Smart Chargers, Strong Grids:

How Electric Vehicle Chargers Can Support Grid Stability

2025

Elaway

SUSI PARTNERS

Introduction: Running a VPP with a Network of EV Chargers

As electric vehicles (EVs) become increasingly widespread, they offer more than just a low-emission mode of transportation. Their batteries, when aggregated, can serve as valuable assets to support grid stability and efficiency.

Elaway is a Nordic EV charging operator specialised in providing full-service charging solutions to housing communities. The company is leveraging its growing network of residential chargers and its market-leading position in the world's most mature EV market, Norway, to create a Virtual Power Plant (VPP) that can offer flexibility services to grid operators. Enabled by its residential charging model, which provides greater visibility and predictability of charging behaviour compared to other models of charging (e.g. fast charging), Elaway is running a pilot project focused on the Norwegian and Swedish flexibility markets. By connecting an existing asset base at minimal cost to provide essential grid services, Elaway's VPP helps avoid costly investments into grid upgrades while creating a shared profit for the company and its customers.

Tangible Market Opportunities

Initially, Elaway is focusing on uni-directional flexibility, i.e. delaying or pausing charging sessions based on market signals. This enables participation in:

- **Load shifting markets:** shifting consumption away from peak demand hours.
- **Frequency regulation markets:** providing frequency response by reducing load within seconds or minutes.

Figure 1: Illustration of a VPP with EV Chargers

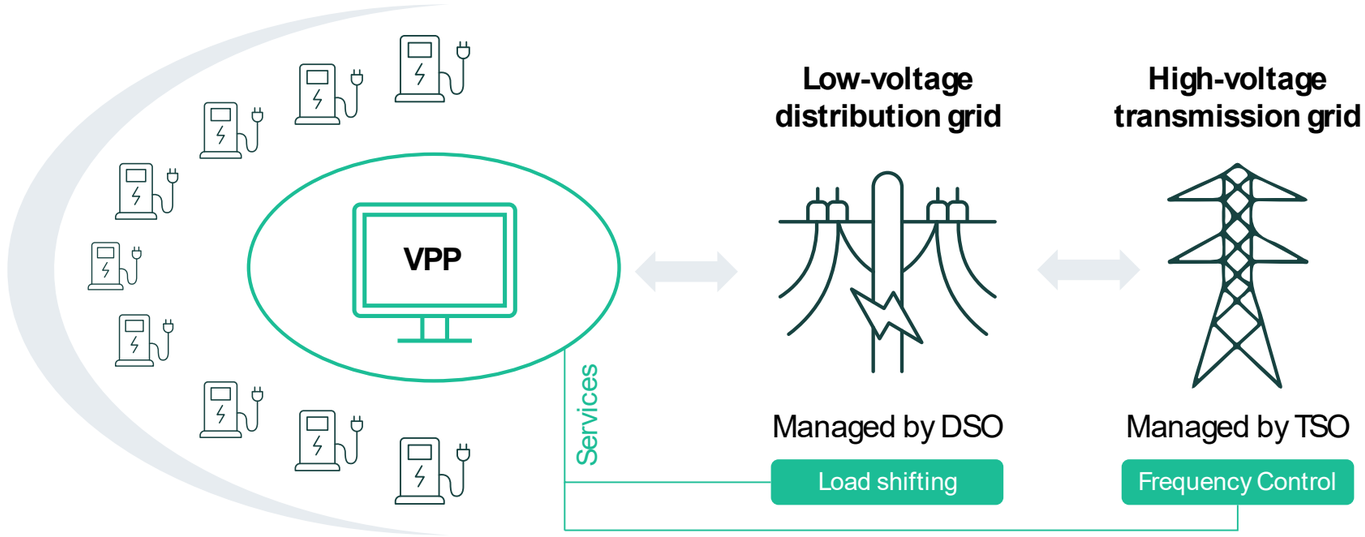

Figure 1: In a VPP configuration, Elaway treats its network of thousands of residential EV chargers as a single, distributed energy resource.

KEY TERMS EXPLAINED

Electrical Load

In power systems, load refers to electricity demand, i.e. the amount of power consumed by devices, buildings, or entire grids at any given time. It's typically measured in kilowatts (kW) or megawatts (MW). For Elaway, the load is the collective power consumption of all the EV chargers connected to its network. E.g. if 1,000 chargers are active and each charger draws 7 kW, the total load would be 7,000 kW or 7 MW.

Distribution System Operator (DSO)

DSOs manage the medium- and low-voltage grids, which cover local neighbourhoods, towns, and cities. A DSO's main priority is to keep voltage levels within safe operating ranges to avoid localised congestion during peak demand periods, which could damage grid infrastructure and power-consuming appliances.

