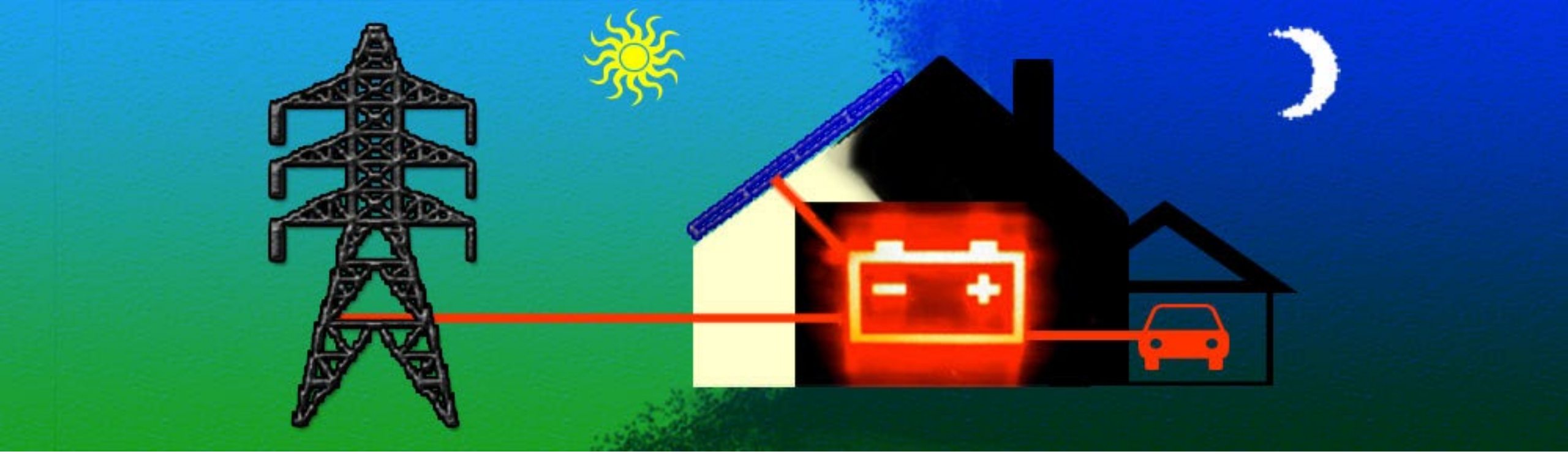


V2G Limited

361 Energy Fair

Barnstaple Pannier Market

September 29th 2024 – 13:50 BST

Jim Hunt

Managing Director of V2G Limited

Member of the BSI's L/13 "smart grid" overview committee amongst many other British and international EV interoperability standard development committees.

Please note that many of the following slides include explanatory links.

Please click them!

What is the “Smart Grid”?

A remote terminal unit (RTU) on a 3 phase electricity pole in Halwill Junction

https://V2G.co.uk/2014/05/the-great-dunchideock-blackout-saga/

What exactly **IS** V2x?

V2x is a three letter acronym (TLA) usually translated into plain English as "vehicle-to-everything". The "x" can be replaced by a variety of other letters, the most well known of which is probably "G" – V2G stands for "vehicle-to-grid".

Using this terse terminology, common or garden charging of the traction battery in an electric vehicle is referred to as G2V, or "grid-to-vehicle". In other words, as the EV's battery is charged electricity is flowing from the electricity distribution grid through some form of "charger" into the car's battery.

There are two fundamentally different types of EV charger. Lower power alternating current (AC) chargers typically used in the "domestic" environment, and higher power direct current (DC) chargers typically found in the "commercial" environment of motorway service stations and leisure centre car parks.

What does a V2x capable EV look like?

