EVSE Application Guide

Version 0.9

MERCURY
CONSORTIUM

TABLE OF CONTENTS

ABBREVIATIONS

API	Application Programming Interface
BESS	Battery Energy Storage Systems
BRP	Balance Responsible Party
BSP	Balancing Service Provider
CSO	Charge Service Operator
DER	Distributed Energy Resource
DR	Demand Response
DSO	Distribution System Operator
DSR	Demand Side Response
eMSP	Electromobility Service Provider
EV	Electric Vehicle
EVSE	Electrical Vehicle Supply Equipment
FCAS	Frequency Control Ancillary Services
FCR	Frequency Containment Reserve
FFR	Fast Frequency Response
FRR	Frequency Restoration Reserve
FSP	Flexibility Service Provider
GCC	Grid Control Center
HVAC	Heating, Ventilation, and Air Conditioning
HEMS	Home Energy Management System
HAR	Harmonization and Reporting function
MPO	Metering Point Operator
MSP	Mobility Service Provider
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
SMGW	Smart Meter Gateway
TSO	Transmission System Operator
UVAM	Virtually Aggregated Mixed Units
VPP	Virtual Power Plant

1 INTRODUCTION

This document is an informative application guide associated with the Mercury Consortium technical requirements Electric Vehicle Supply Equipment (EVSE), EVSE-001-2025-REQ [1].

This guide does not establish normative requirements, but provides insight into the process, use cases and considerations that led to the requirements and identifies application guides that might be useful for Electrical Vehicle Supply Equipment (EVSE) Original Equipment Manufacturers (OEMs), Distributed Energy Resources (DERs) managing entities, and utilities.

1.1 Motivation

Flexibility is becoming a key component of modern power systems, particularly in residential settings. Regulatory measures in many worldwide countries reflect this shift, requiring that high-load residential devices—including Electric Vehicles (EVs) chargers and heat pumps—be made responsive to grid conditions. The aim is to mitigate local grid stress by enabling devices to limit consumption during critical periods. This type of demand-side management places new technical and operational demands on EVSE, which must be capable of reacting to real-time signals in a secure and coordinated manner.

To scale such solutions effectively, there must be a commitment to real interoperability, specifically, a plug-and-play approach. For example, while several standards provide foundational guidelines for the interconnection of DERs with the grid, they fall short of ensuring practical, out-of-the-box interoperability across a variety of devices and vendors. Such standards primarily address performance, safety, and interconnection requirements, but do not resolve the challenges of seamless integration within diverse home energy systems or between grid operators and consumer assets. As a result, custom integrations and vendor-specific solutions still dominate, slowing down innovation and increasing deployment costs.

Mercury consortium aims to define a clear device-level specification to enable the integration of DERs, starting with EVSE into energy flexibility services. The goal is to enable the EVSE to play a pivotal role in demand flexibility services, compatible with any upstream control architecture - such as aggregators, Home Energy Management System (HEMS), or utilities - which monitors and manages energy consumption.

As EVs become increasingly prevalent, the role of EVSE is evolving beyond simple charging infrastructure into a central component of the smart home energy ecosystem. When integrated into a communication system towards a DER Manager (DER-M)—e.g., third party aggregator, utility, HEMS—the EVSE can act as a dynamic asset that not only responds to user preferences and tariff signals, but it can also provide services to the grid.

EVSEs with Mercury certification will be easier to integrate into interfaces from DER managers. Mercury Consortium aims to support efficient energy management while maintaining system flexibility and modularity. Moreover, Mercury Consortium promotes interoperability and simplifies onboarding for manufacturers and solution providers alike. Flexibility is becoming a key component of modern power systems, particularly in residential settings. Regulatory measures in many countries worldwide reflect this shift, requiring that high-load residential devices (including EV chargers and heat pumps) be made responsive to grid conditions. The aim is to mitigate local grid stress by enabling devices to limit consumption during critical periods. This type of demand-side management places new technical and operational demands on EVSE, which must be capable of promptly reacting to received signals in a secure and coordinated manner.

To scale such solutions effectively, there must be a commitment to real interoperability, specifically, a customer friendly and easily accessible approach. For example, while standards like IEEE 1547 provide foundational guidelines for the interconnection of DERs with the grid, they fall short of ensuring practical, out-of-the-box interoperability across a variety of devices and vendors. IEEE 1547 primarily addresses performance, safety, and interconnection requirements, but does not resolve the challenges of seamless integration within diverse home energy systems or between grid operators and consumer assets. As a result, custom integrations and vendor-specific solutions still dominate, slowing innovation and increasing deployment costs.

