energy storage

IEA Technology Collaboration Programme

COUNTRY REPORT
Italy

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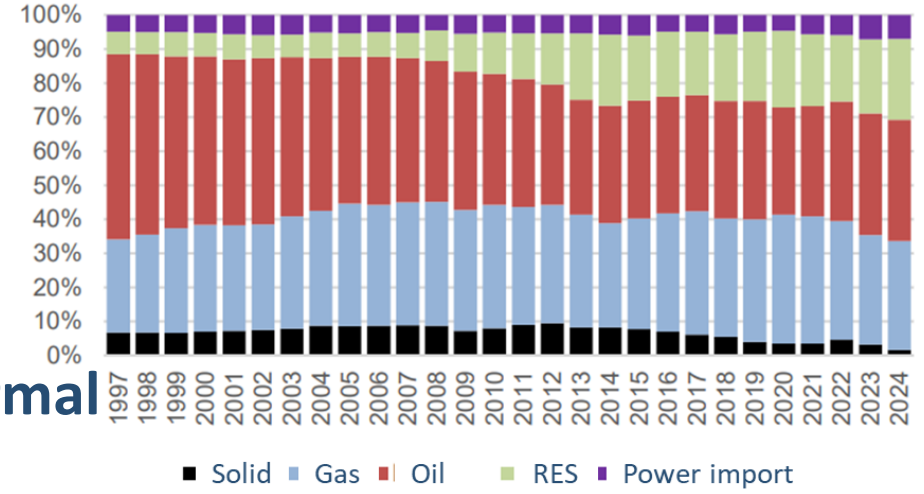
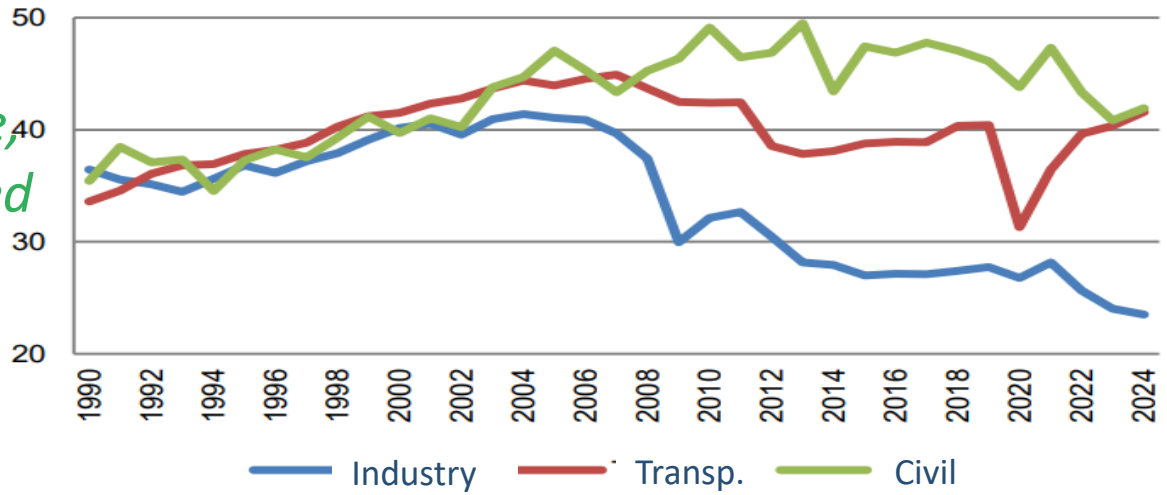
99 XC Meeting, Seville, Spain, 21 May 2025

Country Specific Information

- Population: 58,97 Mio
- Primary source consumption 159 Mtep (stable trend)
- Total Power Consumption: 312,3 TWh (+2% vs 2023)
- Total Net Power Production: 264 TWh (+2,7% vs 2023)
- RES: 37 Mtep (+10% vs 2023) [+30% Hydro; +19%PV;
- -5% wind];
- 35% Hydro; PV: 26%; 20% wind; 14% biomass; 5% geothermal
- CO_2 emissions down (-2.8%) thanks to coal now at its lowest in thermoelectric power (-70%);



