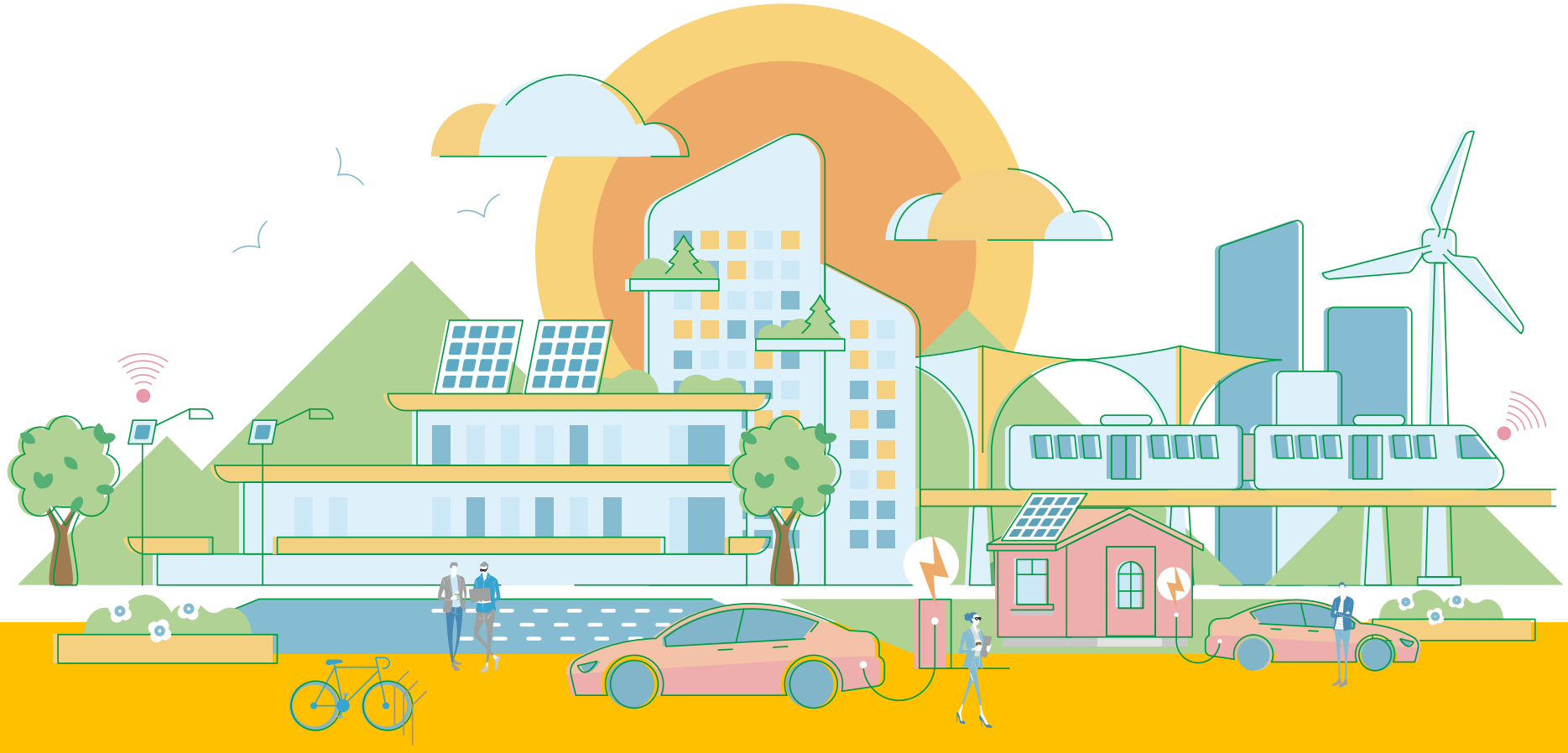
Tackling the Climate change with CHAdeMO V2G

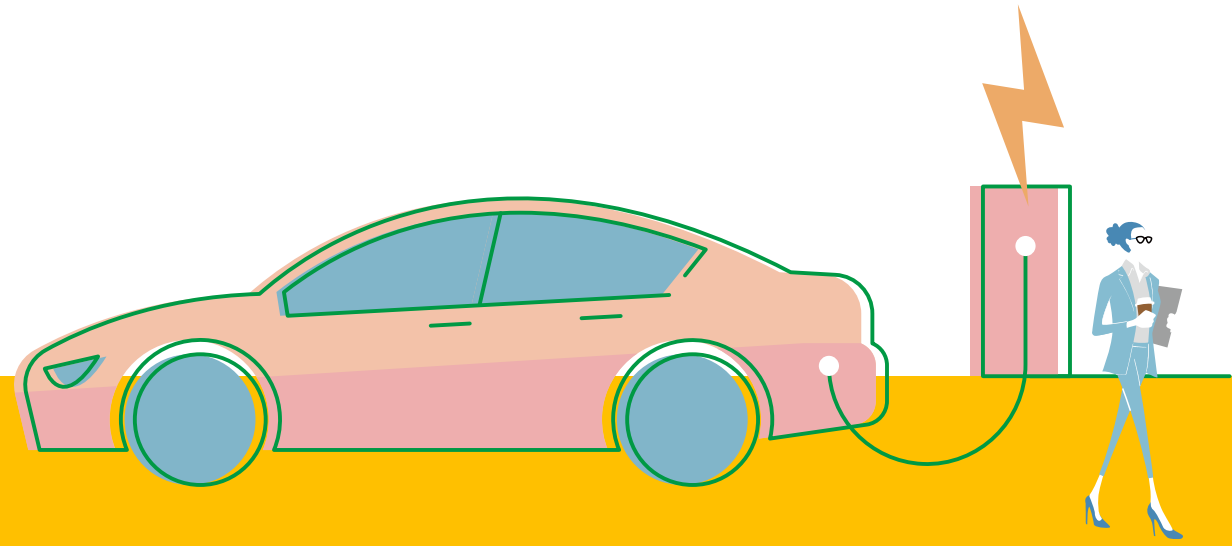
Glasgow | 10 November 2021

CHAdeMO Association Europe



Agenda

- **CHAdeMO basics** -- Tomoko Blech, CHAdeMO Europe
- **CHAdeMO and V2G** -- Naotaka Shibata, CHAdeMO Europe
- **Innovate UK projects --** Dr Josey Wardle, Innovate UK
- **Project Sciurus --** Conor Maher-McWilliams, Kaluza



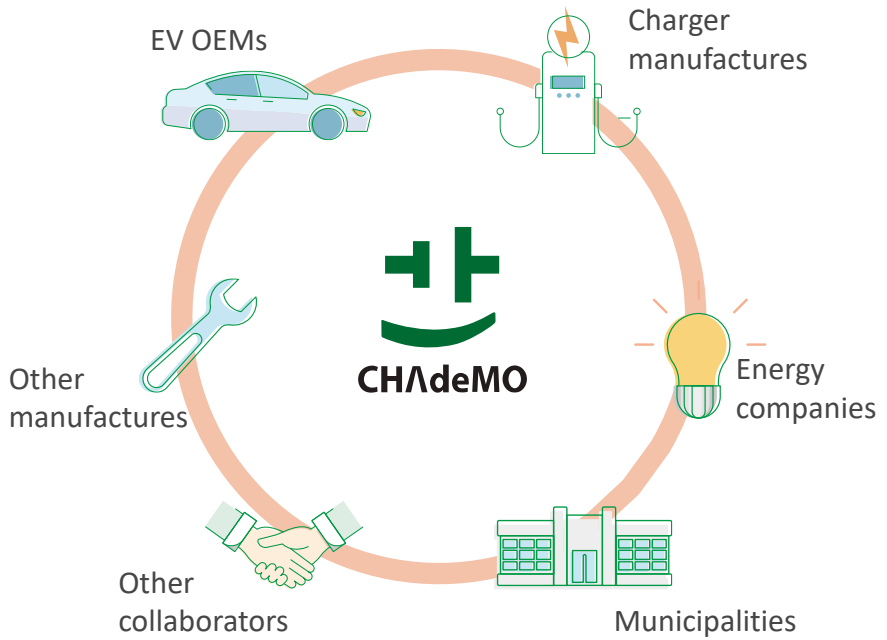
CHAdeMO Basics

What's CHAdeMO?

DC charging Standard

VGI ready

Organisation



develop **certify** **promote**

Our vision: Powering global zero-emission mobility for the happiness of future generations

CHAdeMO

With over 500 members world-wide

Our members:

509

Entities from

47

countries

And many, many more..