This specifications document has been created to address these needs by addressing how EVSE can act as a flexible, grid-aware energy asset. It outlines the technical requirements necessary to enable this vision, supporting a transition toward decentralized, resilient, and interoperable energy systems.

1.2 Scope

The Mercury EVSE Requirements are designed to specify a minimum functional requirement that will facilitate participation in a variety of grid services that could provide additional value to the consumer. They are meant to simplify the integration process to include these assets in grid services and to provide some level of insurance for asset obsolescence in the event that an original supplier of the equipment leaves the market for any reason.

There are benefits to all levels of stakeholders in developing this common set of minimum requirements:

- The requirements and specifications provide straightforward guidance to OEMs for the implementation of basic functions and capabilities that will simplify the integration of these assets with aggregators and other stakeholders that may participate in grid services and offer services to consumers.
- These specifications simplify the process of integrating these assets for DER Managers and Aggregators.
- The specifications provide a simple reference for Regulators and Policy Makers to support integration of distributed resources for support of grid services, resulting in more efficient investment strategies and grid operations.

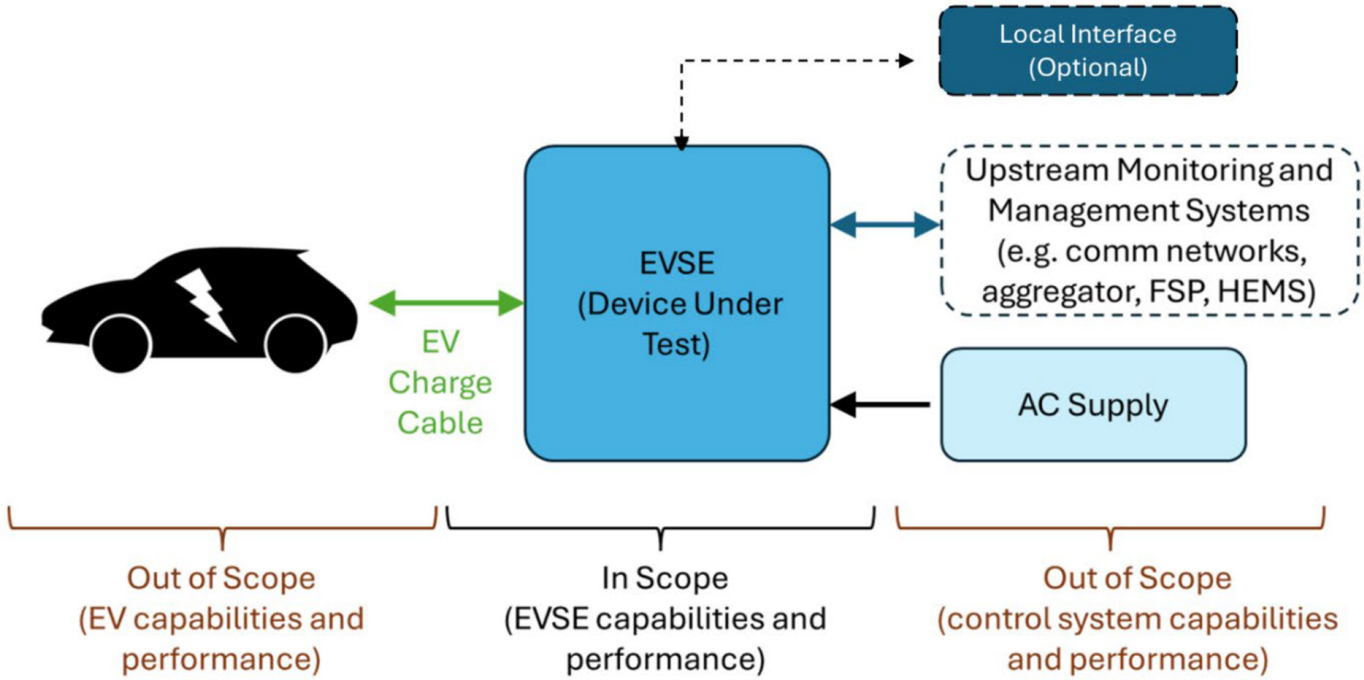

Figure 1. *Scope of this Specification*

1.3 EVSE Innovation

During the development of the Mercury EVSE requirements, it was recognized that EVSE providers are developing increasingly advanced features, built on top of EV charging, to enhance customer experience. In addition to basic functionalities, some commercially available EVSE include advanced features such as the execution of optimization solutions (i.e., starting or interrupting a charging session based on the availability of renewable energy) or the alignment with dynamic electricity pricing to influence charging sessions. Mercury does not intend to limit the technology and services innovation from the EVSE OEMs and more broadly the industry. It aims solely at standardizing the core functional behavior of EVSEs to enable simple use cases and native eligibility to grid services and demand-response programs globally.

