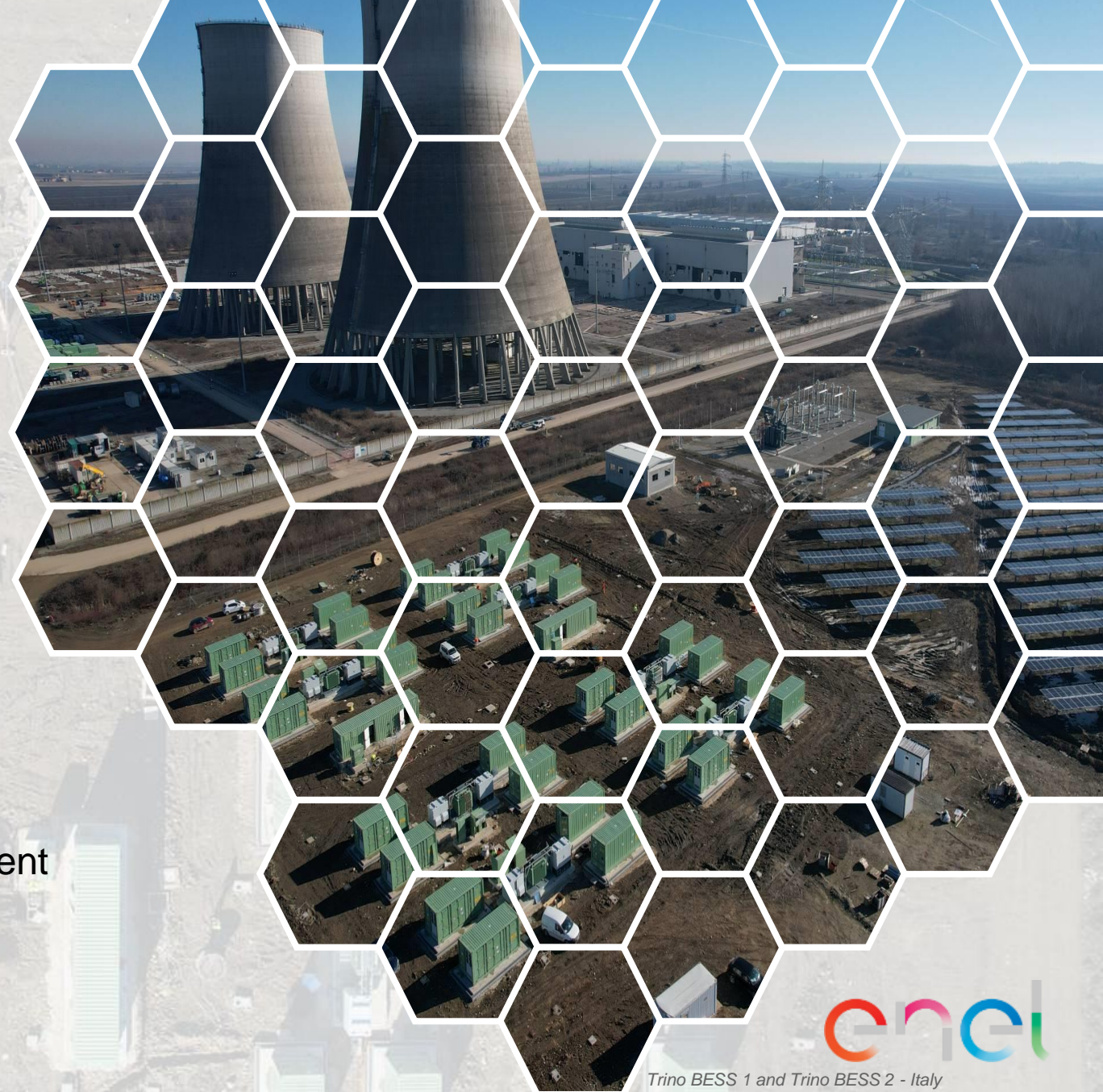


8th AIEE Energy Symposium

Grid security and energy storage

Giuseppe Cicerani, Head of Business Development
Energy Storage – Enel Green Power