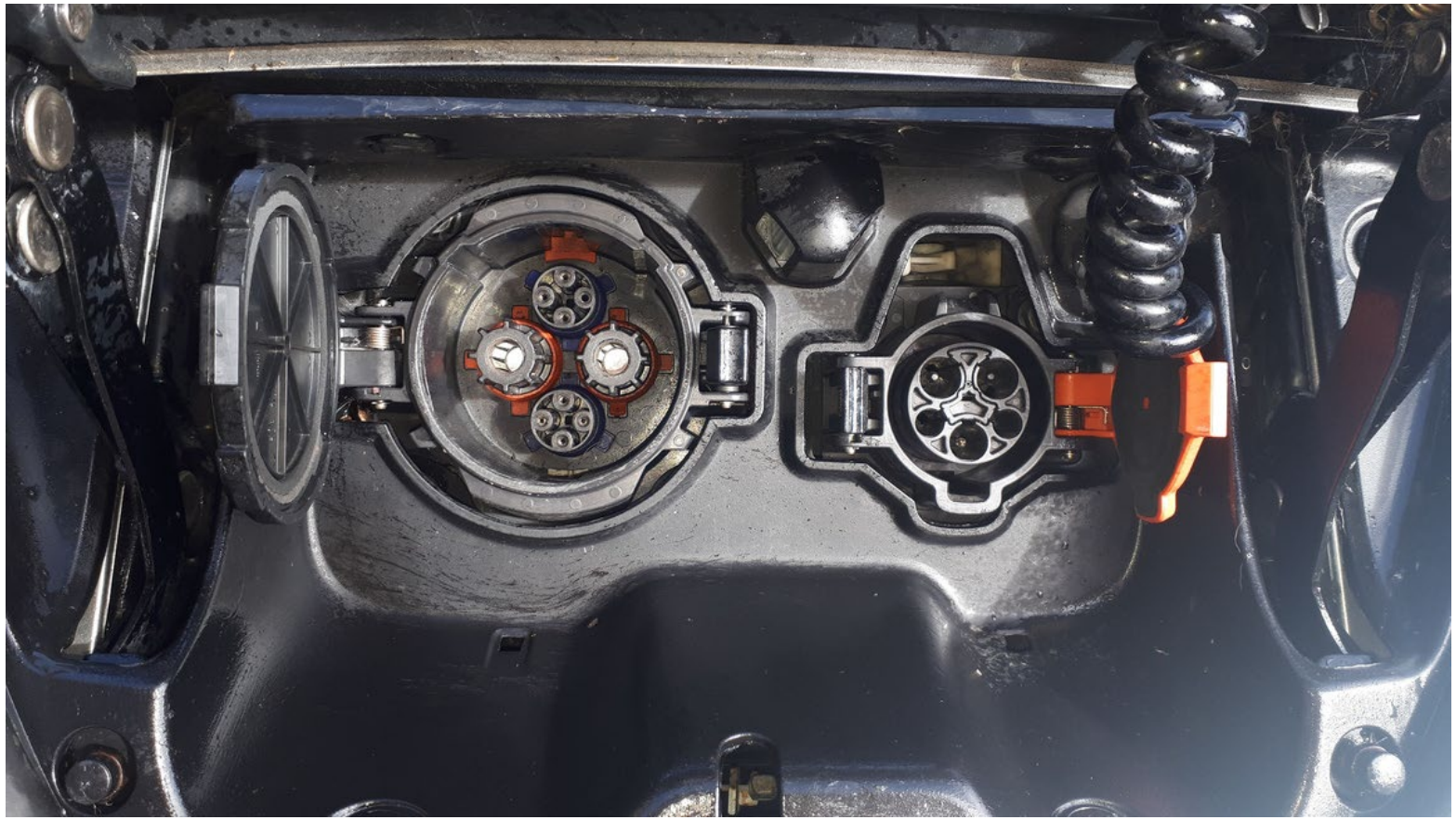
V2G Limited is the proud owner of an ancient Nissan LEAF, fondly known on social media as "Lisa the LEAF". Here's what Lisa looks like:

What's with AC versus DC?

Here's Lisa rapid charging at Exeter Services. The large "charging station" converts AC from the electricity grid into DC to charge Lisa's battery:

What's with AC versus DC?

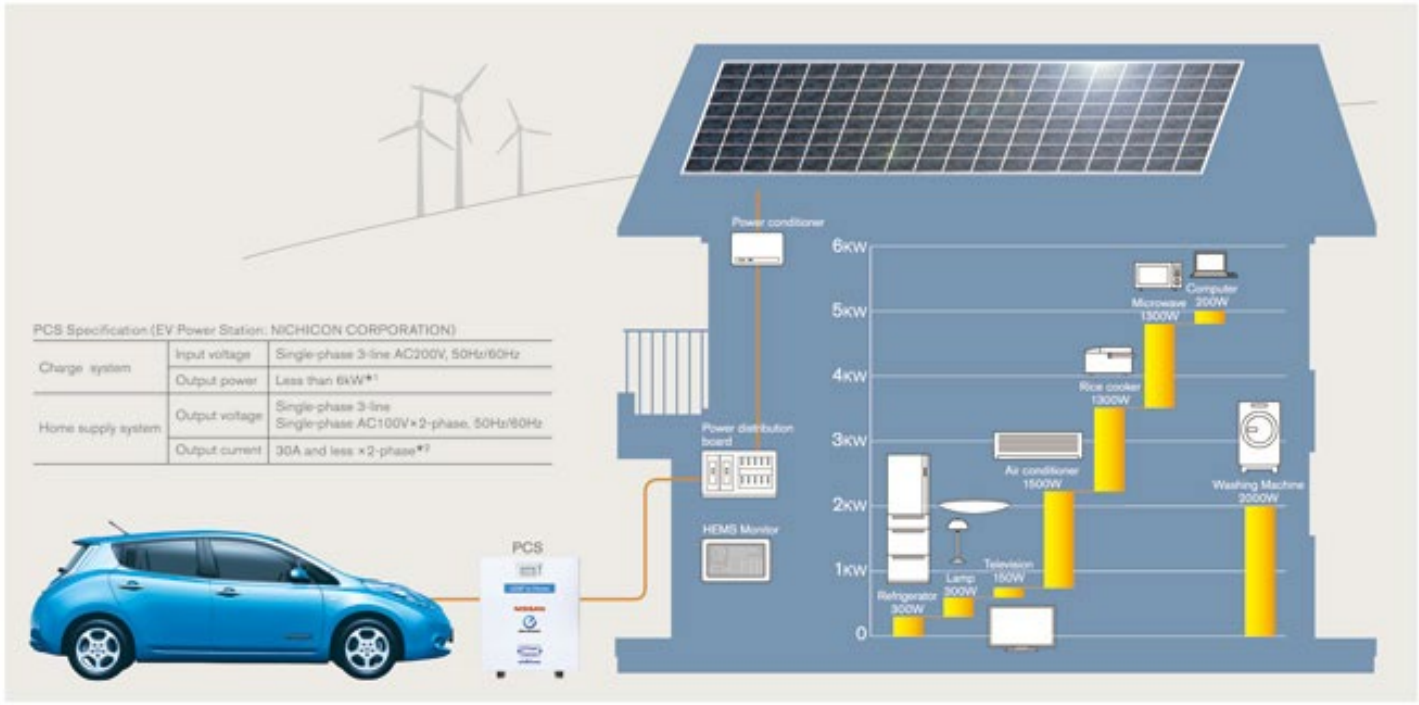
Lisa has two different charging connectors hiding behind the flap below her bonnet. Here's what they look like:



The DC CHAdeMO connector is on the left. The AC connector is on the right.

