

UNMANAGED EV CHARGING


SMART EV CHARGING

# EV BATTERIES AS DISTRIBUTED ENERGY RESOURCE

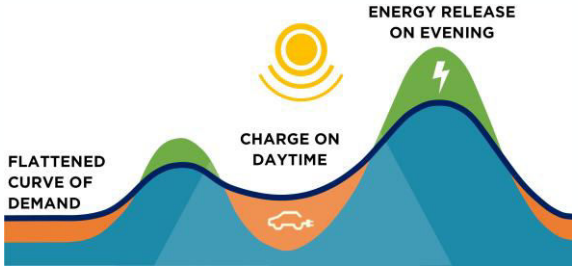
**Vehicle to Grid (V2G)** includes all technologies and systems that achieve a more tight integration of EVs with the Power Grid:

- EVs act as **controllable loads**, to smooth demand peaks
- EVs can act as **distributed storage**, providing energy back to the Grid
- EV drivers earn **rewards** in exchange for grid services




UNMANAGED EV CHARGING


SMART EV CHARGING




VEHICLE-TO-GRID

# V2G MARKET VALUE COULD BE WORTH £3.5BN/YR BY 2040

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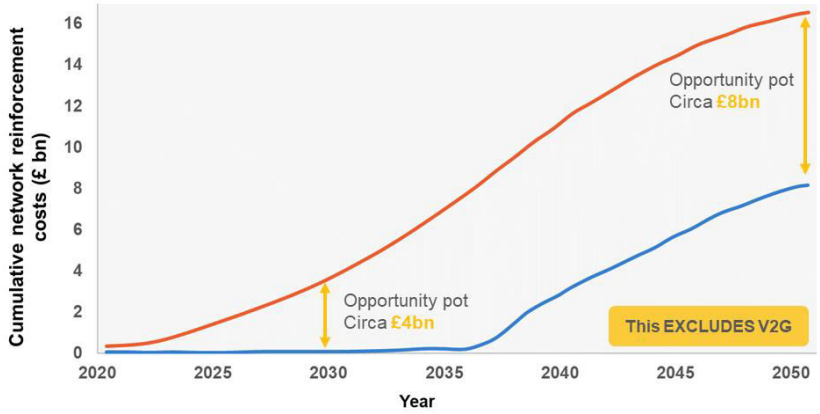
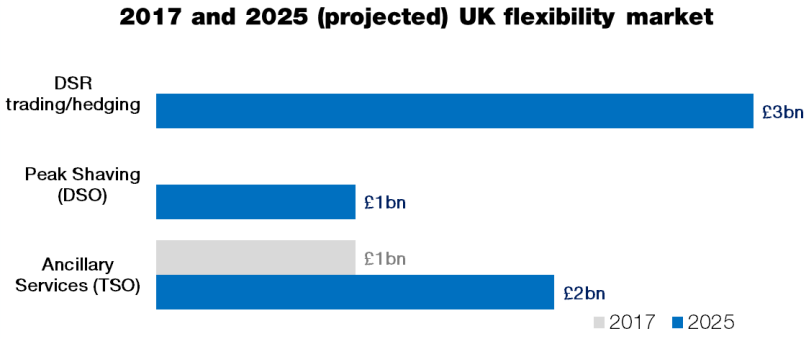
Using EVs as controllable load allows to **defer**

**Power System upgrades**

- Up to **£8 bn** cost savings




Value multiples if EVs act as **flexibility source**




Energy system benefit (£bn/yr)

| Scenario | | Smart Charger | V2G |
|---|---|---|---|
| **Burning platform** | (assumes 50% participating vehicles) | 0.1 | 0.15 |
| **Stepping stone** | (assumes 50% participating vehicles) | 0.5 | 1.4 |
| **Future survival** | (assumes 80% participating vehicles) | 1.1 | 3.5 |

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# V2G CAN SATISFY DIFFERENT GRID SERVICES: STACKING SERVICES MAXIMISES VALUE

