Guidelines and standards

For increased safety in installation and operation of batteries

With the global development of renewables comes a need for flexibility. The deployment of intermittent electricity production systems like wind and solar is facilitated by large-scale development of energy storage technologies, particularly batteries. The installed battery capacity has increased drastically in the recent years, as shown in Figure 1.

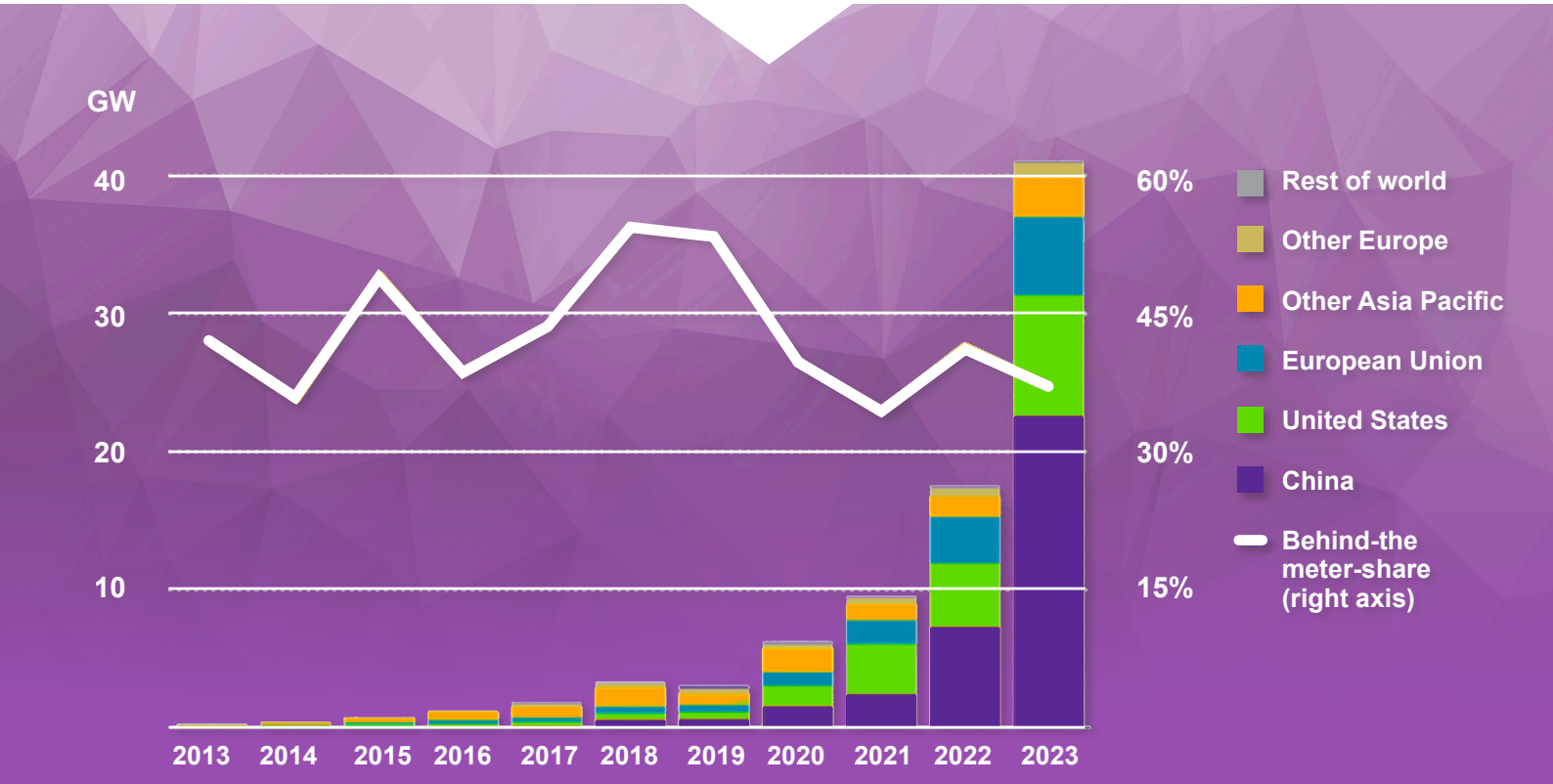
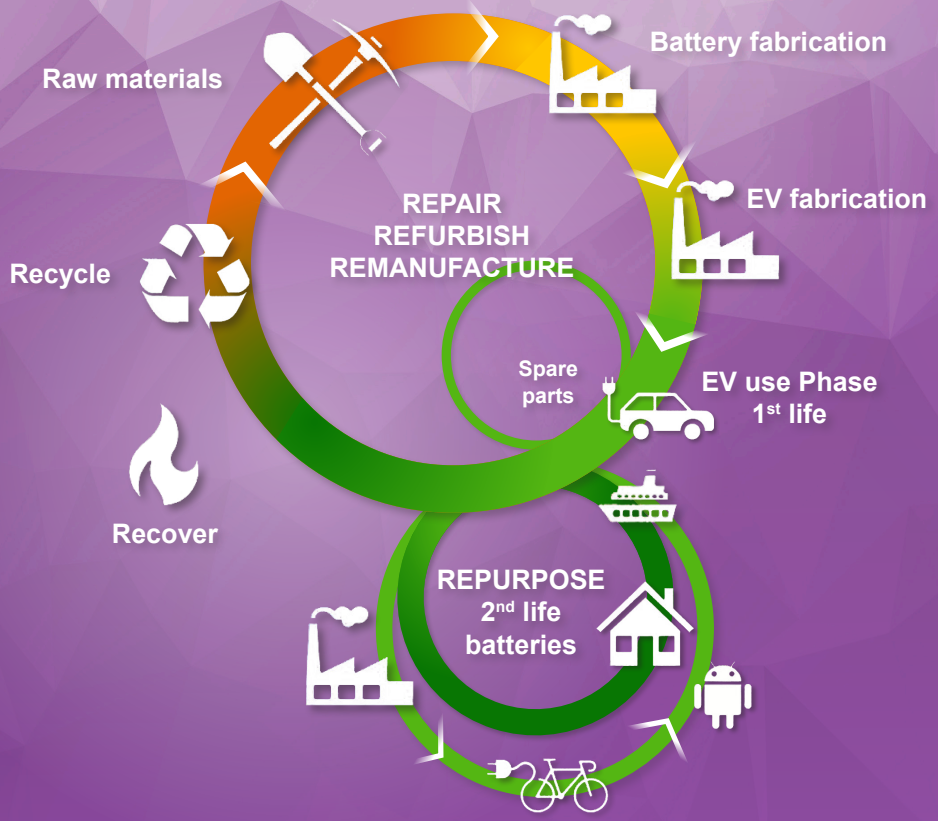