What's with AC versus DC?

The Nissan LEAF was one of the first electric vehicles to incorporate V2x technology. It's possible to use the data pins in Lisa's DC CHAdeMO connector to instruct her to feed electricity stored in her battery back through the charging cable to the charging station or a domestic wallbox:



★1 This is output value of device and does not guarantee actual charging output. This depends on contract demand, electrical load of a house or how much a vehicle is charged.
★2 Load limit control will work to keep maximum current 30A (100V) for one phase. A power output of 6kW may not be ensured as specified power by given device efficiency and wiring connections at each home.

https://V2G.co.uk/2012/06/nissan-announce-leaf-to-home-power-supply-system/

What's with AC versus DC?

The so called "bi-directional" charging station needs to be able to convert DC from the car into AC to power the house. Which requires a sophisticated piece of electronics known as an "inverter". Even today, such devices are large, heavy and hence significantly more expensive than a G2V wallbox:

What's with AC versus DC?

This is the V2x wallbox used for the OVO Energy V2G trial funded by Innovate UK. It takes two people to lift it!

https://V2G.co.uk/2018/01/uk-spends-30-million-on-v2g-technology/

What's with AC versus DC?

Earlier this year Renault announced the Renault 5 E-Tech, which "will be the first in a long series of cars to be fitted with the new 11 kW AC bidirectional charger":

https://V2G.co.uk/2024/02/renault-reveal-v2x-enabled-r5-at-geneva-motor-show/

What's with AC versus DC?

Renault don't provide a publicity image of the R5 E-Tech's charging port, so here's a generic one. The Combined Charging System (CCS) Type 2:

What's with AC versus DC?

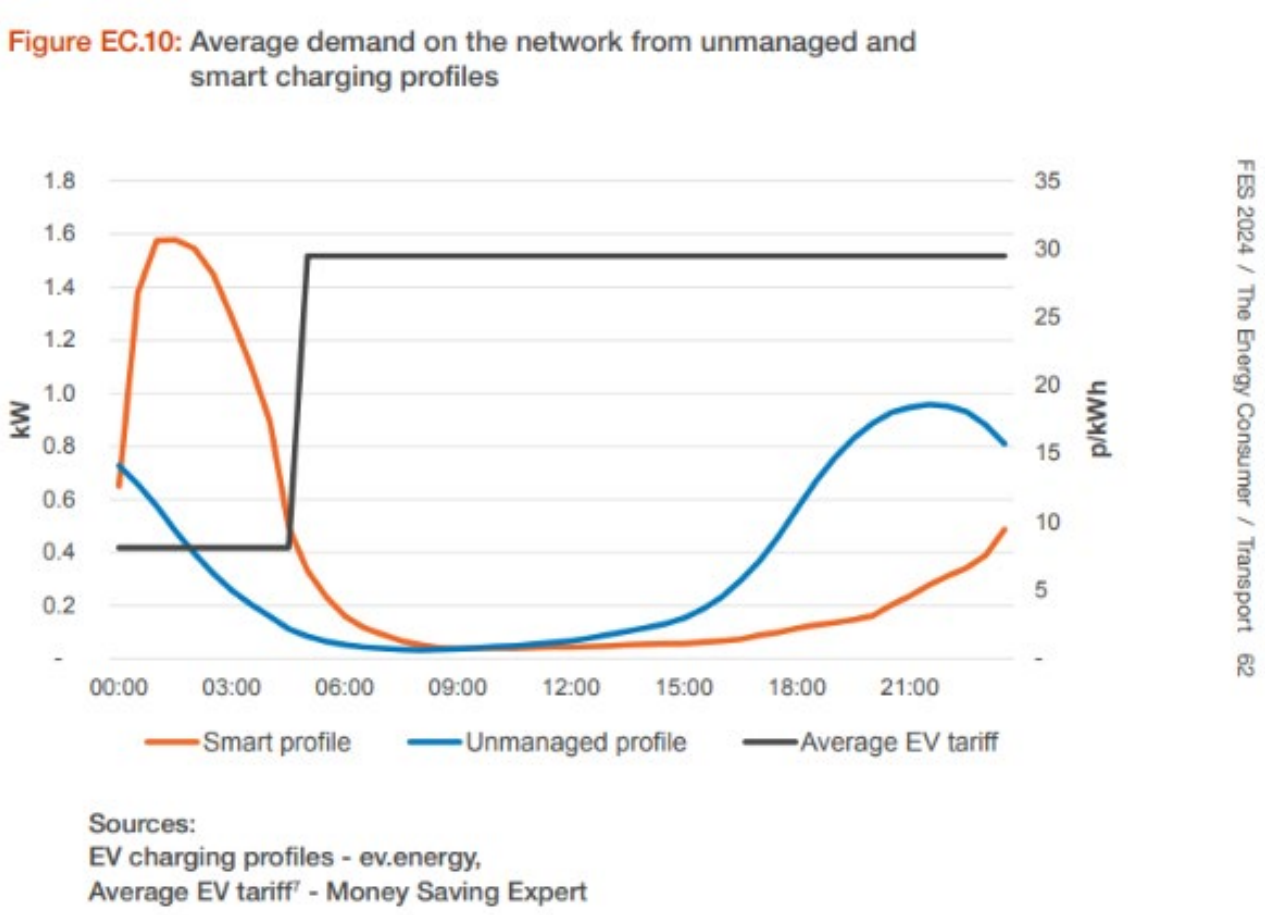
With AC V2x the inverter is located inside the electric vehicle, which means the wallbox can be much smaller, lighter and cheaper. Like this:

What's with AC versus DC?

