Smart charging et V2G : vers des VE smart-grid ready

Comité national

Journée Mobilité Electrique
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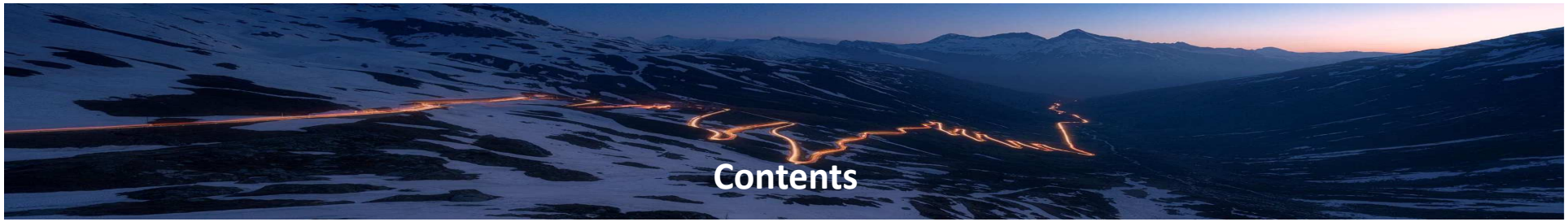
DAMIEN-PIERRE SAINFLOU

2021/10/19



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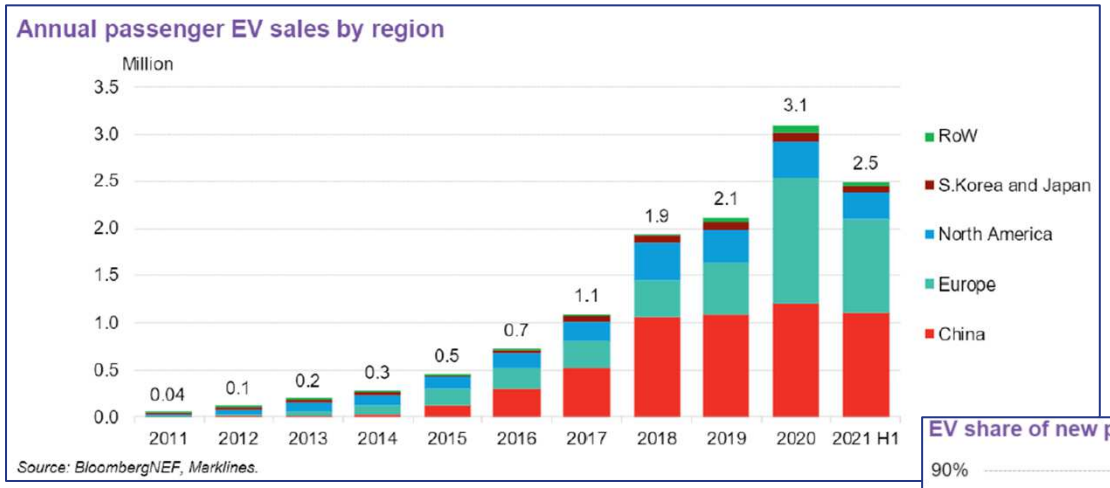
MARKET TENDENCIES

MARKET OVERVIEW



- ➔ xEV sales are taking off
- ➔ xEV sales will represent >30% of vehicles sales in 2030
- ➔ OEM offer and customer demand alignment is on going.

Some keys of success

Batteries size rise :

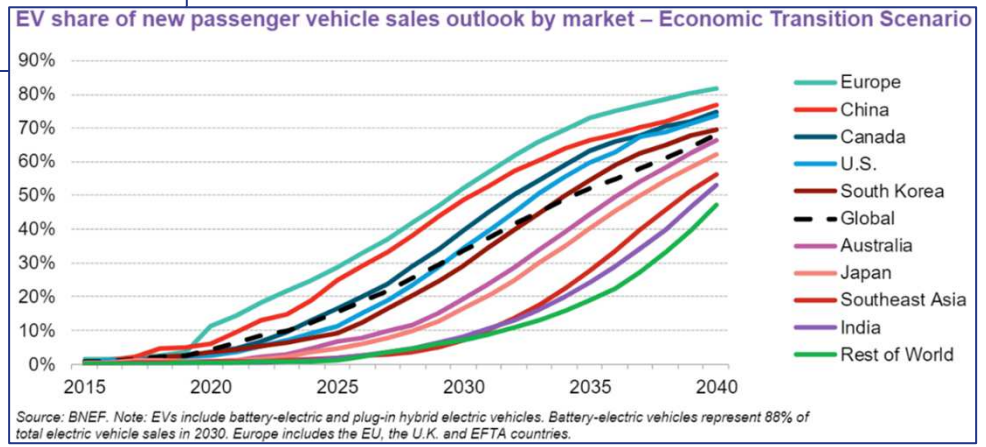
✓ 15 kWh (~150 km)→90 kWh (~600 km)