In Italy, the trend is similar on the way to the Eurozone, but final consumption has started to increase again, led by transport and civil (+3% approximately)



Source: analisi trimestrale del sistema energetico italiano (2024); available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.pubblicazioni.enea.it/download.html?task=download.send&id=728:analisi-trimestrale-del-sistema-energetico-italiano-1-2025&catid=4

RDD Information
(Research, Development and Demonstration)

Three-year National plan of National Electricity System Research (RDS) – Ob: decarbonization

It establishes the priorities, objectives and resources of research and development activities of general interest for the national electricity system and includes also funds for energy storage.

Integrated project 1.2: Electrochemical and Thermal Storage Technologies (17.7 M€)

Activities aimed at increasing energy density, improving safety, reducing the cost and extending the life cycle as well as the environmental sustainability

- Electrochemical Storage: Advanced Materials;
- Electrochemical storage: Innovative systems;
- Electrochemical storage: Environmental, economic and social aspects and cross-cutting topics.;
- Thermal storage: Innovative materials and systems.

Project 1.9: CST/CSP (2.5 M€)

- Improving performance, versatility, and technological maturity, aiming to enhance dispatchability and reduce costs. -
- Hybridization with other renewables, especially photovoltaics, is crucial, involving innovative thermal storage for direct integration of thermal and electrical flows.
- Development and testing of advanced materials, components, and remote monitoring devices will optimize plant operations and reduce maintenance costs, leveraging existing experimental infrastructure.
- Finally, a hybrid CST/CSP-photovoltaic demonstrator for distributed cogeneration of electricity and heat for industrial and civil use will be provided.

RDD Information
(Research, Development and Demonstration)

Objective: digitalization and evolution of the networks (about 50 M€)

- Project 2.1: Cyber Security of energy systems for the digital energy transition
- Project 2.2: Energy scenarios and support for governance
- Project 2.3 a: Evolution in the planning of electricity grids
- Project 2.3 b: Innovations in the management and operation of electricity grids in alternating current (AC) and direct current (DC)
- Project 2.4: Digitalization of the energy system
- Project 2.5: Energy from renewable sources and integration in the territory
- Project 2.6: Resilience and security of the energy system
- Project 2.7: Sustainable mobility and interaction with the energy system
- Project 2.8: The user at the center of the energy transition
- Project 2.9: Energy markets and regulation
- Project 2.10: Flexibility of the integrated energy system

RDD Information Electricity Storage
(Research, Development and Demonstration)

Mission Innovation 2.0

Financial instrument by the Ministry of the Environment and Energy Security
D.M. MASE 17 Nov. 2023, n.386

Open calls on the following research topics (total budget 340 M€):

- electricity storage;
- renewable sources;
- network technologies and digitalization;
- nuclear;
- hydrogen;
- electrolyzers and electricity networks;
- critical raw materials and advanced materials for the energy transition and related national supply chains;
- biohydrogen; biofuels and integration with networks..

Energy Storage Landscape

RSE
UNIBS
POLIMI
BICOCCA
UNIPV
Eni
POLITO
IIT
UNIGE
UNIPI
GISEL (INSTM)
UNIFI
ENEA
UNIRM1 Sapienza
UNIRM2 Tor Vergata
Confindustria
UNINA
Sannio University

FBK
UNIPD
UNIBO
UNICAM
UNIPG
COBAT
Energy cluster (CTN)
UNIFG
UNIBA
UNIBAS
UNIME
CNR
UNIRC

Private associations
Research institutes
Universities

Policies & Market

Fit for 55 Package (2021): EU framework for -55% net emissions by 2030 and climate neutrality by 2050. Includes ETS, renewables, efficiency, low-emission transport, and measures against carbon leakage.