Transmission System Operator (TSO)

TSOs manage the high-voltage transmission grid, which covers entire nations and cross-border transmission systems. A TSO's main priority is to maintain the system frequency (50 Hz in Europe) by balancing power supply and demand at all times.

Load Shifting (DSO)

Load shifting means moving electricity consumption from one time period to another, typically by several hours.

To illustrate: Rather than charging right upon the EV being plugged in when people get home from work in the evening during peak demand hours, the VPP can direct its fleet of chargers to delay charging to off-peak hours, e.g. between 10pm and 4am when demand is much lower, as illustrated in Figure 2.

Load shifting services are sought primarily by DSOs whose goal is to smoothen the load curve to avoid strain on the grid infrastructure during peak demand periods. By procuring load shifting services, they can avoid grid congestion, keep voltage levels within safe operating ranges, and prevent cables, transformers, and substations from being overloaded.

Remuneration

DSO load shifting markets usually rely on bilaterally negotiated seasonal contracts or semi-structured tenders. Some DSOs are testing auction-based procurement, but volumes and standardisation are generally still low. In Norway, the DSOs offer long-term availability contracts with additional compensation for activation. Given the low entry barriers, these have been identified as a good entry point for Elaway to start monetising its flexibility capabilities.

Aside from trading markets, load shifting can achieve significant cost savings for the customer as charging sessions are shifted to hours of lower demand and hence lower electricity prices.

Figure 2: Illustration of EV VPP Effect on Load Curve

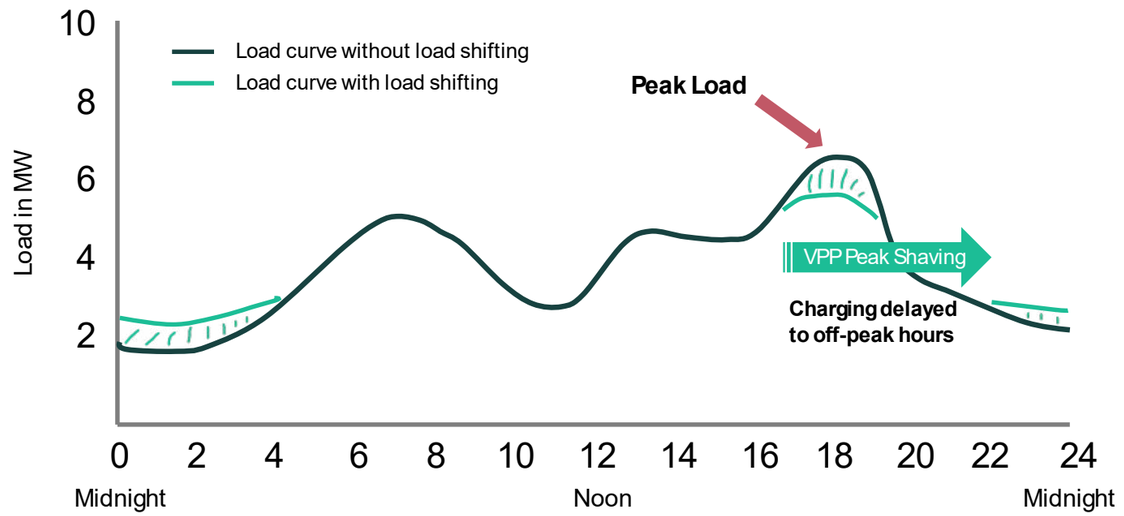

Figure 3: Illustrative Calculation - Revenue Potential per Day of Portfolio of 10,000 drivers (1.3kW per driver) for Load Shifting Services*

Max volume: Total installed capacity available in the VPP	13 MW
Flex factor: Expected share of the total capacity that is usable for flexibility	30%
Hours with reservation per day (e.g. morning and evening peaks)	4h/day
Activation rate: % of reservations that will get activated	3%
Payment per MWh reserved	€20/MWh
Payment per MWh activated	€800/MWh

Availability Payment = 13 MW x 30% availability x 4 h/day* x 97% inactive x €20 /MWh = €303

Activation Payment = 13 MW x 30% availability x 4 h/day* x 3% activated x €800 /MWh = €374

Total Revenue Potential per Month = (Availability + Activation Payment) x 30d = €20,310

30-40% revenue increase potential

Assuming Elaway's monthly subscription fee and corresponding subscription revenues for a portfolio of 10,000 drivers, the additional revenue generated through the provision of load shifting services represents a revenue increase potential of **30-40%** (to be shared between Elaway and its customers).

* Using illustrative but realistic availability, activation, and price assumptions (based on pricing in Norwegian DSO contracts as of July 2025)

Frequency Regulation (TSO)

Through frequency response markets, a TSO can request reserved market capacity to adjust production or consumption very quickly to restore the system frequency.