CHAdeMO

Electrification: a key step to carbon neutrality

CO2 emission

Transportation is responsible for 24% of direct CO2 emissions from fuel combustion[2]

Global warming

To prevent warming beyond 1.5°C, we need to reduce emissions by 7.6% by 2030[1]

Our responsibility

Electrification is an efficient measure to achieve climate neutrality

Source: [1]UNEP facts about the climate emergency, [2]IEA Tracking Transport 2020

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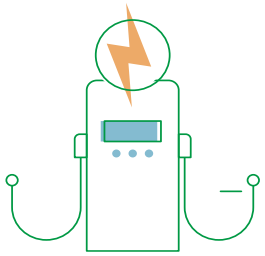
An international charging standard

	CHAdeMO (Global)	CCS 1 (US, Korea)	CCS 2 (EU)	GB/T (PRC)	TESLA (PROPRIETARY)
Connector					
Vehicle Inlet					
UN / IEC	✓	✓	✓	✓	
US / IEEE	✓	✓ (SAE)			
EU / EN	✓		✓		
JP / JIS	✓	✓	✓		
CN / GB	✓ (Reference)				

CHAdeMO

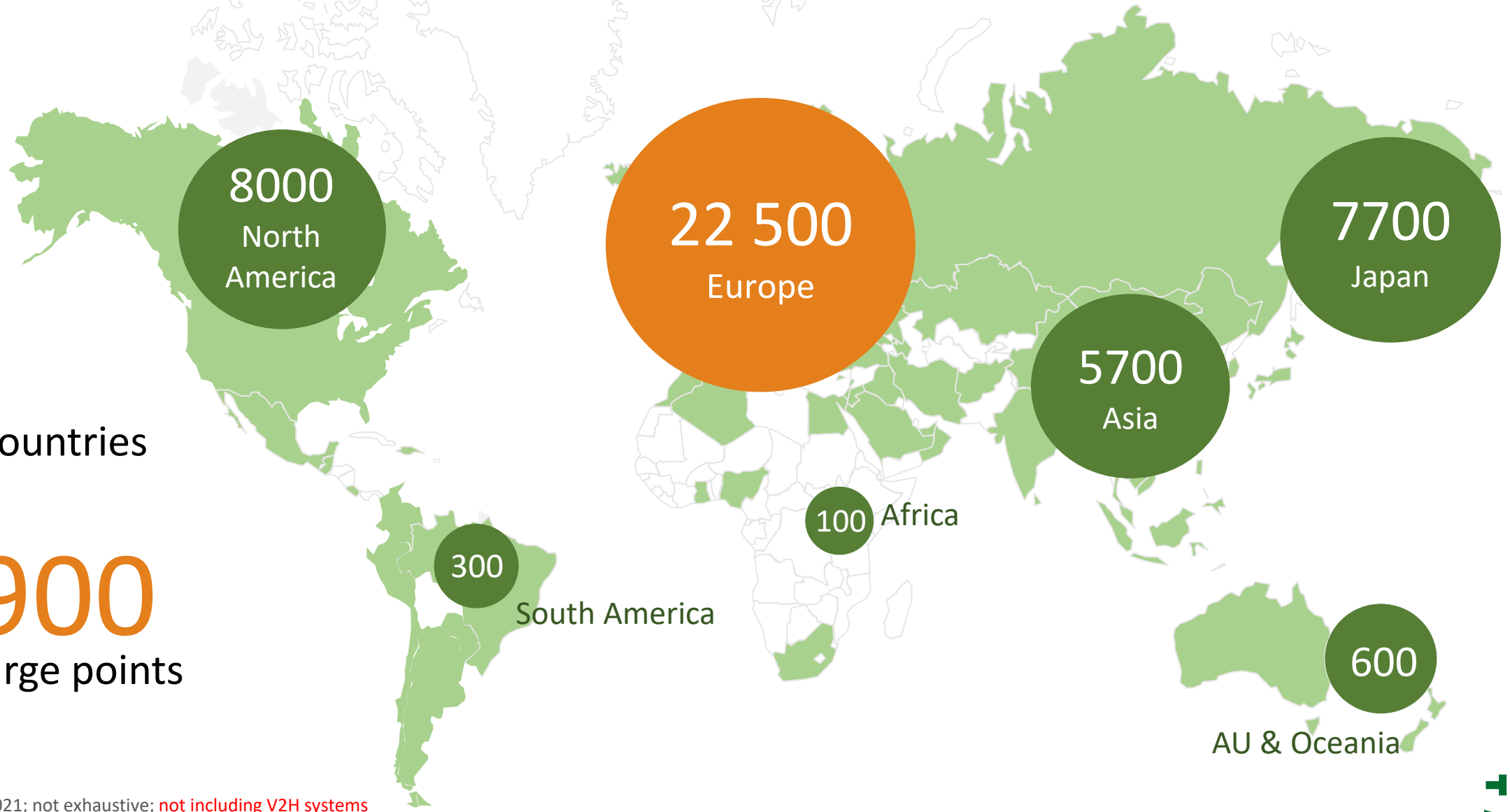
Approaching 50K charge points globally



TOTAL

96 countries

44 900 charge points



Note: as of October 2021; not exhaustive; not including V2H systems

Source: ChargeMap, PlugShare, EAFO, Zap-Map, NOBIL, Girève, GoingElectric, ChargeHub

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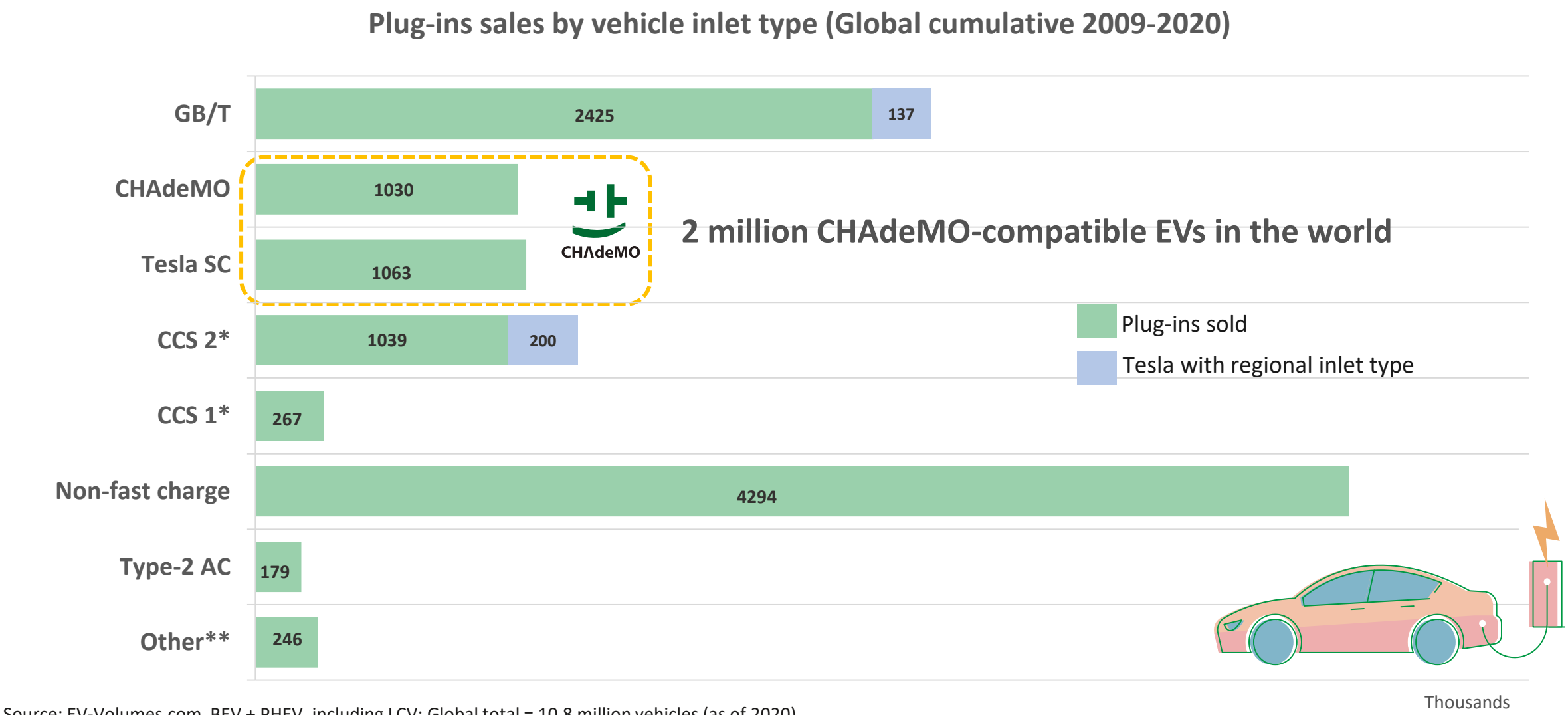
Compatible with 2 million EVs



Source: EV-Volumes.com, BEV + PHEV, including LCV; Global total = 10.8 million vehicles (as of 2020)
Note: *CCS1 and CCS2 breakdown unknown. We assumed the Americas = CCS1, Europe, Africa & ME = CCS2, and prorated the Asia Pacific (85.7K).
**Other includes unspecified, unknown, optional, and BYD.