Also public AC V2x charging stations can be lighter and cheaper than DC:

https://youtu.be/0gDd_k8ZGDc

Smart Charging (V1G!)



The effect of smart electricity tariffs. From: National Grid Future Energy Scenarios 2024 https://www.nationalgrideso.com/future-energy/future-energy-scenarios-fes/fes-documents

Demand Side Response

https://www.nationalgrideso.com/industry-information/balancing-services/power-responsive/demand-side-response-dsr

Demand Side Response

According to the National Grid Energy System Operator:

“Demand Side Response simply involves businesses increasing, decreasing, or shifting their electricity use – in response to a signal – to help balance Britain’s electricity system. In return they receive strong financial incentives.

With more renewable generation – such as wind and solar – coming online we are seeing a requirement for increased system flexibility to balance the system, along with changes in where we can source flexibility and capacity.

National Grid ESO believes that DSR and other forms of flexible technology, such as storage, can help to provide the capacity and flexibility needed to operate the electricity system in tomorrow’s world.”

Demand Side Response meets V2x

Note that the National Grid ESO made no mention of homes, but smart charging is one form of "Domestic DSR". Smart homes adjusting their electricity consumption in response to external "signals", financial or otherwise.

V2x is the next step. Using the batteries in electric vehicles as energy storage devices. Referring back to the V1G slide, one form of financial incentive would be to store energy by charging Lisa's battery in the small hours when electricity can be purchased for 7.5 p/kWh, and then powering your house and its appliances by discharging her battery instead of by buying electricity at 27.5 p/kWh. Rinse and repeat.

Or sign up to a "smart export" tariff and sell the stored energy back to the grid for considerably more than you paid for it. Buy low, sell high. AKA price arbitrage.

Demand Side Response meets V2x

The National Grid ESO's "Future Energy Scenarios" also mentions vehicle-to-grid:

Vehicle-to-grid

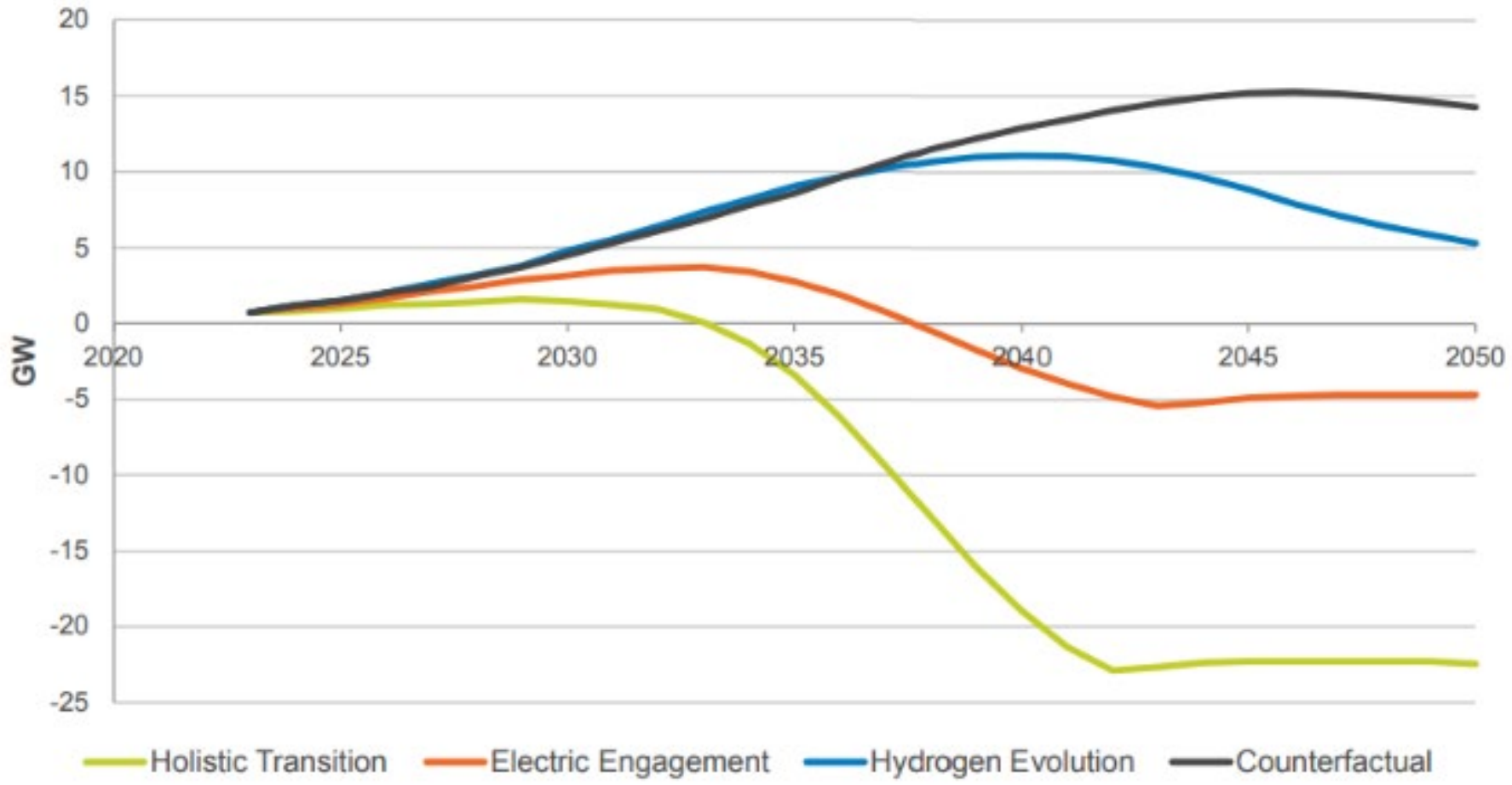
Flexibility

V2G has the potential to balance supply and demand at times of network strain over and above smart charging, while reducing the requirement for fossil-fuelled peaking plants. Trials have helped develop V2G to better integrate with market signals. As public awareness of the impact of V2G on BEV battery degradation increases and the technology is gradually incorporated into more car warranties, barriers to uptake will decrease. Encouragingly, some car manufacturers are now including V2G in warranty terms.

In all pathways, V2G technology is adopted at varying rates to support the grid, offsetting household demand in the first instance. In Holistic Transition, V2G offers up to 32 GW capacity at peak times, a significant proportion of the overall demand at 109 GW.

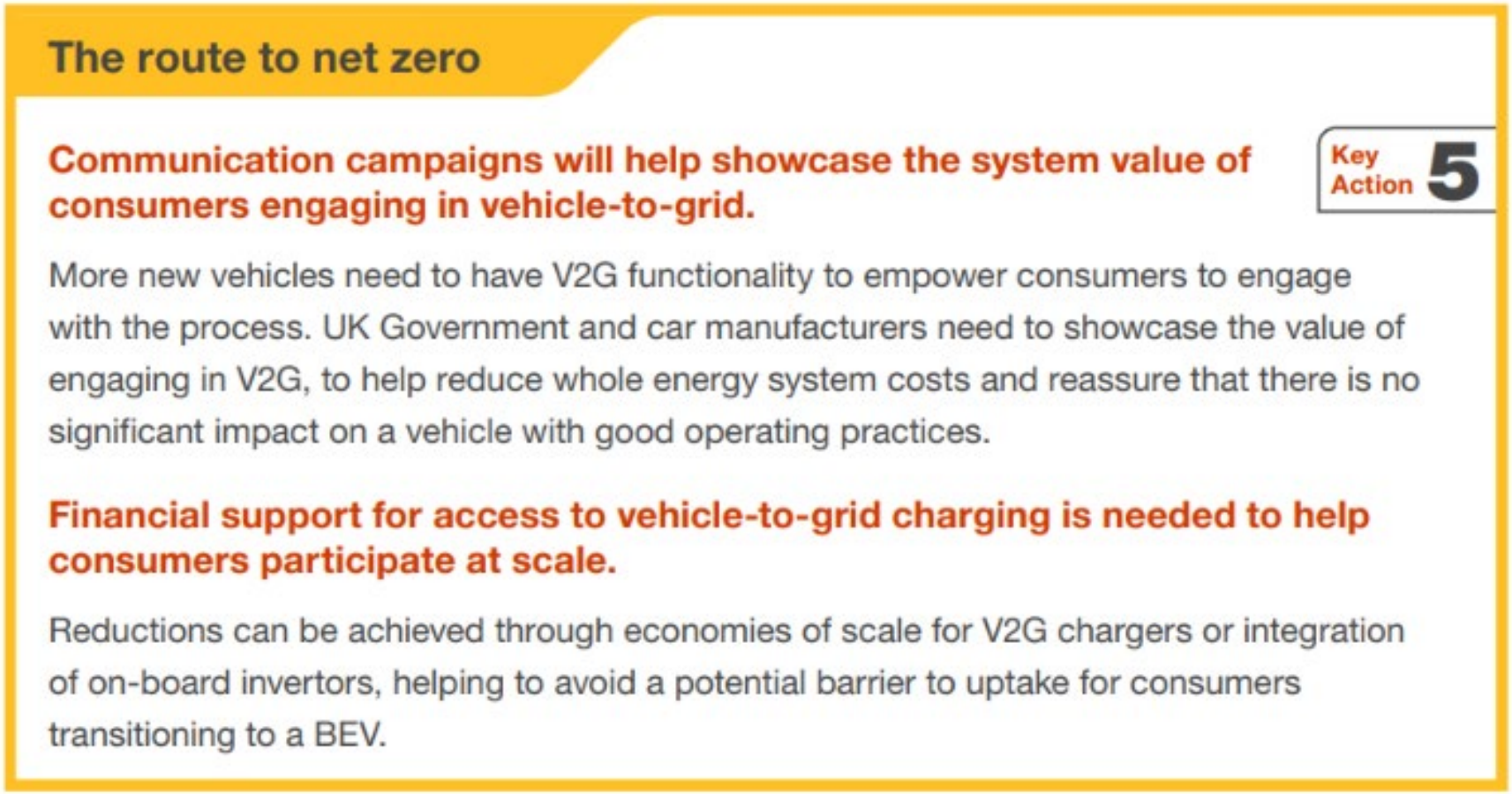
Demand Side Response meets V2x

Figure EC.11: Peak demand from road transport with smart charging and vehicle-to-grid



Demand Side Response meets V2x

The National Grid ESO's FES mentions "net zero", "economies of scale" & V2G



The route to net zero

Communication campaigns will help showcase the system value of consumers engaging in vehicle-to-grid.

