SET Ventures

Virtual Power Plant

A SET Ventures report | July 2025



A decarbonised energy system is a connected system



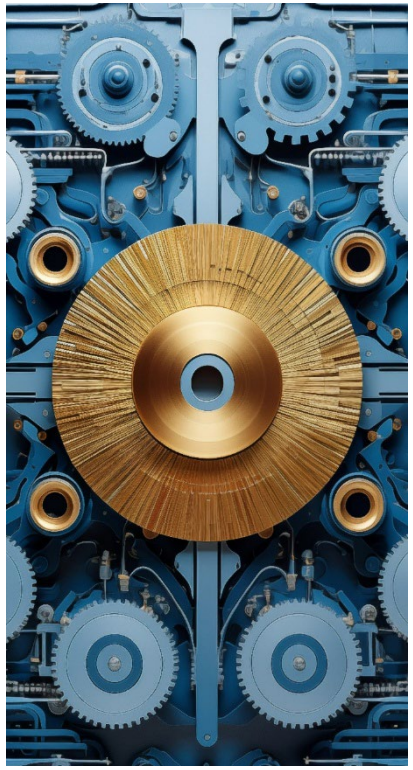
Distributed energy systems

Distributed generation and distribution of energy



Digital utilities

Innovations related to energy retail



AI & enabling technologies

Deep tech beneficial to modern energy services



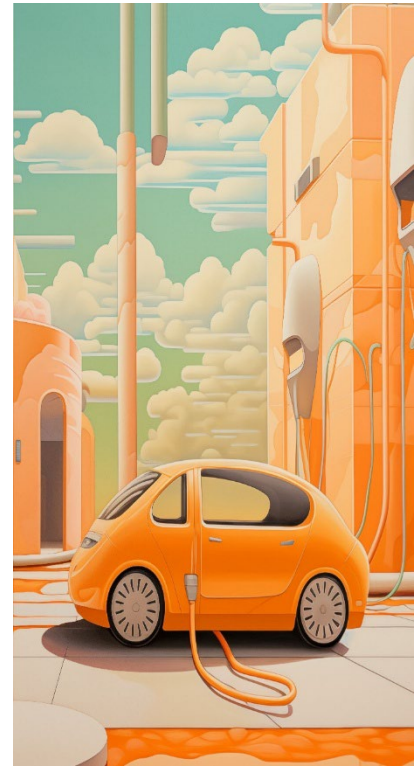
Industrial energy management

Optimising energy use in industry



Built environment

Smart building technologies



Mobility & transport

Electrification of vehicles and other transports

Virtual Power Plants (VPPs) are part of distributed energy systems

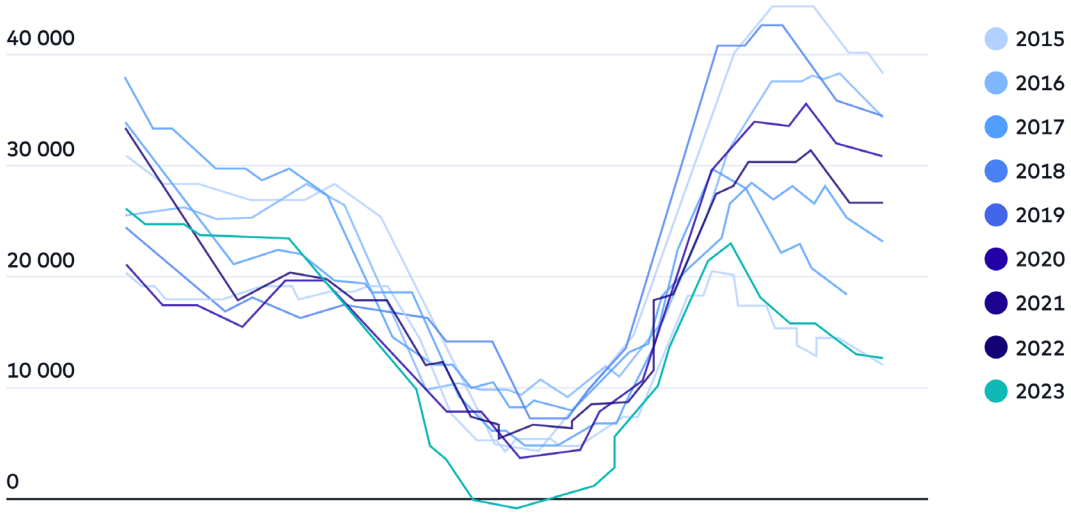
A decarbonised energy system is a connected energy system — and VPPs are the digital backbone that makes this possible. By aggregating and controlling distributed assets across homes, buildings, industry and mobility, VPPs unlock system-wide flexibility, reduce grid stress and enable clean electrification. They are essential to orchestrating the decentralised energy system we invest in.