Padua, November 28th, 2024



Trino BESS 1 and Trino BESS 2 - Italy
30MW/ 119MWh + 209MW/835MWh

Agenda

- 01** Intro, EGP footprint on Energy Storage and growth ambitions
- 02** Drivers of energy storage growth and price signals in the main markets
- 03** Backup



Enel Green Power, an international player in renewable generation, is a subsidiary of the **Enel Group**, a global leader in the **generation, distribution, and sale of electricity.**

Enel's Global Business Lines

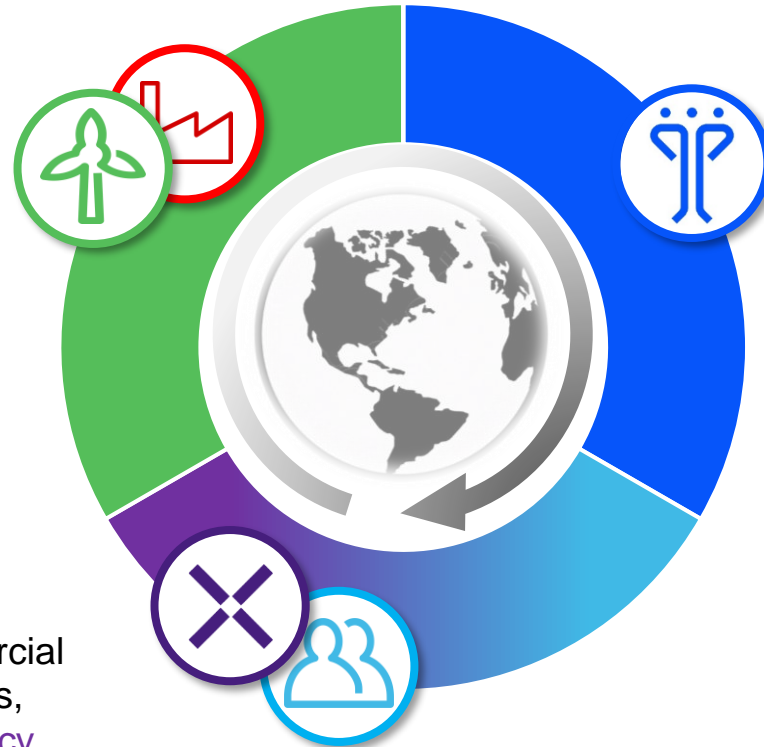


Enel Green Power & Thermal Generation

Leads the rapid expansion of renewable assets, oversees global thermal and storage asset management, ensuring secure operation and maintenance of the generation fleet, maximizing operational efficiency across regions, and conducting engineering and construction activities.

Enel X Global Retail

Optimizes integrated margin while driving commercial strategies, manages energy offerings and services, optimizes customer value and operational efficiency while innovating lifecycle solutions, exploring new technologies and business models, and overseeing the e-Mobility portfolio across countries to maximize growth and profitability



Enel Grids

Guarantees reliability and quality of service in the energy supply through efficient, resilient and digital grids

Global Energy and Commodity Management

Oversees operational functions, including maximizing integrated margins within risk limits, optimizing energy supplies, dispatching generation fleets, trading energy commodities in wholesale markets for the hedging needs of the Group.