CHAdeMO

Over a decade in-market experience

Safety first

10+ years with an impeccable track record

Waste-not

Ensured by backward compatibility

Innovation

The first and the only enabler of V2X

Mature, robust, interoperable

CHAdeMO

EVs as emergency back-up

Re-LEAF prototype, UK

Nagano, Japan

EV battery packs with PV

Amsterdam's Johan Cruijff Arena

CHAdeMO and V2G

Renewables integration to the island & isolated territories

Hawaii

Singapore

Micro-grid optimization for home & office

Netherlands

USA

What is CHAdeMO?

CHΛdeMO

TEPCO invented the fast charging protocol "CHAdeMO" in 2005.

CHAdeMO = *"CHArge de MOve"*
= *"move by charge"*

CHAdeMO = *"O cha demo ikaga desuka?"*
= *"Let's have a cup of tea while charging"*

CHΛdeMO

CHAdeMO V2G - the beginning

Heating

Kettle （700-1000W）

Electric blankets
（50W-90W）

Information access

Phone charging
(15W/phone)

Recovery support

LED floodlight (70W）

LED electric signs (200W)

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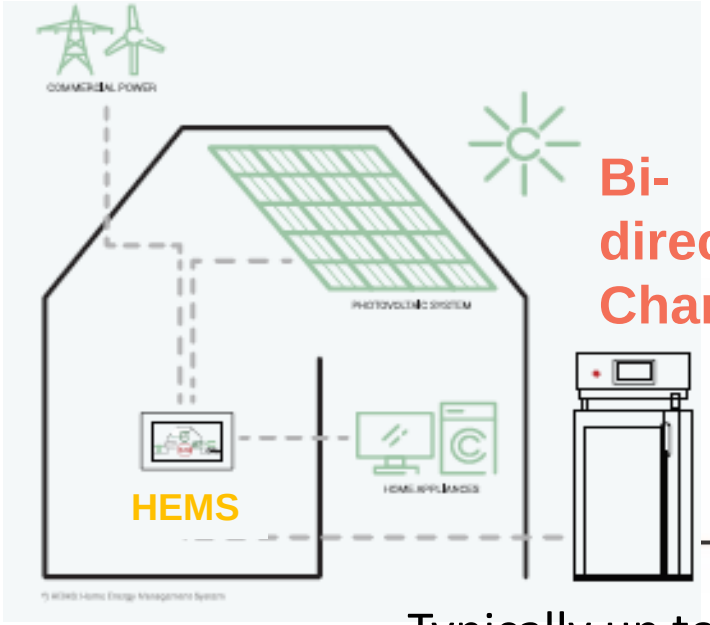
V2G: Already a reality



Bi-directional Charger

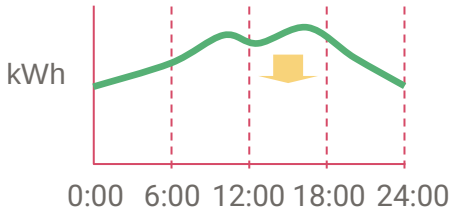
CHAdeMO

Typically up to **10kW**

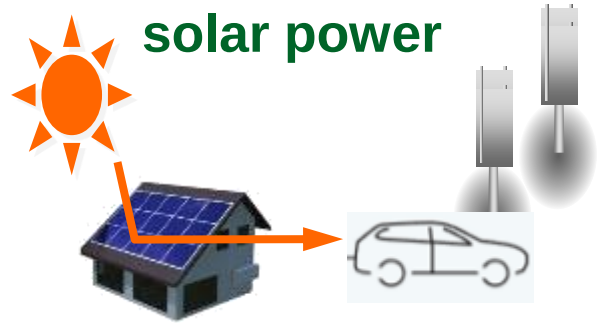
V2G protocol

Back-up for blackout

Electricity peak shaving



Connecting with solar power



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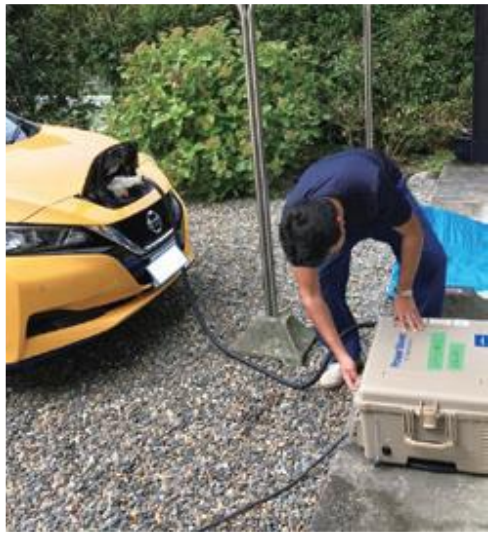
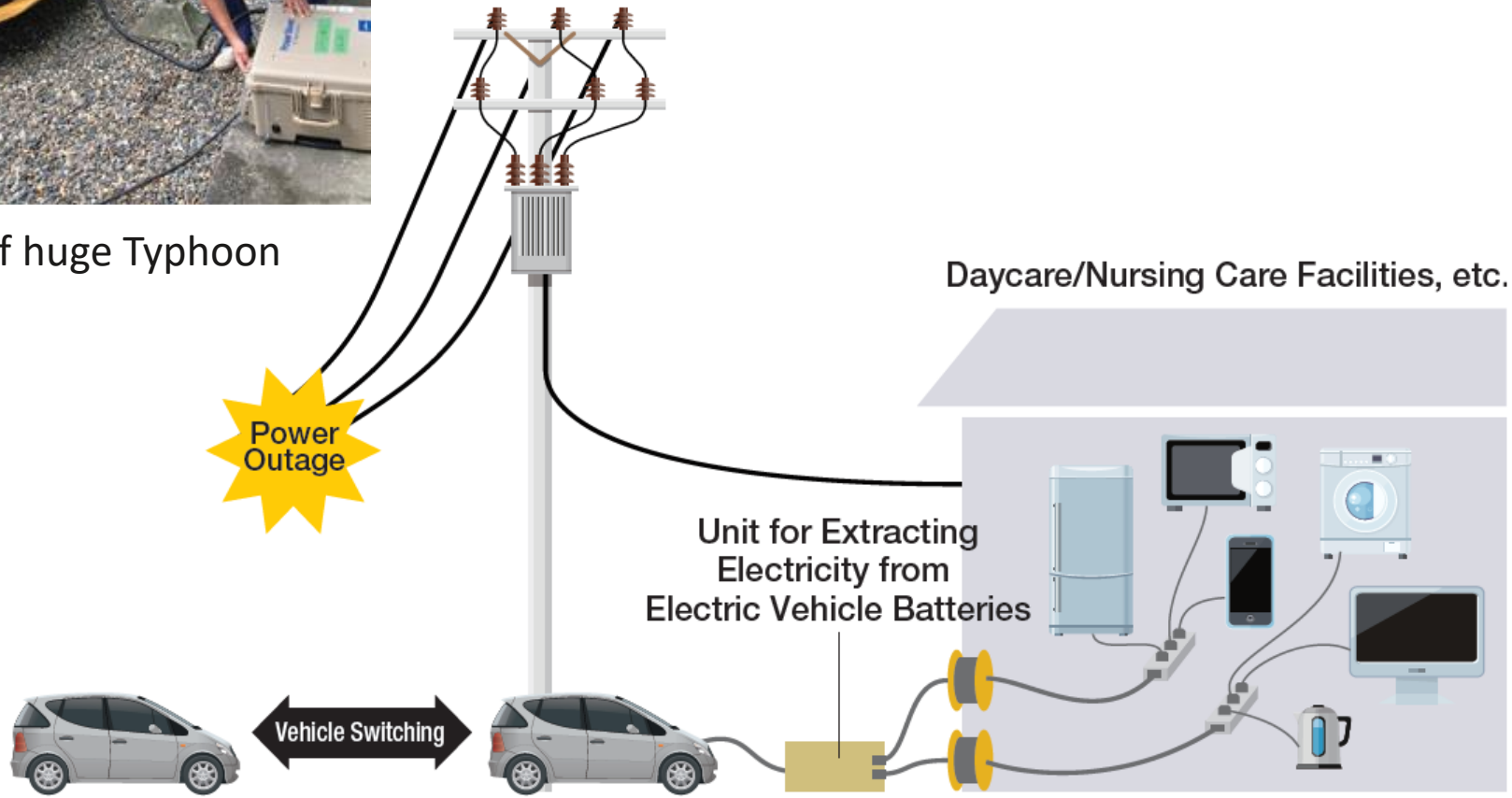
CHAdeMO V2G – Important role of Resilience



Rescue activities for the victims of huge Typhoon

Use EVs as ” Mobile Energy Source”



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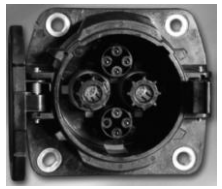
CHAdeMO, the only enabler of V2G

IEC62916-3

	CHAdeMO (Global)	CCS Combo1 (US)	CCS Combo2 (EU)
	 	 	 