The shift to distributed energy requires Virtual Power Plants

As renewable penetration accelerates, the duck curve is deepening into a canyon — highlighting the growing mismatch between generation/demand. Europe's flexibility needs are projected to rise sharply, reaching hundreds of TWh by 2050. Meeting this demand requires scalable, software-based solutions like Virtual Power Plants that orchestrate distributed assets in real time.

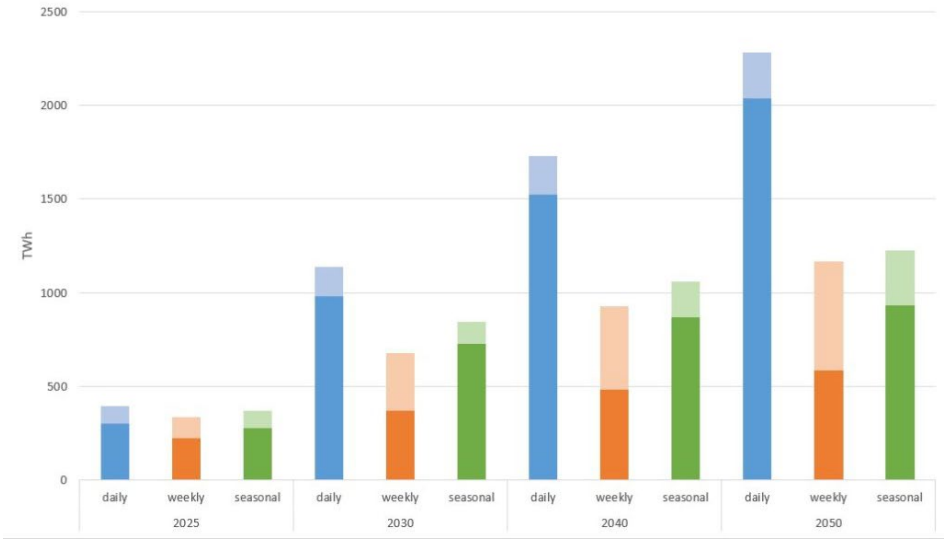
"Duck curve" becoming a "canyon"



Minimum net load day each year in Germany 2015-2023 (MW)

With further rise of DERs, the duck curve deepens and widens into a "canyon" with steep drops in net demand during the day but sharp ramps in the evening when solar fades but demand rises.

Short-term flex on the rise



Evolution of flexibility needs across different timeframes in Europe 2025-2050 (TWh)

Ability to respond to power supply and demand fluctuations on a short-term basis, potentially even within seconds (e.g., FCR), is becoming more and more important going forward.

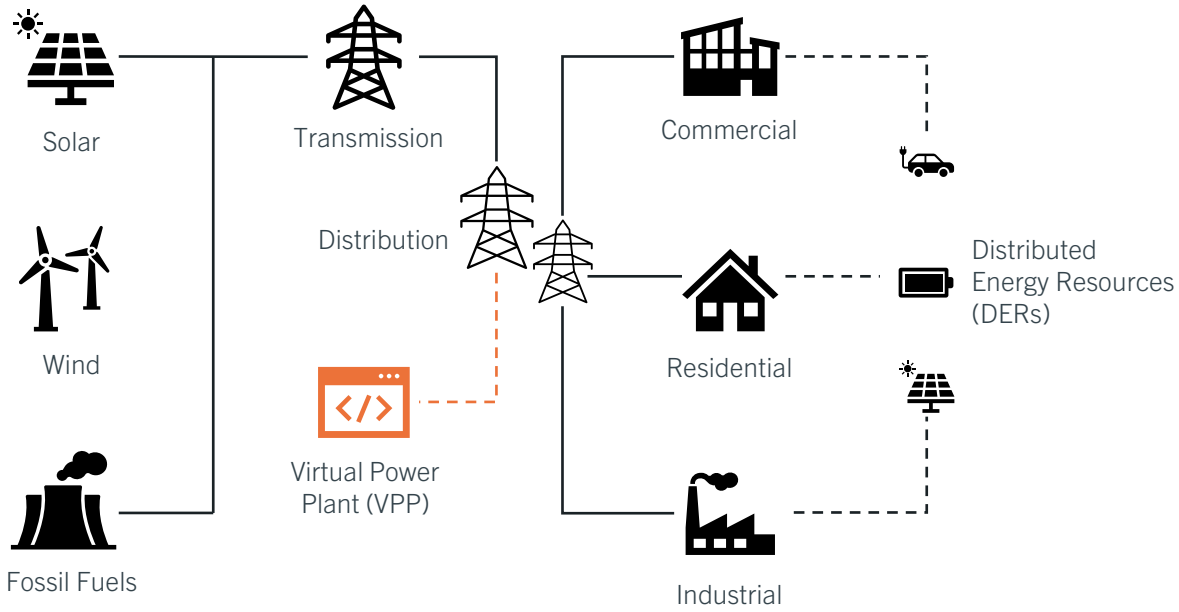
Sources: gridX (2024), euroelectric (2025)