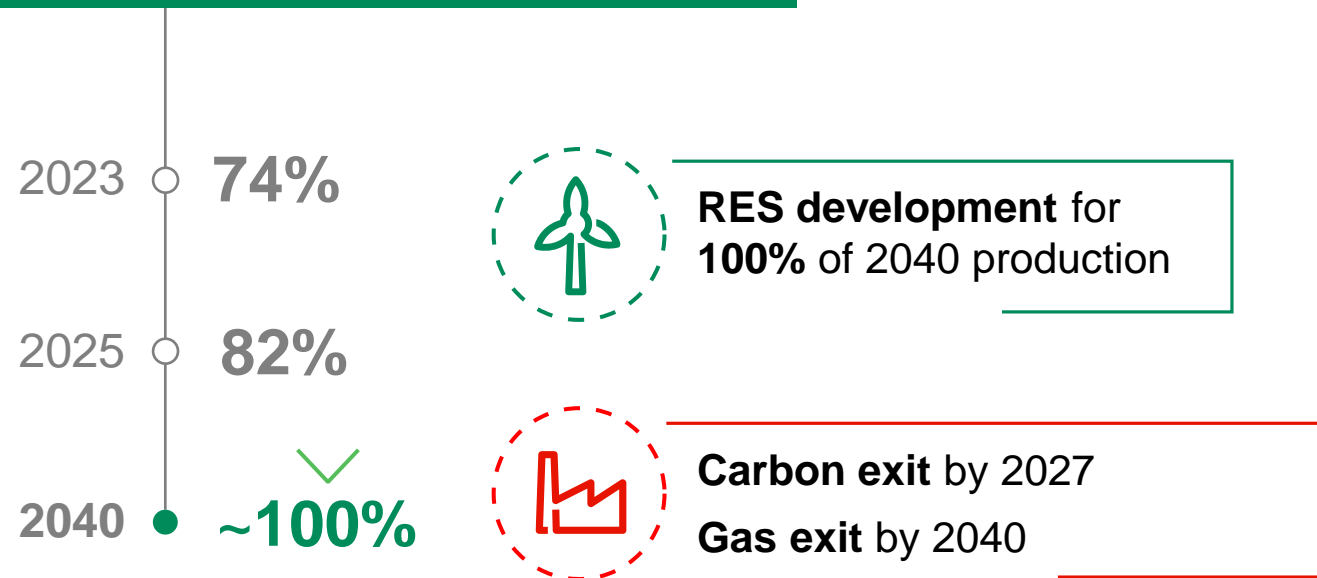
The Enel Group's path to 2040

A concrete ambition: bringing our “carbon footprint” to **zero**



The development of EGP's renewables will lead the Enel Group to its “zero emissions” target, **ten years ahead** of its international commitment.

% RENEWABLES OUT OF TOTAL



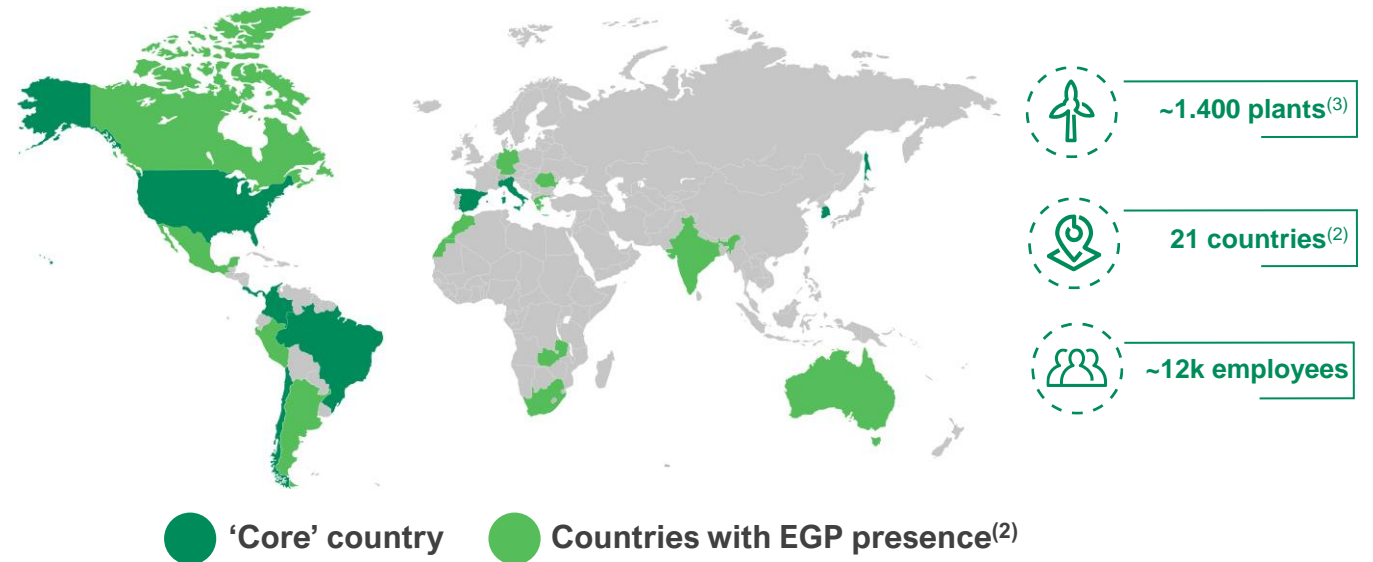
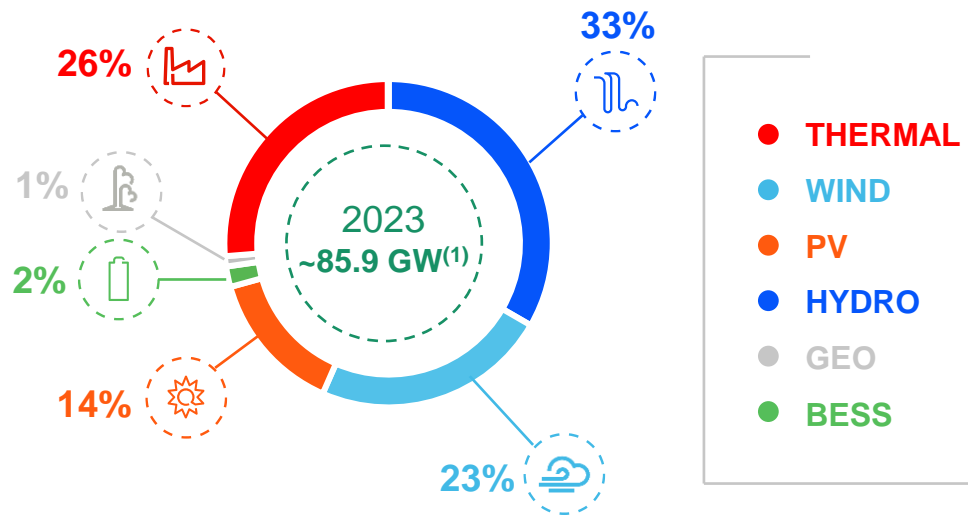
By 2027, through the decommissioning of all coal-fired plants (*coal phase out*), we will meet our commitment to **100% renewable generation**.