Key Action 5

More new vehicles need to have V2G functionality to empower consumers to engage with the process. UK Government and car manufacturers need to showcase the value of engaging in V2G, to help reduce whole energy system costs and reassure that there is no significant impact on a vehicle with good operating practices.

Financial support for access to vehicle-to-grid charging is needed to help consumers participate at scale.

Reductions can be achieved through economies of scale for V2G chargers or integration of on-board invertors, helping to avoid a potential barrier to uptake for consumers transitioning to a BEV.

However it does not mention V2H, V2B, V2L or even V2μG!

Assorted Vnx Acronyms

V1G = Smart Charging

V2H = Vehicle-to-Home

V2B = Vehicle-to-Building

V2G = Vehicle-to-Grid

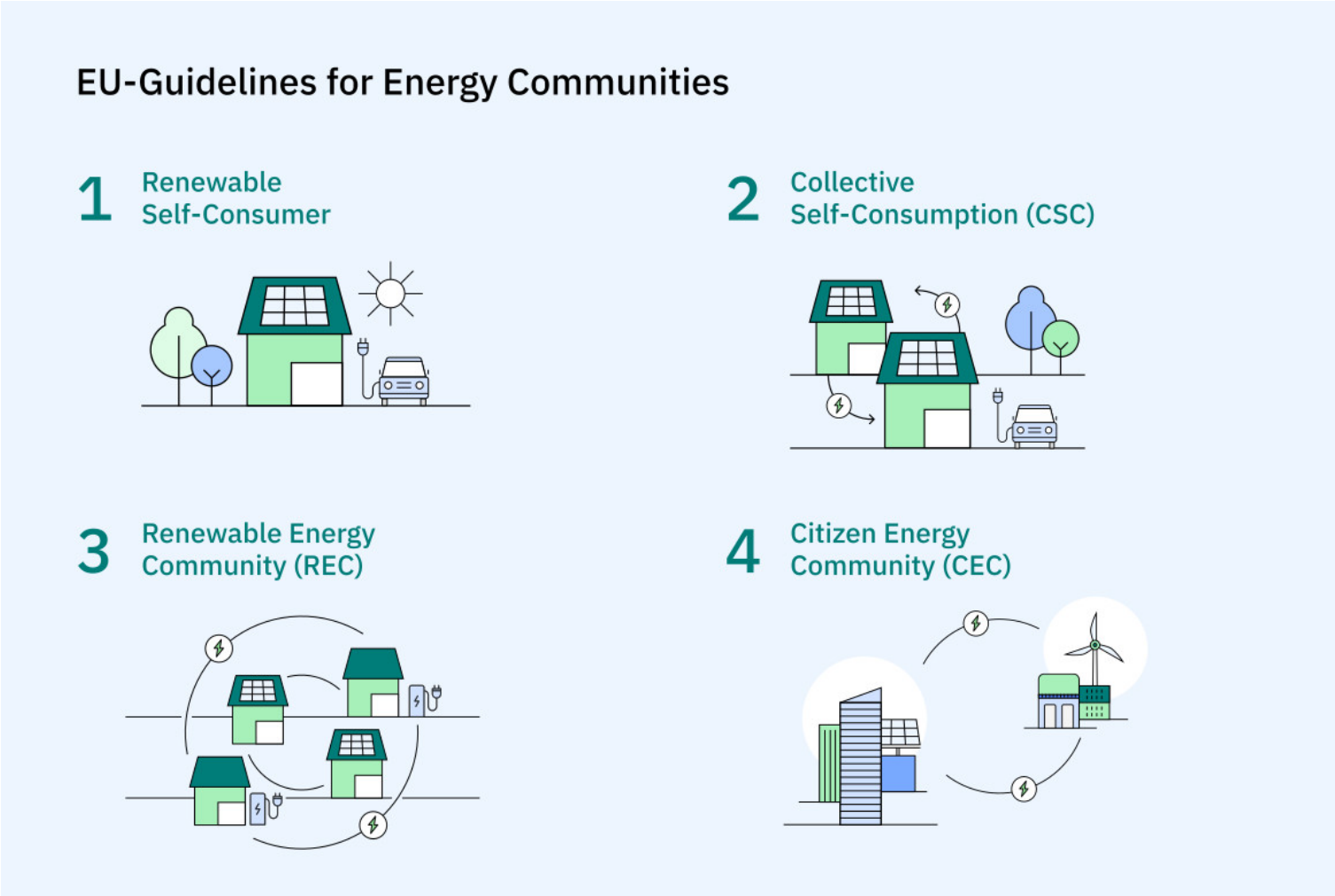
V2μG = Vehicle-to-micro-Grid

V2L = Vehicle-to-Load

V2V = Vehicle-to-Vehicle (also comms)

V2I = Vehicle-to-Infrastructure (comms)

Energy Communities (V2µG)



https://energy.ec.europa.eu/topics/markets-and-consumers/energy-communities_en

“Active Travel” in Halwill Junction?

A bicycle “parke cycles from West Chilla, locks up his bike, and then jumps on the number 6 at the nearby bus stop.

https://www.gov.uk/government/organisations/active-travel-

Wind Turbines

Hender Barrow wind turbine on the horizon, viewed from Halwill Parish Hall

An “Energy Community” based around Halwill Village Hall?

