Smart Charging and V2X

An opportunity for the e-Mobility and Energy Industry

AEIT Automotive

Enel X Way

Vision

We champion e-mobility transformation to benefit people, today and tomorrow.

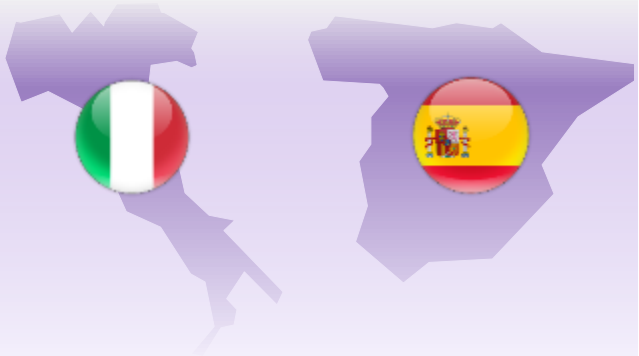
Mission

We enable an easy and convenient transformation towards electric mobility for people, businesses and cities, creating simple, intuitive, turnkey solutions for all.

The e-Mobility enabler

Global Player with First Mover Advantage and Solid Track Record

Leading Market Position



Significant Position in Home Segment

Source: Company information.

EV revolution effects the grid stability, but can became an opportunity for new flexibility services

1 INCREASE OF DEMAND

Main due to growth of charging points. This create majority of problem for public charging locations

2 PEAK EFFECTS

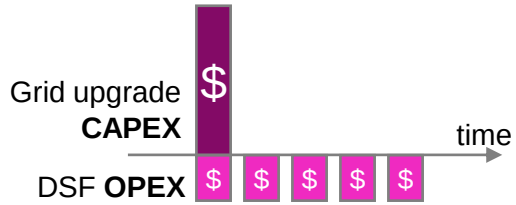
Mainly due to uncontrollable charging on peak hours (morning and evening) and the penetration of High Power Chargers (>150kW)

3 UMPREDICTABLE LOCAL BEHAVIORS

Charging sessions is unpredictable if considered as single user/site. So, stochastic approach is needed to analyse the effect at "aggregated" level

Power issues and related flexibility services:

Level	User	Issue	Service
Behind-the-meter	**End-user**	Local generation	Self-consumption optimization
		Local power limitation	Dynamic Load Management
		Congestion management	ToU tariffs (Implicit DR)
Local	**DSO**	Local congestions	Local congestion management
		Voltage deviation	Voltage Regulation (reactive power control)
		Phase unbalance	Phase balancing
System-wide	**TSO**	Frequency deviation	Frequency Regulation
		Global congestions	Grid Balancing
	BRP	Unbalance management	Portfolio optimization



Demand Side Flexibility (DSF) can be up to 5 times cheaper that reinforce the grid*

*Source: EDSO - Smart charging: integrating a large widespread of electric cars in electricity distribution grids – 2018

EVs are the most fitting asset to provide DSF, opening different value streams

Easy to "shift"

Compared to battery size, average daily usage and charging power, the charging window can be easily shift to better hours (low congestion, high value). See below

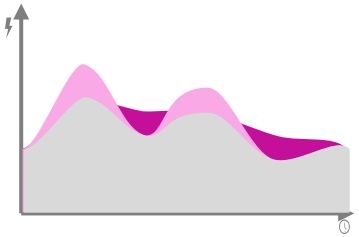
Easy to "control"

EVs can easily modulate the power to charge and have a direct power control model (no complexity as HVAC, that require thermal model)

Bidirectional

Also if majority of current EVs and charging point are one-direction (only charge, a.k.a. V1G), the bidirectional capabilities (charge/discharge, a.k.a. V2X) will open majority of value and capabilities