DC bi-directional	CHAdeMO V2X (2014); IEC 62909-2 (2019); IEC 61851-23 and -24 (on-going) ✓	ISO/IEC 15118-20 (to be published in 7/2022) ; IEC 61851-23 and -24 (on-going)	
AC bi-directional	N/A (DC only)	N/A **Type2 AC plug** (IEC 62196-2): Bidirectional OBC (on-board charger) + ISO/IEC 15118-20 + IEC61851 Ed4 (to be started)	

Source: IEC; https://www.iec.ch/dyn/www/f?p=103:38:12691962765287::::FSP_ORG_ID,FSP_APEX_PAGE,FSP_PROJECT_ID:1255,23,23481

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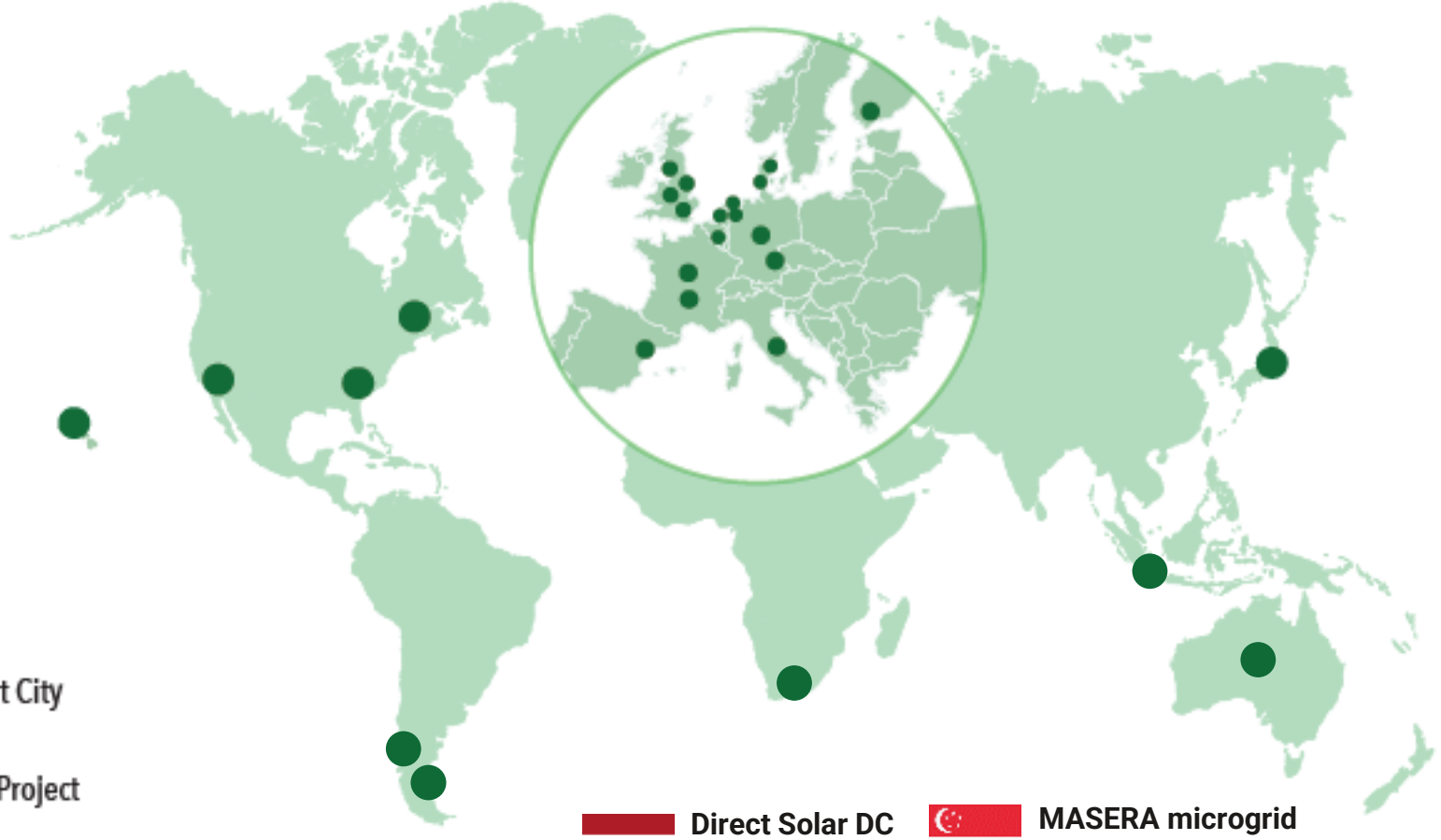
V2G projects & commercial applications



- JUMPSmartMaui, USA
- LA Air Force Base, USA
- UCSD, USA
- PowerStream, Canada
- Yokohama Smart City Project, Japan
- Nikola Project / Parker Project, Denmark
- Nuvve Project, Denmark
- Amsterdam Smart City, Netherlands
- NewMotion V2G Project, Netherlands
- GrowSmarter, Spain
- Peak Drive, Canada
- i-rEzEPT Project, Germany
- UYILO E-Mobility Programme, South Africa
- UNDP Windhoek V2G, Namibia
- Nissan HQ Project, France
- GridMotion, France
- Genoa Pilot, Italy
- Suvilahti Pilot, Finland
- Nissan-Enel Project, UK
- DriveElectric, UK
- Sciurus Project, UK
- Redispatch V2G, Germany
- SEEV4-City, UK, Norway, Netherlands, Belgium, Germany
- Domestic Energy Balancing EV Charging Trial, UK
- Direct Solar DC V2G Hub, NL
- Share the Sun Project, NL
- V2G Zelzate, BE
- MASERA microgrid project, Singapore
- Realising Electric Vehicle to Grid Services, AU

Source: CHAdeMO website, https://www.v2g-hub.com

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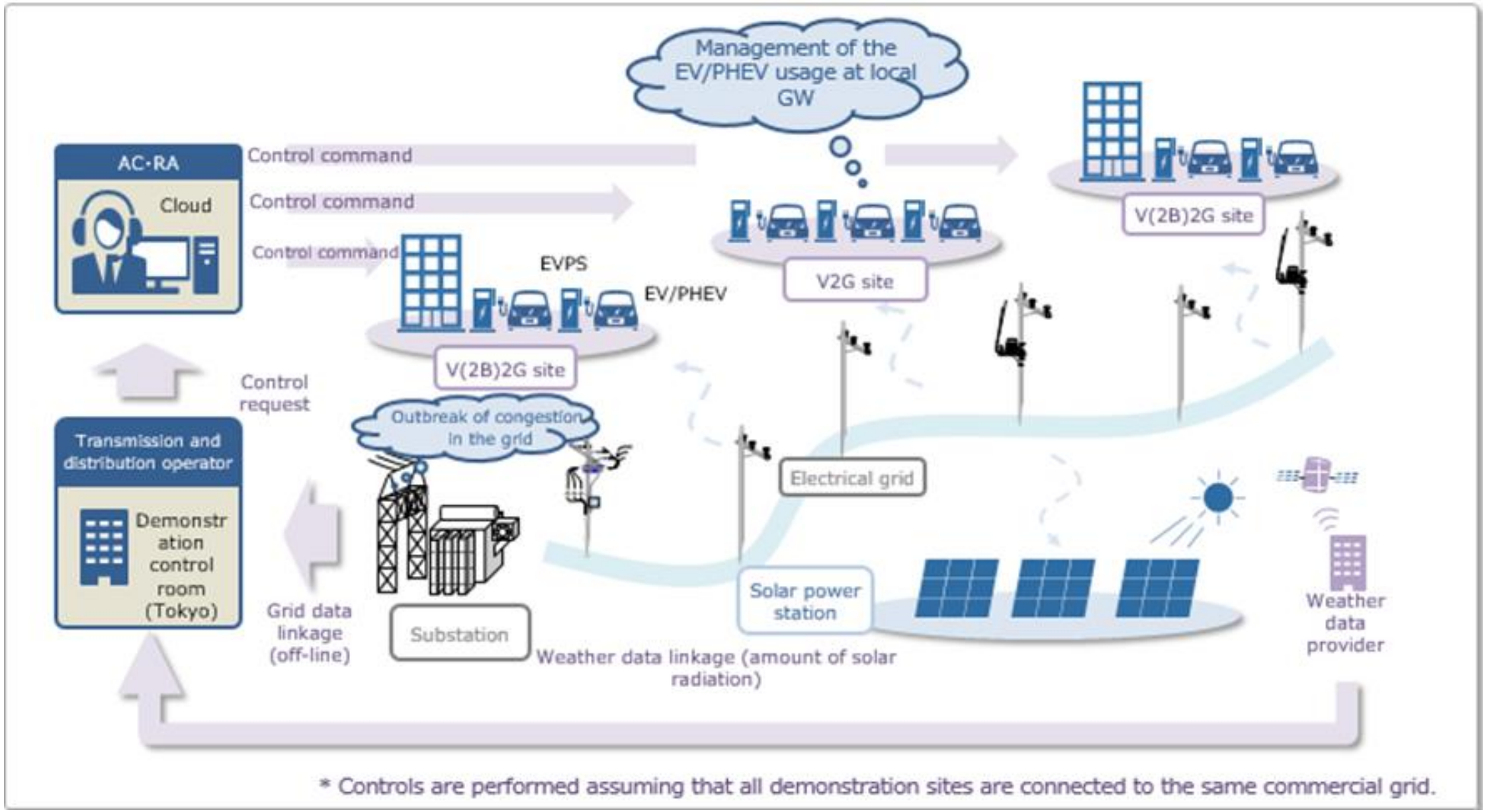
V2G Aggregator Project in Japan by TEPCO