- **PNACC:** Italy's plan for climate change risk reduction and adaptation.
- **SFN:** National strategy for resilient forests contributing to climate action.
- **Circular Economy Strategy:** Aims for decoupling growth from environmental impact.
- **Waste Management Program:** Sets targets for waste reduction and recycling.
- **PA Sustainable Consumption Plan:** Promotes green public procurement (CAM/DNSH).
- **SNSvS :** National framework for sustainable development and policy coherence.
- **PNCIA:** Air pollution reduction plan with a €2.3 billion dedicated fund.
- **PNRR:** Italy's recovery plan allocates significant funds (G€194.4+30 by National Complementary Fund) for ecological transition.
- **REPowerEU:** Integrated into PNRR with €11.18 billion for energy security and renewables

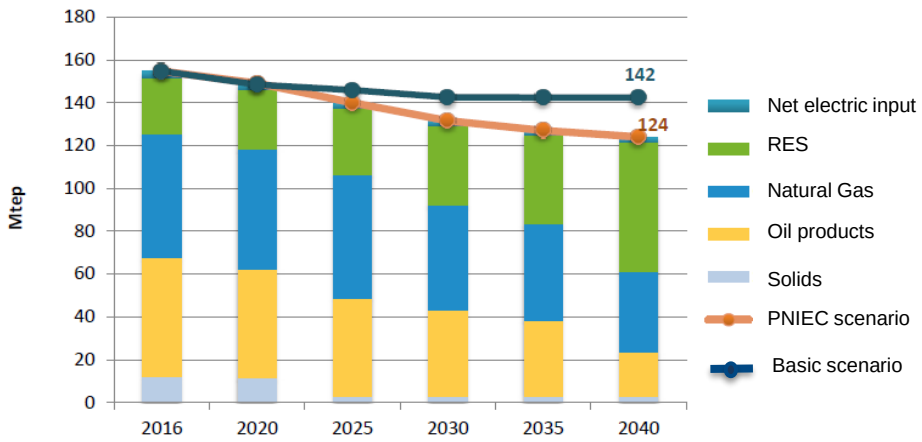
Policies & Market

Over the next 30 years, VRESs will grow globally to 16 times the currently installed capacity

The "joint Terna-Snam scenarios" indicate that around 95 additional GWh of storage capacity will be needed to be in agreement with the Fit-for-55 objectives

71 GWh relating to utility-scale installations with an E/P of 8 hours out of a total of 95 GWh

Evolution of gross internal consumption in the BASIC and PNIEC scenarios [source PNIEC / RSE]



PNIEC: Integrated National Plant for Energy and Climate →

- research activities to develop the integration of systems (electricity, gas, water), exploring, also the possibility of using existing infrastructures for energy storage renewable, even in the long term, with effective solutions from the economic and environmental cost / benefits profile.
- spread and use of *energy storage systems*, including electric vehicles, also including long-term storage, and the integration of the electricity system with gas and water systems.
- Electrochemical and Thermal Energy Storage
- Power to heat
- Power to gas

Top 3 projects

- “RdS Integrated Project 1.2“ 2025-2027
- Electrochemical and thermal storage technologies (ENEA, CNR, RSE, +30 universities)
- Covering the entire value chain from new materials to systems to integration, and crosscutting issues as sustainability and manufacturability
- Digital tool and high performace characterization
- 18 M €

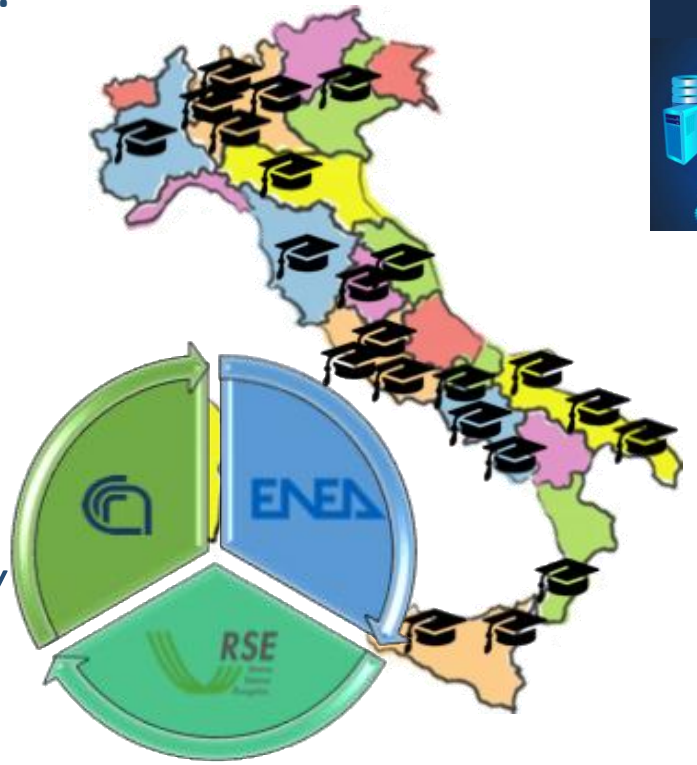
- “Orangees - ORgANics for Green Electrochemical Energy Storage”
- 2023-2026
- The primary objective is to create increasingly sustainable, high-performing, safe, and low-cost batteries to support the transition towards a greener energy future.
- 4 M €