Halwill village hall already has some solar panels on its roof, “parking” for several bicycles, and a nearby bus stop. There is also a large onshore wind turbine and a “wind farm” within easy cycling distance.

Why not add an e-bike charger and a “bi-directional” electric vehicle charger or two on the village hall wall?

And a “community run” Renault 5 or similar electric car? Create an “Energy Community” in rural Devon!

Create a much bigger one in Barnstaple or Bideford too?

https://V2G.co.uk/2024/03/uk-government-announces-185-million-ev-charging-funding/

BSI PAS 1878/89

Based on CENELEC - EN 50491-12-1

PAS 1878 is a "Publicly Available Specification – A work in progress towards a formal standard.

"*It defines good practice for a product, service or process. It's a powerful way to establish the integrity of an innovation or approach*"

Figure 3 – Representation of system level CEM–ESA energy flexibility architecture with separate CEM/ESAG

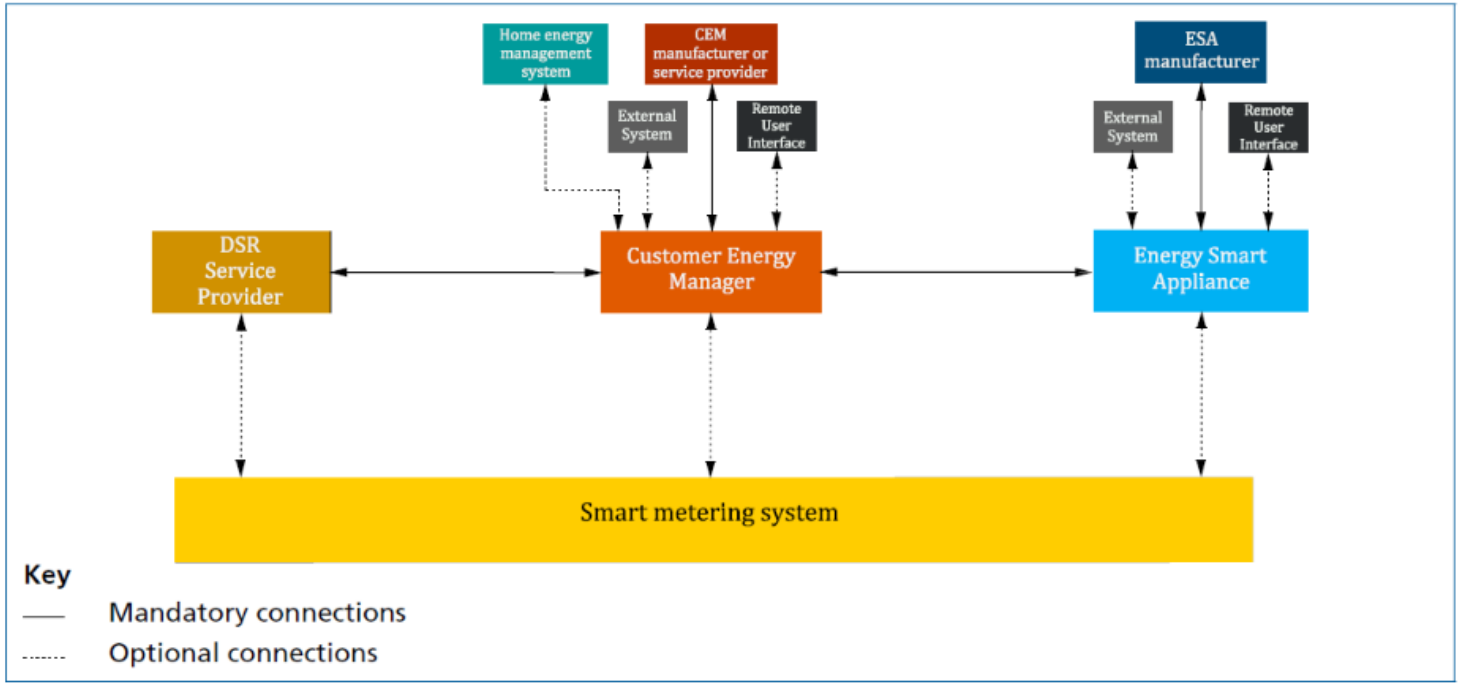
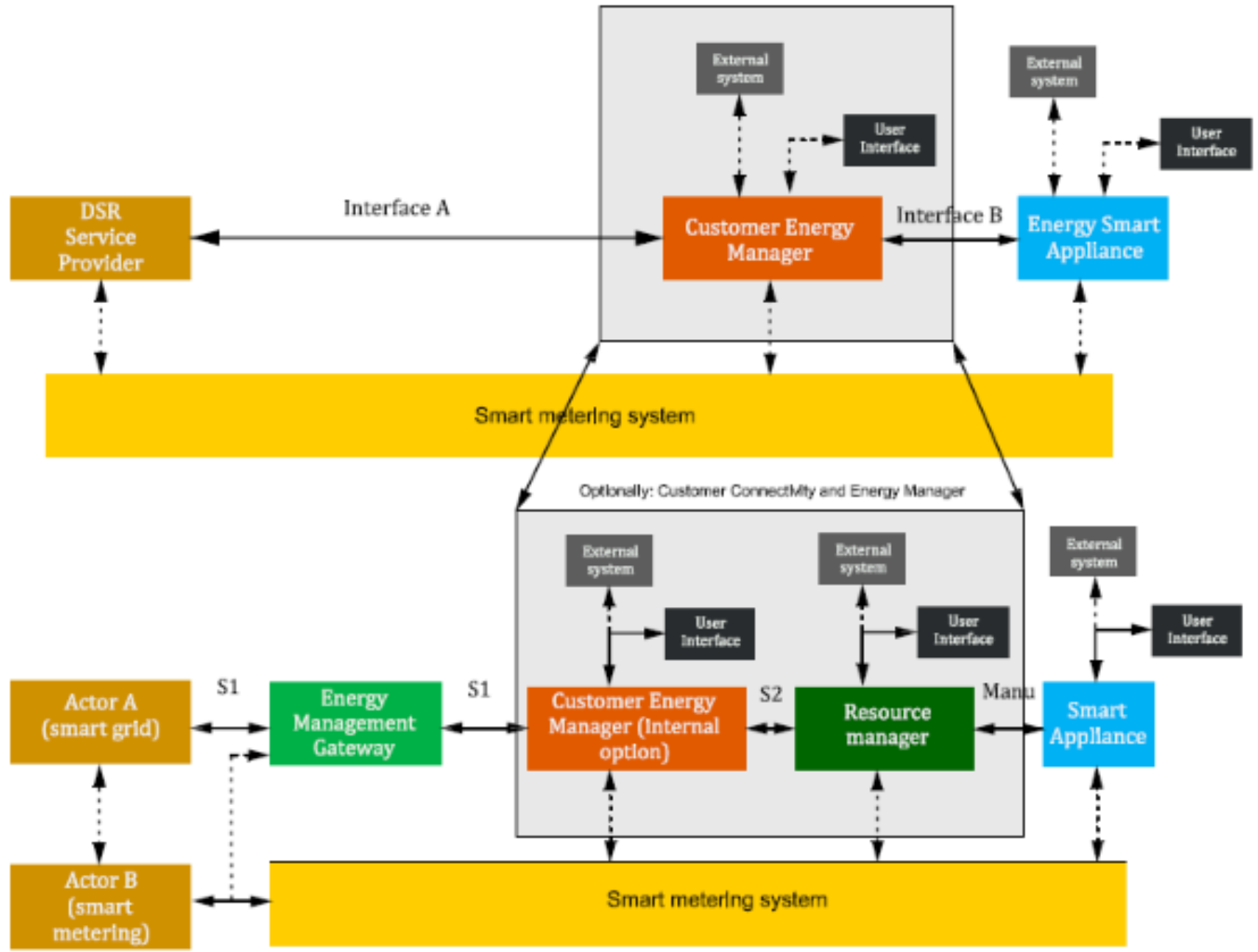