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V2G at work: Parker project

Overview

- Ground-breaking research to demonstrate EV can participate in smart grid services
- 2016 to 2018 (completed)
- Partners:

Activity

- 10 EVs plugged in and engaged in frequency regulation (FCR) services

Results

- Total 13,000 hours of demanding FCR services
- EV market participation possible without adverse effects

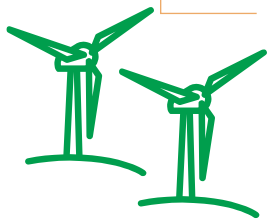
DTU Electrical Engineering. 2017. The Parker Project – Grid integrated electric vehicles. https://www.irena.org/-/media/Files/IRENA/Agency/Events/2017/Oct/EU-Utility-week/The-Parker-Project.pdf

Source: http://parker-project.com/

CHAdeMO

V2G contributes to climate change mitigation !

More Renewables!

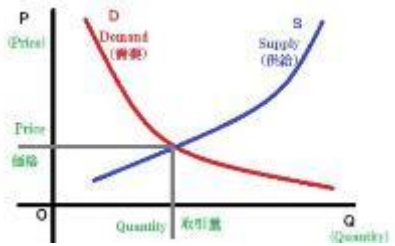


V2G
(Vehicle to the Grid)

Flexibility

VPP Aggregator

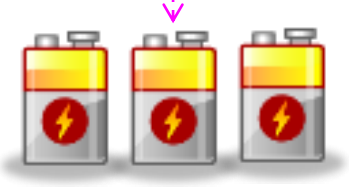
Balancing Market



Flexibility

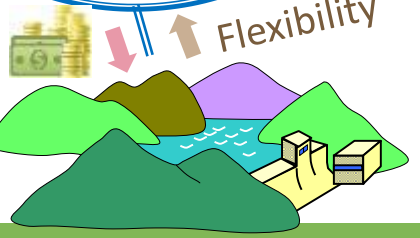
Thermal power plant
with IoT

Flexibility



Energy Storage

Balancing Market Operator



Flexibility

Adjustable Speed Pumped Storage Hydro

Renewable Energy

CHAdeMO

Thank you

For more information:
info@chademo.eu

UK’s world-leading Vehicle to Grid Programme

Dr. Josey Wardle

Innovation Lead – ZEV Infrastructure

Email: josey.wardle@innovateuk.ukri.org

UKRI Innovate UK

Department for Business, Energy & Industrial Strategy

Office for Zero Emission Vehicles

Innovate UK

- Innovate UK drives productivity and economic growth by supporting businesses to develop new ideas.

- We connect businesses to the people that can help them, and fund businesses and research collaborations in all economic sectors, value chains and UK regions to accelerate innovation.

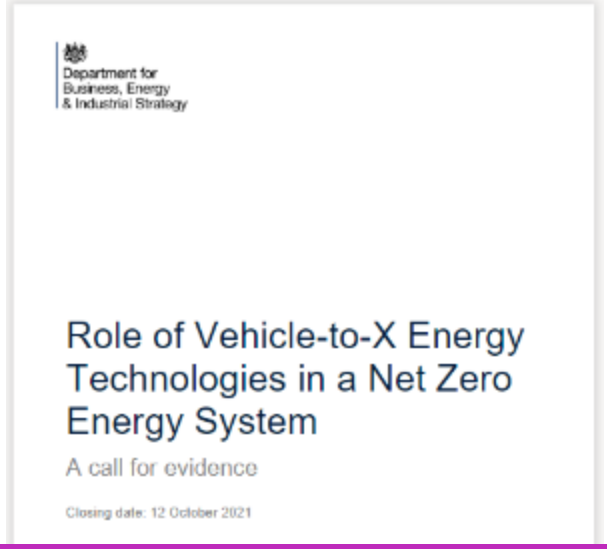
UKRI Innovate UK

HM Government

Why Vehicle to Grid in the UK

- UK legally-binding target of net-zero emissions by 2050
- Decarbonising transport is key = 28% of UK greenhouse gas emissions
- Increasing electricity demand – est.10 million electric vehicles by 2030
- Complex energy system transition – security of supply & customers cost
- Flexibility is a key tool – electric vehicles can help
  - ✓ shift energy consumption to balance supply & demand
  - ✓ store renewable energy locally
  - ✓ export energy back to a system - grid, home, building
- Smart charging, Vehicle-to-grid (V2G) & Vehicle-to-everything (V2X)

Transitioning to zero emission cars and vans: 2035 delivery plan - GOV.UK (www.gov.uk)



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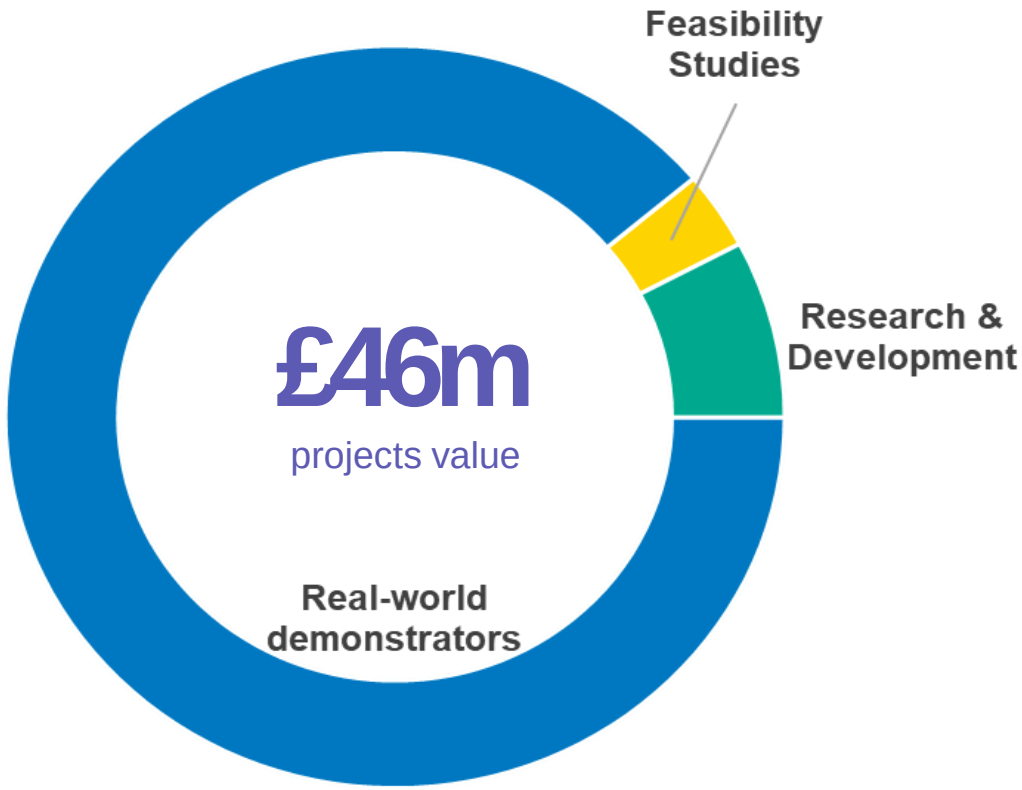
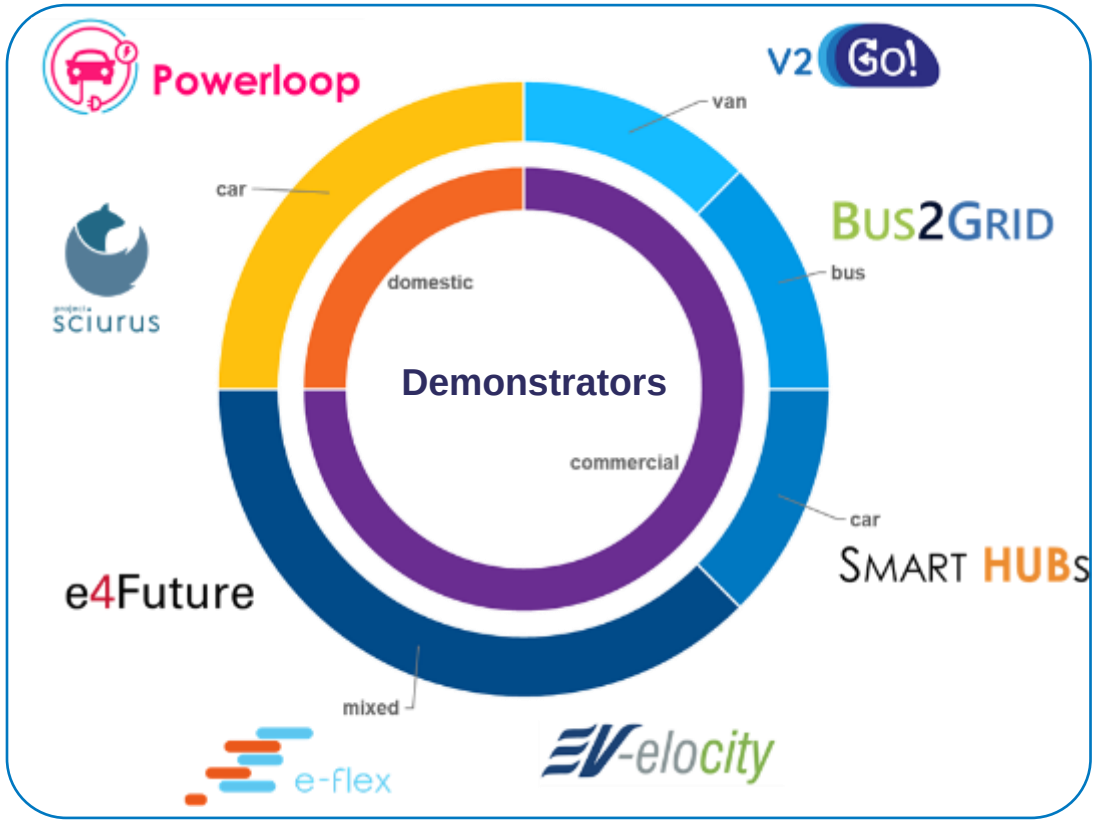
The UK V2G Programme