What is a Virtual Power Plant?

Virtual Power Plants (VPPs) are systems that coordinate and aggregate distributed energy resources (DERs)—such as solar panels, batteries, electric vehicles (EVs), and other controllable loads—so they can operate collectively as a single, flexible entity in energy markets.

Step by step, a VPP:

- Consists of a network of DERs, which may be homogeneous (e.g., a fleet of EVs) or a diverse mix (e.g., solar panels, batteries, EVs, wind turbines, HVAC systems).
- Controls and optimises the operation of these resources, adjusting electricity consumption or production up or down via centralised management to provide grid flexibility.
- Aggregates the available flexibility from individual assets into a single entity that meets the requirements for participation in energy markets, such as capacity thresholds for trading



Advantages of VPPs

Scalable orchestration without large capex and complex integrations compared to large-scale utility-scale applications.

Generating new revenue streams for asset owners (e.g., FCR, aFRR, intraday) and optimizing self-consumption.

Unlocking underused flex in DER (batteries, EVs, HVAC, etc.) and reducing reliance on peaker plants & grid reinforcement.

Sources: Dakota Electric Association (2024)

Typical value chain steps covered by a VPP

Traditional VPPs typically focus on specific steps in the following value chain, with asset or customer acquisition and market integration and trading often falling outside their core scope.



Value mechanism

Asset or Customer Acquisition	Asset Integration & Connectivity	Asset Optimization & Dispatch	Aggregation	Market Integration	Market Trading
Accessing customer through installation of DERs or offering of service (e.g., dynamic pricing) Typically owning customer relationship	Integrating with DER functionality and managing hardware interface and communications to allow for optimization capability	Optimising asset & dispatching flex based on market/network signals and DER information	Aggregating flex across a portfolio of DERs by grouping assets acc. to customer/DER type/capacity to meet market requirements (e.g., min capacity)	Providing aggregators and service providers with access to wholesale/ancillary services markets through integrations	Trading the aggregated flex through various products (value stacking) in the market

