European Association for Storage of Energy

Business Case Taxonomy of Behind-the-Meter Battery Energy Storage Systems in Europe

Stand Alone and Co-Located BESS Solutions

Brussels, September 2023

Introduction

Behind-the-meter (BtM) Battery Energy Storage Systems (BESS) have proven a reliable technology able to provide several service while achieving savings and revenues. As the European Union (EU) strives to achieve its ambitious climate goals and transition towards decarbonised energy, BtM BESS enables the efficient integration of renewable energy at the residential and commercial & industrial (C&I) levels, as well as the provision of innovative services in peak-shaving and load management. Co-locating BESS with other technologies is possible, e.g. with solar photovoltaics (PV) as this allows for self-consumption and makes way for a more responsive and proactive role of consumers in the energy system. Beyond BESS, other BtM energy storage solutions such as Thermal Energy Storage provide consumers with decarbonisation solutions when co-located with renewable technologies. To effectively harness the potential of BtM energy storage, technology neutrality is an essential prerequisite since it ensures that different consumers have access to the solutions most tailored to their needs.

As BtM BESS deployment continues to expand, a clear regulatory framework is critical to achieve the technology's full potential, in particular regarding its diverse portfolio of grid services. This policy paper focuses on the business use cases of BtM BESS and BtM BESS co-located with solar PV (BtM BESS+PV) and provides policy recommendations for supporting their deployment. The positive contribution of BtM BESS+PV technology to the EU's energy and wider climate goals is briefly discussed through the lenses of the EU Taxonomy in the following chapter.

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1. Context

In recent years, Europe has witnessed significant growth in BtM BESS deployment, albeit with pronounced disparities among Member States. Notably, in Germany, the installation of BtM capacity surpasses that of front-of-the-meter (FtM) solutions, as depicted in Figure 1. Conversely, in Ireland, the deployment is very different, with nearly all newly added storage capacity being comprised of front-of-the-meter solutions, as illustrated in Figure 2.

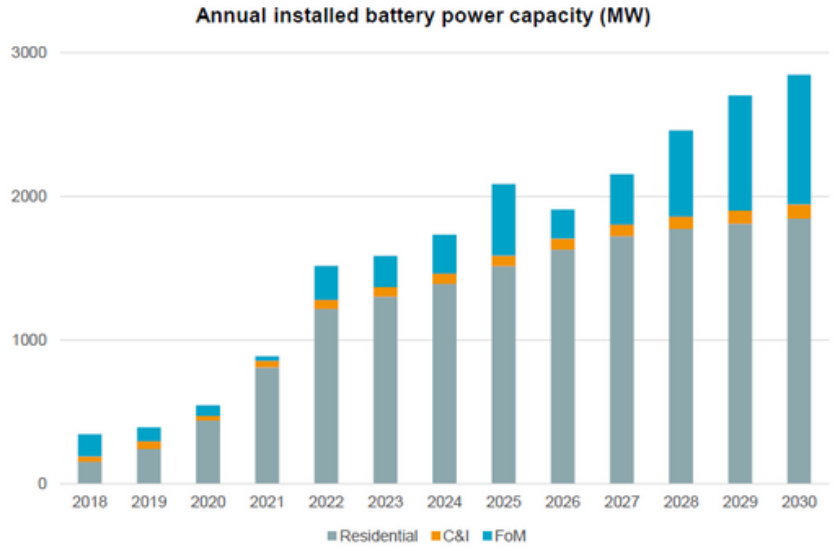


Figure 1: Annual Installed battery power capacity (MW) in Germany, EMMES 7, EASE & LCP Delta 2023

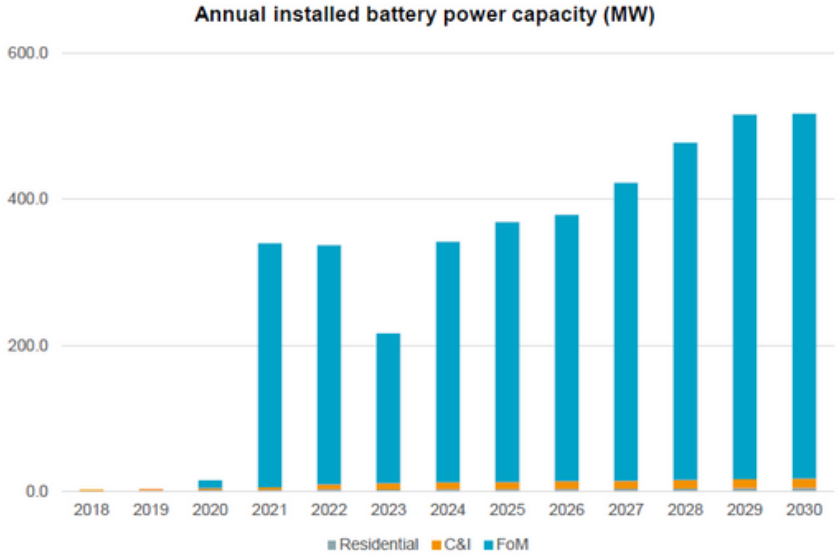


Figure 2: Annual Installed battery power capacity (MW) in Ireland, EMMES 7, EASE & LCP Delta 2023