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| | | | Typical Response Times | Typical Duration of Service | Typical Revenue |
|---|---|---|---|---|---|
| Frequency Services | Including Frequency Regulation, Restoration and Containment i.e. FFR | + − | 0 – 30 seconds | 30 seconds – 30 mins | £££££ |
| Reserve Services | Typically separate positive and negative services i.e. STOR & DTU | + − | 5 – 240 mins (faster response = higher value) | 30 mins to 4 hours | ££ |
| Capacity Markets | Used to ensure sufficient capacity is available to meet system need | + | Up to 4 hours | Potentially unlimited (risk to DSR) | £££ |
| Behind the Meter | Peak shaving services to avoid high price periods i.e. TRIAD, DUoS, TOU Tariffs | + | N/A | 15 – 120 mins | ££££ |
| | Increased utilisation of generation | + − | N/A | 15 mins – 4 hours | ££ |

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# Innovation on V2G

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Transportation and Energy sectors converge: effective V2G implementation still requires work on

- Uptake of EVs in the UK market
- Demonstration of reliable business cases for V2G in UK
- Development of affordable hardware
- Development of aggregation platforms
- Evaluation of long term battery life for combined transport and V2G use cases
- User engagement – EV owners need to ‘buy-in’ the V2G technology and operations

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# INNOVATION ON V2G: THE INNOVATE UK V2G PROGRAMME

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Department for Business, Energy & Industrial Strategy

Office for Low Emission Vehicles

Innovate UK V2G competition awarded **£30m** in 3 key areas:

**Feasibility Studies**

- Uptake of EVs in the UK market
- Demonstration of reliable business cases for V2G in UK

→ **8 projects** explore feasibility of **innovative business models** for V2G

**Collaborative R&D**

- Development of affordable hardware
- Development of aggregation platforms

→ **4 projects** will develop **V2G HW and aggregation platforms** in the UK, creating an integrated V2G supply chain

**Real-world demo**

- Evaluation of long term battery life for combined transport and V2G use cases
- User engagement – EV owners need to 'buy-in' the V2G technology and operations

→ **8 projects** will trial more than **2700 vehicles** in V2G operation, covering different customer types, geographical areas and customer propositions

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# MAKING V2G A COMMERCIAL PROPOSITION: DELIVERING VALUE TO ALL ACTORS

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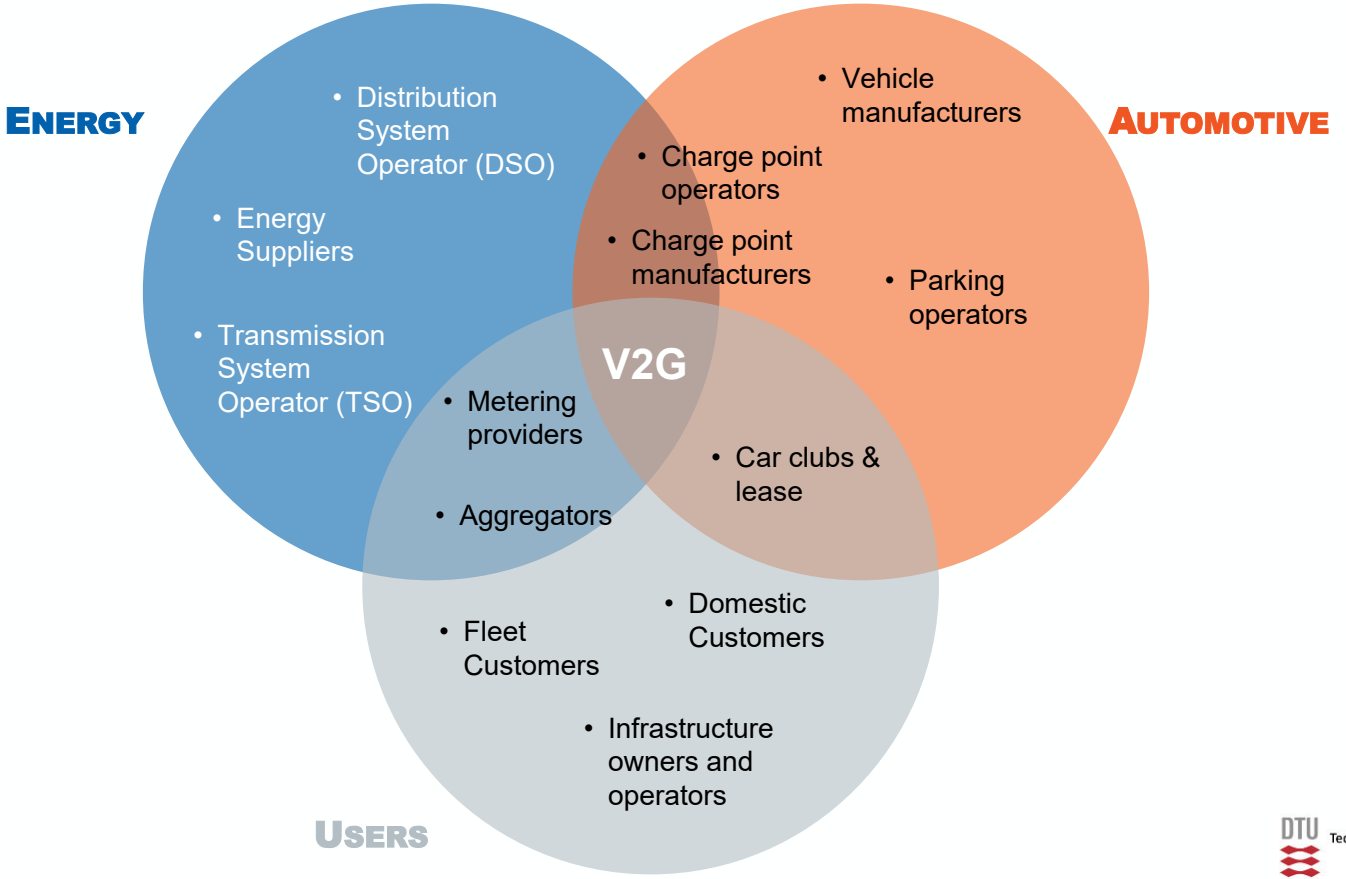