Multiple EV offer to multiple usage/cost :

✓ 10 models in 2017 → +60 models in 2021

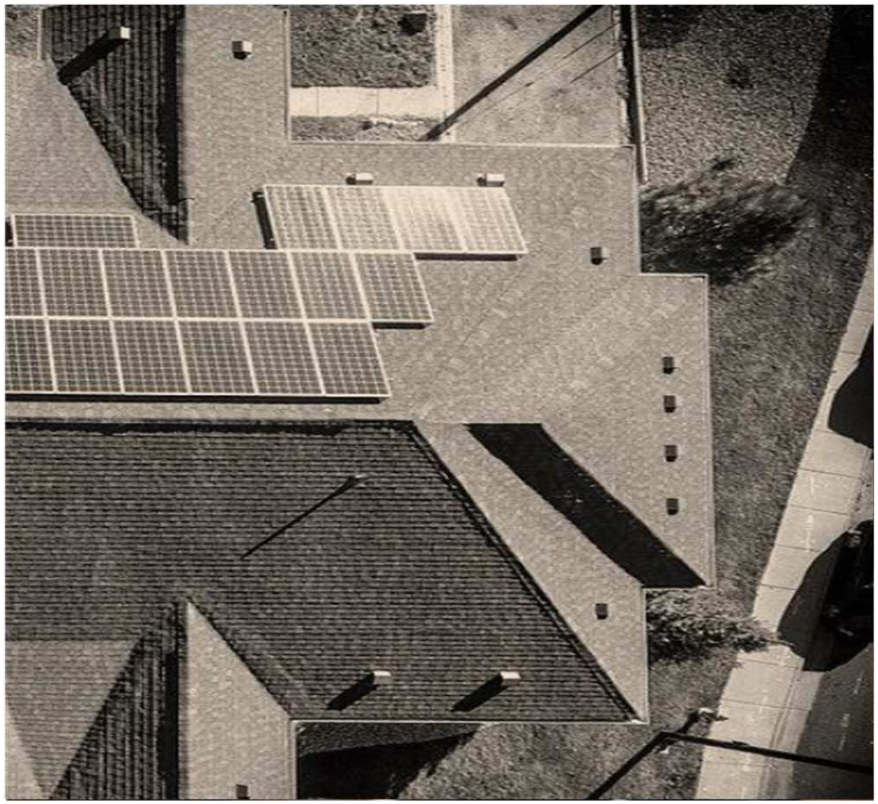
Charge point accessibility improvement

Public policy



Vehicle Grid Integration STEPS

& USE CASES

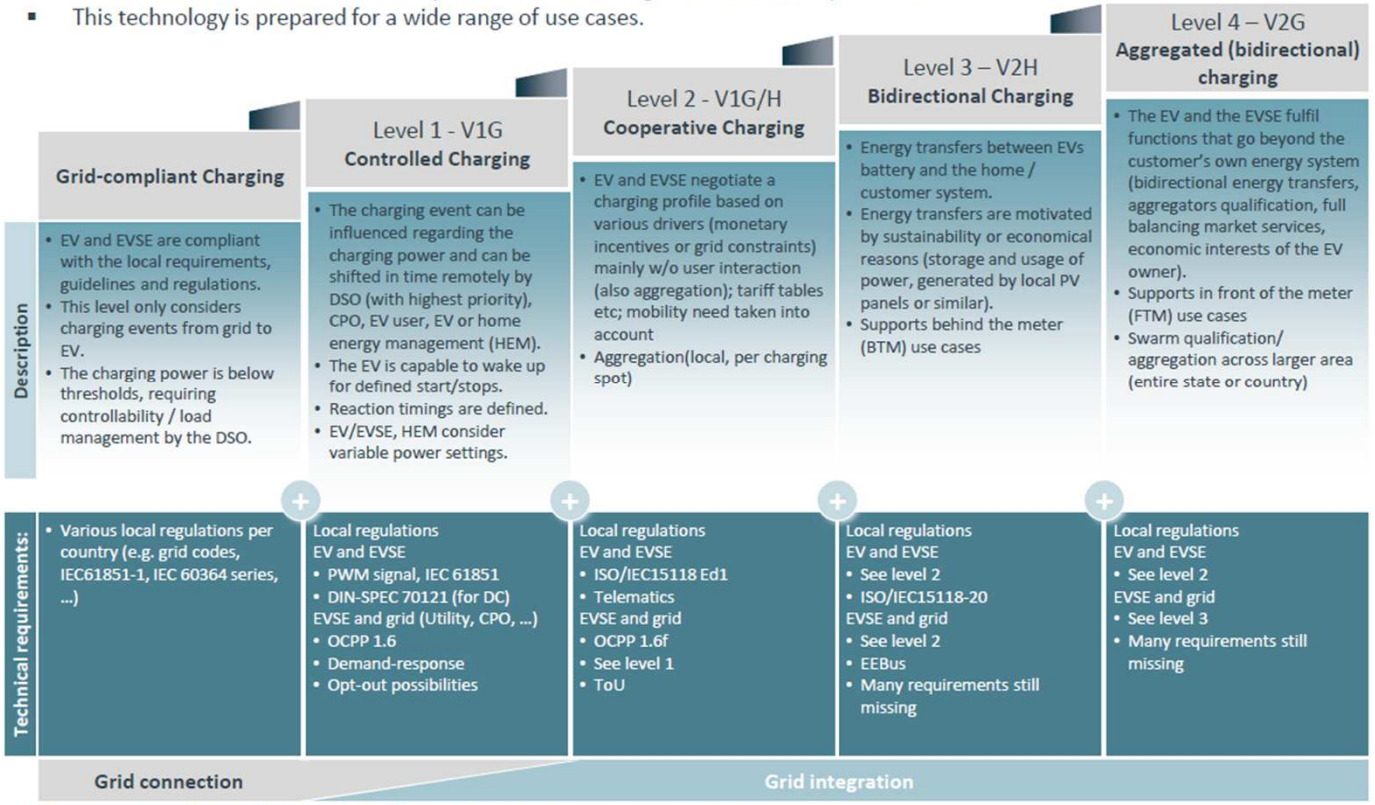


VEHICLE GRID INTEGRATION LEVELS

CHARIN

2020-06-26 V5.2

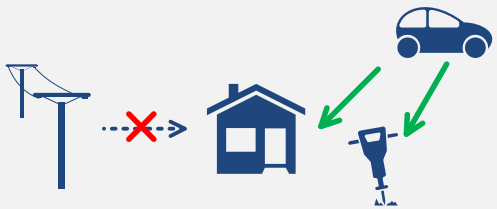
- There are many levels of Grid Integration that can generate value
- CCS with ISO/ISO 15118-20 is the key enabler of Grid Integration and is ready for V2G
