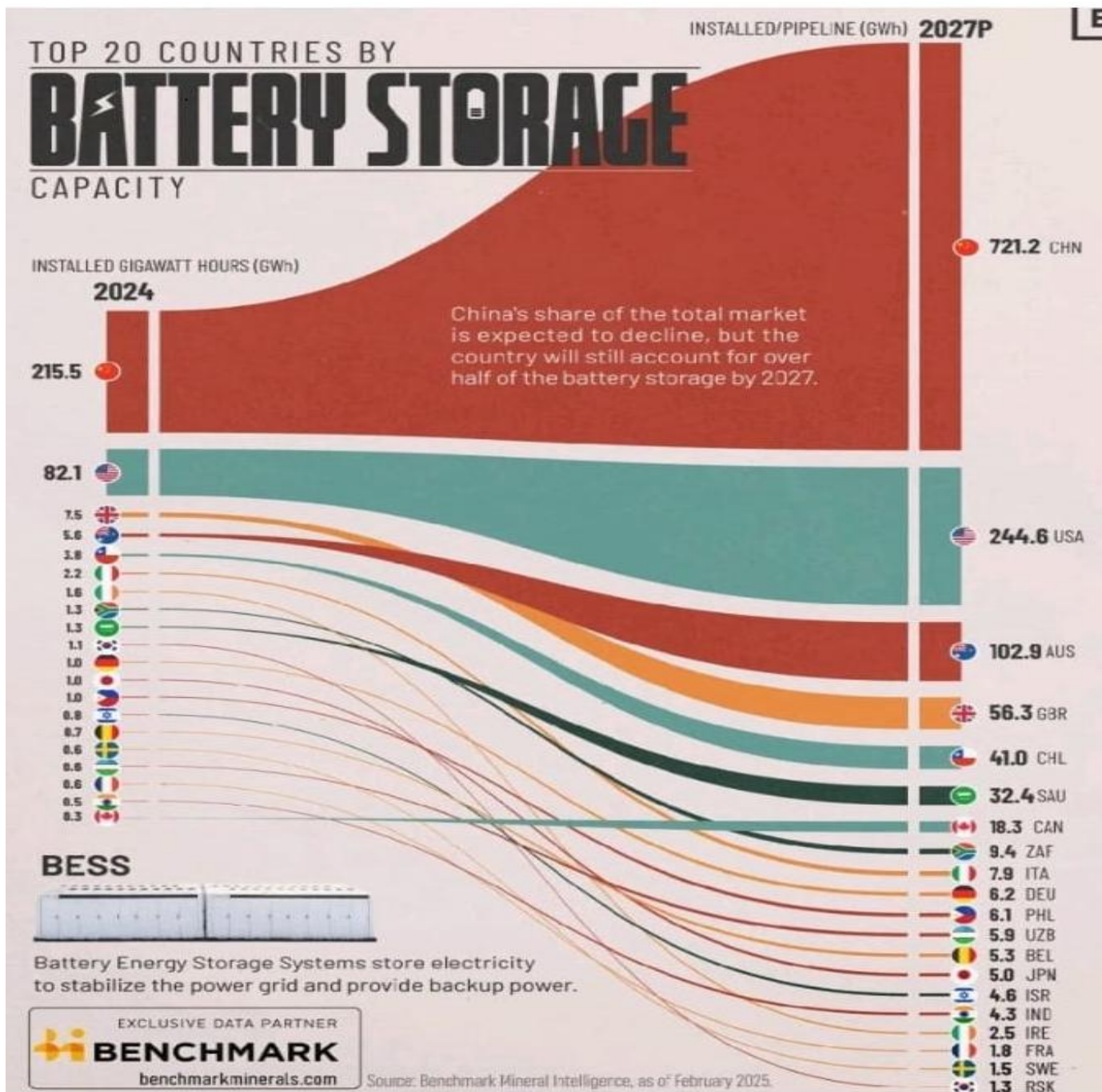




Our World Can't Wait.

