European Association for Storage of Energy

Services to Support Behind the Meter Customer Energy Management

Energy Storage Applications Forms

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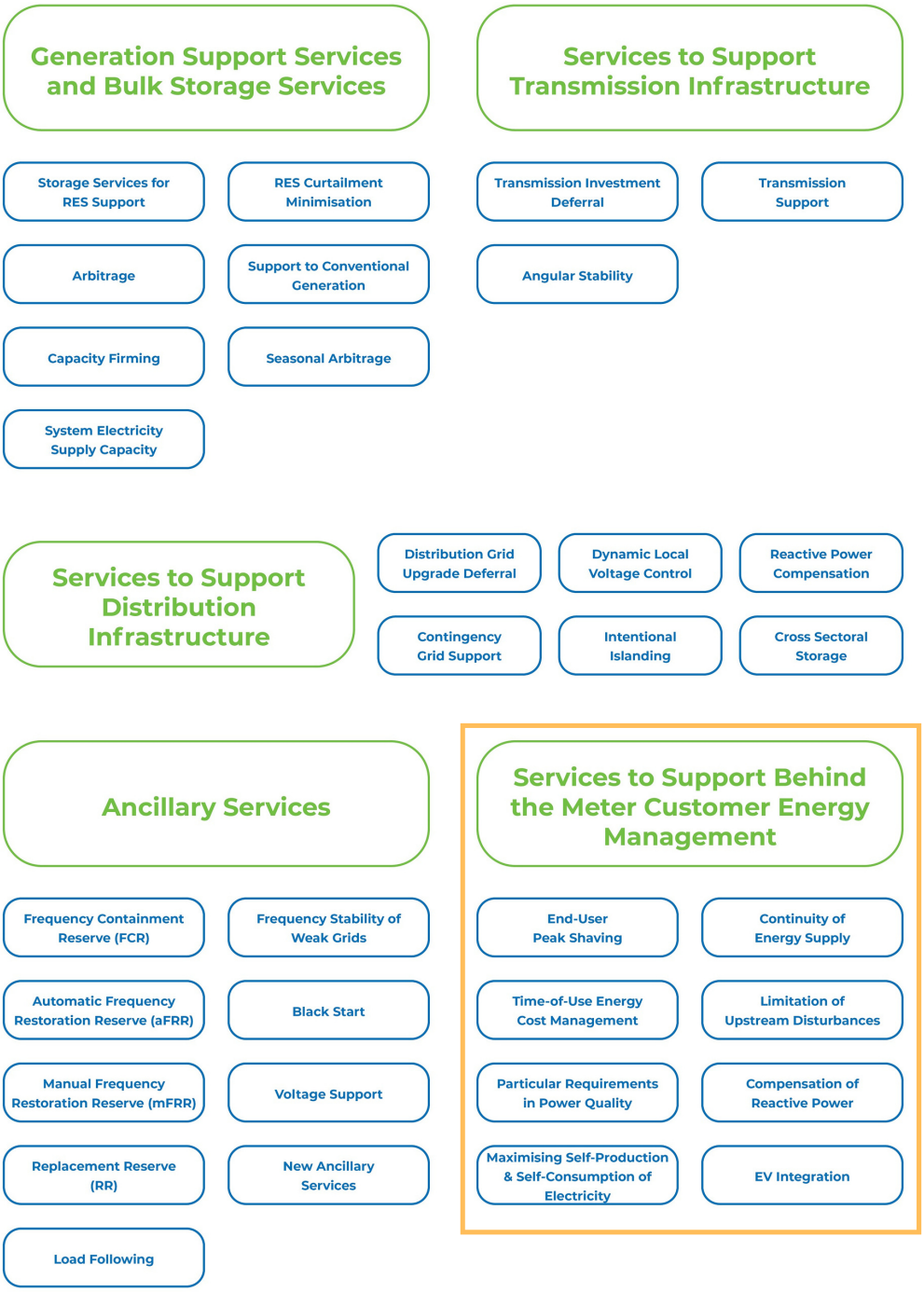
Introduction

This overview provides a summary of the different energy storage applications, focused mainly on the electricity system, in order to illustrate the many services that energy storage can provide. The forms are organised according to the segment of the energy system that benefits from a given service; this categorisation does not necessarily reflect the location in which the storage device is installed. The terms for individual services, as well as their maturity (existing service vs emerging or future service) varies across different EU Member States.