- This technology is prepared for a wide range of use cases.



EV – electric vehicle, EVSE – electric vehicle supply equipment, DSO- distributed system operator ,CPO – charge point operator

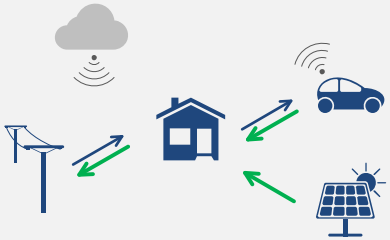
BIDIRECTIONNAL USE CASES

Vehicle-to-load (V2L/H)

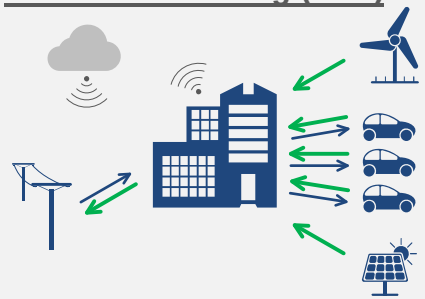


Generator feature
Nomad energy source
Home back-up energy source

Vehicle-to-home (V2H)

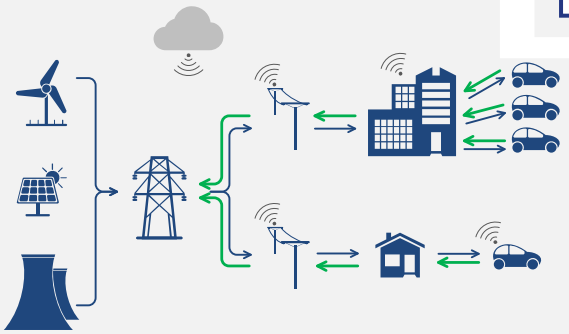


Vehicle-to-building (V2B)