- “IPCEI Batteries“
- 2 national projects
- 20 participants
- public support about 1200 M €
- Industrial projects on the entire battery value chain

Project “1”: RdS Integrated Project 1.2 2025-2027

Contribute to the development of efficient storage technologies starting from materials, synthesis processes and system-level choices.

- OPTIMIZATION OF CONSOLIDATED TECHNOLOGIES (e.g. Li-ion battery of gen. 3, phase change and sensible heat storage systems) AND INNOVATIVE (e.g. Na batteries, thermochemical systems and hybrid electric/thermal storage systems)
- STUDY OF FRONTIER TECHNOLOGIES (e.g. metal-ion batteries (Al, Ca, Mg, Zn), sodium-fused batteries) acting on the main critical issues.
- PROTOTYPING OF ELECTROCHEMICAL CELLS AND LABORATORY THERMAL STORAGE SYSTEMS: proof-of-concept aimed at optimizing charge and discharge cycles (electrochemical technologies) or heat storage and release cycles (thermal and thermochemical), to increase the useful life of the devices with a view to industrial scalability.



Project “1”: RdS Integrated Project 1.2 2025-2027

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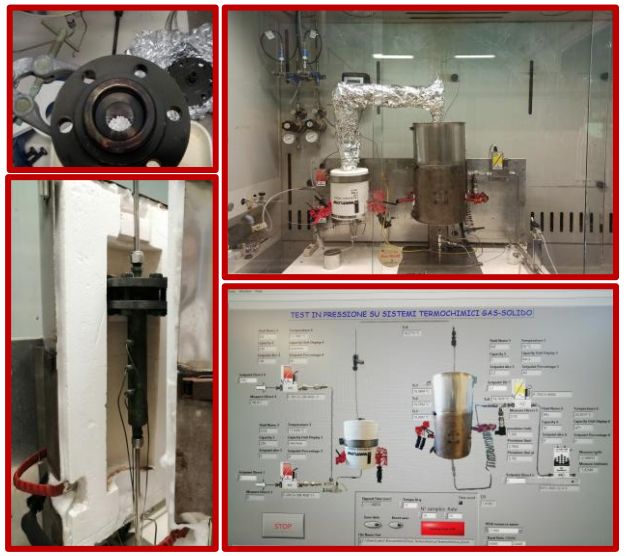
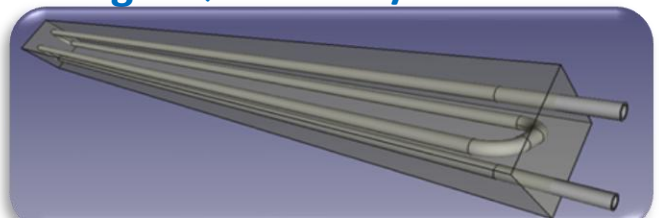
Contribute to the development of efficient storage technologies starting from materials, synthesis processes and system-level choices.