2. BtM BESS and BtM BESS+PV in the context of EU Taxonomy

The EU Taxonomy is a classification system that establishes a framework for identifying environmentally sustainable economic activities that entered into force in 2020. Whether BTM solutions can be considered an environmentally sustainable investment is key: becausethe taxonomy act as a guide for investors, companies, and policymakers in making informed decisions and helps transition to a low-carbon and sustainable economy.

Importantly, BtM BESS and BtM BESS+PV installations can participate in Europe's climate and environmental goals, notably through the energy system's decarbonisation, and as such stand to benefit from Taxonomy classification. Specifically, they fall under the activities "storage of electricity", "cogeneration of heat/cool and power from solar energy", and "electricity generation using solar photovoltaic technology" among others (contributing to "climate mitigation" and "climate adaptation").

3. The BtM BESS and BtM BESS+PV Business Case

3.1. The Revenue Streams

Multiple use cases and opportunities for revenue stacking exist for both stand-alone and PV co-located BtM BESS installations. Below is an overview of the main business cases.

Article	
Self-consumption	BtM BESS co-located with PV installations can maximise self-consumption by storing excess solar energy for later use. When the PV panels of the installation generate more electricity than needed, instead of exporting it to the grid, the excess energy is stored in the BtM BESS. This stored energy can then be utilised during periods of low solar generation or high electricity demand, allowing consumers to rely less on grid-supplied electricity. By optimising the timing of energy usage, BTM BESS enables households and businesses to consume a higher proportion of their generated solar energy on-site, reducing the need to purchase electricity from the grid and maximising the overall self-sufficiency and cost savings derived from PV installations.
Energy Arbitrage on Tariffs (bill management)	BtM BESS standalone and co-located with renewables can provide energy arbitrage on tariffs, offering effective bill management for consumers. Energy arbitrage involves storing excess solar energy generated during periods of low electricity demand and utilising it during times of higher electricity prices. By charging the BtM BESS when electricity prices are low and discharging it during peak tariff hours, consumers optimise their energy consumption patterns and reduce their overall electricity bills. This approach allows PV owners to maximise the value of their solar generation by avoiding expensive grid electricity during peak periods, resulting in cost savings and improved bill management. The combination of BTM BESS with PV enables consumers to take advantage of time-varying tariff structures and actively manage their energy usage to minimise expenses and achieve greater financial benefits.
Demand Charge Management	BtM BESS standalone and co-located with renewables can effectively manage demand charges for consumers. Demand charges are fees imposed by utilities based on the highest rate of electricity usage during peak demand periods. By integrating BtM BESS with PV, excess solar energy generated during low-demand periods can be stored and discharged during peak demand periods. This allows consumers to reduce their peak electricity draw from the grid, thereby lowering their demand charges. The BtM BESS acts as a buffer, supplying stored energy during peak times and reducing the overall grid dependency. This approach enables consumers to optimise their energy usage, minimise costly demand charges, and achieve greater control over their electricity expenditures.

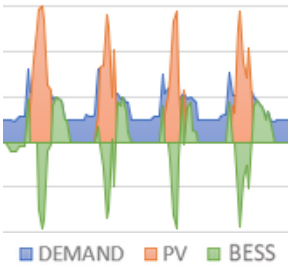
Energy Market and Balancing Market Participation	Depending on national legislation, BtM BESS and BtM BESS+PV installations can actively participate in both the energy market and the balancing market, offering valuable services to the grid. In the energy market, the BtM BESS can sell excess stored energy during periods of high demand or high electricity prices, maximising revenue for the system owner. Additionally, the BtM BESS can participate in the balancing market by providing grid stabilisation services such as frequency stability and voltage stability. By responding quickly to grid signals, the BESS can inject or absorb electricity as needed, helping to maintain grid stability and reliability. This dual participation in the energy and balancing markets allows consumers to monetise their energy storage capacity and contribute to a more efficient and resilient grid system.