The Mercury working group recognized that many functionalities, both consumer-facing and utility-facing, may be possible in complete EV charging systems, potentially including cloud systems, additional in-home equipment, and consumer phone applications. However, it was decided that the EVSE-001-2025-REQ specification would detail only the minimum EVSE requirements. A larger range of advanced system-level functionalities can coexist with the Mercury EVSE requirements although they are not mandated.

2 ENERGY MARKETS AND EVSE MINIMUM REQUIREMENTS

One of the core objectives of Mercury is to enable the native eligibility of certified energy devices to a range of energy and grid balancing services markets globally. Energy stakeholders such as consumers, aggregators and utilities will rely on Mercury certification to buy energy devices, integrate them in demand response or grid balancing services based on a guaranteed functional behavior described later in this document, and tested performance specifications meeting at the DER level the requirements of the corresponding market signals, assuming industry standard practice latencies (addressed in Clause 2.1) between the markets, the Flexibility Service Providers (FSPs) and utilities, the technical aggregators, the DER-M and/or energy management systems managing one DER or a fleet of DERs.

From a DER Manager's perspective, fleets of energy devices in the residential domain must respond to three main families of flexibility signals:

- **Energy markets** such as day ahead, intraday, imbalance, Demand Response (DR), slow reserve markets, and retail markets. Utilities and aggregators/DER-M have between a day and a few minutes to plan their optimization strategies and dispatch controls to the DERs, and deliver a target volume of energy up or down over a defined period, without hard constraint on ramp-up, block shapes, ramp-down. Periodic re-optimization of the fleet with regular "slow" data cadence from each DER is acceptable to reach the desired load curve by flexing the demand and/or injection.
- **Ancillary services** such as Fast Reserve Restoration (FRR), balancing mechanisms, based on capacity or energy bids from FSPs/aggregators which can be activated "now" - i.e., between a few seconds and a few minutes by Transmission System Operators (TSOs) / Distribution System Operator (DSOs). These "pseudo-real time" automatic services obey explicit requirements on response times for ramp-up and ramp-down, delivery accuracy with acceptance corridors, fast data reporting cadence, either at a fleet or asset level depending on countries, with settlement mainly done at the home meter level and at times at the sub-metering level of each asset.
- **Fast Frequency Response (FFR)** services which must be activated in milliseconds, for example via a local load balancing equipment. Alternatively, grid-scale storage assets are designed to meet the harsh reactivity conditions of these services.

Beyond these market related signals, it is worth mentioning the mechanism, in specific countries (e.g., Germany), of remotely controlling the residential energy devices, including the EVSE, by local distribution grid operators to manage grid stability during peak demand or potential overload situations.

The Energy Working Group of Mercury has collected via its members the compliance requirements of the majority of the explicit flex markets in Europe and UK, and some of the U.S., Canada, Japan, Australia markets.

We have mapped the various flex markets based on response times, and aim to harmonize the compliancy requirements of Mercury certified DERs as per the diagram in Figure 2.

Mercury will test and certify DERS in any of the three Mercury levels described in Table 1.

The Mercury certification tiers are defined according to the parameters and quantitative requirements presented in Table 2.