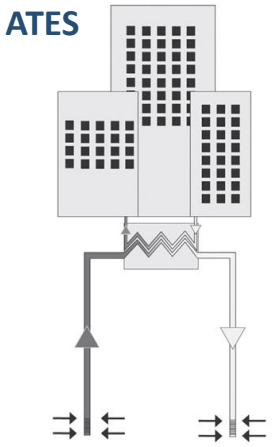
Fluidized bed reactor in Inconel up to 900 °C

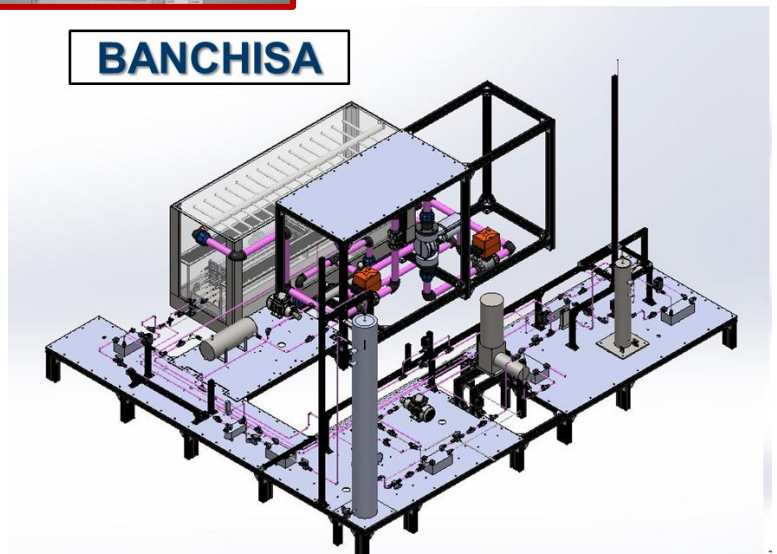


Fixed bed plant for charging and discharging reactions under realistic P and T conditions of carbonates and metal oxides supported by mayenite.

Concrete with form-stabilized PCM (up to 10 wt%) with integrated exchanger → 50 kWh/m³ nominal