3.2. An Assessment of Potential Savings and Revenues

BtM BESS installations are often chosen by consumers for the financial savings achieved through bill management or, in the case of systems co-located with PV, self-consumption. Below is an overview of the computation behind these savings, as well as for the cases of demand charge management and energy and balancing market participation:

BtM BESS & BtM BESS+PV
Installations can generate savings/revenues through the following computations:

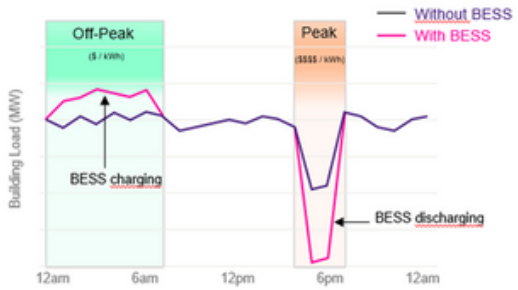
Self-consumption



- **A.** Client's energy tariff (€/kWh) → cost avoided (saving) of withdrawing energy from the grid
- **B.** PV export remuneration → (lost) revenues from sale of the solar energy in excess to the grid*
- **RTE:** Round-trip efficiency

Unitary savings (€/kWh) = A * RTE – B

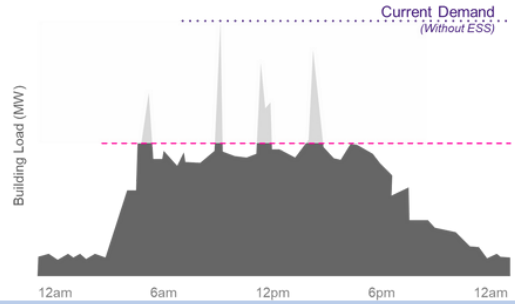
Energy Arbitrage on Tariffs (bill management)



- Discharge (€/kWh) → cost (avoided) of withdrawing energy from the grid during high-price periods
- Charge (€/kWh) → cost (incurred) of charging the BESS from the grid when prices are low
- OWE: One-way efficiency (RTE sq.root)

Unitary savings (€/kWh) = (Discharge* owe – Charge/OWE

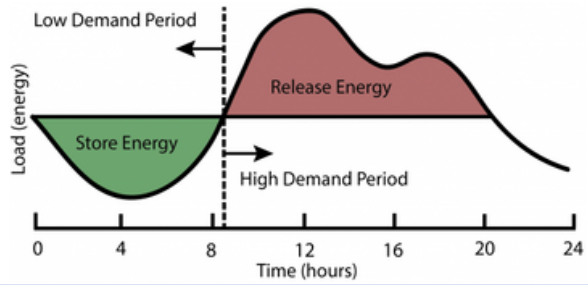
Energy Arbitrage on Tariffs (bill management)



- X → Client's power tariff
- P → peak power potentially shaved (monthly, yearly..)
- SE: software efficiency in identifying and catching peak

Savings (€/kW) = X * P (kW) * SE

Energy Market and Balancing Market Participation



Energy Arbitrage

Spread (€/kWh) between

- Z (€/kWh) → revenues from reselling energy to the grid when prices are high
- X (€/kWh) → cost of withdrawing energy from the grid when prices are low

Unitary revenues (€/kWh) = Z*OWE – X/OWE

Beyond customer benefits, there is also a case for policymakers and regulators to promote the uptake of these systems for their potential positive contribution to the low-carbon transition of the wider energy system. Indeed, large-scale simulations suggest that with BtM BESS operation, self-sufficiency can be increased, network losses can be decreased and the impact of RES on the network can be mitigated if the BtM BESS is used in a network-driven way.

4. Use Case Analysis

Italy: *Battery Energy Storage System for Self-Consumption Maximisation*

In Italy, a BtM BESS+PV project (of 250 kW – 500 kWh and 650kWp) has been developed and will enter operation in 2023. The PV+BESS installation allows the client to self-consume 84% of its PV-generated energy: an increase of 79% if compared to the self-consumption from PV only. As the PV is structurally oversized, with a solar production that almost doubles the customer's load, co-location with BESS leads to a significant maximisation of self-consumption revenues (Figure 3).