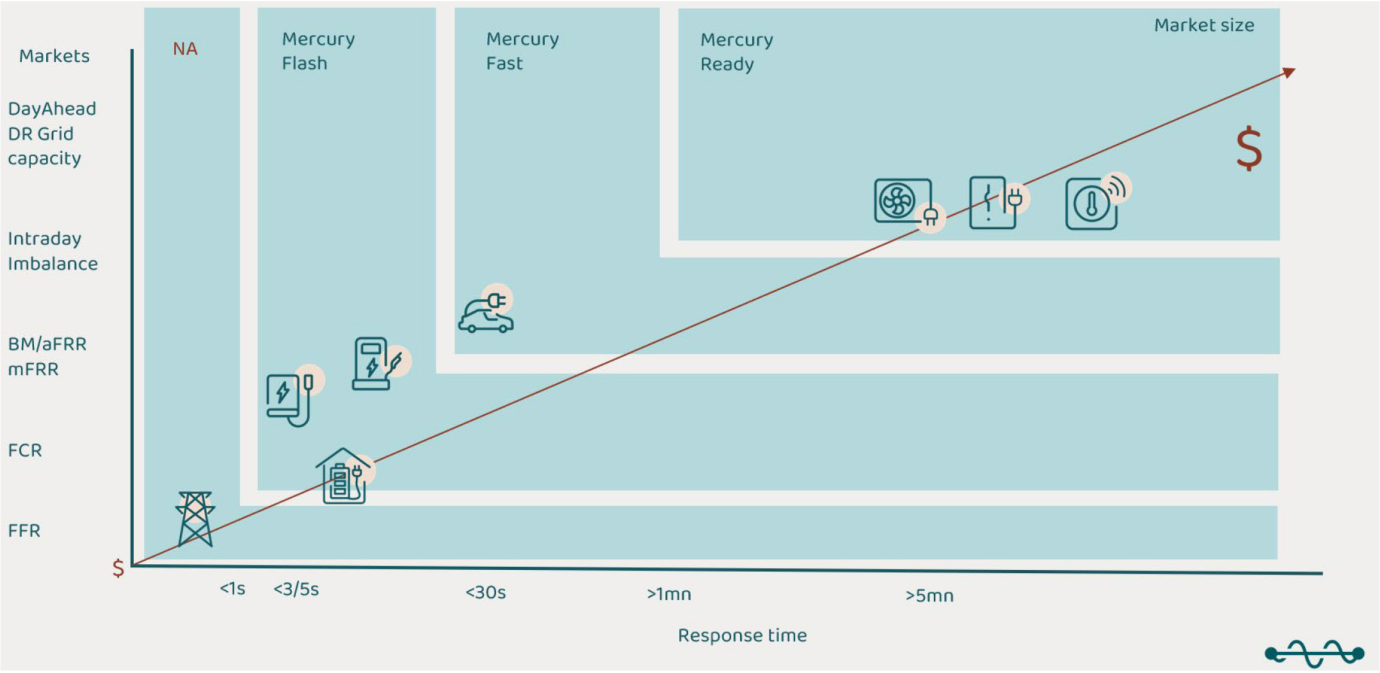

Figure 2. *Categorization of devices with respect to response time and markets*

Table 1. Characterization of Mercury levels

LEVEL 1	LEVEL 2	LEVEL 3
• "Super fast frequency" markets • Strict System Operator Regulation	• Fast reserve markets • Strict System Operator Regulation	• "Slower" reserve, Energy markets and DR programs • Low constraint regulation, best business practice
Example program types: FFR, FCR, Dynamic Containment (NGESO), R1/E-Response (RTE), RERT (AEMO), Contingency, Fast FCAS (AUS)	**Example program types:** FRR (ENTSO-E), Terna UVAM, aFRR, DSO Flexibility (UK, DE, IE), Emergency DR (ISO-NE, CAISO), Slow FCAS (AUS)	**Example program types:** mFRR, Day-Ahead/Intraday trading, Capacity Markets, Time-of-Use Shaping, Flex DR (Japan, Korea), Delayed FCAS & Scheduled Lite (AUS)

Table 2. Parameters and requirements of Mercury levels

REQUIREMENT	DEFINITION	MERCURY LEVEL 1	MERCURY LEVEL 2	MERCURY LEVEL 3
Response time	Time from DER-M command acknowledgement by DER to the first updated meter data sent back to the DER-M with an observable change of power	<3 seconds	<20 seconds	<60 seconds
Telemetry time interval	Minimum time interval between consecutive telemetry data transmissions	<1 second	<1 second	<120 seconds
Meter accuracy	Metering data accuracy	2%	2%	2%

OEMs, utilities and aggregators members of Mercury who adopt Mercury certification will integrate and promote DERs for their respective markets if they comply with these performance requirements, and are certified by a Mercury-approved Lab, as per the Testing and Certification procedure (document ID # EVSE-001-2025-TST, currently under publication).