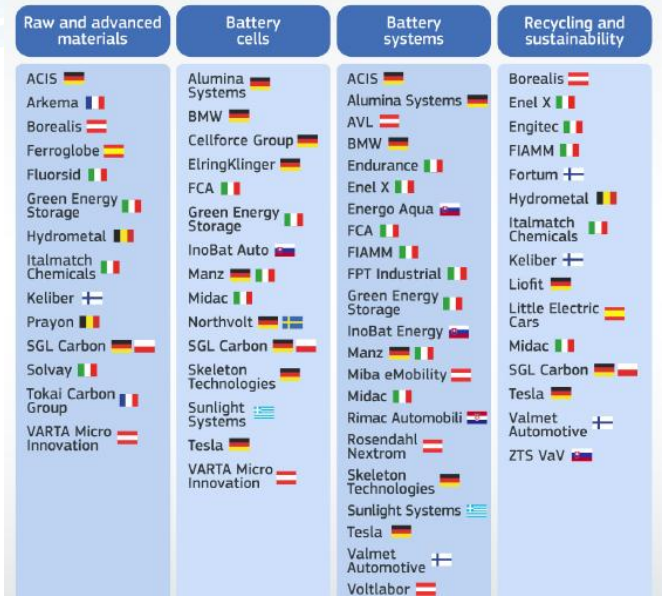
Project “2”: ORANGEES

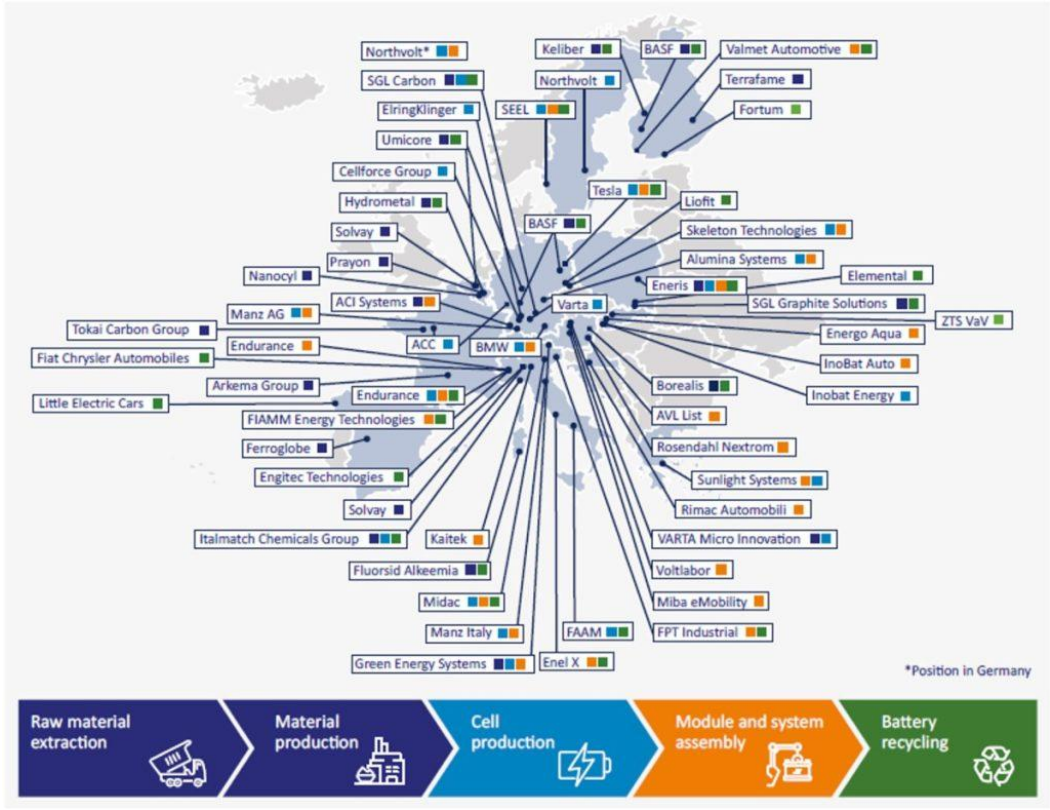
- Study of organic-inorganic **hybrid** compounds for electrochemical storage systems.
- Study of organic compounds, both **synthetic and directly derived from natural sources**, for the development of: new electrolytes, new binders, certain families of crystalline organic compounds.
- Study, synthesis, and validation of a series of compounds derived from **processing waste,** with a focus on sustainability aimed at embracing the concepts of the **circular economy**.
- Support activities for the improvement of performance and environmental/economic sustainability of next-generation electrochemical systems. Theoretical/**modeling** simulation activities, **LCA analysis**, development of functional **texturing**.

Project “3”: IPCEIs on Battery

1^ IPCEI on Batteries (09 Dec. 2019)

- Funding: 3.2 B € public support by Member States which is expected to unlock an additional 5 B € in private investments
- Contribution: 7 member States ,17 direct participants
- Italian Contribution: 5 direct participants, public support 570 M €

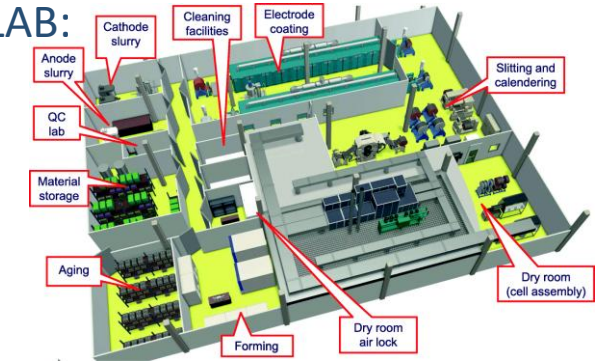




2^ IPCEI on batteries: European Battery Innovation (26 Jan. 2021)

- Funding: 2.9 B € public support by Member States which is expected to unlock 9 B € in private investments
- Contribution: 12 Member States, more than 40 direct participants
- Italian Contribution: 14 direct participants, public support ~ 600 M €

AB-LAB:



IPCEI BATTERIES

Strong collaboration within Italian companies and research centre involved

Other Relevant Information

https://www.gse.it/en

https://www.enea.it/en

https://www.cnr.it/en

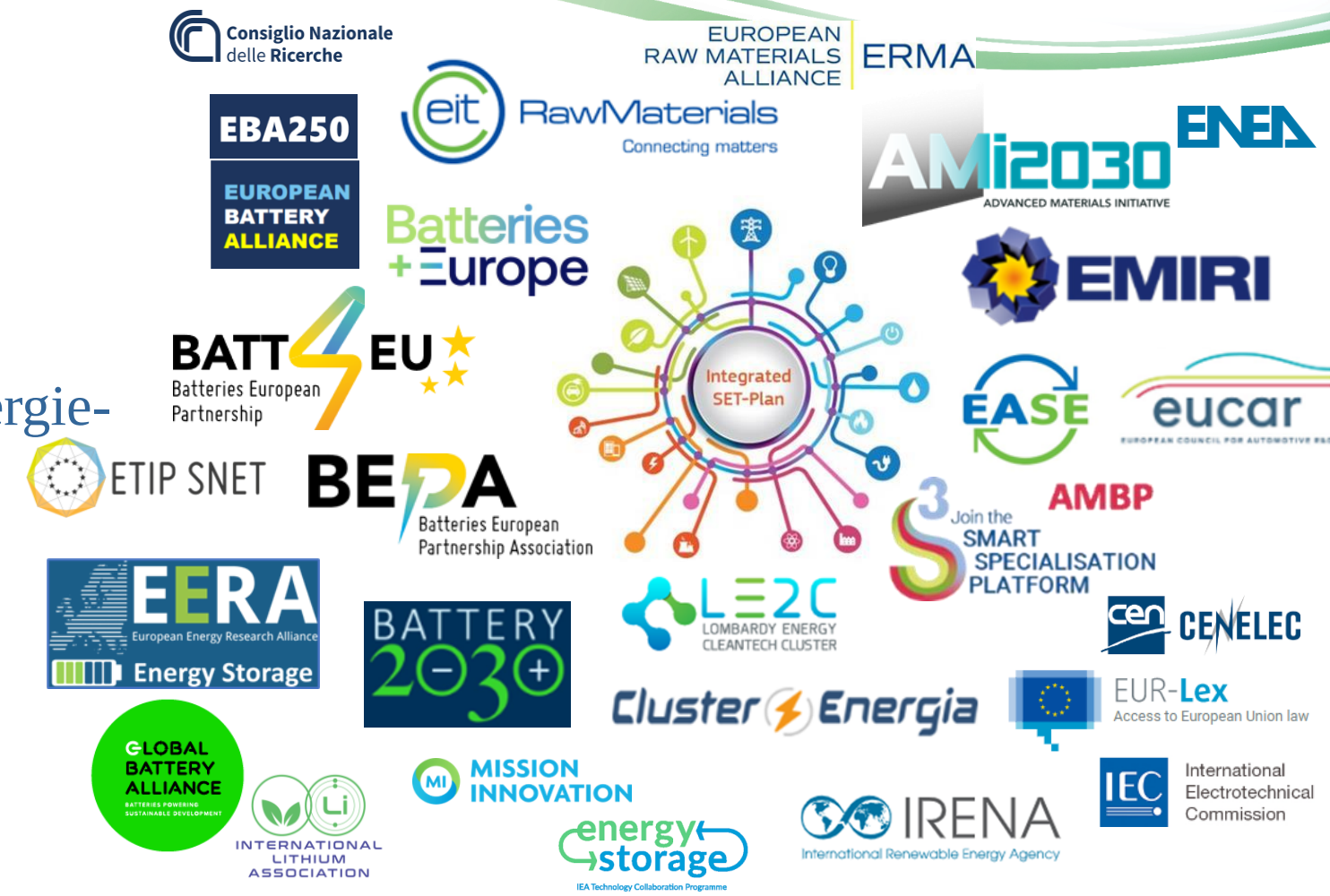
https://www.confindustria.it/en

https://www.greenme.it/informarsi/energie-rinnovabili/termodinamico-solare-concentrazione-sicilia/

https://www.mase.gov.it/

http://www.rse-web.it

https://www.instm.it/en/instm.aspx



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Thanks for your attention

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