Figure 1: *Battery storage capacity additions worldwide in gigawatts (GW), 2013-2023. Source: IEA*

As of 2023, over 40 GW of battery storage capacity is available globally, and the IEA foresees that this number will need to be multiplied up to 14 times by 2030. In parallel, due to the increased pressure on critical raw materials and the resulting environmental and ethical issues, interest in second-life batteries has grown. While EV batteries are often deemed inadequate for further use in vehicles at 70-80% capacity, they can still serve stationary storage purposes. In 2025, the global second-life EV battery market was estimated at USD 2 billion, and by 2034 this is predicted to increase to USD 12.42 Billion. Increased uptake of second-life batteries would greatly improve the degree of circularity in the battery value chain, illustrated in Figure 2.

The continuous changes and rapid development in the battery market makes it challenging for both EU and national legislative authorities to keep up and maintain relevant standards and regulations. The EU Battery Regulation, which entered into force in August 2023, aims to address many of the current challenges over the next few years. However, there are still several areas that will not be sufficiently covered in order to accelerate uptake of second-life EV batteries into stationary energy storage. In particular, **safety challenges with Li-ion** batteries need to be addressed to ensure the planned developments of batteries. Safety is a major concern when it comes to batteries energy storage systems (BESS), in particular risks of thermal run-away. Although the probability of a thermal event is low for Li-ion batteries, the severe consequences make end-users very cautious. These observations extend also to second life Li-ion batteries.

Many of the safety challenges associated with second-life batteries can be mitigated through common policies on battery storage room safety and BESS maintenance. So far, most of the regulatory framework for battery installations is based on international standards, and many new standards have been implemented recently or are under development. The UL 1974: Standard for Evaluation of Repurposing Batteries, which is in place for Canada and the US, is a driver for accelerating installations. Additionally, UL 9540A and NFPA 855 are widely used for BESS safety testing and integration into buildings, respectively. UL and NFPA standards are also widely adopted in the European market. In the EU, the recently implemented Battery Regulation will enforce a Battery Passport for all new batteries larger than 2 kWh, providing easier access to state of health and historical user data for second life battery stakeholders. This will in turn facilitate safer and lower-cost systems. However, the Battery Passport will not be enforced until February 2027, and even after that it will take many years before significant numbers of new batteries with battery passports are available for second-life applications.



Finally, there is a lack of knowledge regarding requirements for battery installations, such as room size and location, ventilation, and construction materials for battery rooms. Extinguishing Li-ion battery fires is particularly challenging, as there is currently no efficient extinguishing agent.