2.1. End-to-End System Considerations

The above technical requirements are based on the following system considerations which will be taken into account as "normative behaviors" for end-to-end system latencies and included in the certification test assumptions. These latencies include the receipt of a market signal at the FSP/Aggregator platform level to a DER-M and the DER itself, including aggregate optimization including assets constraints and users settings, disaggregation and dispatch, communication networks, acknowledge of a start/stop event by the DER, and back-up to the acknowledgement of start of resource activation (e.g., start of ramp up or down at target % level) at the balancing market or trading platform level for:

- Mercury Level 1: up to 2 seconds
- Mercury Level 2: up to 10 seconds
- Mercury Level 3: up to 30 seconds

3 FIRMWARE MANAGEMENT

Although OCPP1.6-J supports firmware management, Mercury does not require this feature. It is understood that in the EVSE landscape Firmware can come from multiple sources (app, OCPP, direct from OEM server). The transport of this feature is not required.

4 BLUEPRINT AND DEFINITIONS

The Mercury certification mark guarantees that DERs enable common use cases and are eligible natively to a range of energy and grid balancing markets globally. These DERs are integrated into a consumer-centric energy management ecosystem which is represented in the blueprint in Figure 3.

Such blueprint can be further detailed when applied to the EV Charging and energy ecosystem as presented in Figure 4.

Mercury members have also decided to adopt the definitions listed in Appendix A for the different roles and acronyms we use in our specifications and our functional standardization works.