The customer energy management applications refer to energy storage installed behind-the-meter to support end users to manage their energy supply and/or costs. In this context, customer can refer to either residential consumers or commercial & industrial customers. Many EU markets are seeing rapid growth in the residential and commercial & industrial energy storage segments, as more customers install solar PV and are exposed to variable electricity tariffs.



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Abbreviations

List of abbreviations used in this form:

- **CAES:** Compressed Air Energy Storage
- **DSO:** Distribution System Operator
- **ES:** Energy Storage
- **EV:** Electric Vehicle
- **LAES:** Liquid Air Energy Storage
- **PHEV:** Plug-in Hybrid Electric Vehicle
- **SMES:** Superconducting Magnetic Energy Storage
- **ToU:** Time of Use
- **TSO:** Transmission System Operator
- **V2G:** Vehicle-to-Grid

1. End-User Peak Shaving

Existing Application

1. Definition

Use of energy storage to level out peaks in electricity use by residential or industrial and commercial power consumers, with the aim of minimising the cost of a customer's invoice that varies according to their highest power demand (e.g. peak demand charge).

2. Technical characteristics

- ES size range: 50 kW → 10 MW
- Target Discharge duration range: 1 h → 4 h
- Minimum Cycles/Year: < 50/year
- Ramp-up: ms to minutes

3. Application providers

- ES operator
- Demand Aggregator

4. Application beneficiaries

- Customer

5. Market value of the application

- Electricity bills decrease
- Electricity peak decrease

6. Application synergies for stacking

- TOU energy cost
- Power quality

7. Potential energy storage technologies

- Electrochemical: Classical & Flow batteries
- Mechanical: For commercial & industrial consumers, CAES technology with underground piping as well as LAES technology. Most of the time, the system uses existing compressors and adds extra compressors to store the energy.
- Thermal: Carnot batteries (Heat & Cold Storage)

2. Time-of-use Energy Cost Management

Existing Application

1. Definition

Use of energy storage by customers subject to variable or 'time-of-use' electricity pricing to reduce the overall costs for electric service. For instance, customers may store electricity from the grid when prices are low and discharge the storage for self-consumption when prices are high, thus reducing their overall energy costs.

2. Technical characteristics

- ES size range: 1 kW → 10 MW
- Target discharge duration range: 1h – 6h
- Minimum Cycles/Year: 50 → 250
- Ramp-up: ms to minutes

3. Application providers

- ES operator
- Demand Aggregator

4. Application beneficiaries

- Customer

5. Market value of the application

- The valuation is based on the difference between the peak and off-peak customer electricity prices

6. Application synergies for stacking

- Power Quality
- Demand Charge Management
- Electricity Service Reliability

7. Potential energy storage technologies

- Electrochemical: Classical batteries
- Mechanical: For commercial & industrial customers, CAES and LAES apply here in the same way as the peak-shaving. Most of the time, the system can charge during the weekend and discharge during the week. If relevant opportunity, the storage can be charged.
- Thermal: Carnot batteries (cold and heat storage)

3. Particular Requirements in Power Quality

Existing Application

1. Definition

The objective is to use energy storage to provide a high level of power quality above and beyond what the system offers (e.g., critical load) to some customers.

2. Technical characteristics

- ES size range: 100 kW → 10 MW
- Target discharge duration range: 10” → 15”
- Minimum Cycles/Year: 10 → 200
- Ramp-up: ms

3. Application providers

- ES operator

4. Application beneficiaries

- Customer

5. Market value of the application

- Depends on the local market conditions

6. Application synergies for stacking

- TOU Energy Cost Management
- Demand Charge
- Electric Service Reliability

7. Potential energy storage technologies

- Electrical: Capacitors, SMES
- Electrochemical: Classical batteries
- Mechanical: Flywheels

4. Maximising Self-Production & Self-Consumption of Electricity

Existing Application

1. Definition

Use of energy storage to maximise self-production and self-consumption of electricity, especially when energy storage is associated with PV.

2. Technical characteristics

- ES size range: 2 kW → 50 kW
- Target discharge duration range: 2h → 6h
- Minimum cycles/year: 1/day
- Ramp-up: few sec.

