E-MOBILITY
The role of Electric Vehicles within flexibility markets

Clio Ceccotti
Enel X Global e-Mobility – Vehicle Grid Integration
Enel X
4 Global Product Lines to capitalize upon the power industry transformation

- **e-Industries**
  - Consulting and auditing service
  - Distributed generation on/off site
  - Energy efficiency
  - Demand response and demand side management

- **e-City**
  - Smart lighting
  - Fiber optic wholesale network
  - Distributed generation & energy services

- **e-Home**
  - Installation, maintenance and repair services
  - Automated home management
  - Financial services

- **e-Mobility**
  - Charging infrastructure (public & private)
  - Maintenance and other services
  - OEM back-end integration

Addressing new customer needs with innovative technologies
Electric Vehicles Market
Driver: Renewable growth and flexibility

The rapid growth in the use of renewables sources, especially solar and wind power, has introduced an increasing amount of non-programmable sources in the power generation system.

In order to maintain system reliability an increasing amount electricity grid flexibility is required and this is an opportunity for improving EV Customers TCO.

Electricity grid is requiring more and more flexibility to face renewable growth.

EV batteries are an example of existing distributed storage that might be aggregated in a platform-based business model, providing value for the electrical system and creating a virtuous cycle.

Vehicle Grid Integration helps reducing the EV customer’s TCO combining revenues from new grid services with fixed & variable energy cost saving

1) Depending on the reference Market: benefit may include Time of Use tariff, demand charge tariff, grid connection optimization plus grid regulation services to national TSO.
Our solutions
Our offering
A flexible end-to-end charging ecosystem

What we offer are **flexible, best-in-class, end-to-end** smart charging **solutions** delivering benefits to the entire EV value chain
Vehicle Grid Integration
Unlocking EVs flexibility

*Flexibility can be provided aggregating both unidirectional (V1G) or bidirectional (V2G) EV chargers:*

V1G allows to activate a charge process or to switch-off an ongoing charge. It does not allow to provide power back to the grid.

V2G allows to activate a charge process, switch-off an ongoing charge and discharge the EV battery to the grid. This results in a wider power aggregation with V2G compared to V1G.

Best technology (V1G and/or V2G) to be used for aggregation, shall be defined based on the market requirements, EVs customer behavior and availability and considering the different investment and operating costs.
Vehicle Grid Integration
Enel X Core Energy Services

Local Energy Optimization ("behind the meter")

**Time Of Use tariff optimization**
Scheduling charging processes in order to optimize the share of energy consumed in the most profitable tariff (according to relevant Utility TOU Rates)

**PV balancing/optimization**
Manages EV charging to occur when generation source is operating (e.g., rooftop solar); second-by-second balancing of demand and supply

**Demand Charge Management & Demand Limitation**
Scheduling charging processes in order to reduce recurrent system costs linked to power absorption

**Load Balancing (connection fee reduction)**
Limit total coincident consumption of EVSEs during specific time intervals based on power constraints at site level

Grid Services Monetization ("in front of the meter")

**Demand Response (Capacity Market participation)**
Commitment to reduce/increase capacity available for periods of system stress in order to guarantee Power System Adequacy

**DAM vs RTM optimization and hedging**
Dispatch instruction to EVSEs from wholesale market for curtailment when market clearing prices are greater than bid prices

**Frequency Regulation / Response**
Provide fast reserve to maintain system frequency at operational levels

**DSO managed congestion relief programs**
Curtail a group of EVSEs as a result of a utility instruction

**Energy2grid**
Energy Arbitrage (with V2G)
Vehicle Grid Integration Software
Optimize your investment through energy cost savings

Cost Savings
Minimize unwanted demand peaks and reduce utility demand charges

Energy Optimization
Coordinate your EV charging load with your on-site generation and energy management systems

Our technology helps you **maximize your return on EVSE investment**, through **energy cost savings** arising from optimized charging load control
Vehicle Grid Integration Software

Optimize your investment through revenues from grid services

**Front of the meter**

Customer Provides Mobility Preferences

- **Bid & Awards based on Market Prices**
- **Long Duration Curtailment**
- **Fast Response Curtailment**

Our technology helps you **maximize your return on EVSE investment**, through **revenues** from grid services provision.
Case studies
Case study Utilities: Helping Sonoma Clean Power integrate renewables

Turn-Key FlexCharge concierge program to help utilities develop and manage EV resources
Case study Residential: Solar balancing

Generate up to $1,000 per year in energy cost savings in non-NEM markets (e.g., Germany)

- **eMW JuiceMeter** (2) on the solar inverter output measures real-time solar production
- **eMW JuiceBox** (6) modulates charging rate to match solar production and maximize self-consumption
- Customer saves on their energy bill and ensures clean power

EV Charging Load (a 9 kW car, allowed to draw [Solar output + 1.7kW])

Linked Solar Generation (a 10 kW panel 1.5 miles away)
Case study Automotive: Helping Honda drivers to Save Money and Reduce Environmental Footprint

Find the best time to charge electric vehicles according to electric grid conditions: reducing customer costs and CO2 emissions; earning rewards through DR programs participation in California.