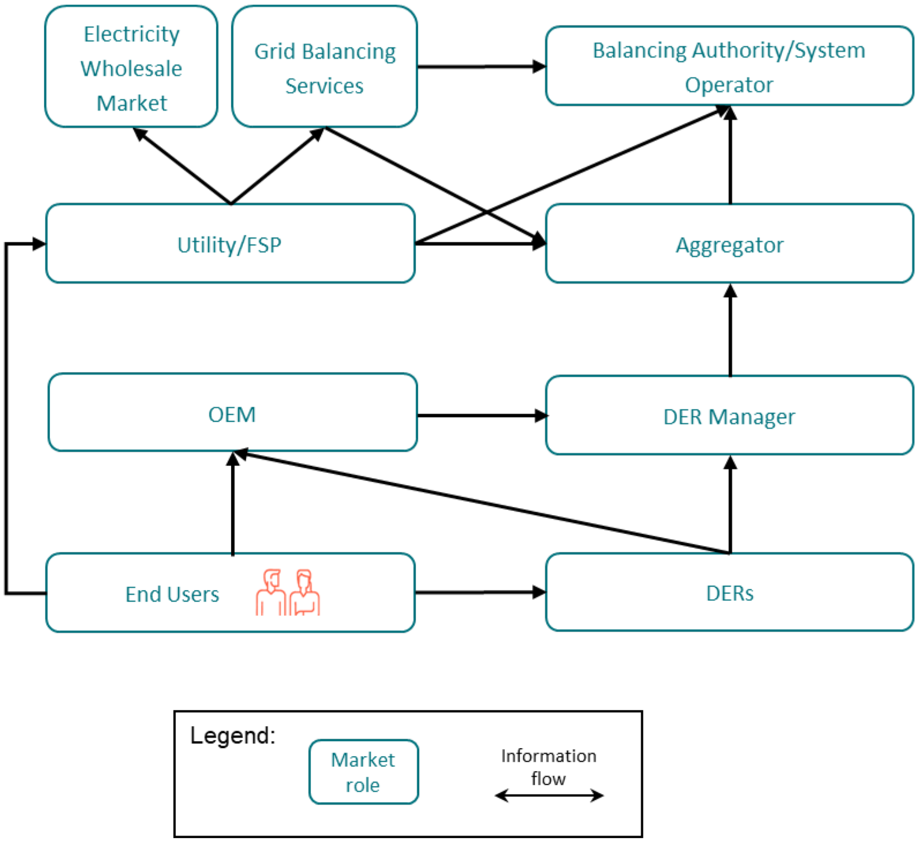

__Figure 3.__ Mercury DER Management Blueprint

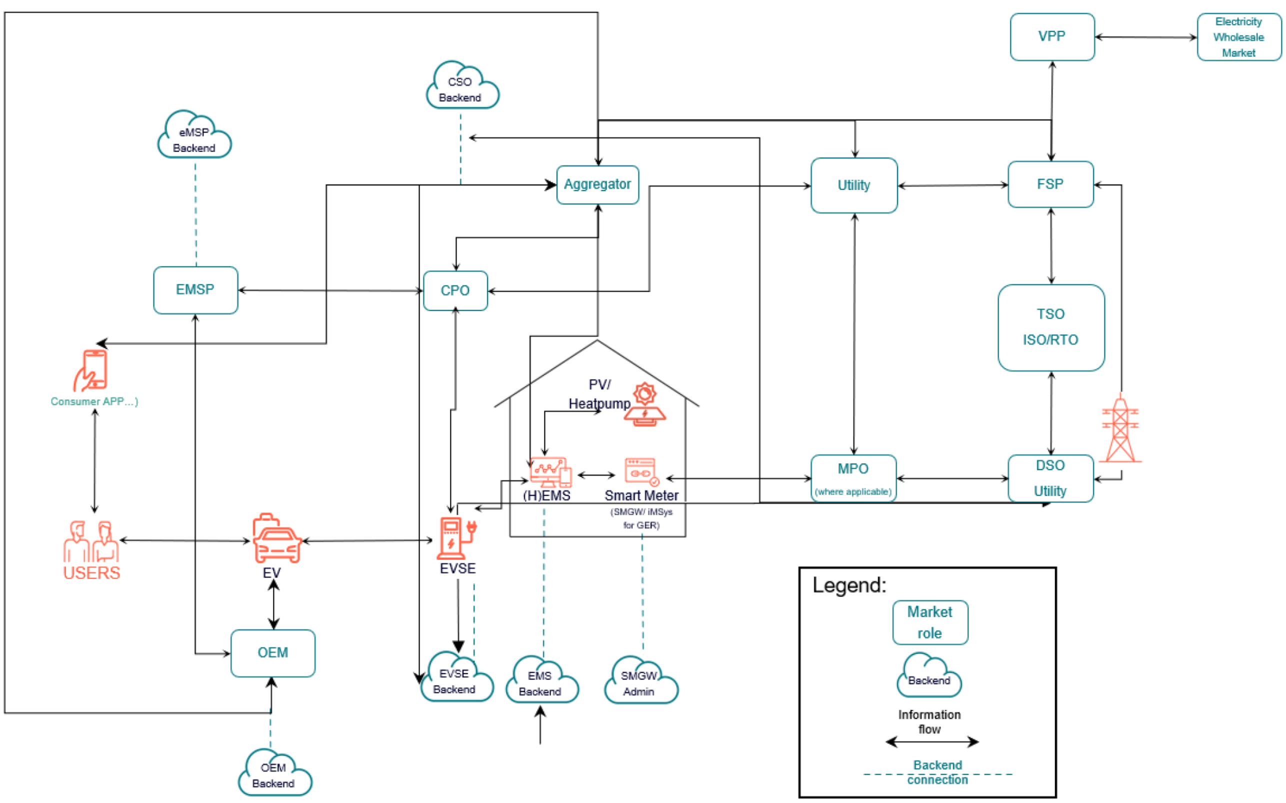

__Figure 4.__ EV Charging and Energy System Blueprint

5 ROADMAP

The Mercury initiative has gained momentum in a couple of months with over 60 stakeholders who have decided to work first on EV charging. We have finalized the first Mercury functional and performance specifications in five months and have applied them for now to one market leading communication protocol OCPP 1.6, after a comprehensive survey of EVSE open international protocols.

Our roadmap reflects the ambition of Mercury to enable simple use cases and unlock residential DER flexibility at scale:

- On EV Charging, the Technology Working Group will expand our current functional guidelines to:
  - For EVSEs:
    - OEMs Cloud Application Programming Interface (API), with fail-safe, coupled with an additional standard protocol for energy management, such as OpenADR 3.X, to unlock further compliance of OEMs devices and energy management programs in different geographies;
    - At least one HEMS/home IoT standard protocol, such as Matter 1.4 to open additional consumer use cases and local interaction with other energy devices;
    - Bidirectional charging based on 15118-20 and OCPP 2.1;
  - For Electric Vehicles:
    - Harmonization of the functional behavior and performance of the OEMs back-end APIs;
    - Bidirectional charging based on 15118-20;
- In parallel, new Working Groups will be created to create Functional Specifications for residential batteries (BESS), heat-pumps, PV inverters, electric water boilers, smart thermostats in a sequence to be approved by the Mercury members.

The Mercury consortium will pursue three goals to accelerate its rollout: (i) secure broader OEM buy-in, as most investment for implementation and certification lies with manufacturers; (ii) reach a consensus on cybersecurity and failsafe protocols through dedicated technical working groups; (iii) stay focused on the adoption of key communication protocols and extension to a wider array of DERs.

