Vehicle-2-Grid

What will it take to be part of the V2G revolution?

TUMIVOLT, Webinar,
December 3rd 2021
Our team

Unique global expertise in the field of e-mobility

• Over 10 years of experience
• Completed over 500 e-mobility projects
• Largest independent EV Office
• Multidisciplinary backgrounds (e.g. technical, commercial, economic, legal)
• International experience with e-mobility strategy, project management and innovation
• Vehicle-to-grid (V2G) specialists
Our clients

Government

Energy & Utility

Automotive & Operators
Our work

Accelerating EV in 500 projects in 20 countries
Our V2X experience

A selection

- Global review of V2G - IUK & UKPN
- City-zen V2G - Alliander Amsterdam
- FCR Netherlands - TenneT
- V2GO – Oxfordshire Country Council
- J. Cruijff ArenA V2B - City of Amsterdam
- FCR with V1G & V2G - Elia
E-mobility in the Netherlands

- Number of EVs on roads: 2.5%
- Target: 25%
The decade of V2X scale up

• V2G technology works and is moving towards universal standards
• V2G has large business potential and social impact
• Charger evolution towards efficient, compact, user-friendly and inexpensive next-generation bi-directional chargers
• Development of attractive, integrated customer proposition
• V2G can supply many types of energy services, which vary widely in revenue, from €10 to €1,800 per year
• Strong collaboration among stakeholders accelerates rollout
Topics for this presentation

What is V2G? & its benefits?

Use Cases V2G applications

V2G Services Types and current readiness level

V2G architecture & Challenges to adoption

Requirements Power grid & Asset level

Roadmap to V2G implementation in a country
Creating a central resource for all V2G projects: V2G Hub

www.v2g-hub.com
What is Vehicle-to-Grid (V2G)?

V2G is technology enabling bi-directional energy transfer from/to plug-in electric vehicles. Power from the vehicle's battery can be fed (back) to a home, an office building, a street or the national electricity grid. This way, an electric vehicle can be used as a battery, supporting a future of smart grids and decentralised renewable power production. This is distinct from 'dumb' one-way charging and 'V1G' or 'smart' charging where the rate and time of charge can be varied.

Benefits

- Less concerns for grid overload
- Novel economic revenues for consumers
- Cheap and fast energy storage
- Making use of existing resources
- Supporting electrical grid, reducing concerns for grid overload
- Reduction of environmental impact
V2G benefits

Value Propositions

Revenue-Generating Energy Trading

Resilience

Personal Net Zero / Self Sufficiency

Benefit to Society

Enhanced Battery Management
Use Case V2G applications

96 projects
6100+ chargers
22 countries
Use Case V2G applications

Japan : M-Tech Labo

Services
- Time shifting for energy users
- Emergency back-up

Vehicles
Company cars

Beneficiaries
Building & fleet owner
Use Case V2G applications

Netherlands: City Zen

Services
- Distribution system services
- Arbitrage

Vehicles
- Shared cars

Beneficiaries
- Regional grid operator (DSO)
- Shared EV driver
Use Case V2G applications

Hawaii: JUMPSmartMaui

Services
- Time shifting for energy users

Vehicles
- Private cars

Beneficiaries
- Grid operator
- (EV drivers)
Use Case V2G applications

United Kingdom: Bus2Grid

Services
- Frequency Response
- Time Shifting for energy users
- Arbitrage

Vehicles
30 Electric buses

Beneficiaries
- National grid operator (DSO)
- Fleet owner
Use Case V2G applications

Netherlands: J. Cruijff ArenA V2B – City of Amsterdam

Services
- Time Shifting for energy users
- Emergency back-up

Vehicles
Private cars (of visitors)

Beneficiaries
- Regional grid operator (DSO)
- Building owner
Types of V2G Services

V2H / V2B
- Time shifting
- Emergency power / off-grid

V2G
- Meter point
- Arbitrage
- DSO Services
- Frequency response & reserve
## Readiness level

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>SERVICE READINESS LEVEL (SRL**)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. RESEARCHED</td>
</tr>
<tr>
<td>ARBITRAGE</td>
<td>FRANCE, DENMARK</td>
</tr>
<tr>
<td>RESERVE</td>
<td>FRANCE</td>
</tr>
<tr>
<td>FREQ RESP.</td>
<td>FRANCE</td>
</tr>
<tr>
<td>DSO SERVICES</td>
<td>DENMARK</td>
</tr>
<tr>
<td>TIME SHIFTING***</td>
<td>KOREA</td>
</tr>
</tbody>
</table>

V2G architecture & Challenges to adoption

- V2G CAR
- USER INTERFACE
- USER
- V2G CHARGE POINTS
- UTILITIES & MARKETS
- OPERATOR & AGGREGATOR PLATFORM
V2G architecture

TenneT Crowd Balancing Platform
https://www.tennet.eu/our-key-tasks/innovations/crowd-balancing-platform-blockchain-technology/
Requirements

Power grid level

1. Open data & digitalisation
   *Development of digital passports for EVs Elia & 50Herz*
   *Crowd Balancing Platform TenneT & European TSOs*

2. Smaller & shorter bids in existing flex markets

3. Creating of markets DSO services (local grids)

4. Adapt interconnection standards & processes

5. Time of Use tariffs
Requirements

Asset level

1. **V2G-ready car / vehicle**
   with bidirectional charging standard & plug

2. **V2G charger (AC or DC)**
   with bidirectional meter, upgraded controller unit, and extra safety components