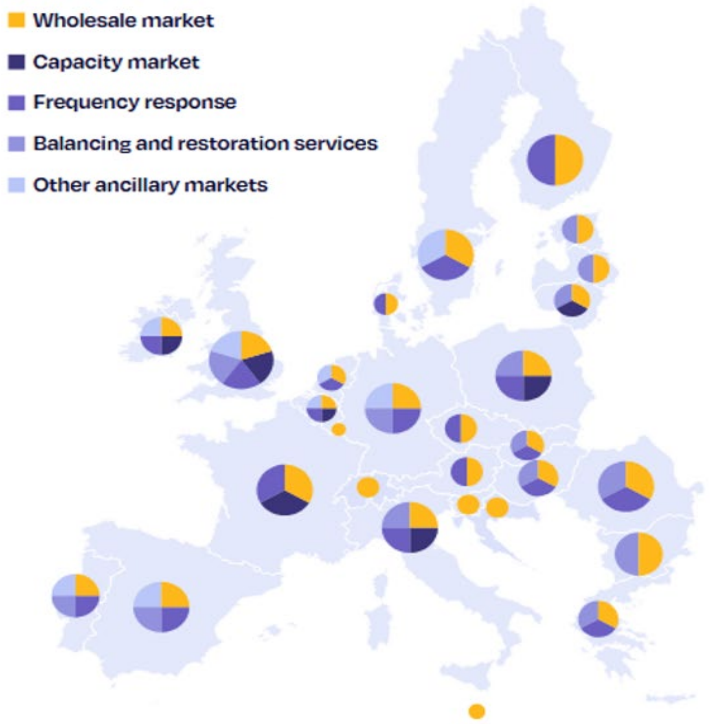
Stakeholders

Asset or Customer Acquisition	Asset Integration & Connectivity	Asset Optimization & Dispatch	Aggregation	Market Integration	Market Trading
• OEM • Installer • Retailer	• Data & connectivity provider	• EMS provider • Utility • Network operator	• Aggregator	• Data & connectivity provider	• Trader • Aggregator

Markets differ substantially in terms maturity across Europe

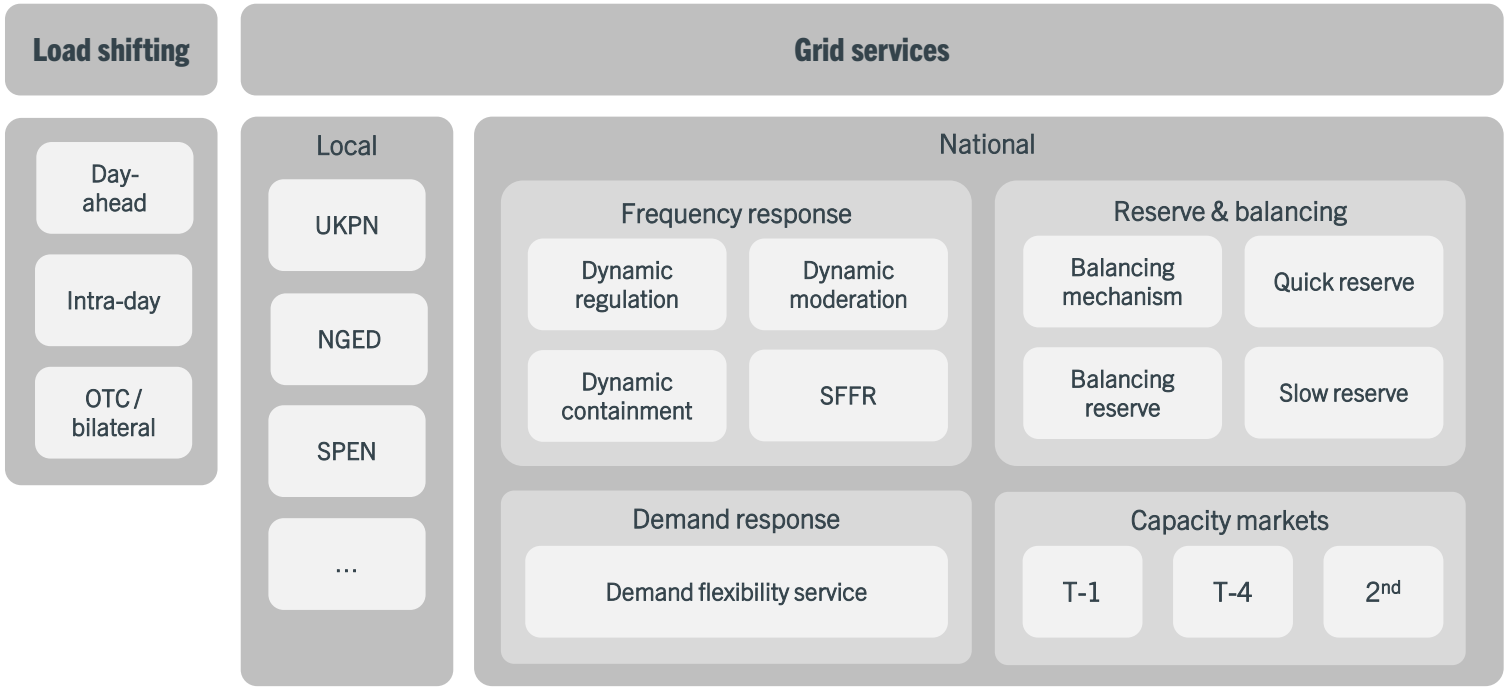
More flexibility revenue streams have opened across Europe. Nevertheless, most grid services are still not remunerated in most countries. The UK market is the most advanced in terms of remuneration mechanisms for flexibility services and trading.