£30m funding from government



- **8 Feasibility Studies:** innovative business models and applications for V2G
- **4 R&D Projects:** onboard charger development, V2G on-streets, gamification for V2G



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Aims & Achievements

- Build a V2G Community
  - ✓ Automotive, energy sector, fleets & academic collaboration
- Investigate technical feasibility
  - ✓ Cars, vans & buses
  - ✓ Homes & workplaces
  - ✓ Grid connection
  - ✓ Integrating smart energy tools
- Investigate commercial feasibility
  - ✓ Cost reduction
  - ✓ Customer reward
- Develop V2G customer propositions and advance engagement
  - ✓ New V2G products and services
  - ✓ Domestic & fleet consumer education in energy & V2G
- Demonstrate V2G in a commercial setting with real customers

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Using V2G in homes

- 30p per kWh exported
- Earn enough to drive your EV for free

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Project Sciurus: Achievements from the world's largest V2G trial

project sciurus

£420

Average customer saving per year

50%

Proportion of fleet exporting during Supply Margin Notice event, 6th Jan 2021

900 MWh

Total energy exported to the grid

3 million

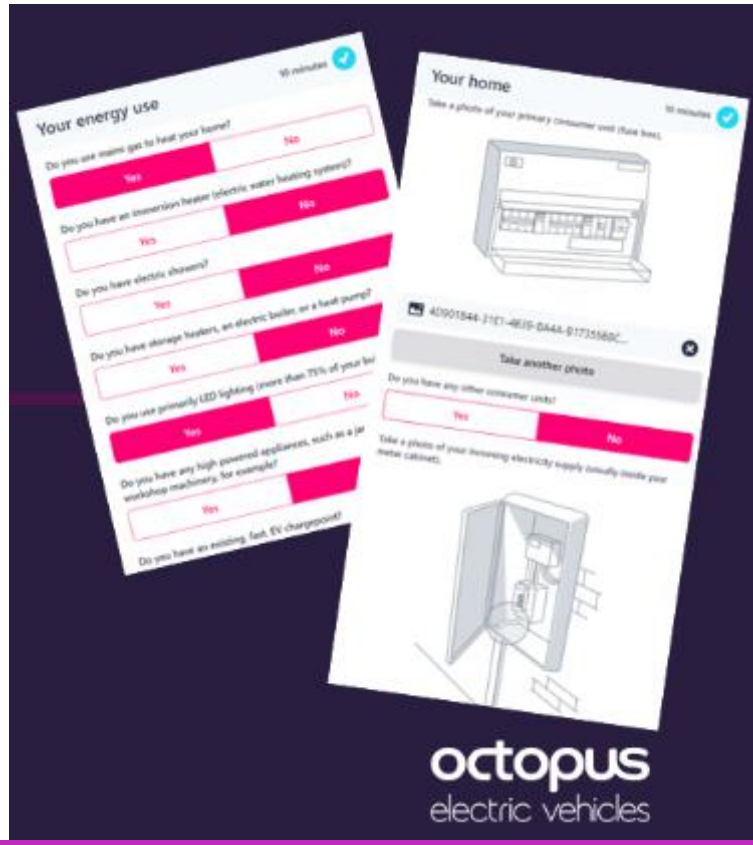
Free miles driven by V2G customers

Lessons from our consumers

- There is demand for V2G but customers need reassurance:
  - Private consumers - vehicle availability & battery degradation
  - Fleet customers - operational impacts & sound investment case
- Lack of understanding about home energy systems & V2G benefits
- Clear financial rewards are necessary
- Smart charging experience improves receptiveness to V2G
- Interest is constrained by the few V2G capable vehicles available

Opportunities

- Educate consumers
- Easy to understand V2G propositions & tools
- More V2G capable electric vehicles are required



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Lessons from the energy system

- Grid connection process is complex & takes too long
- Additional equipment is required to protect the grid in constrained areas
- Minimum grid participation levels are prohibitive for V2G
- Integrating smart energy devices optimises benefits for both consumers & the energy system
- Ongoing reform of UK Energy Regulations delays the V2G business case

Opportunities

- Simplify Grid connection process & reduce cost to consumers
- Coordinate smart devices to optimise benefits for all
- Encourage smart charging until V2G enabled vehicles are mainstream
- Reduce barriers to grid market participation

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Commercial Lessons

- The V2G business case works for some consumers
  - Regular, long plug-in duration at peak times of energy demand
- Costs are still a constraint, making the business case uncertain
  - grid connection, installation, equipment
- UK Energy system benefits worth £3.5bn/year by 2040 are available with V2G
  - Source: Imperial college/OVO Energy 2018 “Blueprint for a post carbon society”

Opportunities

- Focus on locations and use cases with best potential
- Drive down V2G costs further
- Develop more consumer propositions, new revenue streams likely from 2023

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Coming soon from the UK V2G programme

- Powerloop – grid balancing mechanism study
- EV-elocity – EV battery degradation study
- Europe's largest Bus2Grid demonstration

What's needed next?

- Comprehensive V2G standards
- More V2G enabled electric vehicle models
- Further cost down activity
- More customer propositions
- Adaptions to UK energy regulations

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To find out more about V2G around the world

Visit https://www.v2g-hub.com/

Thank You for listening

Any questions?

Please contact

josey.wardle@innovateuk.ukri.org

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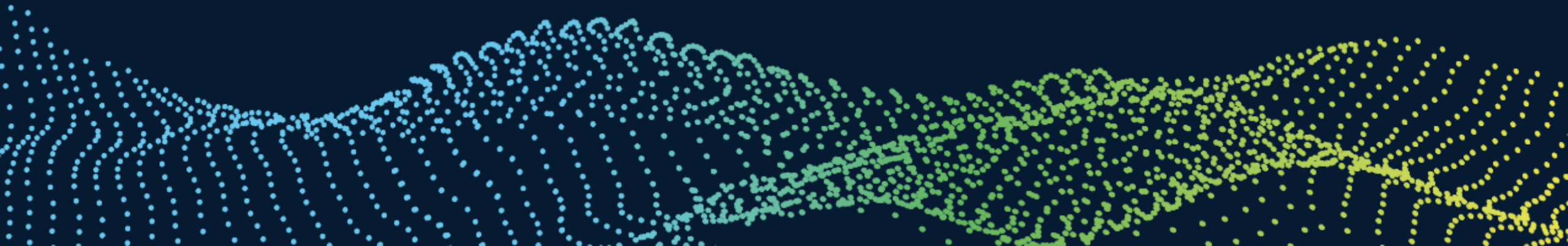
KALUZA