Peak Shaving/Load Shifting



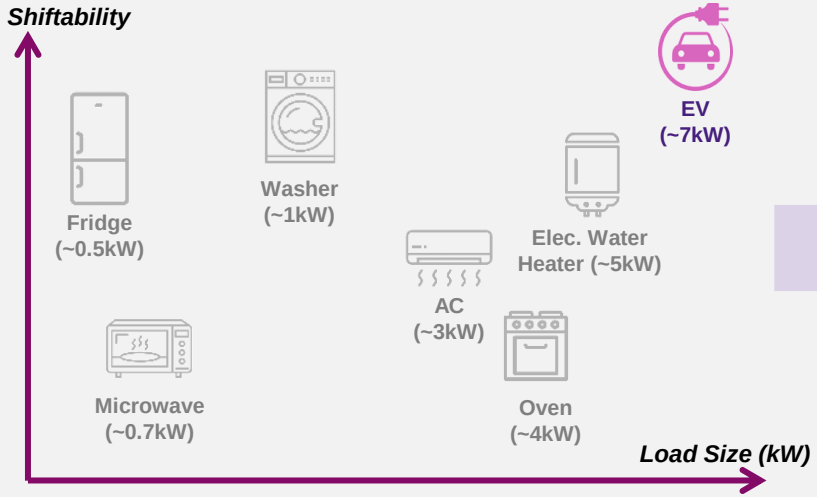
Since is **nature** and **flexibility** of **use**, EVs can easily do **load shifting** and **peak shaving**, enabling **cost saving/revenue flow** for local energy optimization (behind the meter) and grid services (front of the meter)

Behind the meter

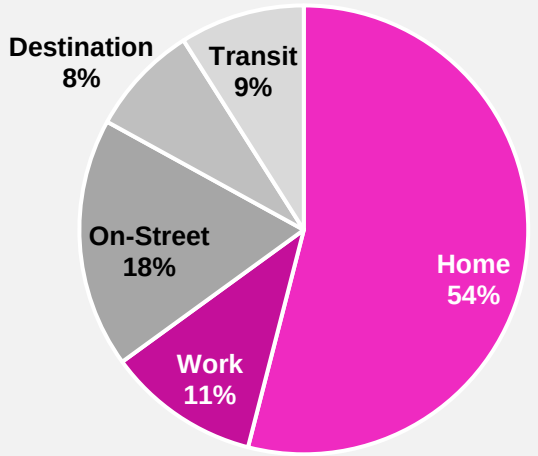
Local energy **optimization** services (load balancing, ToU charging, self consumption optimization, etc..) that normally enable **savings** on electricity bill

Grid services (electricity and ancillary services to TSO/DSO) based on **aggregated** and **distributed** flexible asses, that enable **direct revenue**

Front of the meter



- 50- 70 km average daily commute requires **10-15 kWh** energy per day with **1-2 h charge time**
- Majority of long duration charging sessions (**over 6 hours**) happen at **home** and/or **work**, but drivers usually need **less than 2 hours** of charging
- In the **medium-long term** (5-10 years), bidirectional capabilities (**V2X**) will **unlock majority** of the **value**, since "**flexibility**" provided can be up to **7 times more**.