Electric bill optimization
Self-consumption
Intelligent charge plan
➔ *-10/-15% on energy bill.*

Vehicle-to-Grid (V2G)



Grid reachable Services
Primary frequency reserve
Capacity reserve – Demand response market
Between 300€ to 1400 €/y value creation to be shared (internal estimation and Insero Mobility)

- ✓ **Several service levels available depending of aggregation integration in the grids**
- ✓ **Complexity and value creation increase with deeper grid integration**

NORMATIVE AND REGLEMENTARY CONTEXT

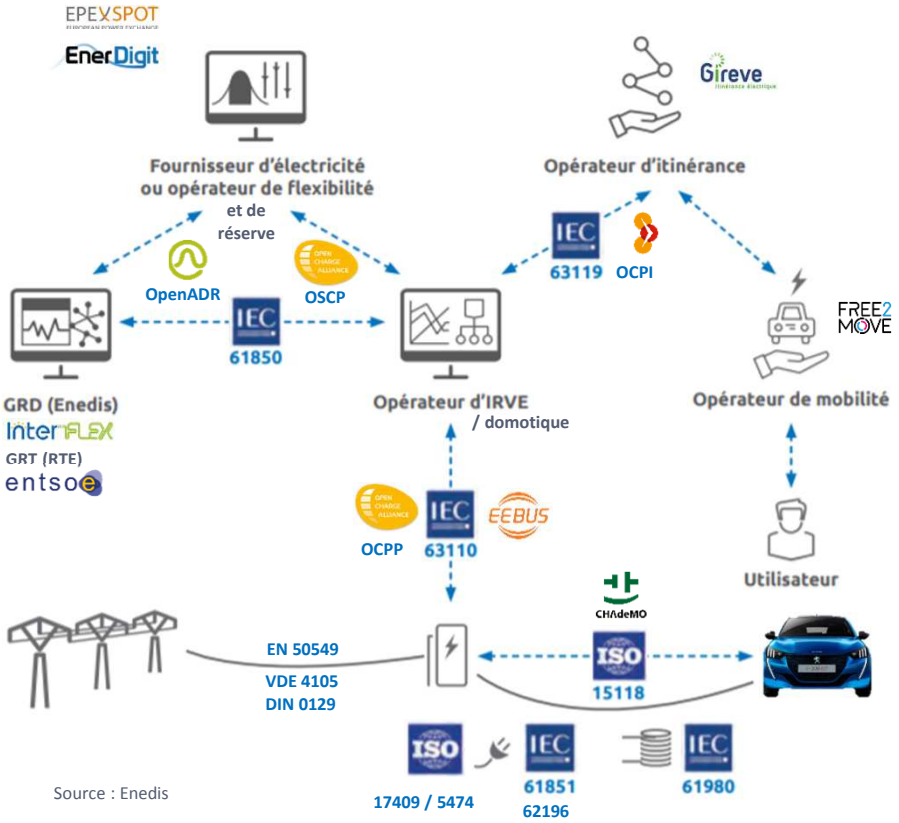
Different standards cover the complete system

Charging Spot – EV :
- ✓ Topology of charging system (incl. plugs types)
- ✓ Electric Security during recharge/discharge
- ✓ Communication protocol

Charging Spot to Back end :
- ✓ Charging infrastructure management
- ✓ Added value services (smart charge, …)

Back end to back end
- ✓ Roaming of charging payment
- ✓ eMSP
- ✓ Energy service activation/control

DER context
- ✓ Grid Code
- ✓ Installation specification



Source : Enedis

Constraints for Bidirectionnal charging/discharging

Grid connection compliancy

- ✓ Local Grid codes (Volt./Freq. deviation survey/support/immunity)
- ✓ LV generator in // of LV grid topology
- ✓ DSO specific

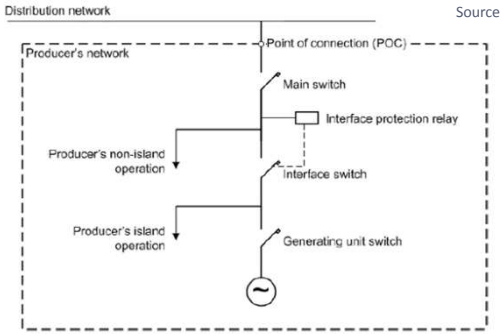
Services rules (Front/Behind the meter)