Different maturity across Europe



Key revenue streams for flexible capacity per EU country (2025)

The UK market is leading in terms of monetisation options



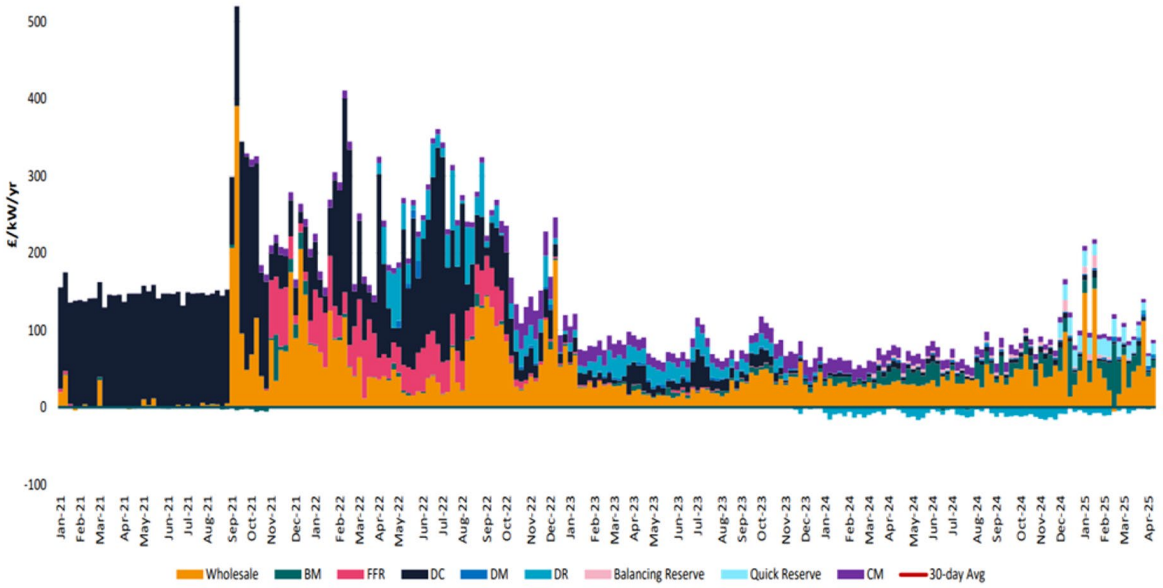
Revenue streams for flexible capacity in the UK (2025)

Sources: SolarPower Europe (2025), Axle Energy (2025)

Revenue stacking will remain, but €/MW will decrease

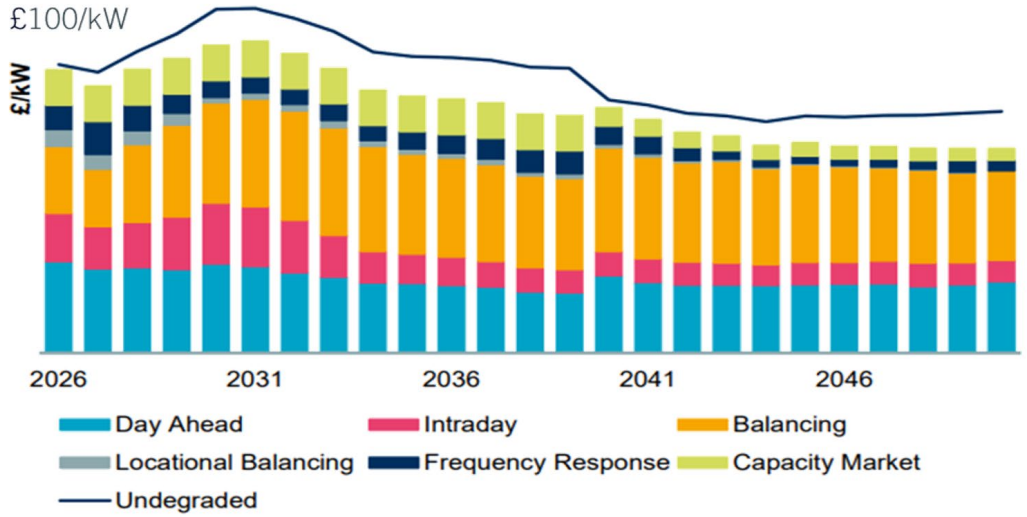
Opportunities in early markets clearly exist with revenue per kW surpassing €500/kW in many countries. However, over time, revenues decline as more participants enter newly established markets causing revenues to converge towards €80-100/kW.