SOURCE: LCP Delta 2022

EVs will became the main assets to provide Demand Side Flexibility

Available flexible power per technology, on average in 2030

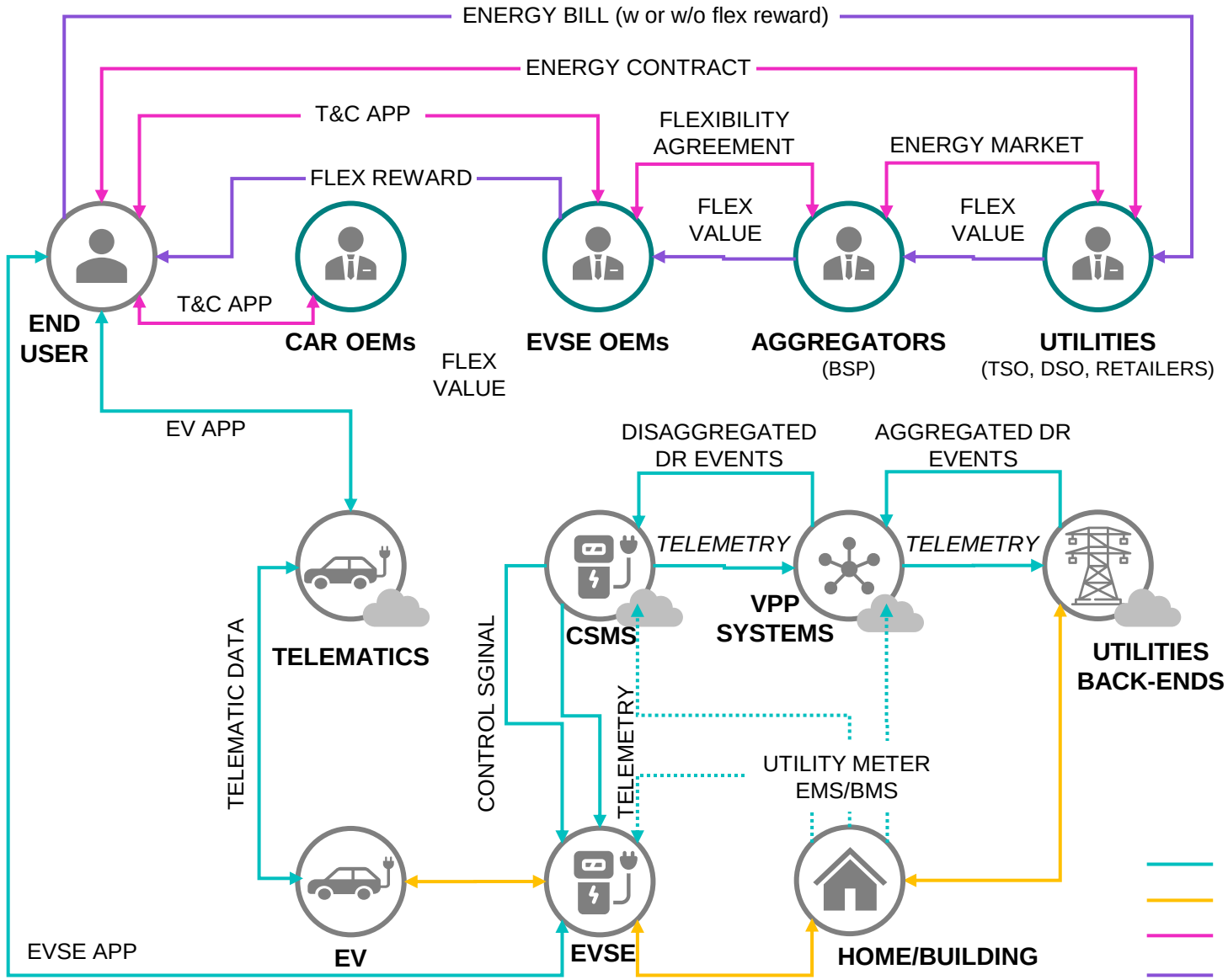
Technology	Upward flexible power [MW]	Downward flexible power [MW]
Industrial DSR	21.731	0
BESS Behind the meter	10.850	10.850
Smart charging	**48.704**	**16.295**
V2G	**25.594**	**25.594**
Residential electric heating	32.841	73.385
Industrial electric heating	7.082	0
Industrial heating – CHP	6.355	482
District heating – CHP	10.581	3.500
Total	**163,738**	**130,106**

Activated flexibility per technology in 2030

Technology	Upward flexible power [GWh]	Downward flexible power [GWh]
Industrial DSR	1.071	0
BESS Behind the meter	637	871
Smart charging	**106.286**	**106.266**
V2G	**21.009**	**23.764**
Residential electric heating	195.532	195,532
Industrial electric heating	141	0
Industrial heating – CHP	12.697	12
District heating – CHP	59.601	14.032
Total	**396.974**	**340.477**

Source: Demand-side flexibility in the EU: Quantification of benefits in 2030 – SmartEN – September 2022