By 2040, we will generate power with zero emissions and no CO₂ sequestration.

A balanced and resilient generation portfolio



EGP's strength as an international player comes from its **global** presence and diversified **technologies**, with a strong grounding in the countries where it is active.



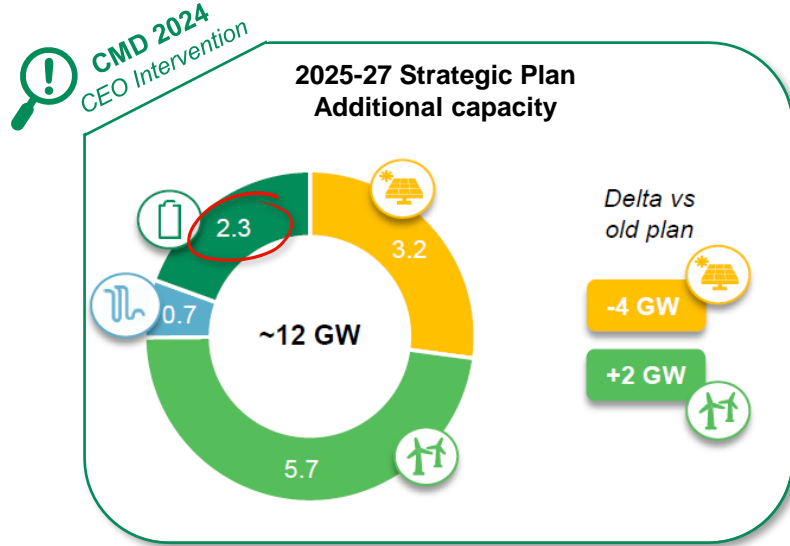
Established presence in all **renewable technology chains**: hydropower, onshore wind, photovoltaics, geothermal

Geographical diversification, selecting the most **interesting** investment opportunities and sharing operational **best practices** from country to country.