5.1 EV Charging

As a next step for EV Charging, OEMs are to be certified through Mercury compliance by leveraging their cloud APIs, in combination with OpenADR and/or OCPP, and at least one HEMS protocol. This approach ensures that devices can communicate effectively with both utility systems and in-home energy management platforms.

The next phase involves a deepening of security requirements. Integration with a future version of the protocol OpenADR and Matter—a new standard for smart home interoperability—is also envisaged, along with a broader HEMS integration.

A major technical milestone in this phase will be the incorporation of ISO 15118-20, the common standard supporting Vehicle-to-Everything (V2X) communication. This will allow EVs not only to receive power from the grid but also to inject back to the grid, enabling bidirectional energy flows and more dynamic grid participation.

Furthermore, Mercury aims to harmonize functional performance across EV APIs provided by the OEM back-end systems and ensure functional interoperability and performance alignment as per Mercury specifications. It includes defining how the vehicle communicates and responds to grid signals, its behavior under demand response events, and how it integrates into different types of DER managers.

For this EV Charging roadmap, a lab-based certification program is being established, starting with a few leading labs to validate compliance in relation with communication protocols defined in Mercury requirements. This will help reduce the certification burden on OEMs by standardizing testing procedures to become Mercury certified.

The roadmap also includes the development of a process for tracking the evolution of relevant standards and updating certification criteria accordingly. As the ecosystem matures, more labs will be added to the certification network, and the framework will adapt to the final V2X standards.

By standardizing the DER performance for grid services and energy markets eligibility, Mercury can contribute to the grid codes and markets harmonization initiatives undertaken by policy makers, regulators and the industry around the world. The Mercury consortium is open to such conversations to further align its performance requirements of the three certification tiers during the next dissemination phase of its first functional specifications.

5.2 Next Classes of DERs

Mercury will address different device categories as heat pumps and thermostats as well as Battery Energy Storage Systems (BESS) and smart inverters.

Similar to the EV charging track, this phase focuses on the organizational build-up necessary to support the inclusion of other DERs. This involves forming additional technical working groups, engaging relevant stakeholders (e.g., OEMs, utilities, regulators), and aligning the initial scoping and prioritization of devices. The main objective is to prepare the groundwork for standardizing other DER classes beyond EVSEs and EVs.

In the long term, Mercury plans to support resilience and microgrid operations, enabling DERs to function autonomously or in coordination with local energy systems during grid outages or peak demand events. This phase also includes a review of common frameworks in collaboration with other standards bodies and industry alliances such as Matter, OpenADR, IEEE, and TEIA, CSA, IEC, OCA, EEBUS, CharIn ensuring alignment and avoiding duplication of efforts.

The roadmap anticipates the inclusion of additional device types, such as air conditioners (AC), heat pump water heaters (HPWH), and other smart appliances. Part of this will be to define content generic to many or all devices such as price reception and response, and energy reporting.

6 DEFINITIONS

ACRONYM	DEFINITION
Aggregator	An entity that aggregates multiple small energy resources or flexible loads to act as a single energy management resource for the use of their flexibility by a service provider for grid services or energy market participation. Such an aggregator therefore combines multiple (consumer/producer) DER e.g. chargers, Electric Vehicles, heat-pumps, home batteries (BESS), PV inverters, Electric Boilers, smart thermostats.
Ancillary Services	Support services procured by a transmission system/network operator to maintain stable and reliable grid operation. These services ensure proper power flow, balance supply and demand, and help the system recover from disturbances.
Appliance	Product or system that consumes, stores, or generates electrical energy during use.
Balancing Authority/ Independent System Operator (ISO)/ Regional Transmission Organization (RTO)	US-based entities maintaining operating conditions of the high-voltage transmission grid and run regional wholesale electricity markets across multiple utility areas. ISOs/ RTOs balance supply and demand in real time and ensure open access to the network, performing functions similar to European TSOs in maintaining grid reliability.
BEMS (Building Energy Management System)	Energy management system for a commercial or industrial building that monitors and controls the building's energy use - Heating, Ventilation, and Air Conditioning (HVAC), lighting, EV charging, etc. - to optimize efficiency. A BEMS can respond to grid signals or tariffs in a similar way to a HEMS, but at a larger building scale.
CPO (Charge Point Operator)	Operator of EV charging infrastructure (recharging point or station, home chargers/ EVSEs) responsible for managing and maintaining charging hardware and providing charging services to EV users. In Europe, a CPO runs the charging station and may partner with eMSPs to offer services to drivers.
Demand Flexibility	Capability of electricity consumers to adjust their consumption (or on-site generation/ storage usage) in response to price signals or direct requests. By deviating from normal usage patterns when signaled, these demand-side resources help balance the grid and provide flexibility.