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# EMPOWERED CUSTOMERS PARTICIPATE IN V2G VOLUNTARILY

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- **Choice, not obligation** – Participation in V2G programmes must be voluntary
- **Reward** – V2G business models need to find a way to compensate EV drivers
- **Engaged users** – customers will join V2G schemes if they see clear advantages and no disruption to use of EVs for transport

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# A WORLD-LEADING RANGE OF V2G PROJECTS

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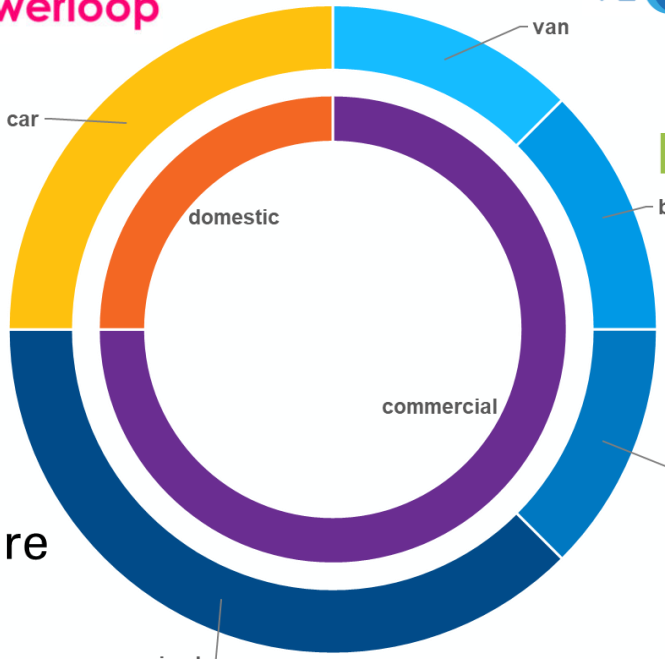
Powerloop

V2 Go!

project sciurus



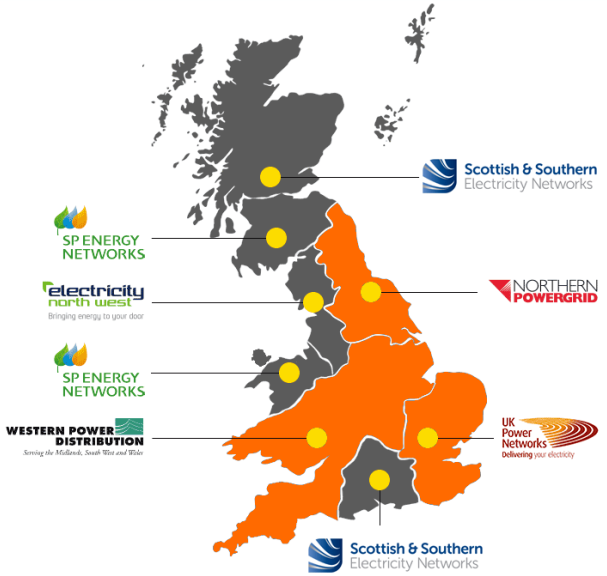

BUS2GRID

SMART HUBS

e4Future

e-flex

EV-elocity

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# THE UK V2G PROGRAMME HAS ALREADY GENERATED TANGIBLE IMPACTS

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- **UK world leader on V2G** – The sheer size and diversity of the programme have made the UK the centre for developments on V2G in the world