Extracting value from EVs is complex and involve different stakeholders



1. Yes, is a mess! We **need standards** to ensure **interoperability** to end-user
2. In the short term, we need **simple solutions** to **make user aware** of **value** to provide grid services and make it "comfortable" ("play" with my EV, but ensure EV ready on time and no battery degradation)
3. Vehicle Grid Integration can happen only if **we work "as industry"**, simplifying user pain points

Focus

1. Standards to ensure interoperability to end-user

2. Simple solutions to make user aware of value

3. Work "as industry"

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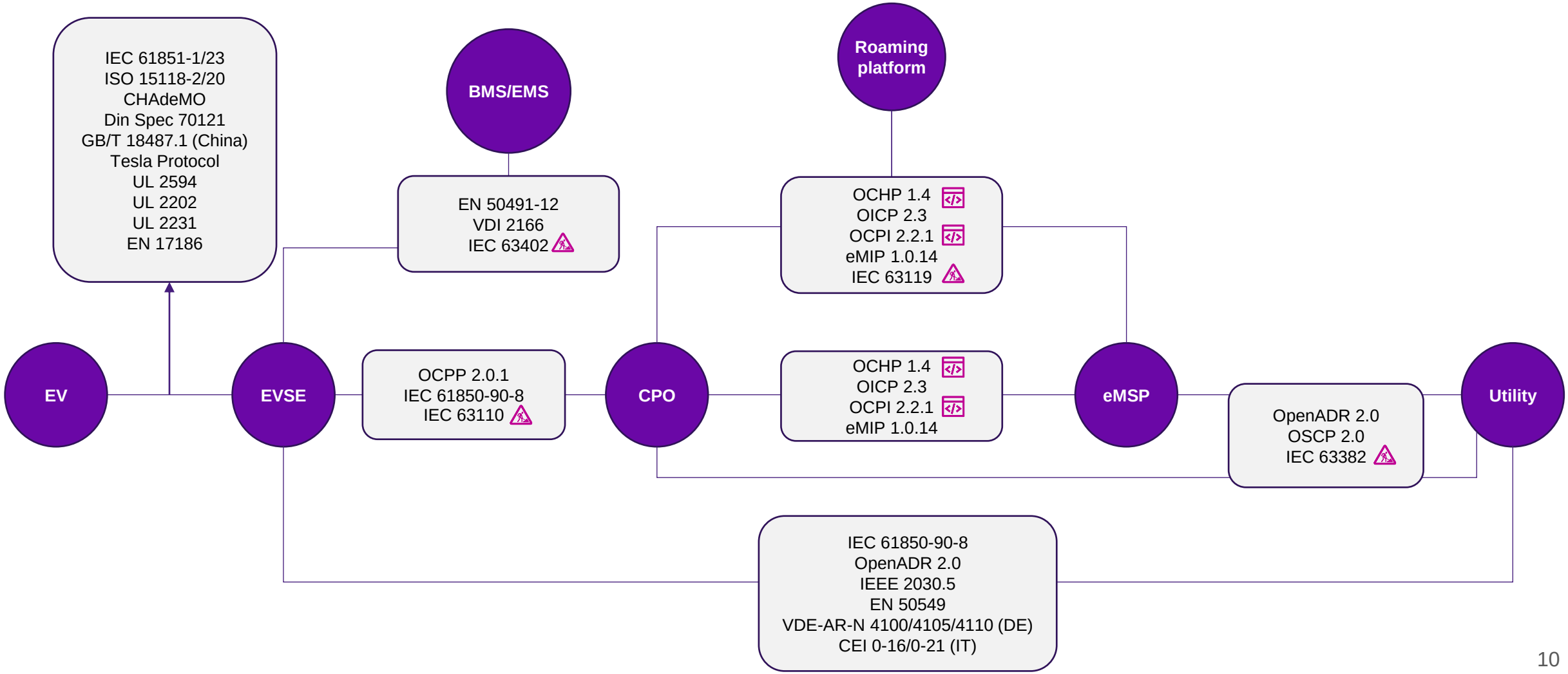
Open Protocol simplified the market kick-off. Majority are under standardization process