Flex markets remain volatile with early markets seeing prices of up to €500/kW



2h BESS index – Revenue stack per kW in the UK 2021- 2025 Q1

Flexibility prices decline over time, with the structure of the revenue stack expected to shift going forward

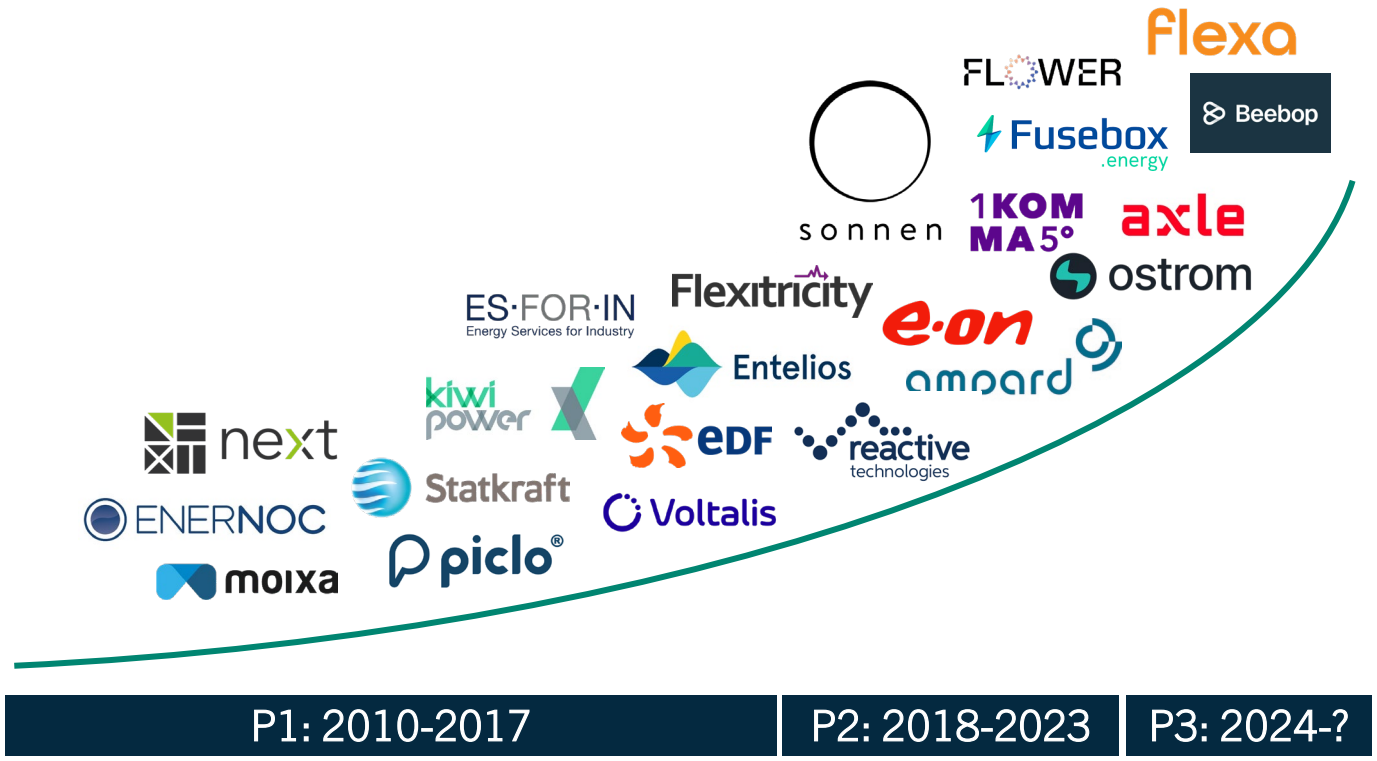


2h BESS index – Revenue stack forecast per kW in the UK until 2050

Sources: LCP Delta (2025)

VPPs may be entering a new phase

At SET Ventures, we were early backers of *sonnen*, which launched one of the first residential VPPs in 2018 by leveraging its battery fleet. Many early VPPs struggled to scale due to limited access to flexible assets, narrow revenue streams, and technical integration hurdles. While some challenges remain, the market is now entering a new phase of growth.



Phase 1: Early days of VPP

Predominately large loads, batteries and grid services, FCR-only.

Phase 2: Emerging adoption of VPP

Decentralised, controllable assets (EVs, HPs, HVAC etc.) and market stacking (e.g., FCR + aFRR + intraday).