- **V2G commercial customer propositions already available** – Companies like OVO, Octopus and EV8 are setting commercialisation routes and offerings for V2G

- **Fast-growing supply chain** – multiple EV charger manufacturers developing V2G HW and energy services platforms integrating V2G functionality

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# Takeaways and Open Points

- **From problem to solution** – V2G can turn EVs into flexibility resources, generating value for customers, making the Power System more reliable, increasing penetration of renewables
- **UK as a world leader on V2G technologies** – from battery degradation to HW/SW development to customer engagement and business modelling, the iUK is the first V2G programme in the world trying to address current barriers to V2G at scale and for a variety of customers/vehicles
- **International growth of V2G market from mid 2020s** – regulatory support is needed for V2G commercial deployment and DSR-enabled markets will be the first movers in this space
- **Proven business cases and transferability** – business cases still in development: directly related to customer proposition and not transferrable directly across markets
- **Standardisation and Interoperability** –multiple standardisation efforts that need to be synced across the whole V2G value chain, and allow interoperability (both in same market and across markets)

# Further stimulating V2G growth: publicly available V2G studies

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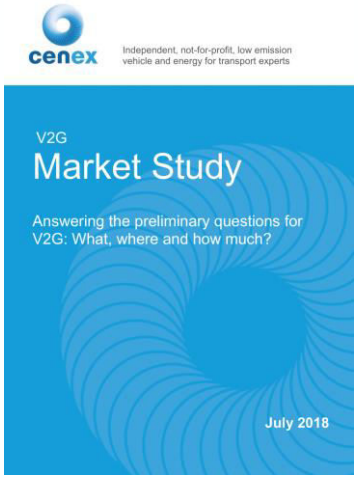