3. **Link to energy management system**
   and smart meter at home or building
   + coupling to energy markets
Roadmap to V2G implementation in a country

From charging to V2G

Yesterday

Today

Tomorrow

Enable e-mobility

Realize value pools

> V2H
> V2G
> Grid and energy services
> Swarm management
> Battery Care

Minimize cost

> Smart charging
> Optimized grid extension
> Reduce demand charges
> Increase utilization

Charging infrastructure
> Services (CPO, MSP, Roaming)
> Installation services

V2H
V2G
Grid and energy services
Swarm management
Battery Care
Roadmap to V2G implementation in a country

V2G standard

Grid-compliant Charging
- EV and EVSE are compliant with the local requirements, guidelines and regulations.
- This level only considers charging events from grid to EV.
- The charging power is below thresholds, requiring controllability/ load management by the DSO.

Level 1 - V1G Controlled Charging
- The charging event can be influenced regarding the charging power and can be shifted in time remotely by DSO (with highest priority).
- CPO, EV user, EV or home energy management (HEM).
- The EV is capable to wake up for defined start/stops.
- Reaction timings are defined.
- EV/EVSE, HEM consider variable power settings.

Level 2 - V1G/H Cooperative Charging
- EV and EVSE negotiate a charging profile based on various drivers (monetary incentives or grid constraints) mainly w/o user interaction (also aggregation); tariff tables etc; mobility need taken into account.
- Aggregation (local, per charging spot)

Level 3 – V2H Bidirectional Charging
- Energy transfers between EVs battery and the home / customer system.
- Energy transfers are motivated by sustainability or economical reasons (storage and usage of power, generated by local PV panels or similar).
- Supports behind the meter (BTM) use cases

Level 4 – V2G Aggregated (bidirectional) charging
- The EV and the EVSE fulfil functions that go beyond the customer’s own energy system (bidirectional energy transfers, aggregators qualification, full balancing market services, economic interests of the EV owner).
- Supports in front of the meter (FTM) use cases
- Sub/m qualification/ aggregation across larger area (entire state or country)

Technical requirements:
- Various local regulations per country (e.g. grid codes, IEC61851-1, IEC 60364 series, ...)
- Local regulations EV and EVSE
- PWM signal, IEC 61851
- DIN SPEC 70721 (for DC)
- EVSE and grid (Utility, CPO, ...)
- OCPP 1.6
- Demand-response
- Opt-out possibilities

Grid connection
- Local regulations EV and EVSE
- ISO/IEC 15118 Ed1
- Telematics
- EVSE and grid
- OCPP 1.6
- See level 1
- ToU

Grid integration
- Local regulations EV and EVSE
- See level 2
- To see level 2
- EVSE and grid
- See level 3
- Many requirements still missing

EV – electric vehicle, EVSE – electric vehicle supply equipment, DSO – distributed system operator, CPO – charge point operator
Roadmap to V2G implementation in a country

Technological demonstration
Commercial prototypes & small scale pilots

Commercial scale-up
Consumer-ready product & large scale pilots

Mainstream adoption
Adoption by early majority
- buses
- at home
- company fleets
- public chargers

Roadmap to V2G implementation in a country

UK: Commercial scale-up phase

Octopus Powerloop
Get our vehicle-to-grid bundle

£30 Cashback
Every month on your lease

What you get:
- A new Nissan LEAF
- A dedicated app to control charging
- £30 cashback every month*
- A free charger
- 100% renewable electricity at home
- A smart meter installed for free

How it works:
1. Plug in before 6pm, and keep it plugged in until at least 5am the next day to complete the cycle
2. Use the app to tell us when you need your car and we’ll schedule your sessions around you
3. Complete 12 cycles to get £30 cashback on your Octopus Energy account every month

In partnership with

*£30 cashback based on 12 full cycles per month

By 2050, up to 80% of households smart charge their electric vehicle (EV) and up to 45% actively provide V2G services

the Netherlands: Commercial scale-up phase

450 public V2G chargers currently in the City of Utrecht

Worlds largest bidirectional charging plaza
PAVING THE ROAD TO RENEWABLES

SMART INTEGRATION OF ELECTRIC VEHICLES TO INCREASE UTILISATION OF INTERMITTENT RENEWABLES INTO AN ISLAND ENERGY MIX
Sjoerd Moorman
EV Consultant ⚡ Expert V2X & Smart charging ⚡

What I work on:
EV strategy: Roadmaps - EV modelling - Fleet transition plans
Innovation: Charging hubs - Smart Charging - V2X

• World-first Global Review of Vehicle-to-Grid projects
• Smart Charging Strategy & Roadmap for DNO UK Power Networks
• Market sizing for V2B services in the UK
• Fast charging rollout business case for supermarket chain in France
• Fleet transition plan for City of Amsterdam
• World-first online EdX course on electric mobility (>140,000 learners worldwide)

https://www.evconsult.nl/en/v2xconference/
Contact

Amsterdam
Tim van Beek
Overtoom 60-4
1054 HK Amsterdam
+31 6 17 35 29 43
info@evconsult.nl

Antwerpen
Greet van Wesemael
Mechelsesteenweg 271
2060 Antwerpen
+32 499 51 66 33
info@evconsult.be