D²XCEL

Large-scale Stationary Energy Storage

1. Short Description

Large-scale stationary energy storage solutions for addressing the challenge of intermittent renewable energy sources and especially with seasonal supply & demand fluctuations. Heat, electricity, and other energies are covered. Targeted solutions include geothermal storage, flow batteries, gravitational & pumped hydro, and hydrogen, as well as software & AI systems for energy management, grid stabilisation and demand-response.

2. The Problem

The energy transition in Europe has been strongly focused on two renewable energy sources: solar and wind. They both have huge energy potential, but also a key disadvantage: their intermittent production. Solar energy is only produced during (clear) days, not at night and mostly in summer. Wind energy is very weather dependent. As the fluctuations in supply and demand of (renewable) energy are incongruent, massive energy storage capacity is needed, which is cost-effective, reliable, sustainable (over its complete lifecycle), independent of critical or scarce materials and optimised for long-term applications in a stationary situation. This requires very different solutions than e.g. e-vehicle batteries.

Innovative, scalable solutions are thus needed for both short-term and long-term (up to seasonal) energy storage, in three categories:

- Large-Scale Storage Systems (LSS)
- Industrial Storage Systems (ISS)
- Home Storage Systems (HSS) – outside of the scope of this Market Opportunity

Lithium-Ion batteries are currently used at large scale, also for stationary storage (e.g. as companion to solar parks), but this is not a long-term solution due to several disadvantages of this technology:

- Dependency on critical materials and scarce minerals, largely controlled by non-European entities
- R&D and production capacity largely controlled by non-European entities
- Sustainability footprint of such batteries
- Risk of fire
- Not optimised for stationary use, e.g. long-term storage
- Strongly needed for electrification of transport and mobility sector

Also Lead Acid-based batteries are widely used for stationary storage due to its low cost, but are facing serious health concerns.

Therefore, there is an urgent need for innovative stationary energy storage solutions, which are effective and efficient in storing energy (esp. power and heat) for short and esp. longer periods (weeks, months), while being sustainable, independent on imports from outside the EU, cost-effective, safe and acceptable by EU citizens.

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3. Sustainability and Sovereignty Impact Potential for Europe

Developing and deploying innovative solutions for Stationary Energy Storage is essential for Europe to:

- Assure power/energy availability at all times, despite strongly fluctuating power generation from esp. solar and wind, to provide European sovereignty (no dependence on import of fuel or power).
- Strongly reduce dependency on import of current battery technologies (Lithium-Ion) and the associated raw (critical) materials.
- Realise the ambitions of REPowerEU and the Renewable Energy Directive, and the Commission principles for energy storage as reflected in the Clean Energy for all European package adopted in 2019 and the Commission Recommendation Energy Storage – Underpinning a decarbonized and secure EU Energy System, adopted in March 2023.
- Secure a EU leadership position in alternative, stationary storage technologies (which is unlike to be possible for Lithium-Ion batteries).
- Create a flourishing industry and a substantial number of jobs.
- Reduce the dependency on import of raw materials that are critical for the energy transition, such as Lithium, by extracting these from geothermal sources.

4. Deeptech and Digital Innovation Potential

A broad range of Deeptech and Digital innovations will be considered to address the challenges mentioned above. These include, but are not restricted to:

- Geothermal energy storage
- (Redox) Flow and Sodium batteries
- Pumped Hydro storage
- Gravitational Energy Storage
- Flywheel
- Compressed Air or Liquid
- Heat / Ice storage
- Building thermal energy storage (ice)
- Hydrogen or Ammonium storage
- Hybrid storage solutions
- Cloud-based, AI-based energy management platforms
- Demand-Response Energy management solutions (inc. AI)
- Grid Infrastructure innovations

One source of information about the market for innovative energy storage technology is the 2020 report on “Energy Storage Grand Challenge: Energy Storage Market Report” by the U.S. Department of Energy.

5. European Market Potential

The IEA expects global installed storage capacity to expand by 56% from 2021 to 2026 to reach 270 GW, while utility-scale battery solutions should grow 44-fold between 2021 and 2030, to reach 680

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GW (source: IEA and COMMISSION STAFF WORKING DOCUMENT - Energy Storage - Underpinning a decarbonised and secure EU energy system, March 2023). For Europe, multiple studies point to energy storage capacity of 200 GW by 2030 and 600 GW by 2050 (source: EASE, Energy Storage Targets 2030 and 2050 - Ensuring Europe's Energy Security in a Renewable Energy System, 2022).

Market size estimates for the Stationary Energy Storage Market vary widely, depending on definitions and methods. One source sizes the global market at 38 B US in 2022 and project it to grow to 335 B US by 2032 with a CAGR of 25%, including batteries, flywheels, pumped hydro (source: Acumen Research and Consulting). Another source provides similar numbers (35 B US in 2022 with CAGR of 24% to 2030) and estimates that in 2022 Europe accounted for about 15% and "in front of meter" accounted for 37% of global market (source: Coherent Market Insights). Yet another source estimates the market at 71 B US in 2022 and projects growth of 27% GAGR to 870 B US in 2032, with the Flow Battery segment growing fast at over 30% GAGR (source: Global Market Insights).

European electricity storage installation capacity was about 4,5GW in 2022 and is forecasted to grow to almost 12GW by 2030 (source: European Association for Storage of Energy – EMMES 7.0 of March 2023).

The global market for Battery Storage Systems was about 10GWh in 2017 and was forecasted to grow to 180-420 GWh by 2030 (Source: IRENA and BNEF).

The total revenue of the German energy storage sector in 2018 has been estimated to be 5 BEU, of which 38% for battery storage, 36% for pumped hydro storage, 19% for heat storage, and 5% (250MEU) for R&D (source: Team Consult and BVES).The German storage demand is projected to grow to 100 GWh by 2030 and 180 GWh by 2045 (source: ISE Fraunhofer). Germany had 59 LSS in operation in 2018, with a total capacity of 550MWh with the main purpose of stabilising (frequency containment) of the grid. Dominant technology was Lithium-Ion batteries. (source: The development of stationary battery storage systems in Germany – A market review).

Global corporate-backed investments in energy storage totalled over 80 B US in 2021 (source: GlobalVenturing).

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