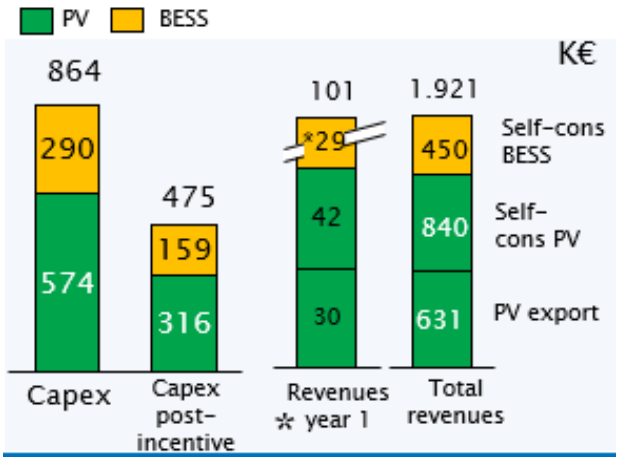


Figure 3: Revenues of the Italy use case project, EASE & Enel 2022

With a dedicated software, the battery is also able to perform peak shaving, to reduce the client's monthly power peak (€/kW) and ensure savings to the client. By performing self-consumption and peak shaving, the battery employs more than 300 equivalent cycles/year.

In the context of the Italian legislation, BtM export to the grid is not yet possible, limiting the project to the provision of market-related services that could potentially be stacked together with the existing revenue streams, increasing the profitability of the project. To unlock this potential and allow BtM BESS standalone and BESS+PV installations to play their full part in market participation regulations must evolve. In this context, the new dispatching model TIDE (Integrated Text on Electricity Dispatching), currently in consultation and that will enter into force by the beginning of 2025, will likely open new opportunities for BtM BESS participation in markets in Italy.

5. What Accelerates or Hinders BtM BESS and BtM BESS+PV Deployment?

5.1. Barriers to BtM BESS and BtM BESS+PV Deployment

BtM BESS and BtM BESS+PV solutions face barriers that limit their deployment:

- **BtM exports are not allowed in all countries:** Oftentimes, national regulations restrict or prohibit the export of surplus energy generated by BtM BESS+PV systems back to the grid. For example, in Italy, the provision of grid services through BtM exports is not allowed. These restrictions limit the potential revenue streams and market opportunities for BtM systems owners, inhibiting the full utilisation of the system's capabilities. The rationale behind this restriction lies on grid constraint considerations.
- **Complex tax structures:** VAT, high taxation, and complex financial obligations increase the upfront costs or create uncertainties to potential system owners, discouraging investment.
- **Regulated retail prices:** The existence of regulated retail prices, inconsistent feed-in-tariffs, and net-metering/net-billing policies in certain Member States negatively impact the business case for BtM storage by distorting market prices. Net metering notably reduces the appeal of co-located installations and self-consumption.
- **Insufficient consideration of energy storage in system planning:** grid issues such as double charging of access may due to energy storage being not sufficiently accounted for in system planning. Only few Member States are in the process of solving this barrier. Limited data availability also leads to uncertainty, reducing investment attractiveness.
- **Bureaucratic barriers:** Administrative processes, lengthy approval procedures, and complex paperwork pose significant barriers to the uptake of BtM BESS systems. These bureaucratic hurdles deter potential system owners, increase project timelines and costs, and hamper the scalability of these integrated systems.

Policymakers and regulators can solve these challenges by establishing clear and supportive regulatory frameworks to enable grid exports, provide fair compensation for services, and simplify administrative procedures. Currently, The barriers mentioned above vary significantly from one Member State to another, requiring tailored answers as well as EU-level efforts.

5.2. Catalysts for BtM BESS and BtM BESS+PV Deployment

The deployment of BtM BESS and BtM BESS+PV installations can be favoured through several initiatives:

- **Recognising prosumers:** Establishing the right of consumers to produce and consume their own electricity, through clear and enforceable definitions in EU policy, is essential to allow BtM BESS adoption.
- **Establishing regulatory incentives:** Implementing supportive policies and regulations that facilitate the deployment of socioeconomically viable use cases for BTM BESS and BtM BESS+PV is essential. This includes streamlining permitting processes, establishing clear grid connection codes, metering access, and ensuring favourable tariffs. Solar mandates, coupled with storage, could potentially also further the adoption of BtM BESS+PV as they have with FtM