Phase 3: Mass deployment of VPP

Compounding of deployed, flexible assets & maturation of monetisation mechanism (f.e. capacity, balancing + restoration & others).

Sources: Insta Associates (2020)

Historically, VPP exits have been frequent but modest

To get to meaningful scale that allows for a successful exit of >250m EUR, we believe a company will have to reach 30m EUR in annual/revenues (and is still growing fast at exit), which represents 1% of the total EU market in 2030 (assuming 8.7x EV/revenue multiple).

Company	Buyer	Company Value Prop	Exit value*
limejump	Shell	Integrated digital energy platform providing flexible assets with access to balancing services.	**N/A < 100m**
Flexitricity	quinbrook infrastructure PARTNERS	Advanced modelling and aggregation of flexible assets including DERs and gas peaking plants.	**€12M**
next	Shell	Large-scale VPP operator and power trader on various European energy exchanges (e.g., EPEX and EEX).	**€177M**
AutoGrid	uplight	Solution that unlocks grid capacity by activating customers to generate, shift, and save energy.	**€52M**
kapacity.io	EnergyHub	Heat pump optimization and demand response solution, evolving into a virtual power plant platform.	**N/A < 100m**

VPP exits since 2018

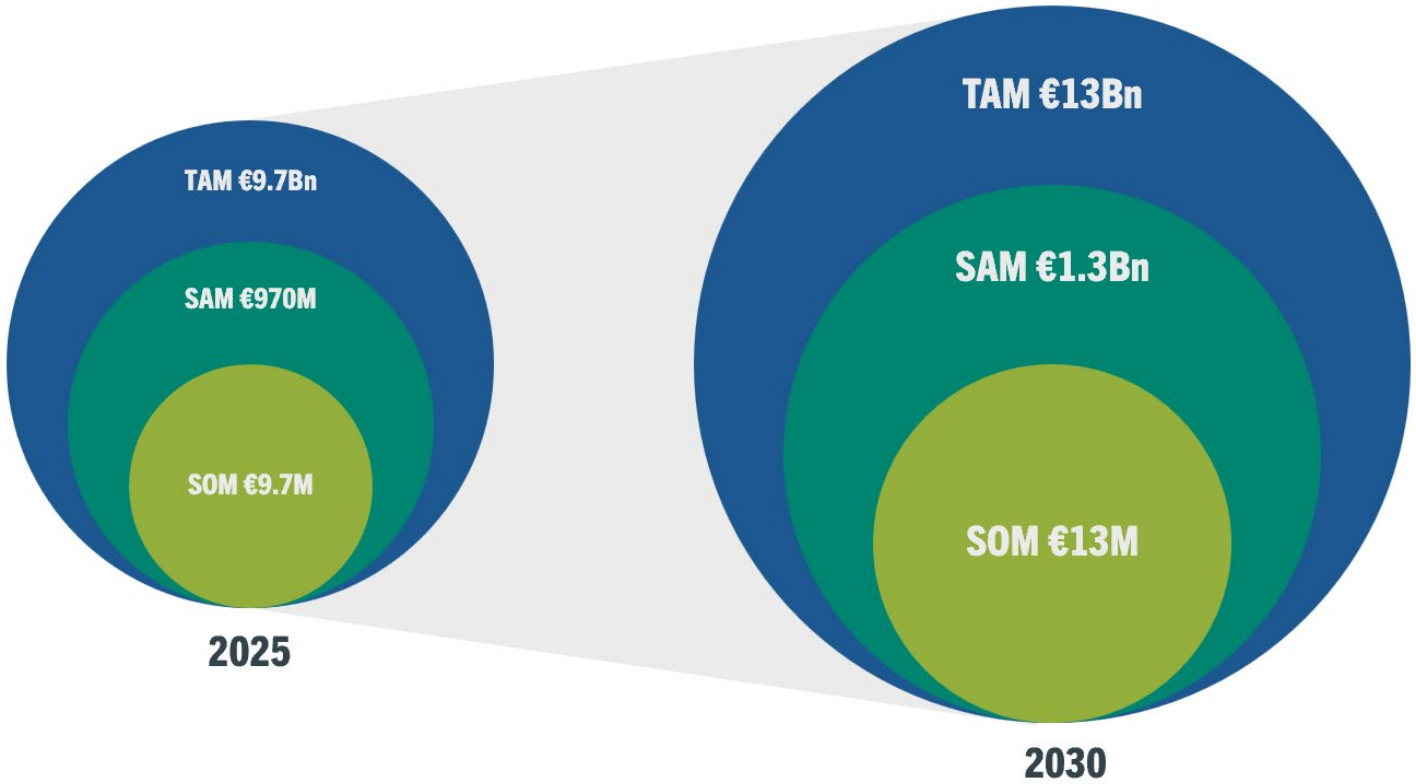
- Historically, exits in the VPP sector have been frequent but modest (typically below €100M), with known EV/R multiples ranging from 1.2x to 12.2x.
- This mainly had to do with the limited capacity for aggregation and a lack of mature markets and products to monetise flexibility.
- While market conditions have improved the landscape has also become increasingly crowded (over 70 VPP startups in EU).