This policy brief suggests new policies to provide a safer regulatory framework for the exponential growth of the battery sector. The recommendations cover the installation, maintenance, and operation of battery systems. Second-life batteries should also be addressed within those policies.

Figure 2: *EV battery value chain with a high degree of circularity. Lluc Canals Casals, 2017*

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Policy recommendations

1 Regulatory framework for battery rooms

A regulatory framework with focus on national standards regulating the minimum requirements for a battery room should be established. This should also include a standard for risk assessment for installation of large BESS. The standards should include factors such as size of room relative to the size of the BESS, location in the building, ventilation requirements, explosion protection, choice of construction materials, fire, smoke and gas detection, suppression systems requirements and handling of runoff waters from fire extinguishing.

Research performed in the Norwegian project SafeBESS, coordinated by SINTEF, has revealed that current lack of regulations leads to large variations in battery room solutions with regards to secure access, ventilation, detection and suppression solutions. A regulatory framework for battery rooms and battery room risk assessment would ensure that all BESS installations follow a minimum safety standard. Establishing a national regulation will make planning and design of battery rooms more efficient and significantly reduce the cost of implementation for the building owner. Currently, large costs are often incurred during the planning and installation phase to ensure that proper safety precautions are taken. These additional costs may hinder potential end users from investing in BESS solutions.

Reduced installation costs and established standards for safety and risk assessment is expected to accelerate uptake of both new and second-life BESS. The national authorities should initiate the establishment of such a regulation.

2 Minimum requirements for training of building maintenance staff and BESS operators

This policy covers the lack of knowledge on how to correctly handle, carry, install and do maintenance on battery systems. It should also address the potential dangers and how to act in case of a thermal event or emergency situation in the building not necessarily caused by the BESS itself.

Currently, very few maintenance staff and BESS operators have sufficient knowledge of how to handle a large BESS, neither during normal operation nor during an emergency. This may cause staff to unintentionally initiate a thermal event or even cause escalation of already dangerous situations. Properly trained maintenance staff and BESS operators can also be an important resource for the fire and rescue services in the event of a fire, whether the fire is caused by the BESS or originating somewhere else in the building.

Establishing this regulation should be initiated by the national authorities. The responsibility of ensuring that the regulations are followed will lie with the building owner.

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Battery demonstrations

Not all countries are EU members and thereby automatically covered by the new regulations. Additionally, several areas identified in the TREASoURcE project are not well covered or covered at all by the Battery Regulation, one being safety of battery systems in installation and operation in battery rooms.

Addressing the identified challenges regarding battery safety with relevant policies will have a strong impact in ensuring a safe and viable deployment of BESS in Norway. With proper framing of regulations regarding safety, the frequency of thermal incidents should notably decrease, together with the considerable consequences of those events. Standards and best practices for particularly risk assessment of BESS installations, as well as recommendations or standards for battery rooms, will have a significant economic impact for the end-user. Based on our experiences from the implementation of three demonstration units in the TREASoURcE project, one in Finland and two in Norway, there is now significant efforts required to ensure the safety of the installations. The lack of regulations and recommended best practices, invoke uncertainty and fear of not implementing sufficient safety measures. This significantly complicates the process and increases the cost of BESS installations. In addition to regulations and standards covering the installation and room construction, there is also a need for regulations protecting the control and maintenance staff who operate the BESS on a daily basis. Proper training of maintenance staff will increase awareness of potential dangers and reduce the risk of incidents and damage to both personnel and buildings.

This policy brief has been produced as part of the TREASoURcE project work package ”Circular economy framework analysis and actions to enhance circular economy”. It provides policymakers and stakeholders with a foundation for developing effective practices to promote the transition to circular economy. This policy brief is based on a conducted literature review as well as stakeholder engagement, which was used to validate the findings. The project report D1.3 Legislative and regulatory framework for target value chains addresses critical challenges and opportunities for advancing the circular economy transition.

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References

IEA. (2023). Batteries and Secure Energy Transitions.

Lluc Canals Casals B. A. (2017). Electric Vehicle Battery Reuse: Preparing for a Second Life. Journal of Industrial Engineering and Management, 278.

Precedence Research. (2025, May). Second-life Electric Vehicle Batteries Market Size and Forecast 2025 to 2034.

SINTEF. (2026). SafeBESS: Technology and building design for safe operation of battery energy storage systems. Publications from the SafeBESS project.

TREASoURcE is a four-year (2022–2026) EU Horizon Europe-funded project aimed at promoting the circular economy through regional circular economy pilots. The project focuses on three value chains: unused plastic waste, reuse of electric vehicle batteries, and biobased side and waste streams. Utilizing diverse stakeholder work, the project’s goal is to significantly increase the circulation of products and materials and the circular economy knowledge of citizens in the Nordic and Baltic regions.

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