- ✓ Performance (speed, precision, availability, controllability, …)

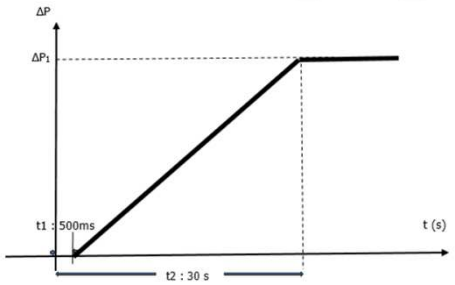
Electric compliancy (Front/Behind the meter)

✓ Electric source quality definition, EMC	IEC 61 000
✓ Vehicle design compliancy	R 100
✓ Security of installation	NF C 14/15 100

Source : EN 50549



Source : RTE



On Board Impact

for VGI ready EVs

Battery ageing impact

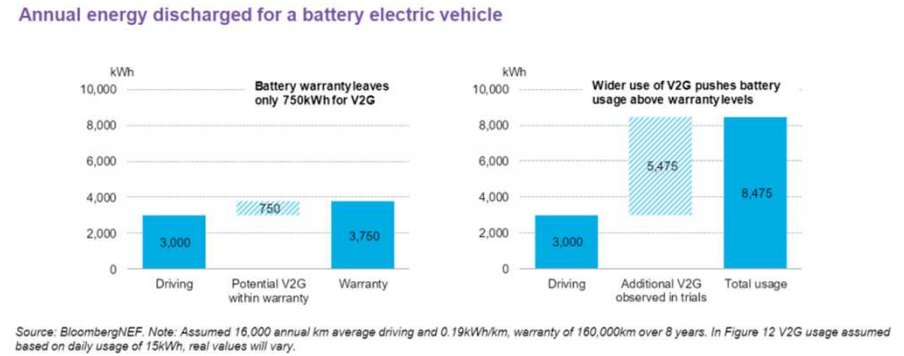
Additional cycling due to VGI

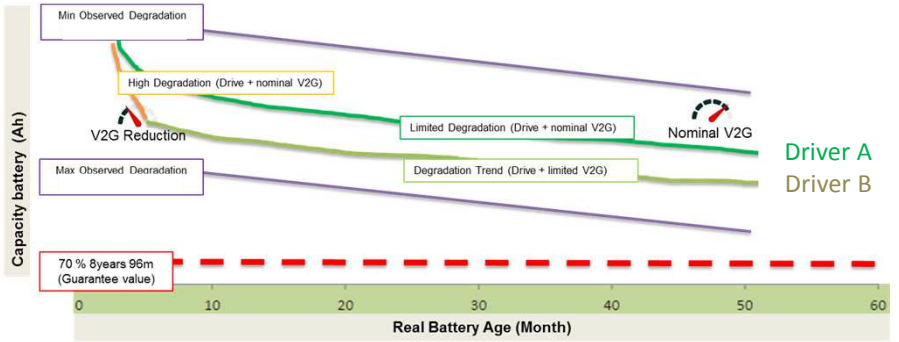
- ✓ Depends of grid service
- ✓ Power services (FCR, load management, …)
- ✓ Energy services (Self consumption, capacity, flexibility, …)

OEM enabler

- ✓ Battery Warranty preservation (customer acceptability, OEM Warranty risk mitigation, …)
- ✓ Limitation of VGI service mechanism (API, VGI authorisation, …)
- ✓ Depends of Driving type, climate, …
- ✓ Depends of Chemistry, BoL* design (PRF), …

*Beginning of Life battery characteristics





Driver A : Low average km/year, moderate climate, …
Driver B : Sportive/high average km/year, hot climate, …

Charging Topology AC vs DC

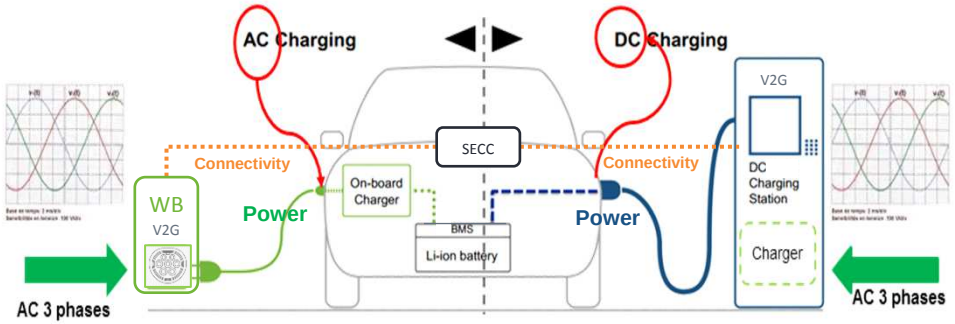
V2X DC

- ✓ No additional HW cost on vehicle
- ✓ High Infrastructure cost (~3000€/5000€)