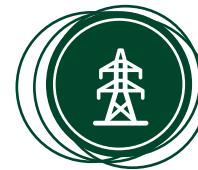
1. Of which 63 GW of renewable capacity is approx. 1600 MW BESS
2. Countries with plants (including thermal) in operation or under construction
3. Including RES and thermal plants that are in *ownership, partnership, and stewardship*

Enel positioning on Energy Storage

Storage as enabler of energy transition, responding to increasing flexibility need



The **growth of renewable generation** generates **effects on spot markets** (profile costs and negative price hours) that increase **system flexibility needs (x 4,5 from 2022 to 2050**)**. **Energy Storage will cover approximately half of the additional need, with always increasing storage durations.**



Investments in Storage are increasingly remunerated through **mechanisms** that are **partially** (ex. Capacity Market) **or completely regulated** (ex. MACSE for 8 hours duration).

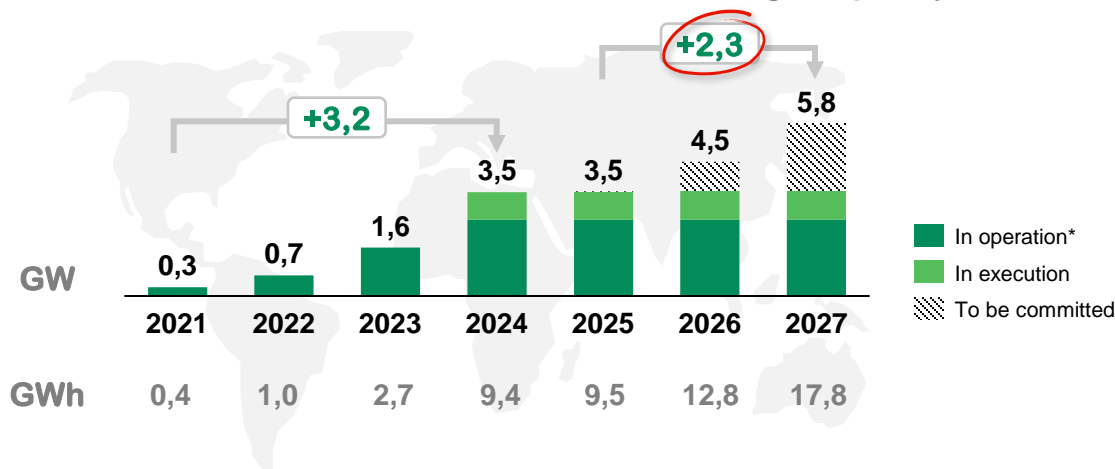


Enel is developing **new pumped hydro plants** by primarily enhancing its infrastructure, through conversion from generation to pumping and upgrading existing pumped hydro plants.



Enel is also actively developing storage systems based on both **consolidated technologies (pumped hydro and lithium batteries)** and **innovative ones**, monitoring **technological evolution** in order to diversify the portfolio of solutions.

Focus on evolution of EGP cumulated storage capacity



*Projects that have reached the Additional Capacity milestone are considered to be in operation, ** IEA, World Energy Outlook 2023,