Prof. Manlio F. Coviello
President
ENERGY DOME Latam

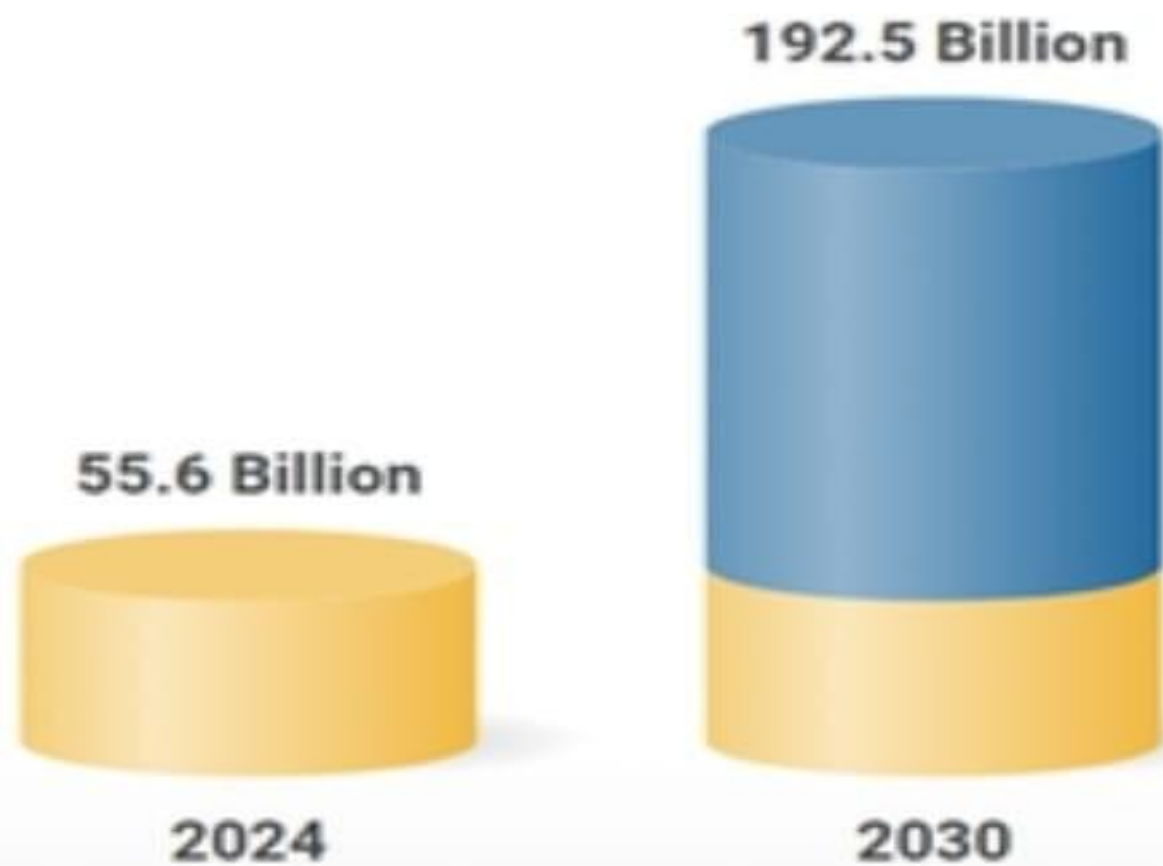
The only viable alternative for long-duraton energy storage



ONDE FICA O
BRASIL ??