➔ **Suitable for Experiment/Early-adopter/B2B**

Advantage

- ✓ HLC* communication & HW already existing (Chademo Experience)
- ✓ Grid Code & Safety compliance mainly done by EVSE



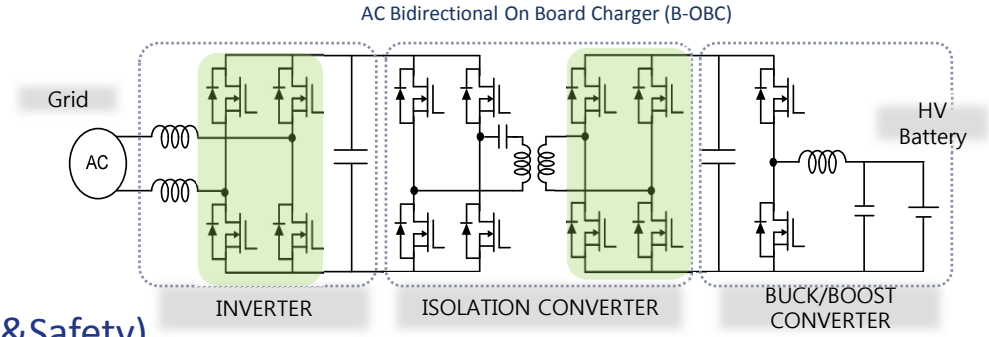
V2X AC

- ✓ Low infrastructure cost (~+1000€)
- ✓ Marginal cost for OBC

➔ **Suitable for Mass Market**

Issues

- ✓ Extra Cost / Volume in the OBC & EVSE (G.C&Safety)
- ✓ HLC* & Interoperability



Diodes bridges ➔ Mosfet/IGBT arms

*High Level Communication = CPL (ISO 15118)

Source : PSA internal study

EVSE-EV Communication protocol

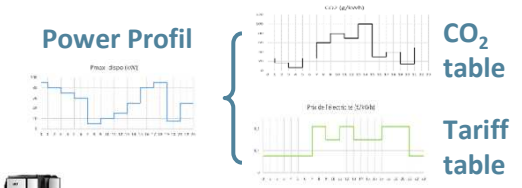
ISO 15118-20 example

- ✓ 2 control modes
- ✓ Request/Response messages pairs
- ✓ Use Preference can be distribute by OEM back-end, or CPO back-end.
- ✓ Grid Following or Grid Forming control (Off-Grid)
- ✓ Phase Balancing
- ✓ P/Q power control
- ✓ Secured communication (TL1.3)
- ✓ SECC/EVCC ECUs to store protocol
- ✓ With HSM* to store Certificates

*Hardware Security Module

Scheduled

Communicates the grid constraints: Max available power, tariff ..

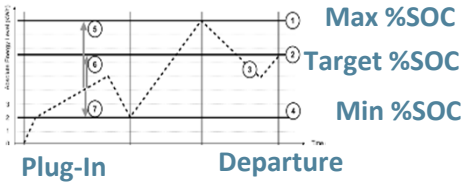


Calculates optimized charging profile

Optimized charging profile

Dynamic

Dynamically sends of the charge power set point during a charging session



Dis/Charging Set point*

- Sends EV limitations
- Follows the sent power setpoint
- Updates the SOC and physical limitations

*Depends of AC or DC

EVSE impact

Input

- ✓ EV+EVSE are considered as DER system
- ✓ EV+EVSE couple must be compliant with Grid Code & connection rules (local)

Main function

- ✓ Anti Islanding protection
- ✓ Decoupling / Re-coupling rules
- ✓ Response to Frequency deviation
- ✓ Response to Voltage deviation
- ✓ Immunity to Hz/V events

DER compliancy

- ✓ Are independent of Ancillary or local services

Basic task

- ✓ Store local grid code (installation)
- ✓ Measure Hz/V
- ✓ Calculate P/Q set point (grid code)
- ✓ Power conversion
- ✓ Couple / decouple to rest of the grid

Source : Renault EVS30 summit

Questions ?