Agenda

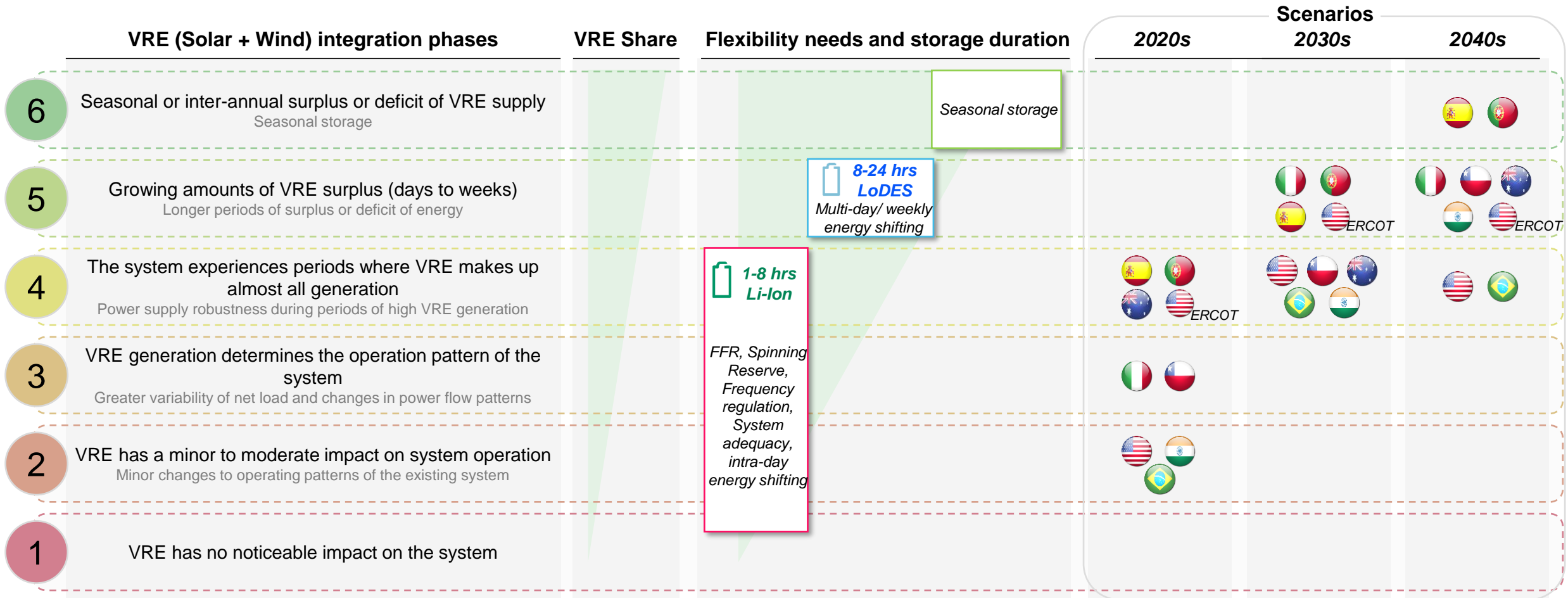
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The need for energy storage

Variable Renewables (VRE) penetration defines the needed duration



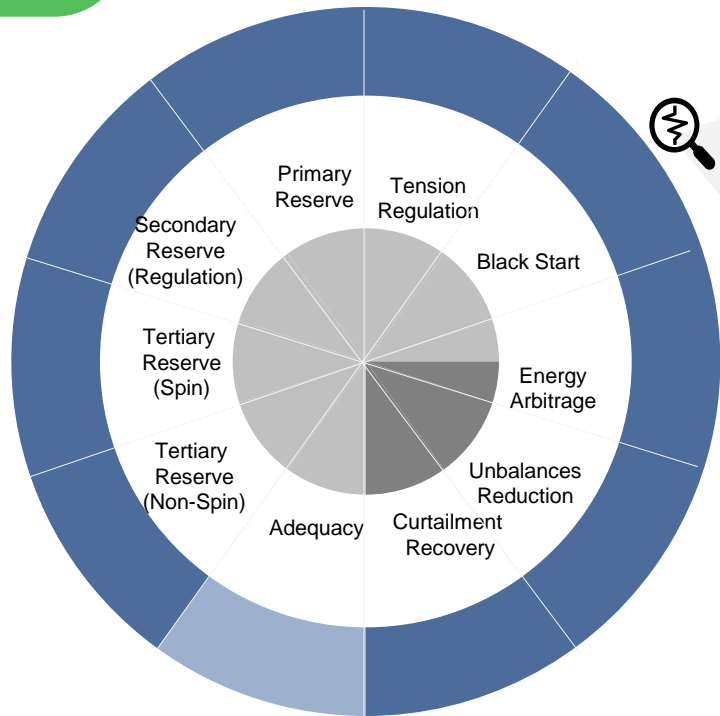
Li-On BESS reference tech until around 2030 and LoDES in next decade



Price signals for energy storage growth in main markets



Energy Storage Applications



- Services to the grid
- Adequacy
- Services to the plant
- Energy and Ancillary Services Markets