Standard under work New version under work

Focus

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Regulatory framework limits or unlocks the value of the EV flexibility

		Service provided to the end-user leveraging its flexibility	Service provided to an Utility* leveraging end-user flexibility
	How extract value (use cases)	• **Local energy optimization** (Energy Management) → load management/balancing, self consumption optimization • **Implicit DR** → Optimize over a ToU rates	Service to the grid/**Explicit DR**
	Regulatory drivers	• Tariff regulation/Tariff component structure → ToU rates, demand charge • Safety and/or electrical regulation	Electricity market regulation (wholesale, intraday, ancillary, DSO services)
	Current barriers (main from regulatory)	• Adoption of dynamic ToU rates (both energy/demand) → Hourly/15 mins tariff linked to wholesale market • AMI (Advanced Metering Infrastructure)→smart meters • Submetering	• Market participation of distributed asset • Entry barriers (i.e. min size, symmetric vs asymmetric services), metering and other devices (cost) • Value on the market (energy/capacity)
V1G or smart charging	**One Way**	• **Mature** at **global** level • Good **value** to **extract** and **key** features to **sell HW**	• **Mature** in some **countries**: UK & Nordics, US state-dependent • Good feature to **position** on the market
V2X	**Bidirectional**	• **Good value to extract** as soon as **compatible V2X EVs and EVSEs** will me the standard	• **Not mature** in majority of country (**small** and **local pilots** happening mainly in US and UK) • Good feature to **position** on the market

*Utility=TSOs, DSOs, Aggregators or Energy Retailers

Simple and complex "tools" to provide "price signals" to end-users. Majority need regulatory changes

	What	Reasoning	How	Complexity
Implicit Flexibility	**Dynamic ToU tariff for EV (submetering)**	Optimize load vs market signal but without too warries on baseloads	Bill the **EV charging energy** on **dynamic ToU** rates, separately from baseloads (that can remain on flat or static ToU rates)	• **Regulated market** → Complex, need regulatory framework for submetering • **Free market** → Can be easy if utility "built" as single tariff
	Price signal on connection power (demand)	Give a price signal on power based on local congestions	• Simple approach → **ToU demand charge** rates (i.e. Spain) • Complex approach→ **Non-firm connections or Dynamic ToU**	Since both cases leverage a regulated market, changes on **regulatory** framework is needed
Explicit Flexibility	**Enable DSO markets**	Real DSF value is on DSO grids.	Open market framework to start to provide simple services in an **aggregated** and **best effort** mode (i.e. congestions management via a day-ahead DR signal)	• DSO is **fragmentated market:** common rules are needed from regulatory based on global best practices • **Best effort** mode open possible problems on **unbalances**, but can be a **game changer** in case of DSF
	Simplify rules for TSO market access (if we want)	TSO markets was created for centralized generation (big power plant)	• Simplify **access rules** (i.e. qualification process, telemetry flow) • Works on "**real aggregated**" VPP (**stochastic** approach)	• TSO markets was built for power plants (built also to provide ancillary services)→**redefine regulatory framework** • **TSO and DSO coordination** (not only technical, but also value)
OEMs	**Clear/standardized battery warranty rules in case of V2X**	Any indirect cost need to be part of the business case (i.e. EV can do only 1 cycle/day)	• Phase 1: at least OEMs need to **declare** "something" • Phase 2: **standardized rules**	• OEMs is a **closed market** • **Battery** is the key component
	Vehicle Data	Data is key for VGI. Some data is still not available (i.e. AC charging) or some data is valuable when EV is not plugged in	• Define a **non-discriminatory framework** for data access • Access **cost** need to fit in the specific customer segment **"intention to buy"**	• **No communication standard** defined for **Vehicle data** • **Regulatory** need to **define rules** (something moving on, see "Revision of the Union legislation on vehicle type approval (Regulation (EU) 2018/858) with regard to access to in-vehicle data")

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To make market boom, we need to work together. Different tables exist and OEMs are welcome!

