

Introduction: Current Developments in Battery Research with a Focus on the National Three-Year Programme (PTR 2025–2027).

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Over the past decade, battery research has attracted increasing attention, leading to the emergence of numerous new topics and trends. At the European level, several key stakeholders—such as ETIP Batteries Europe, BEPA, and Battery 2030+—have recently published roadmaps and strategic research agendas to guide the sector’s future developments.

This presentation will provide a brief overview of the main ongoing developments in battery research, with a particular focus on the Italian national programme.

In Italy, the **Ricerca di Sistema (RdS)** funding scheme has been supporting research and development in the field of batteries since the early 2000s. The current integrated project, titled “*Electrochemical and Thermal Storage Technologies*”, involves CNR, ENEA, and RSE as part of the **2025–2027 Three-Year Plan (PTR)**. This initiative contributes to the broader objective of achieving full decarbonization by 2050.

The RdS programme primarily aims to foster technical and technological innovation in the electricity sector for the public benefit. Its goals include improving performance, safety, and economic and environmental sustainability to ensure the conditions necessary for Italy’s sustainable development.

The project adopts a comprehensive approach to the development of energy storage technologies, covering the entire value chain—from raw materials and advanced materials to systems integration and manufacturability. Energy storage, particularly through battery systems, plays a central role in the decarbonization process and is essential for advancing the green energy transition.

While lithium-ion batteries remain dominant, new chemistries are needed to meet the diverse demands of energy storage applications, offering greater flexibility, reliability, and improved environmental, economic, and social sustainability. Among these, **sodium-ion (Na-ion)** batteries are attracting growing interest as one of the most promising and sustainable alternatives.

The research prioritizes the development of low-cost, environmentally sustainable active materials. This includes both mature technologies and emerging frontier solutions, with the goal of consolidating and validating their performance to pave the way for the **sustainable battery of the future**.

Additionally, the programme incorporates comprehensive sustainability assessments through **Life Cycle Cost (LCC)**, **Life Cycle Assessment (LCA)**, and **socio-economic impact analyses**, alongside **advanced characterization techniques** and **physicochemical modeling** of materials, interfaces, and complete cells, as well as **system-level simulations** of entire storage systems.