Stationary Energy Storage Market

Market forecast to grow at a CAGR of 23.0%

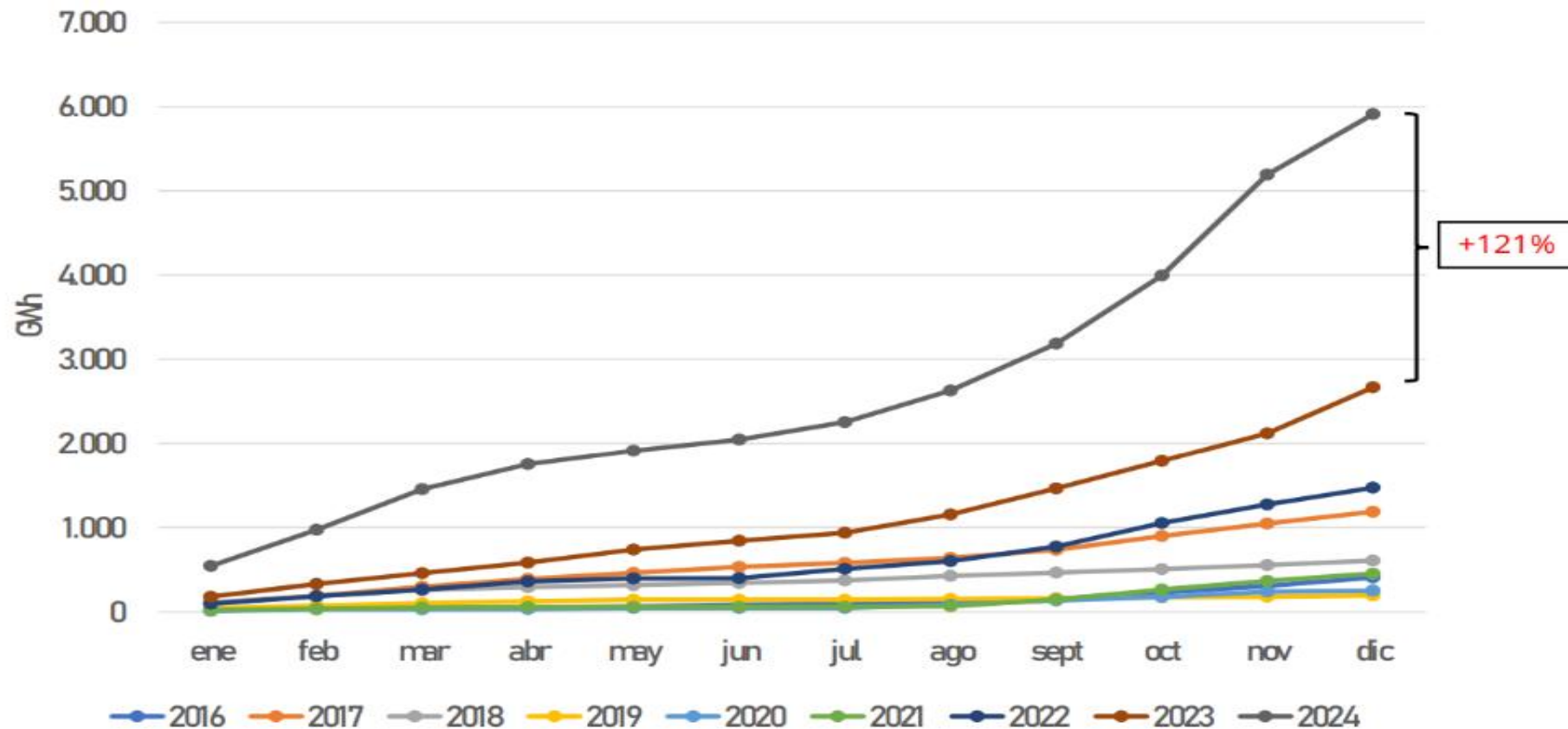


NEWS

Chile curtailed 6TWh of solar PV and wind power in 2024

By Jonathan Touriño Jacobo

January 13, 2025



BESS en auge: Chile tiene más de 14 GW de capacidad en proyectos en fase de calificación

Además, el país suma 999 MW de potencia operativa en baterías, 574 MW en fases de prueba y más de 3500 MW en construcción según datos de la Asociación Chilena de Energías Renovables y Almacenamiento.



FEATURES, ANALYSIS, INTERVIEWS

BESS: Chile's renewables saviour?