Figure E.1 – Mapping of PAS 1878 and CENELEC/IEC functional architectures

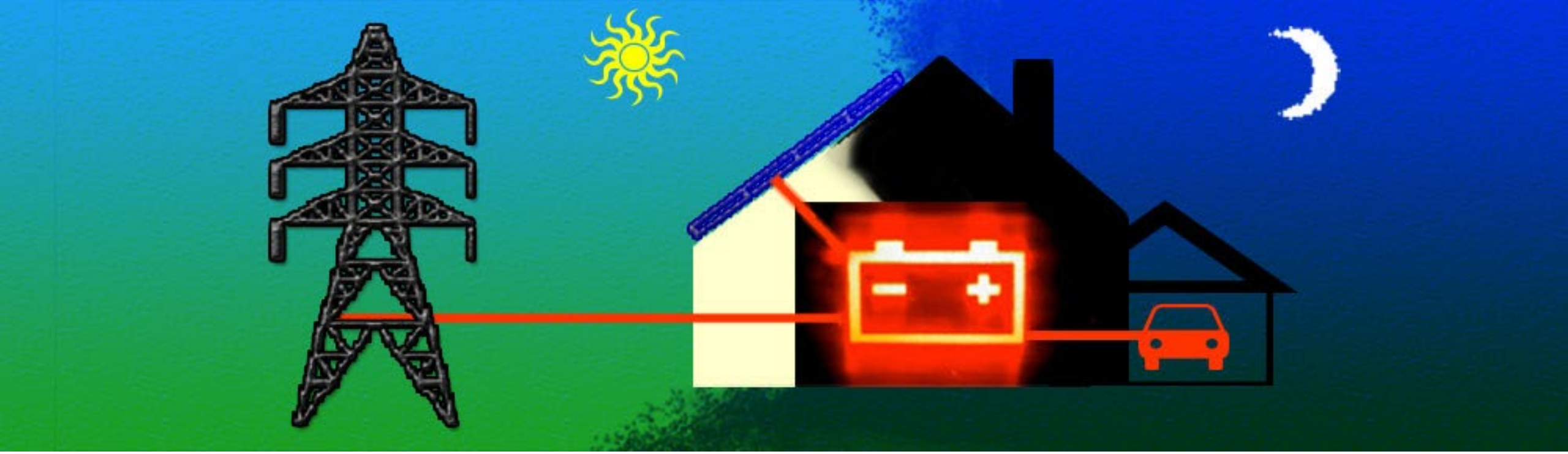
PAS 1878 architecture



CENELEC and IEC functional architecture representation

https://V2G.co.uk/2021/05/electric-vehicles-as-energy-smart-appliances/

https://V2G.co.uk/2024/05/v2g-at-everything-electric-north-2024/



Any Questions?

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