**Cenex V2G Market Study**

Available at: https://www.cenex.co.uk/energy/vehicle-to-grid/

**Everoze & EVConsult V2G Global Roundtrip (c. by UK Power Networks)**

Available at: http://everoze.com/v2g-global-roadtrip/


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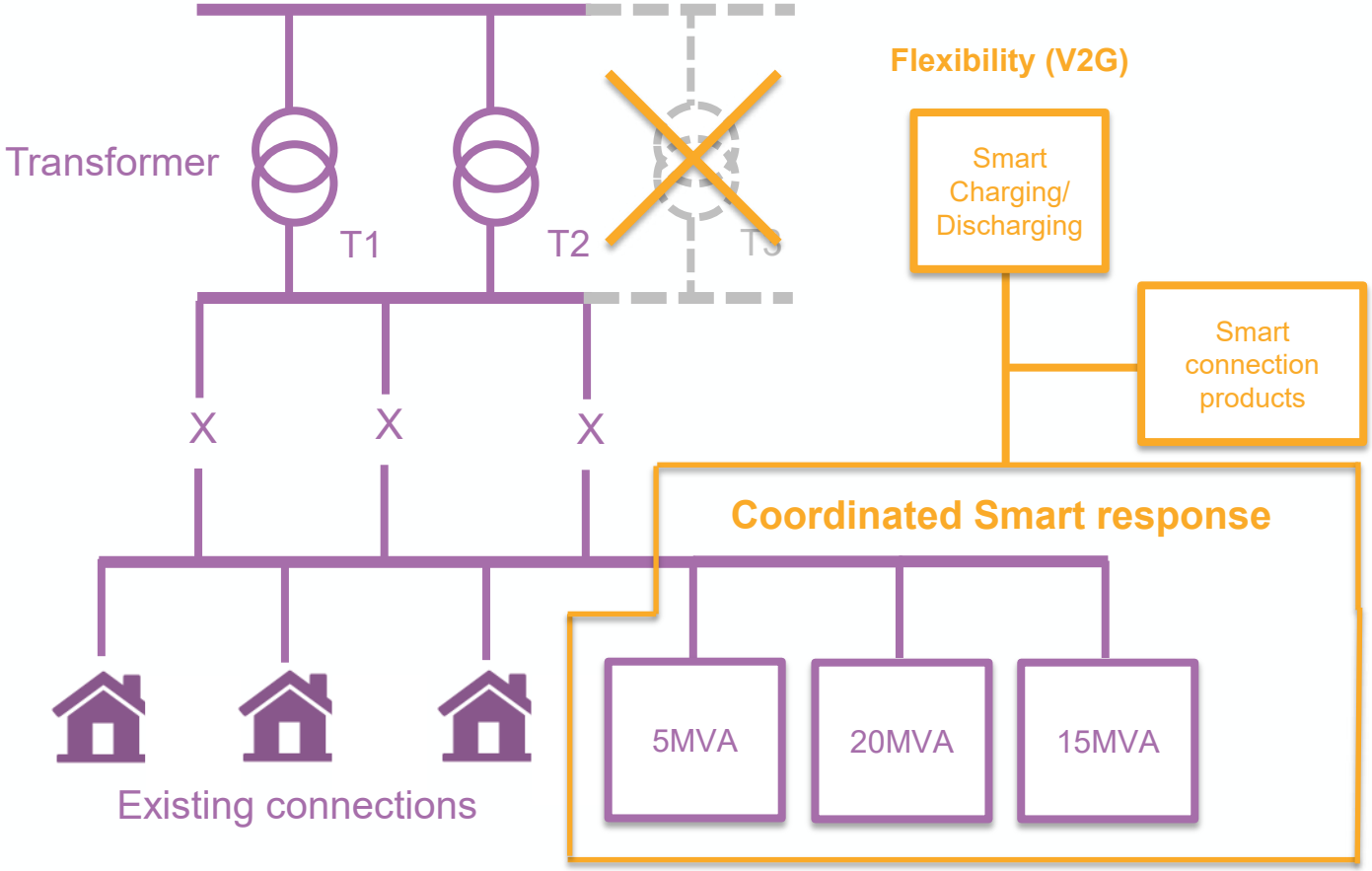
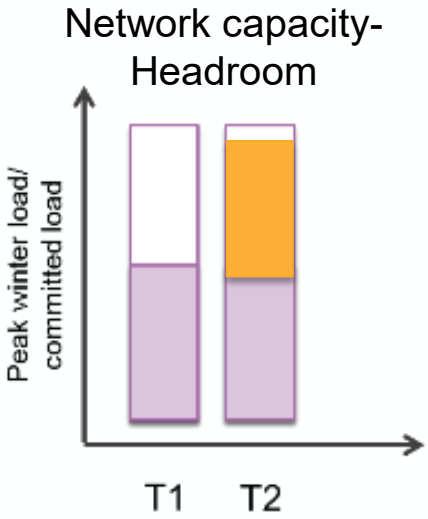
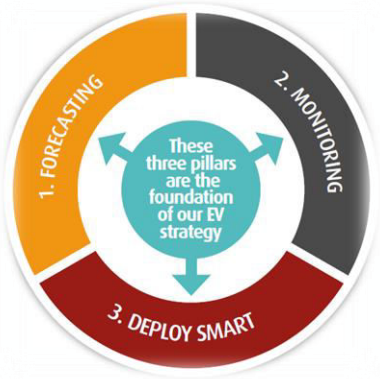
# How networks will be managed SMART



# EV NETWORK READINESS




Enablers - Innovation and BAU projects

## Commercial Solutions

- Timed Connections
- PicloFlex – Flexibility procurement
- Smart Charging flexibility
- V2G Flexibility
- Beyond the meter Smart

## Technical Solutions

- LV CB and SOPs
- LV Phase Switching
- LV Engine- SPEN
- Active Response- Network Meshing & proactive reconfiguration

# UKPN TransPower (V2G) Portfolio

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UK Power Networks
Delivering your electricity


## Network Operator Objectives:

- System integration to **dispatch vehicle services** through smart charging & aggregation
- Testing **DSO service interface** methods
- **Business case outcomes** informing potential for commercial smart savings in next regulatory period
- **Standards** and specifications for vehicle flexibility service provision
- **Develop commercial contracts** between UKPN and third party intermediaries
- Develop new flexibility products - **understand the value**