A TSO's primary concern is to always maintain a balance between supply and demand since imbalances lead to either rises (more supply than demand) or drops (more demand than supply) in the system frequency (50 Hz in Europe), which in turn can lead to grid failures and blackouts.

For a TSO to maintain the grid frequency stable, it relies on market participants that can respond very fast, i.e. within milliseconds to minutes, to a supply-and-demand imbalance by either adjusting the amount of electricity they supply to the grid or by adjusting the amount they draw from the grid.

To illustrate: Should the grid frequency drop due to electricity demand outweighing supply, Elaway's VPP could reduce or pause charging activity across its network to reduce demand within seconds and thereby help restore balance to the grid.

While pausing and resuming charging activity is technologically simple, implementing advanced functions such as force-charging to absorb excess supply or discharging via Vehicle-to-Grid (V2G) to support the grid during shortages is significantly more complex. Since participation in many frequency control markets requires such capabilities, Elaway is pursuing technological upgrades across its charging network in partnership with its technology suppliers to fully exploit its flexibility potential.

Remuneration

Typically, market participants can bid into a daily capacity auction indicating how much capacity they can offer and at what price. TSOs will then accept the cheapest combination of offers to cover the required system needs. As is the case with load shifting services, accepted bids will usually be remunerated through a combination of availability and activation payments (see illustrative example on page 4).

Figure 4: Overview of Frequency Regulation Services

Different layers of frequency response work sequentially and in coordination to stabilise the power grid when the system frequency deviates from its nominal value. Each reserve type kicks in at a different time scale, with overlapping roles to ensure both fast response and sustained correction. EV VPPs currently cannot participate in fast frequency reserve (FFR) markets due to EV hardware limitations, but markets demanding response times of several seconds and more can be accessed with advanced metering capabilities, comprehensive IT integration, and sophisticated algorithms. These markets are highly liquid and offer greater trading volumes than local load shifting markets.

Notes: FFR = Fast Frequency Reserve; FCR-D = Frequency Containment Reserve - Disturbance; FCR-N = Frequency Containment Reserve - Normal; aFRR = automatic Frequency Restoration Reserve; mFRR = manual Frequency Restoration Reserve

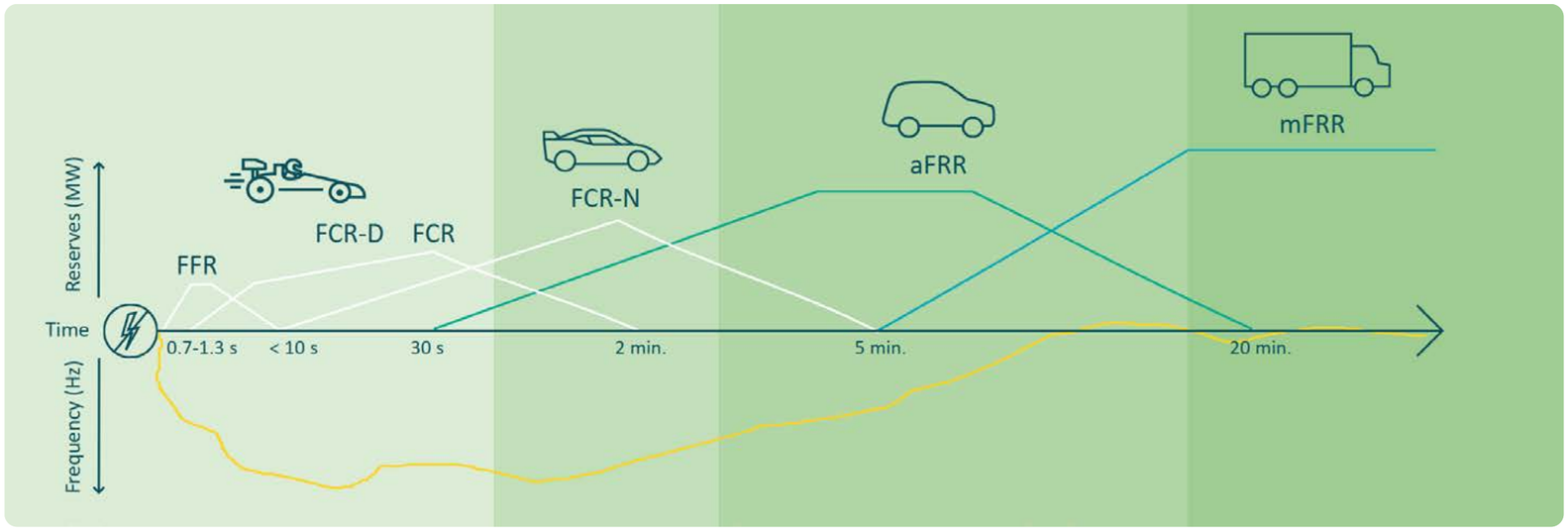

Figure 5: Illustrative Calculation - Revenue Potential per Day of Portfolio of 10,000 drivers (1.3kW per driver) for Frequency Regulation Services*