Revenues Streams

Energy and Ancillary Services Markets

Adequacy

Long-Term Remuneration

Other Support Schemes

- ITALY**
- SPAIN**
- GREECE**
- BRAZIL**
- CHILE**
- ERCOT**
- PJM**
- SPP**

- Energy Arbitrage
Primary (from 2028)
Secondary
Tertiary
- Energy Arbitrage
Secondary
Tertiary
- Energy Arbitrage
Ancillary services
(recently introduced)
-
- Energy Arbitrage
- Ancillary Services
- Energy Arbitrage
Spin/Non-sp. Reserve
Regulation
- Energy Arbitrage
Spin/Non-sp. Reserve
Regulation
- Energy Arbitrage
Spin/Non-sp. Reserve
Regulation

- Capacity
Market (reg.
15y)
- Capacity
Market (to be
introduced)
- Capacity
Market (to be
introduced)
- Capacity
Auctions (reg.,
exp. in 2025)
- Potencia
Suficiencia
(spot)
-
- Reliability
Pricing Model
(reg., 1y)
-

- MACSE tender
(expected in
2025)
-
- Stand alone and
RES+BESS
-
-
- RES+BESS
RFP
-

-
- EU Recovery Fund (R&D,
stand-alone, RES+BESS)
- EU Recovery Fund, Connection
priority for DPGUs
- Import tax exception for BESS
-
- Investment Tax Credit
(30%-50% Capex eligible)

Long term remuneration schemes being introduced with fully regulated mechanisms or stacked with spot markets revenues (arbitrage and ancillary services) as alternative.

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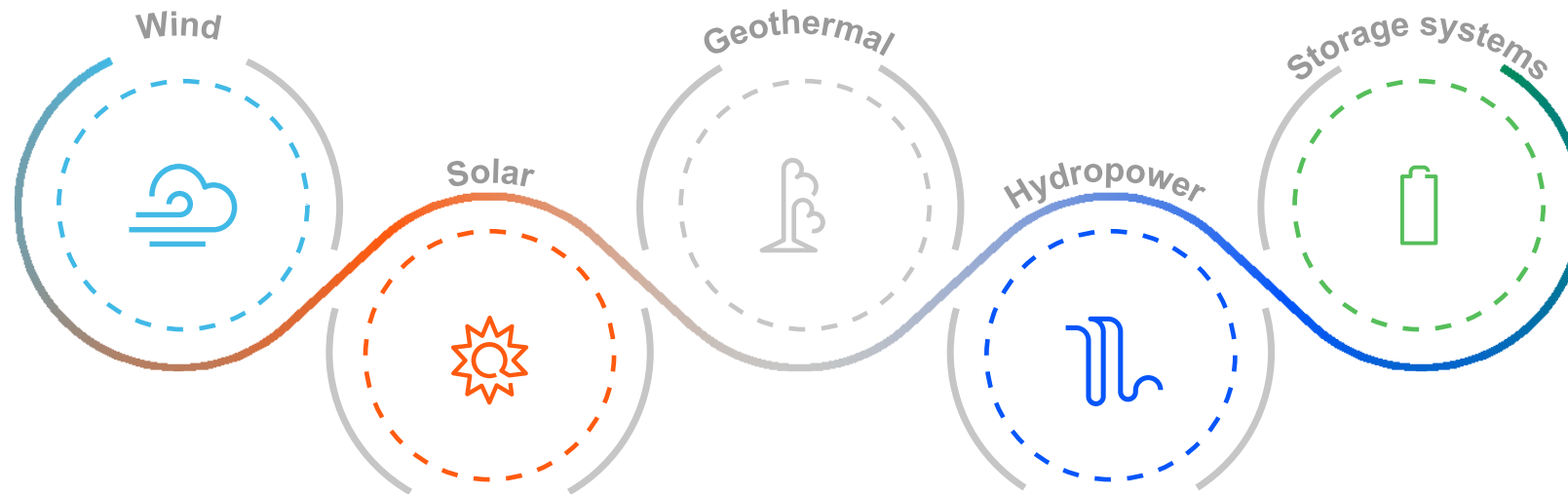
*Trino BESS 1 and Trino BESS 2
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Enel Green Power: 'front runner' in renewables

Our industrial calling, our operating style



Enel Green Power is a global leader in clean energy, thanks to a generation mix that includes **wind, solar, geothermal, and hydropower**, as well as **storage systems**.