* Note: Exit data from Pitchbook.

Limited VPP market size makes it difficult to achieve scale

Our analysis estimates the total flexibility value potential in the residential and C&I sector combined is at ca. €9.7Bn, based on the current deployment of DERs across Europe. Given that VPPs typically capture around 10% of traded flexibility value, the current addressable market for VPPs in Europe is estimated to be under €1Bn.

Market sizing for VPP in Europe



2025: Current market size limited

Given current market conditions, revenue potential is still modest — under €10M with a 10% take rate and 1% market share.

2030: Market size remains limited

While residential and C&I asset capacity is set to grow, we expect flexibility value to converge around €100k/MW — capping the total addressable market at €13B by 2030.

Note: Assuming EVs, heat pumps, batteries, and PV systems (only residential & C&I)

VPP models considered in scope of this deep dive

We see two VPP models for residential and C&I: basic *Aggregators* that pool DERs for flexibility services, and more advanced *End-to-end VPPs* that combine asset control with full market integration and direct trading in a unified platform.



Aggregator VPP	✓	✓	✓		
End-to-End VPP	✓	✓	✓	✓	✓

Aggregator VPP: Solution that connects with DERs, managing hardware interfaces and communications to enable flexible, coordinated control. Facilitates aggregation of DERs for dispatch in response to energy market signals or grid needs. Not involved in actual market trading (no BRP).

E2E VPP: A further integrated version of the aggregator model that includes also seamless market participation capabilities. It provides an all-in-one solution for operating a VPP, encompassing aggregation, market integration, and potentially direct market trading within a single solution.

An active startup ecosystem with 70 EU startups

Asset or Customer Acquisition → **Asset Integration & Connectivity** → **Asset Optimization & Dispatch** → **Aggregation** → **Market Integration** → **Market Trading**

Asset-led models

1KOMMA5° · SPOT MY ENERGY · Enpal · OTOVO · capture energy · FLOWER · ELVY

Market access

piclo · NODES · ELECTRON

Retail-led models

ostrom · tibber · greenely · amber · octopus energy

Core of VPP

Aggregator VPP

Fusebox .energy · Beebop · MARKEDROID · sympower · bamboo energy · Sourceful Energy · Flexa · wattz · FLEXTHOR · ELECTRYONE AI · Levl · FEVER · pearlstone · next

E2E VPP

axle · Powernaut · leap · SUR VOLTAGE · Tilt · LIFEPOWR · SYNERGI · GridBeyond formerly Endeco Technologies · Qurrent · CyberGrid · podero · Gridio · FRACTAL ENERGY · EMULATE

DER connectivity

FlatPeak · Enode

Market access

Engrate

Traders

ES·FOR·IN Energy Services for Industry · DEXTER · Entrix · enspired

Our thesis for the VPP sector

- Market: The VPP market in Europe is still small (<€1B today) and crowded, with meaningful exits requiring rapid landgrab of hundreds of thousands of DER assets.
- Capabilities: Winning players must aggregate diverse loads (batteries, heat pumps, etc.) across multiple countries and markets with high reliability and technical replicability.
- Business Model: SaaS-style fixed fees are preferred over flex revenue share models, which are low-margin, confusing to customers, and unpredictable.
- Go-to-Market: Scale depends on acquiring asset capacity, not end-customers, through OEMs and installers with large installed bases of flexible assets.
- Solution: VPPs focused on scalable value chain steps (connectivity, dispatch, aggregation) are best positioned, avoiding country-specific build-outs and acting as the flex “brain” for incumbents.

If you are building a solution in this space, we want to hear from you



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