- **Introducing financial incentives:** Direct financial incentives for end consumers such as tax credits, grants, or low-interest loans encourages consumers and businesses to invest in these systems. For example, national support schemes for PV can incentivise BtM BESS+PV if properly designed. Subsidies or tax depreciation for storage and/or solar installations also significantly reduce the upfront costs associated with installing BtM BESS and BtM BESS+PV systems. Tax credits for prosumers would also make the investment more attractive to consumers and businesses, accelerating the adoption of these technologies and facilitating their market penetration. However, such incentives can only be justified if the aforementioned BtM BESS and BtM BESS+PV use cases have socioeconomic relevance in the given market. To do this, detailed, technology-neutral economic analyses (such as Cost-Benefit-Analyses) are required.
- **Pushing for smart metering and technological solutions:** The presence of advanced metering infrastructure, including smart meters and submeters, enables real-time monitoring and data collection, providing valuable insights into energy consumption patterns to optimise the operation of BtM BESS and BtM BESS+PV services. Technological advancements need to be furthered by supportive research & innovation policies.
- **Fostering time-of-use tariffs:** Member States should promote time-of-use grid tariffs, as they are crucial to the development of Behind-the-Meter storage, increasing flexibility incentives. Dynamic pricing also increases the responsiveness of consumers to market conditions and allows them to engage in demand response through the use of storage, however, this comes with higher price volatility risks.

By combining regulatory and financial incentives, leveraging the strong presence of solar resources, utilising smart metering infrastructure, and providing subsidies and tax credits, policymakers and stakeholders can create an enabling environment that promotes the deployment of BtM BESS and BtM BESS+PV systems. However, supportive measures must follow technology neutrality and be designed after careful assessment of the socioeconomic relevance of the given BtM BESS and BtM BESS+PV use case(s) to ensure their efficient application(s).

6. Recent Policy Developments Impacting the Potential of BtM BESS and BtM BESS+PV in the EU

While BtM storage is positively considered by the EU through its Taxonomy framework as an effective technology to meet its climate and energy goals, there is still limited regulatory space for the services it could potentially provide. The Electricity Market Design (EMD) revision proposed by the European Commission in March 2023 is set to provide overarching rules for the future of Europe's electricity markets and some of its provisions improve the outlook for the various BtM BESS use cases.

The EMD lays down the following definition of an "active customer": "a final customer (or group of jointly acting customers) who consumes or stores electricity generated within its premises located within confined boundaries or self-generated or shared electricity within other premises [...], or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity". This definition provides an essential foundation to enable the participation of BtM BESS+PV customers in the energy and balancing markets and unlocking the potential of this segment of the market. The EMD also introduces limitations to new net metering schemes for active consumers, improving the case for self-consumption.

Finally, the European Commission incorporated several recommendations on Energy Storage in the EMD revision, including that "Member States promote, through regulatory and non-regulatory action, the uptake of demand response and Behind-the-Meter storage'. BtM BESS deployment would benefit from this as well as the broader electrification of end-use sectors. However, the recommendation remains too general and is as such prone to lax implementation.

Other EU policy developments likely to impact BtM BESS and BtM BESS+PV are the Battery Regulation, the Renewable Energy Directive, and the Energy Performance in Buildings Directive.

Conclusion

BtM BESS and BtM BESS+PV installations offer numerous benefits and opportunities for the European Union (EU) in its pursuit of ambitious climate goals and a rapid energy transition. These systems not only enable the efficient integration of renewable energy at residential and commercial levels but also empower consumers to actively participate in the energy system. However, realising the full potential of BtM BESS and BESS+PV requires a clear regulatory framework and policy support.

To accelerate the deployment of BtM BESS and BtM BESS+PV, several barriers must be addressed. These include restrictions on BtM exports and market participation, fair remuneration, net metering and data availability limitations, complex tax structures, regulated retail prices, inadequate consideration of energy storage in system planning, and bureaucratic hurdles.

Further economic studies on the BtM BESS and BtM BESS+PV use cases will be highly useful in providing evidence to policymakers and support improved regulatory frameworks wherever these use cases offer socioeconomic added value. Besides, investigation focused on non-BESS BtM energy storage (e.g. Thermal Energy Storage) are key, as they enable decarbonisation and provide cost-competitive solutions.

By addressing these issues and providing the necessary policy support, the EU can unlock the full potential of BtM BESS and BtM BESS+PV technology, promoting a sustainable and resilient energy system while empowering consumers to actively participate in the energy transition.

Notes

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About EASE:

The European Association for Storage of Energy (EASE) is the leading member - supported association representing organisations active across the entire energy storage value chain. EASE supports the deployment of energy storage to further the cost-effective transition to a resilient, carbon-neutral, and secure energy system. Together, EASE members have significant expertise across all major storage technologies and applications. This allows us to generate new ideas and policy recommendations that are essential to build a regulatory framework that is supportive of storage.

For more information please visit www.ease-storage.eu

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Disclaimer:

This content was elaborated by EASE and reflects a consolidated view of its members from an energy storage point of view. Individual EASE members may adopt different positions on certain topics from their corporate standpoint.

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