EGP generates in 21 countries, with a total capacity of **86 GW⁽¹⁾**, **63 GW** of which is **renewable**, with **plants** in Europe, the Americas, Africa, Asia, and Oceania. Technological innovation and operational excellence - internationally recognized - are also applied to repowering existing plants, to increase **efficiency** and **reliability**, while cutting generation costs.

1. Includes capacity managed in *ownership, partnership, and stewardship*

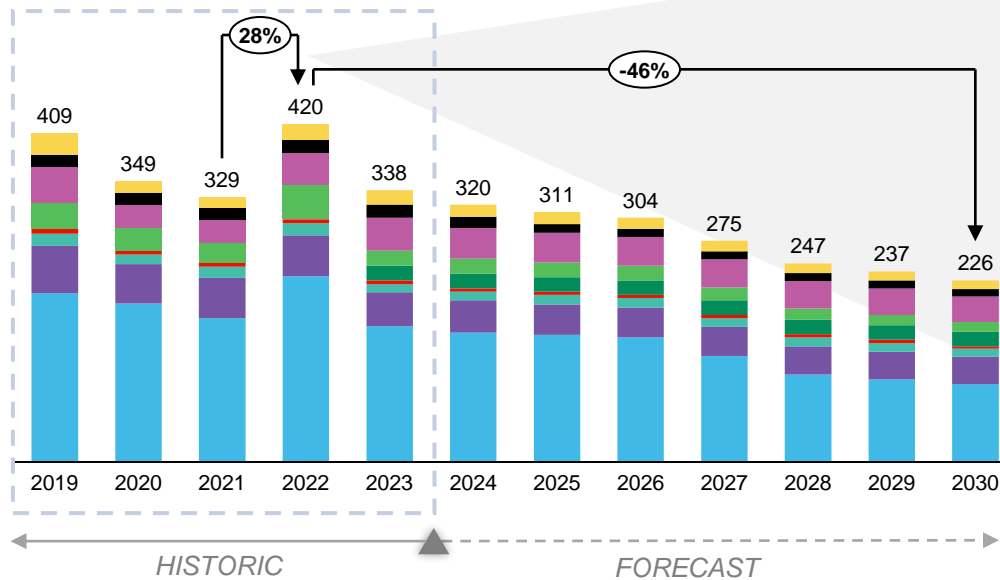
BESS CAPEX – historical perspectives and outlook

Lithium huge increase in 2021-22 strongly impacted BESS Capex



BESS 4h Full Capex: historic trend and outlook (2023)
Real 2023 USD/kWh

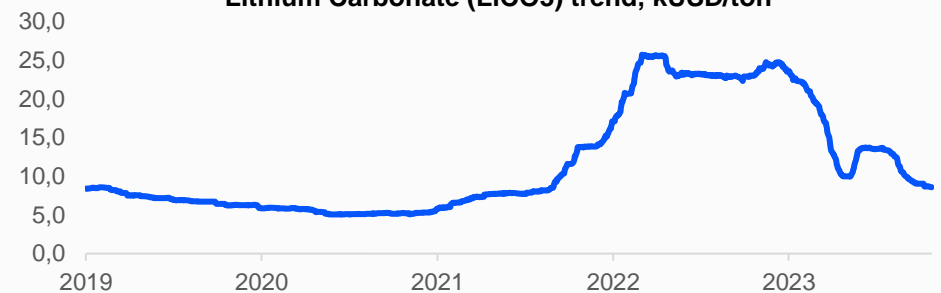
Source:
BloombergNEF



BATTERY COST FOLLOWS THE SUSTAINED RAW MATERIALS PRICE INCREASE

- **Lithium carbonate price** has seen a strong price increase in 2021-2022 as a result of **supply-demand imbalances and supply chain constraints**
- Strong correlation between raw material price and battery capex increase

Lithium Carbonate (LiCO₃) trend, kUSD/ton



Source: metal.com

Against a sustained drop of the BESS total capex during the 2017-2021 period (**-54%**), the raw materials price increase between 2021 and 2022 caused a trend inversion (**+28%**) decelerating deployments in the near term.

Battery prices restarted to drop in 2023 and are expected to reach a value around **-46%** by 2030