Final Report: ELAG

Exploiting the Potential of Spent Electric Vehicle Batteries, Electric Agder

Project number:	321111 – RFF AGDER
Project period:	20.04.2021 – 19.04.2025 (4 years)
Project owner:	University of Agder
Project manager:	Bernhard Fäßler
Partners:	8
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Motivation

The ELAG-project (Exploiting the Potential of Spent Electric Vehicle Batteries, Electric Agder) aims to develop competences within the Agder region to support local companies in creating sustainable value through the reuse and recycling of electric vehicle (EV) batteries. The project addresses the need for innovative and circular solutions for end-of-life battery management in Norway, leveraging the region's first-mover advantage in the lithium-ion battery EV market.

Work Packages (WPs):

1. **WP1: Battery Characterisation:** Develop rapid, automated, and robust methods for characterising large volumes of spent EV batteries.
2. **WP2: Automated Discharging:** Create safe and automatic discharging techniques for various EV batteries.
3. **WP3: Second Use Battery Applications:** Identify sustainable value creation opportunities for spent EV batteries in industrial, grid, and residential applications.
4. **WP4: Battery Value Chain Sustainability Assessment:** Assess the environmental impact of using spent EV batteries in new energy storage solutions through life cycle assessments and circularity assessments.

Project Consortium: The ELAG consortium includes energy storage companies (BTG Solenergi, Pixii, Green Waves, Greenstat Energy), recycling actors (Norsk Hydro, Elkem, Batteriretur), and the University of Agder (UIA). The project will also involve collaboration with key stakeholders and researchers to ensure multidisciplinary expertise and comprehensive solutions.

Impact: The project aims to reduce e-waste, promote renewable energy sources, and create new business opportunities in the Agder region. By extending the life of EV batteries through second use, the project will contribute to a more sustainable and circular battery value chain.

Results

The ELAG-project is making significant progress in managing used batteries in the Agder region. This section looks at the important findings and results from the project's work packages. What we have learned will help us develop new ways to grade batteries, discharge them safely, find second uses for them, and assess their environmental impact.

Work Package 1

Major Findings and Conclusions: WP1 successfully demonstrated that automated, multi-sensor battery characterization is feasible and essential for efficiently sorting used EV batteries into appropriate pathways (reuse or material recycling). Combining fast preliminary checks with targeted follow-up tests achieved a strong trade-off between speed and accuracy, allowing quick grading of batteries by State of Health without sacrificing confidence in the results.

Relevance and Impact: WP1 provides a critical foundation for the ELAG project by enabling quick triage of used batteries. This capability has significant economic and environmental benefits, allowing companies to recover more value from each battery and avoid unnecessary waste. The findings support new business opportunities in second-life energy storage and improve the sustainability of the battery value chain by extending battery service life and reducing demand for new raw materials.

Work Package 2

Major Findings and Conclusions: WP2 demonstrated that automated discharging of EV batteries is feasible and highly beneficial. The implemented vision system accurately located and distinguished battery connectors across different battery designs, enabling the robot to make reliable connections without human help. The system maintained safe operating conditions, validating that even high-energy batteries can be discharged autonomously with low risk.

Relevance and Impact: WP2 improves worker safety by minimizing human contact with potentially dangerous high-voltage batteries and significantly reduces the cost and time required to process each battery. These innovations empower industry partners to handle greater volumes of spent batteries efficiently. Faster and safer battery processing facilitates the scaling of second-life battery markets and contributes to sustainability by ensuring proper de-energization for recycling.

Work Package 3

Major Findings and Conclusions: WP3 proposed using a hybrid energy storage system (HESS) to address power and energy requirements in grid applications. The research involved theoretical approaches to battery modeling, simulation frameworks for peak reduction and valley filling, and multi-objective optimization to manage HESS for multiple grid applications.

Relevance and Impact: The findings demonstrate that HESS can effectively balance grid supply and demand, reducing peak-to-average ratios and power variance. By optimizing storage to minimize electricity costs and maximize profits, WP3 supports new business opportunities in the renewable energy sector. The research contributes to sustainability by improving the utilization of battery resources and enhancing grid stability.

Work Package 4

Major Findings and Conclusions: WP4's environmental assessments showed that reusing spent EV batteries for energy storage reduced the carbon footprint by 84% and the water footprint by 97% compared to new battery production. Interviews and surveys with stakeholders identified important policy changes needed to strengthen battery reuse, including better eco-design standards, producer responsibility, and mandatory reuse targets.

Relevance and Impact: WP4's findings have significant environmental benefits and highlight the importance of policy changes to support battery reuse. By promoting circular activities, the work package contributes to a more sustainable battery value chain and encourages industry adaptation to reuse practices.

Conclusion

The ELAG project demonstrated that automated battery characterization, discharging, and hybrid energy storage systems are not only feasible but also highly beneficial for creating a sustainable battery value chain. The environmental assessments underscore the importance of reusing spent EV batteries to reduce carbon and water footprints. Together, these findings support the development of new business opportunities in second-life energy storage and contribute to a more circular and sustainable battery economy.

To further advance the promising results of ELAG, a follow-up project is essential to scale up these innovations and make them even more relevant to the industry. This project would focus on upscaling the methods developed in ELAG, moving from laboratory settings to industrial applications. By doing so, it would enhance the efficiency and impact of battery reuse and energy storage solutions, thereby fostering greater adoption and integration within the industry.