FREE DRIVING: THE INTELLIGENT ENERGY PLATFORM UNLOCKING THE POWER OF V2G

Conor Maher-McWilliams
Head of Flexibility



INCREASING RENEWABLE PENETRATION IS CHANGING THE WAY THE **GRID** OPERATES

Growth in renewables

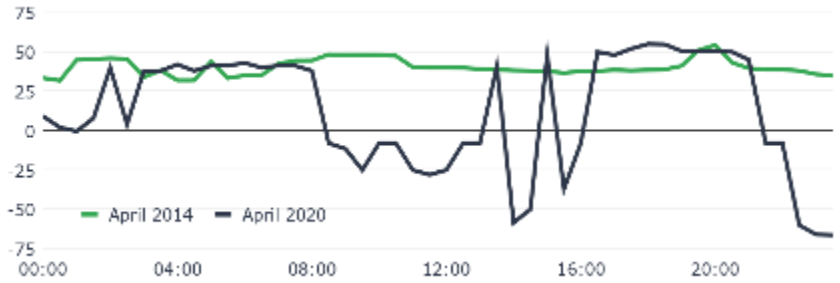
April
2014
London, UK

Installed Capacity
25 GW

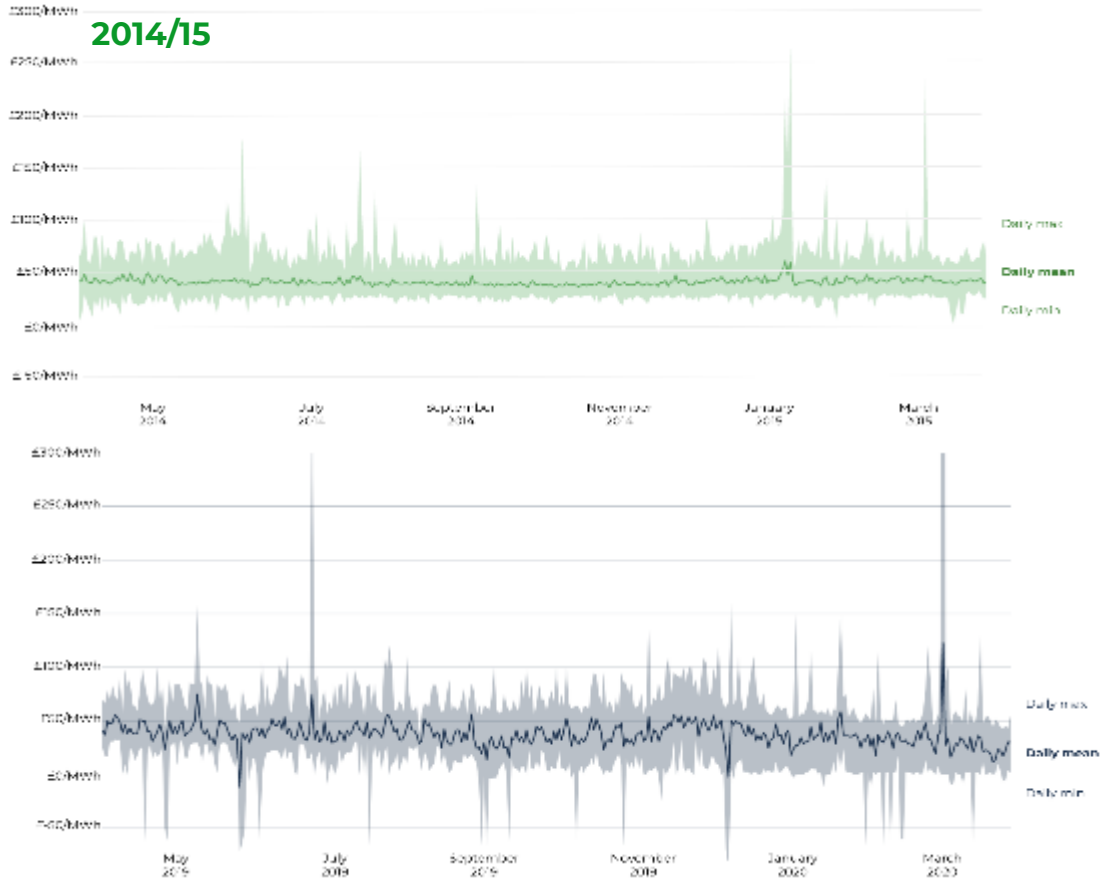
April
2020
London

Installed Capacity
47 GW

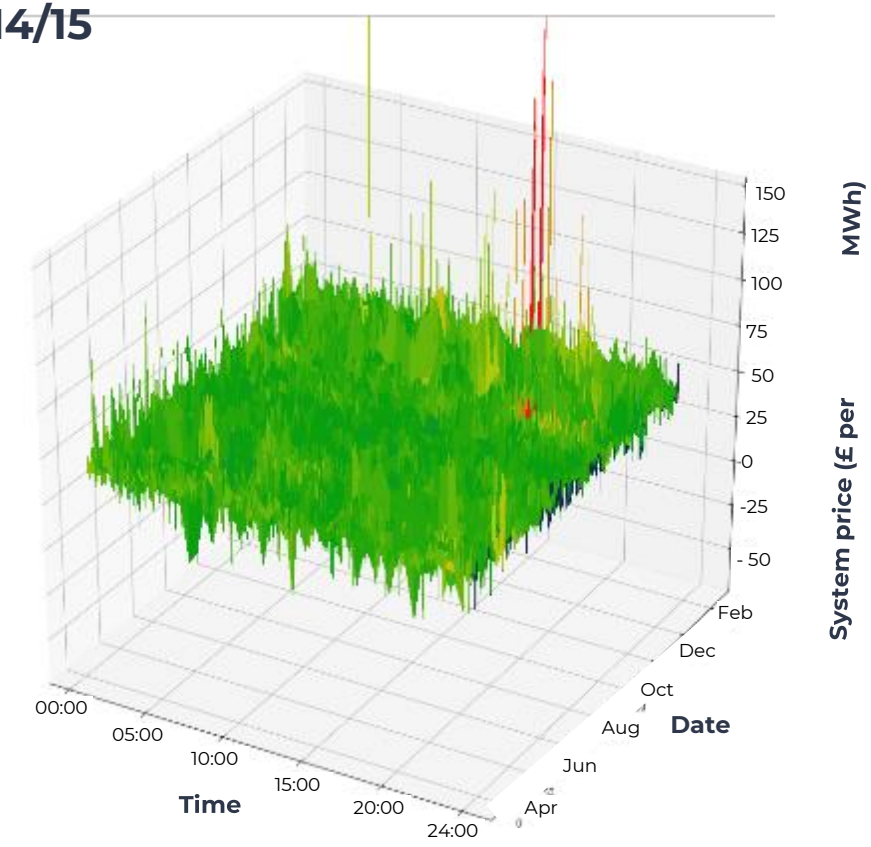
Drives price volatility (£/MWh)