3. Application providers

- ES operator

4. Application beneficiaries

- Customer (either residential consumer or commercial & industrial)

5. Market value of the application

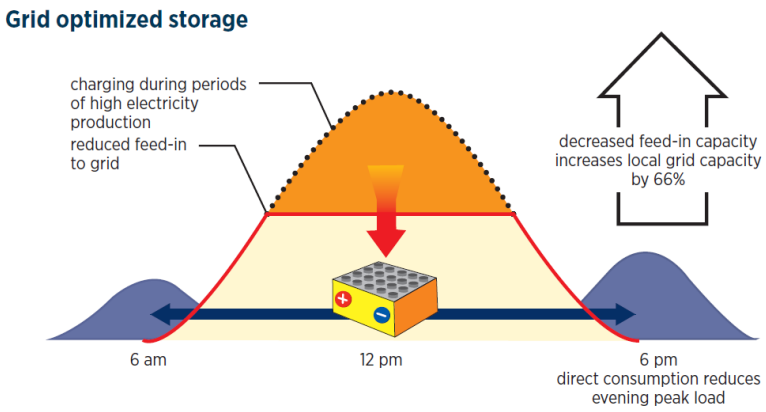
- Revenues are generated by avoiding the electricity consumption from the grid and by the sale of surplus electricity. (If allowed by the regulatory framework)

6. Application synergies for stacking

- Power Quality
- Continuity of Energy Supply
- TOU Energy Cost Management
- End user peak shaving

7. Potential energy storage technologies

- Electrochemical: Classical batteries
- Mechanical: CAES and LAES apply in case of industry
- Thermal: Carnot batteries



5. Continuity of Energy Supply

Existing Application

1. Definition

Use of energy storage device to substitute the network in case of interruption.

2. Technical characteristics

- ES size range: 50 kW → 20 MW
- Target Discharge duration range: some minutes → some hours
- Minimum Cycles/Year: < 50/year
- Ramp-up: ~ ms

3. Application providers

- ES operator

4. Application beneficiaries

- Customer

5. Market value of the application

- No power loss

6. Application synergies for stacking

- TOU energy costs
- Demand charge management
- Power quality
- Ancillary services
- End-user peak shaving

7. Potential energy storage technologies

- Chemical: synthetic fuels (hydrogen, biomethane, etc.)
- Electrochemical: Classical & Flow batteries
- Mechanical: for commercial and industrial customers, CAES and LAES can apply if they are combined with battery of flywheels for current quality. Furthermore, LAES can be filled like fuel which is not possible for other technologies.
- Thermal: Carnot batteries

6. Limitation of Upstream Disturbances

Emerging Application

1. Definition

Use of energy storage to limit the disturbances caused by distribution grids on upstream HV grids to contractual values.

2. Technical characteristics

- ES size range: N/A
- Target discharge duration range: N/A
- Minimum Cycles/Year: N/A
- Ramp-up: ≤ few seconds

3. Application providers

- ES operator
- DSO's

4. Application beneficiaries

- DSO's

5. Market value of the application

- Grid investment avoidance

6. Potential energy storage technologies

- Electrochemical: Classical & flow batteries

7. Compensation of Reactive Power

Emerging Application

1. Definition

Use of energy storage to compensate locally the reactive power.

2. Technical characteristics

- ES size range: N/A
- Target discharge duration range: N/A
- Minimum Cycles/Year: There is no need to cycle the storage system as no active power cycling is necessary
- Ramp-up: N/A

3. Application providers

- ES operator

4. Application beneficiaries

- Customer

5. Market value of the application

- Depends on the individual market

6. Potential energy storage technologies

- Electrochemical: Classical & Flow batteries
- Mechanical: CAES or LAES can provide this reactive power by stacking services; flywheel can be dedicated to this service.

8. EV Integration

Emerging Application

1. Definition

The objective is to use an electric vehicle (EV) or plug-in hybrid EVs (PHEV) to provide Vehicle to Grid (V2G) functions to contribute to the grid balancing.

2. Technical characteristics

- ES size range: 1 kW à 100 kW
- Target discharge duration range: 1 h à 6 h
- Minimum Cycles/Year: ~ 1/day
- Ramp-up: depends on the type of V2G functions

3. Application providers

- ES operator
- Customer
- Demand Aggregator

4. Application beneficiaries

- Customer
- Distribution Grid
- TSO

5. Market value of the application

- The V2G applications need to be identified
- Balancing

6. Application synergies for stacking

- V2G functions correspond already to a stacking of individual services.

7. Potential energy storage technologies

- Electrochemical: Classical batteries

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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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