Max volume: Total installed capacity available in the VPP	13 MW
Flex factor: Expected share of the total capacity that is usable for flexibility	30%
Hours with reservation per day (e.g. morning and evening peaks)	12h/day
Activation rate: % of reservations that will get activated	10%
Payment per MWh reserved	€18/MWh
Payment per MWh activated	€200/MWh

Availability Payment = 13 MW x 30% availability x 12 h/day* x 90% inactive x €18 /MWh = €758

Activation Payment = 13 MW x 30% availability x 12 h/day* x 10% activation x €200 /MWh = €936

Total Revenue Potential per Month = (Availability + Activation Payment) x 30d = €50,820

75-90% revenue increase potential

Assuming Elaway's monthly subscription fee and corresponding subscription revenues for a portfolio of 10,000 drivers, the additional revenue generated through the provision of frequency regulation services represents a revenue increase potential of **75-90%** (to be shared between Elaway and its customers).

Plico: VPP with Residential Solar PV and Battery Systems in Australia

SUSI Partners' equity portfolio also includes Plico, an Australian provider of residential solar and battery systems. Plico was an early mover in unlocking additional value by offering customers the opportunity to connect their Plico system to their VPP.

Plico customers' systems not only work in tandem to supply stored electricity to the grid in times of peak demand but also manage oversupply in times of high levels of solar supply and low demand by switching off production and charging batteries from the grid.

As of July 2025, the Plico VPP has supported the WA grid for three summers, with its first successful activations occurring in January and February 2023. In 2024, it was activated more than 10 times. In 2025, it was activated to prevent 13 grid emergencies with an estimated 25 MWh exported to the grid. Plico also provides VPP contracted services for certain suburbs in Perth, that are known hotspots for grid instability.

As part of SUSI's dedicated energy transition infrastructure portfolio, platforms like Plico, Elaway, and other innovative clean energy companies regularly exchange insights on operating a VPP through SUSI-organised knowledge-sharing events. Plico's experience in managing a VPP has directly supported Elaway in the successful launch of their own.

* Using illustrative but realistic availability, activation, and price assumptions (based on historical pricing and activation rates for mFRR in 2024)

Conclusion

By using DSO load shifting markets as an entry point, Elaway is laying the groundwork to participate in flexibility markets at scale.

For its analysis, Elaway assessed all available flexibility products across Norway and Sweden. Putting theory to practice, the company has successfully started selling load shifting services to Norway's DSOs. Thanks to low technical and regulatory requirements, this market has been identified as a logical first step to build know-how and pilot a commercial concept at scale.

The next step for Elaway will be to start offering frequency regulation services on the more mature and liquid TSO markets. Elaway is therefore working closely with its technology suppliers to meet the technical and regulatory requirements of participating in frequency reserve markets. This will allow the company to optimise returns by selecting between DSO and TSO markets based on the highest willingness to pay in any given trading interval.

Elaway's flexibility project positions the company as a first-moving charging operator in the Nordic flexibility markets. When implemented at scale, the concept will unlock additional revenue streams, deliver tangible value to the company's customers, and support grid operators in reliably and affordably maintaining grid stability.

Table 1: Overview of Tangible Revenue Opportunities for EV VPP

Revenue Source	Distribution System Operator (DSO)	Transmission System Operator (TSO)
Responsibility	DSOs manage the medium- and low-voltage grid (local neighbourhoods, towns, cities).	TSOs manage the high-voltage transmission grid (national or cross-border).
Focus	• Ensure cables, transformers, and substations are not overloaded • Keep voltage levels within safe operating ranges • Avoid localised congestion during peak demand periods	• Keep generation and consumption balanced at all times • Maintain system frequency (50 Hz in Europe) • Handle power flows across regions • Prevent cascading failures that lead to blackouts
Problem Faced	Local grid congestion during peak demand periods	Real-time imbalance between supply and demand leading to deviation from system frequency
Solution / Services Required	**Local load shifting / peak shaving: Slow response (typically hours)**	**Frequency regulation: Fast response (milliseconds to minutes)**
Market Characteristics	• Emerging • Lower volumes • Localised	• Mature • High liquidity • National, cross-border
Procurement Style	Seasonal, bilateral, or pilot auctions	Standardised daily/hourly auctions
Complexity for VPP	Low entry barriers	Higher technical and regulatory requirements
Revenue Potential	While the illustrative examples provided in Figure 3 and Figure 5 are based on realistic assumptions, revenue potentials from DSO and TSO markets cannot simply be summed, as the VPP can only trade the assets in one market at a time. An integrated trading strategy aims to maximise revenue by selecting the market with the highest willingness to pay in any given trading interval.	

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