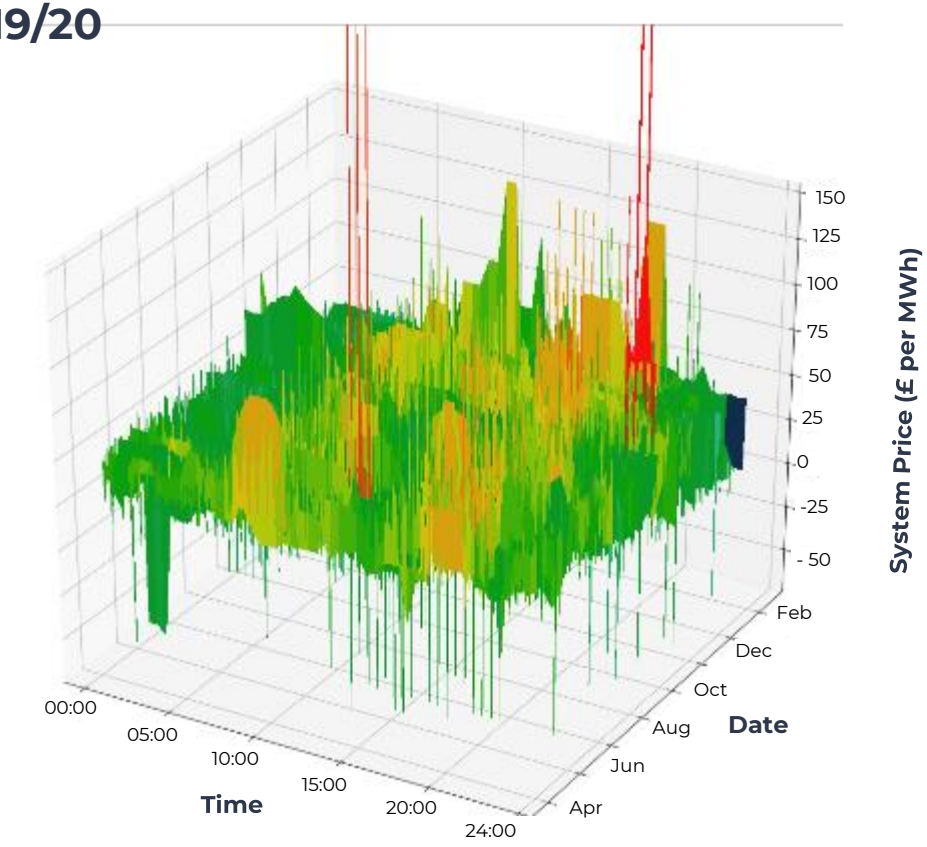
Wholesale price volatility increase



2014/15



2019/20



KALUZA FLEX: HOW IT WORKS

THE WORLD'S FIRST AND LARGEST V2G ROLLOUT

WORLD'S FIRST DOMESTIC V2G DEVICE + WEB APP

THE CUSTOMER PROPOSITION

INTELLIGENT ENERGY PLATFORM

3
YEARS

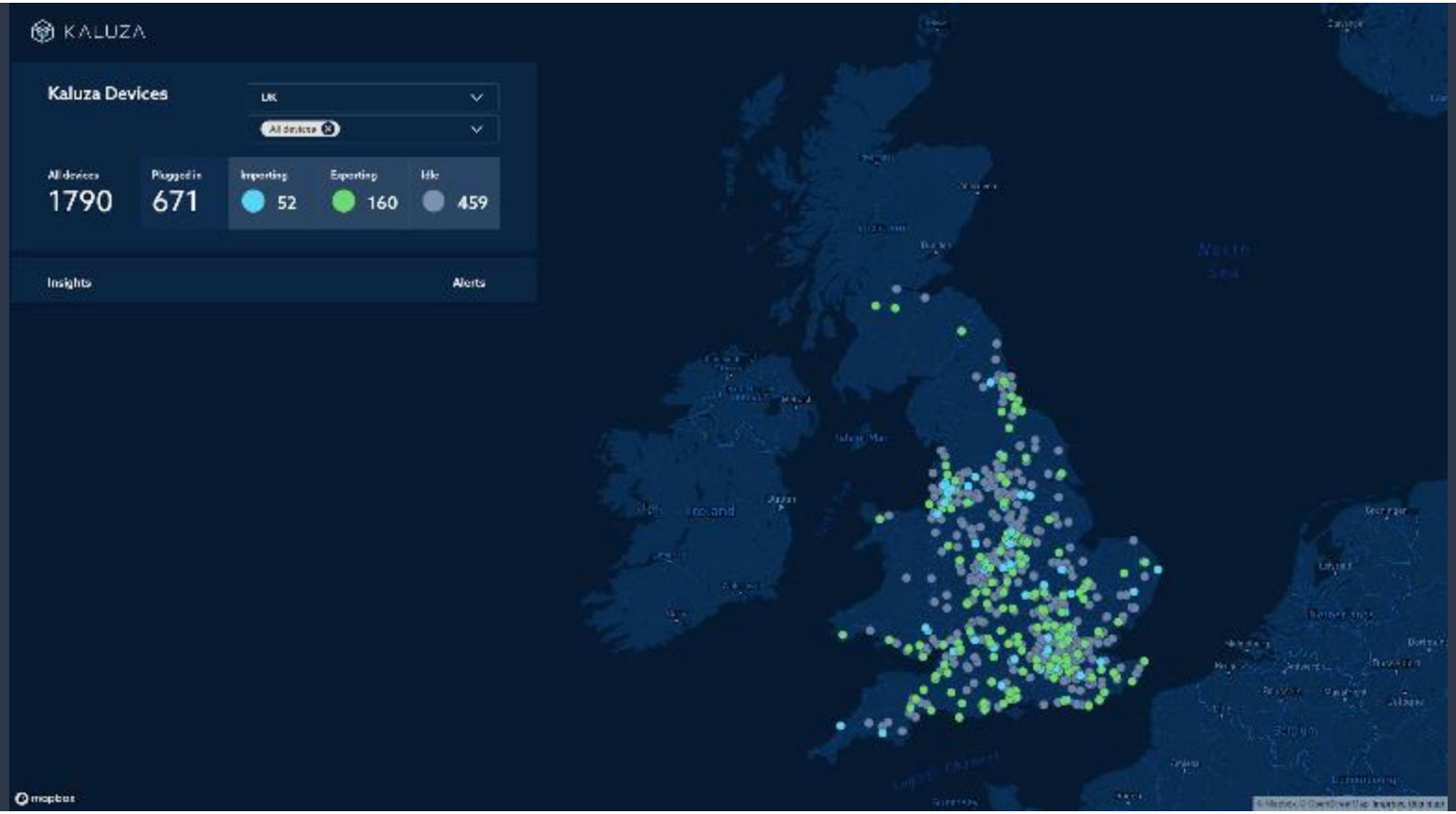
£5M
£3M FROM INNOVATE UK

1,000
MANUFACTURED CHARGERS

330
V2G devices installed and Kaluza integrated

BRINGING IT TO LIFE

KALUZA DEMO



KEY BENEFITS

Customers save up to £820 per year

Over 3 million free miles for customers

~16GW of daily flexible capacity created per year if 5 million EVs were V2G-enabled

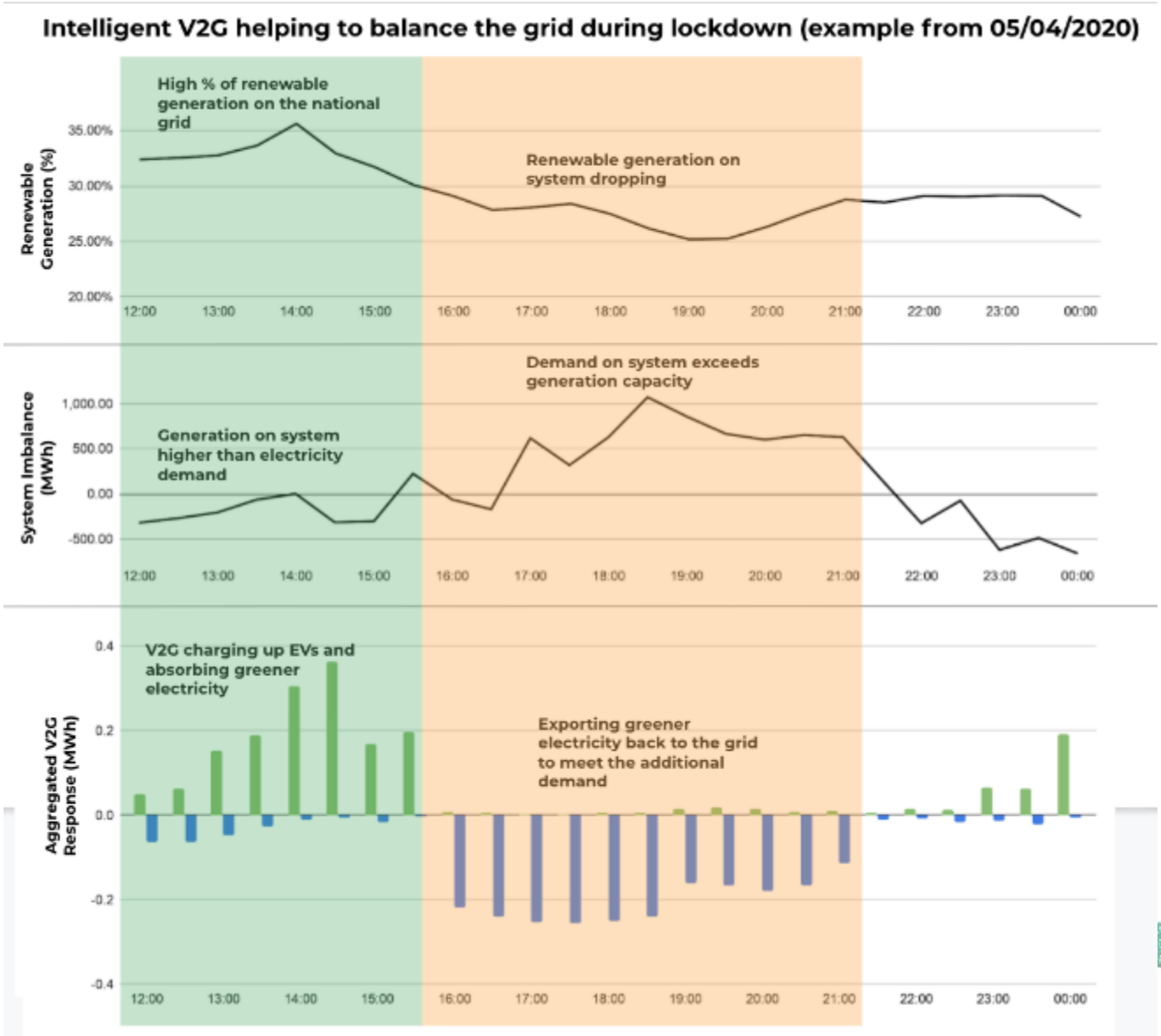
£3.5 billion per year cost saving on grid infrastructure reinforcement

Source: Kaluza Analysis and Cenex White Paper

V2G helped to balance the grid during lockdown

Increases in V2G portfolio availability were observed across the day as more people were working from home.

As a result, on some days we saw increases of **up to 30% in available flexible capacity** from the V2G portfolio compared with pre-lockdown portfolio availability patterns.



Source: Kaluza Analysis and Cenex White Paper

V2G to play a key role in the transition to net zero

The technology is gaining momentum

Energy market reforms are a necessity

Q&A

partner@kaluza.com kaluza.com @kaluza_tech