ACRONYM	DEFINITION
DERs	Decentralized generation, storage, or controllable load resources connected at the distribution level. These resources can be managed (are responsive) to provide energy or grid services, in contrast to large central power plants.
DER-M	Logical entity managing one or more DERs to provide services to the DER owner and enable demand flexibility services directly or via aggregators.
DSO / Distribution Network Operator (DNO)	Regulated entity that operates the regional/local electricity distribution network (low to medium voltage). The DSO is responsible for maintaining and developing the grid that delivers electricity to end-users and ensuring reliable supply at the distribution level. This is also a role of Utilities in the US
Demand Side Response (DSR)	Shifting or modulation of energy use by DERs based on external signals with consumer agreement.
EMSP (electromobility Service Provider)	It is also known as Mobility Service Provider (MSP). Company that provides EV drivers access to charging services, often via apps or subscriptions, handling user authentication, charging session management, and billing. In EU legislation, an EMSP is defined as a party selling recharging services to end users for a fee.
Energy Supplier/Utility	Company that supplies electricity to consumers (or to entities like CPOs), typically by purchasing or generating power and selling it through service contracts or tariffs. Energy suppliers ensure electricity delivery to their customers and often participate in wholesale markets to balance their supply with demand.
EVSE	Electric Vehicle Supply Equipment (Charger or Wallbox)
FSP	Entity that manages and offers aggregated flexible energy capacity to the grid or market. FSPs bundle customer loads, generation, or storage (DERs) and offer these combined resources as services (e.g. demand response) in energy markets, or grid balancing services, operating independently of traditional energy suppliers or producers. A FSP can a Balance Responsible Party (BRP) and/or a Balancing Service Provider (BSP): • A BRP is financially responsible for balancing off-take and feed-in through the allocation points in his/her portfolio for each imbalance settlement period. The BRP may also act as a trader on the market platforms, buying and later selling services to different customers. • A BSP offers balancing energy and/or balancing capacity to a Balancing Authority/TSO which procures balancing capacity and activates balancing energy from BSPs to balance out any unforeseen imbalances in the electricity grid.
HEMS (Home Energy Management System)	Energy management system for a home or residential setting, typically consisting of hardware and software that monitor and control home energy devices (appliances, HVAC, solar panels, EV chargers, etc.). A HEMS optimizes the household's energy use and can respond to external signals (such as utility demand-response events or time-of-use pricing, highly dynamic pricing, or capacity coordination), to adjust consumption, and export when applicable, for efficiency, cost savings and possibly revenue generation. It also supports compliance with grid connections for both import and export safety.
Local Congestion Management Services	Local Congestion Management refers to the process by which DSOs/DNOs address and mitigate congestion issues within the distribution network. This is achieved by utilizing flexibility services from distributed energy resources (DERs), such as demand response, energy storage, and distributed generation, to defer or avoid traditional network reinforcements.

ACRONYM	DEFINITION
Meter Point Operator (MPO)	Entity independent from a DSO which, depending on national smart meter regulation, can be responsible for the installation, commissioning, maintenance, and management of electricity or gas metering equipment at a specific supply point. The MPO ensures that metering devices accurately measure energy consumption or generation, comply with regulatory standards, and facilitate the reliable collection and transmission of energy data to relevant stakeholders, such as energy suppliers and grid operators.
OEM (Original Equipment Manufacturer)	Company that produces original products or equipment, which may be marketed under its own brand or used by other companies. In the Mercury context, OEM refers to vehicle manufacturers (car manufacturers) that design and build electric vehicles, or to manufacturers of EV Supply Equipment, home batteries (i.e., BESS), heat-pumps, PV inverters, smart thermostats.
TSO or Transmission Network Operator (TNO)	Operator maintaining and balancing high-voltage transmission grids.
Wholesale Market	Electricity market for bulk energy trading, where generators, suppliers, and traders buy and sell electricity in large quantities before it is sold to end consumers. Wholesale markets are often organized by market operators or exchanges (e.g. day-ahead and real-time markets run by ISOs/RTOs), with prices set by supply and demand bids across the grid.

7 REFERENCES

1. Mercury – EVSE Application Guide Document
   (URL: www.mercuryconsortium.com)

May 2025

Mercury Consortium

www.mercuryconsortium.com