Honda SmartCharge monitors wholesale electricity markets for when energy demands spike and inefficient peaker power plants need to pick up the slack.

In such events, we defer charging temporarily until the grid electricity load has dropped sufficiently to avoid needing these inefficient fossil fuel power plants. This happens automatically, while ensuring your car is at maximum charge when you need it.

By adjusting the time of charging of your Fit EV along with other Fit EVs in your area, Honda earns payments from its utility partners and is then able to share those profits with you.
Case study Fleets: Denmark V2G Hub

The Danish Vehicle-to-Grid hub is the European’s first fully commercial V2G hub. The utility Frederiksberg Forsyning installed Enel V2G units and purchased electric vans to connect them together and to turn them into small power plants and micro distribution grids.

Generate potentially up to €1,000 per EV per year through FCR-N remuneration

Denmark was a good test environment considering the possibility of providing frequency containment reserve (DK2 FCR-N) service through Low Voltage aggregated resources.
Enablers for EV demand participation in electricity markets

What is needed?

Customers shift charging of EV during off-peak periods due to Time of Use retail prices, no direct/indirect participation to energy/balancing markets (smart charging / V1G)

- Availability of retail dynamic pricing offers:
  - Energy component: e.g. day/night; hourly based or Network component: e.g. “on-peak” and “off-peak

Participation in energy/balancing/capacity markets through aggregators:

- Smart charging / V1G: charging of EV in response to signals from intraday and balancing markets (especially primary reserve)
- V2G: charging and discharging of EV in response to signals from intraday and balancing markets (especially primary reserve)

- Market for primary reserve (e.g. in Italy no market, obligation to reserve 5-10% of capacity, regulated payment for some production unit)
- Asymmetric balancing products (downward and upward) with adequate size (1 MW)
- Long-term contracts for balancing services
- Aggregation allowed
- Possible participation to capacity market

Multiple business opportunities for EVs but adequate regulatory framework needed
Thank you

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Backup
Enel Group today

- #1 private network operator globally
  - 65 mn end users and 44 mn digital meters
- +4.5 mn end users
- +8.4 mn smart meters
- ~20 mn free retail customers
  - #1 in Italy, Iberia and top 3 in Latam
- +5 mn free customers
- +20% electricity sold in free market
- #1 renewable operator
  - ~40GW managed capacity
- +6 GW
  - +80% additional capacity
- ~47 GW thermal capacity
  - Highly flexible and efficient assets
- 10 GW capacity closure
- Enel X
  - +5.7 GW demand response
- Countries of presence
**Enel X e-Mobility ecosystem**

An open system ensuring interoperability

**EVSE**
- JuiceBox AC
- JuiceBox DC
- JuicePole AC
- DC Fast Charger
- Juice2Grid

**EVSE back-end**
- EMM Platform

**Aggregation Platform**

**Customers**

**EVs**

**OEM back-end**
- Energy Front Office & Markets Interaction

Enel can be a full stack technology provider (incl. EVSE) or an aggregation technology provider

**EVSE** = Electric Vehicle Supply Equipment
Smart charging infrastructures
Field-proven charging technologies

A portfolio of highly affordable charging stations, ensuring reliability and industry-leading communications and control intelligence to meets all your needs

**JuiceBox** (3.7 – 22 kW)
- Single charging session handling
- AC charging
- Indoor and Outdoor Rated
- Socket and cable version
- Smart charging – Power Modulation

**JuicePole** (22 kW)
- Simultaneous charging of two vehicles
- AC charging
- Indoor and Outdoor Rated
- Socket and cable version
- Smart charging – Power Modulation

**Juice2Grid** (15 kW)
- Single charging session handling
- Bidirectional DC charging
- Enabled for storage integration
- Smart charging – Power Modulation

**Fast Recharge** (50 kW)
- Simultaneous charging of two vehicles
- Indoor and Outdoor rated
- AC and DC charging
- Smart charging – Power Modulation
Smart charging infrastructures
Home stations

Global
Product certified for Europe, US, Canada

Prime
Attractive and ergonomic design for top-quality EV bundled offers

Tailored
Availability of various versions to meet your requirements

Smart
Equipped with on-board connectivity and intelligence

Flexible
Easily integrated into existing back-end systems

First-class home charging technology to enhance your EV offering