Regulatory Advocacy

smartEn is the European business association integrating the consumer-driven solutions of the clean energy transition. It make advocacy action for flexibility business.
A dedicated "**E-mobility task force**" is very active at European level.

Vehicle Grid Integration Council (**VGIC**) is an US advocacy group committed to advancing the role of electric vehicles and smart EV charging through policy development, education, outreach, and research.

Technology Advocacy

CharIN is a non-profit organization with over 200 members from different business around e-mobility. The purpose of the CharIn association is the worldwide promotion and support of the Combined Charging System. In this connection the limits drawn by antitrust laws are to be observed by all members.

A dedicated **"Grid Integration" Focus Group** works on smart charging and V2X topics.

Labs & Pilots

Enel Grids has since 2021 a "Flexibility Lab", where different stakeholders work to dive on DSO flexibility topics, with 4 different lab, where is possible to test different use cases in a sendbox.
Open to all the industry. OEMs are welcome

Enel X Way has a new VGI lab to test interoperability and use cases on Smart charging and bidirectional capabilities (V2X).
Open free of charge to OEMs.

Terna (Italian TSO) launched a VGI lab facility in Tourin ("ESI Program") where both EVSE manufacturers and EV manufacturers can test interoperability and use cases on VGI space.

Thank you!

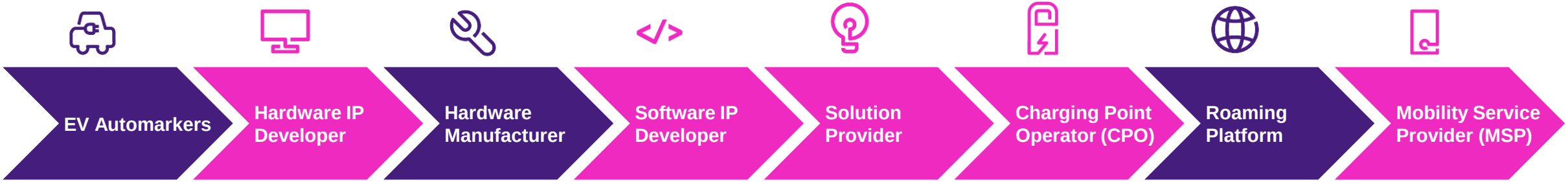
Davide De Michino
Head of Products and Energy Services

BACKUP

Our strategy is underpinned by an extensive positioning in the eMobility value chain

At this early stage, the marketplace is not yet fully organized, however, it is possible to identify **eight core strategic plays** in the eMobility value chain

● **Third Parties** ● enel way



- Battery Electric Vehicles (BEVs)
- Plug-in Hybrid Electric Vehicles (PHEVs)

- Wallbox AC and DC
- AC destination charging station
- Fast charging station
- Ultra Fast Charging Station
- eBus charging station
- Lighting pole embedding charging station
- V2G (Bi-directional Charger)

- EVSE (Charging Station) Production and Customization
- State-of-the-art AC and DC portfolio that may include also EVSE Back-end

- EVSE Back-end (Operation & Maintenance)
- End-Customer App for charging services (residential and public)
- Energy Services SW solutions:
  - behind the meter
  - in front of the meter

- EVSEs and SW services provider (even third party IP) to End-Customer as well as Business Customers

- Charging Infrastructure management
- Charging Infrastructure operations and maintenance
- Wholesale charging services

- Specialized in the delivery eRoaming services, thus enabling customers access to charging networks at global level
- Enel X has a 12,5% stake on Hubject Roaming Platform, which has around 1.300 partner in 45 countries

- Retail charging services
- Charging points localization and booking
- Micro-mobility, parking, and third party services
- Customer Care

EVSE = Electric Vehicle Supply Equipment

Italian regulatory is working to incentivize EV Flexibility