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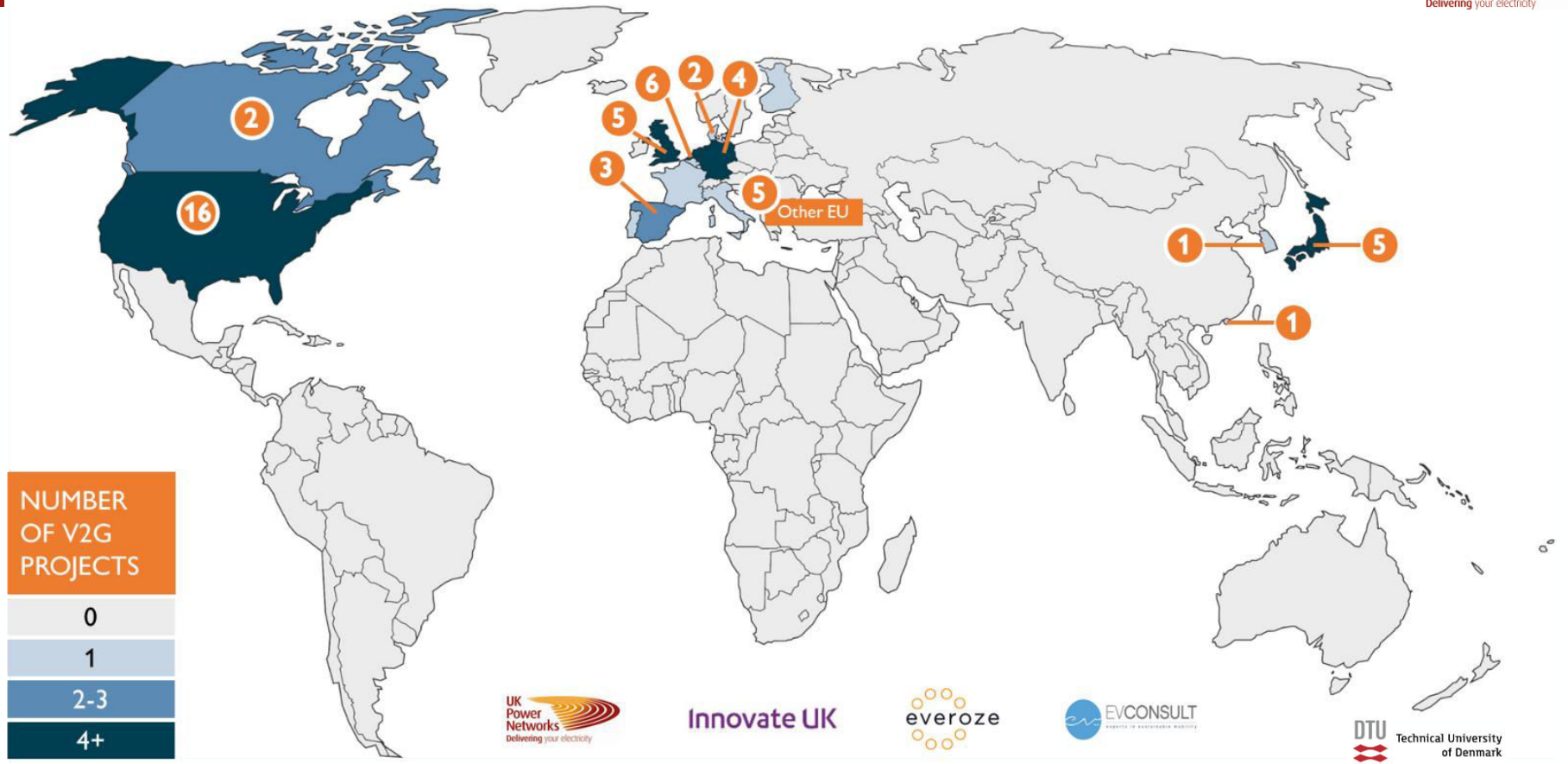
# THE V2G MAP OF THE WORLD



# THE V2G MAP OF THE WORLD

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UK Power Networks
Delivering your electricity

**50** projects **globally**
with physical deployment

Most projects **focused** in **technical** aspects rather than social or commercial

**Renault, Nissan, Mitsubishi**
main OEMs participating

**25** projects in **Europe**

# Thank you

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