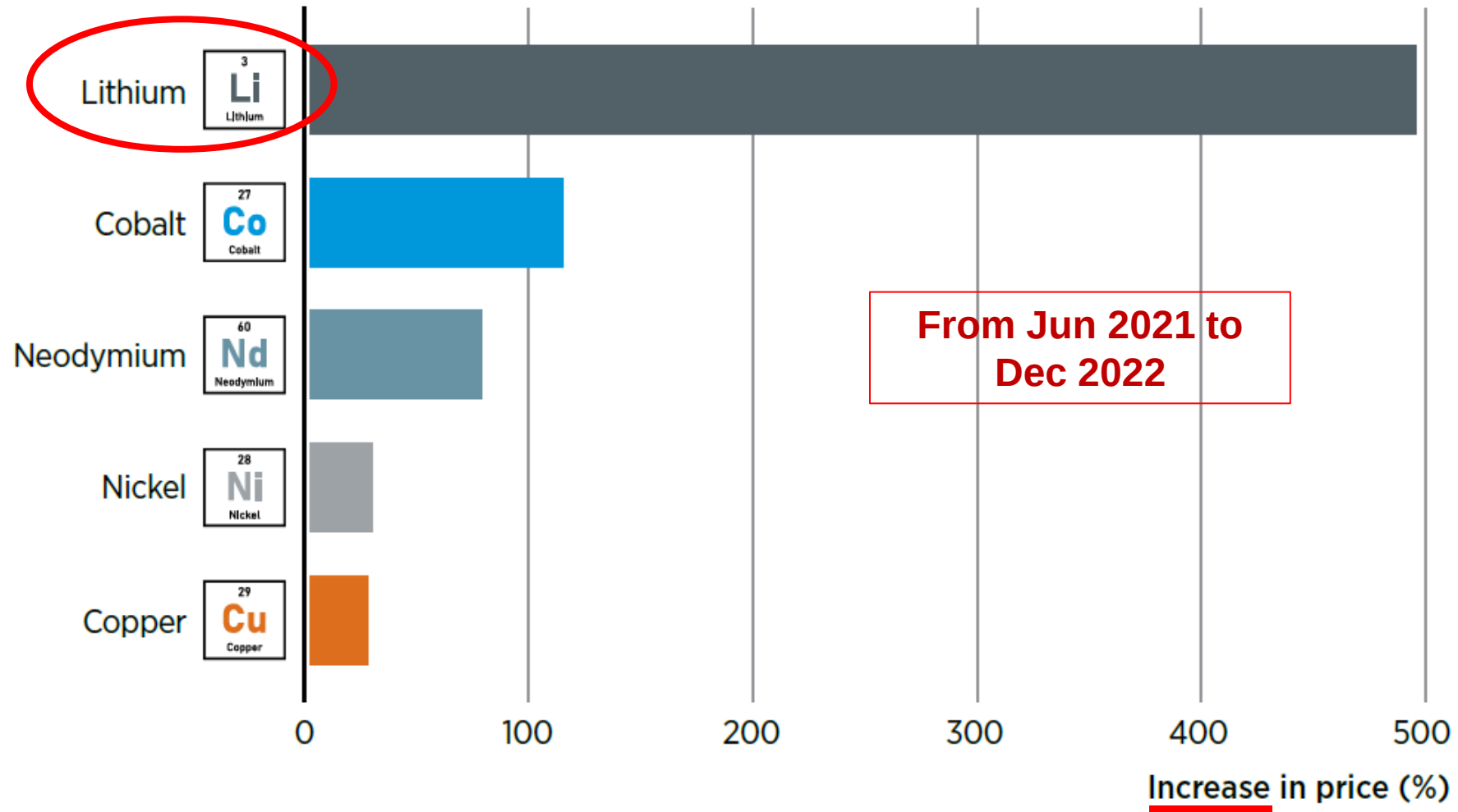
By [Jonathan Tourino](#)

January 27, 2025

Few obstacle to this “rescue”:

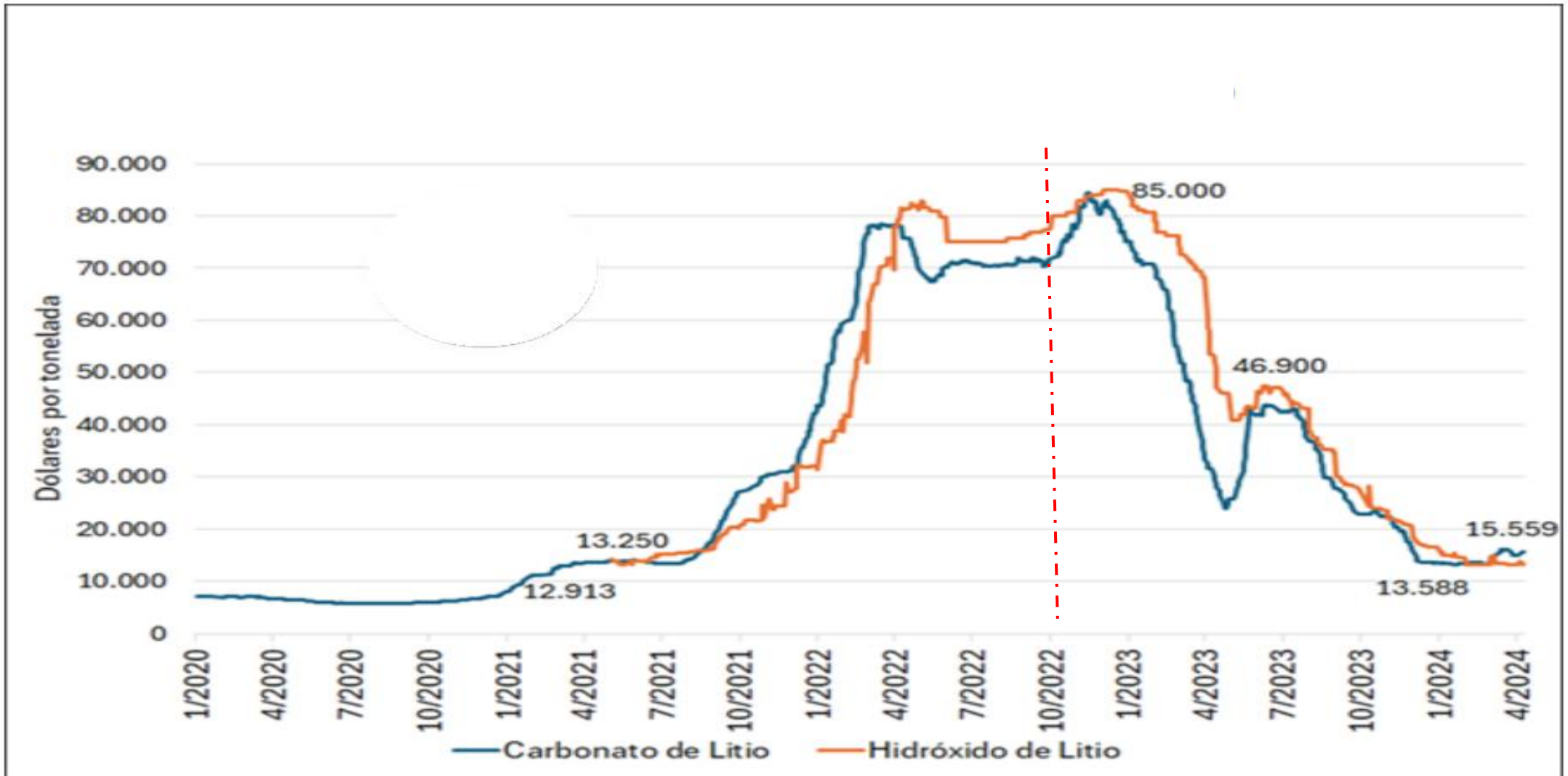
- **Degradation** of Ion-Lithium BESS shows higher rate than forecasted
- There's the risk of “storage **curtailment**” at specific hours in the night
- Unclear future **prices** of both lithium & BESS (all controlled by China..)
- Unclear if BESS will efficiently operate for longer **duration** (i.e. **8+** hours)

COST OF CRITICAL MATERIALS

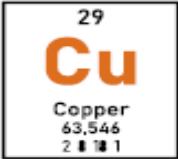
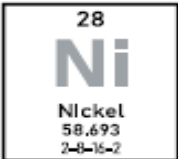
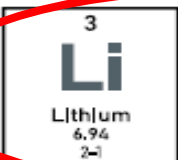
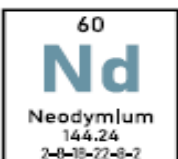


PRICE VOLATILITY OF **LITHIUM**

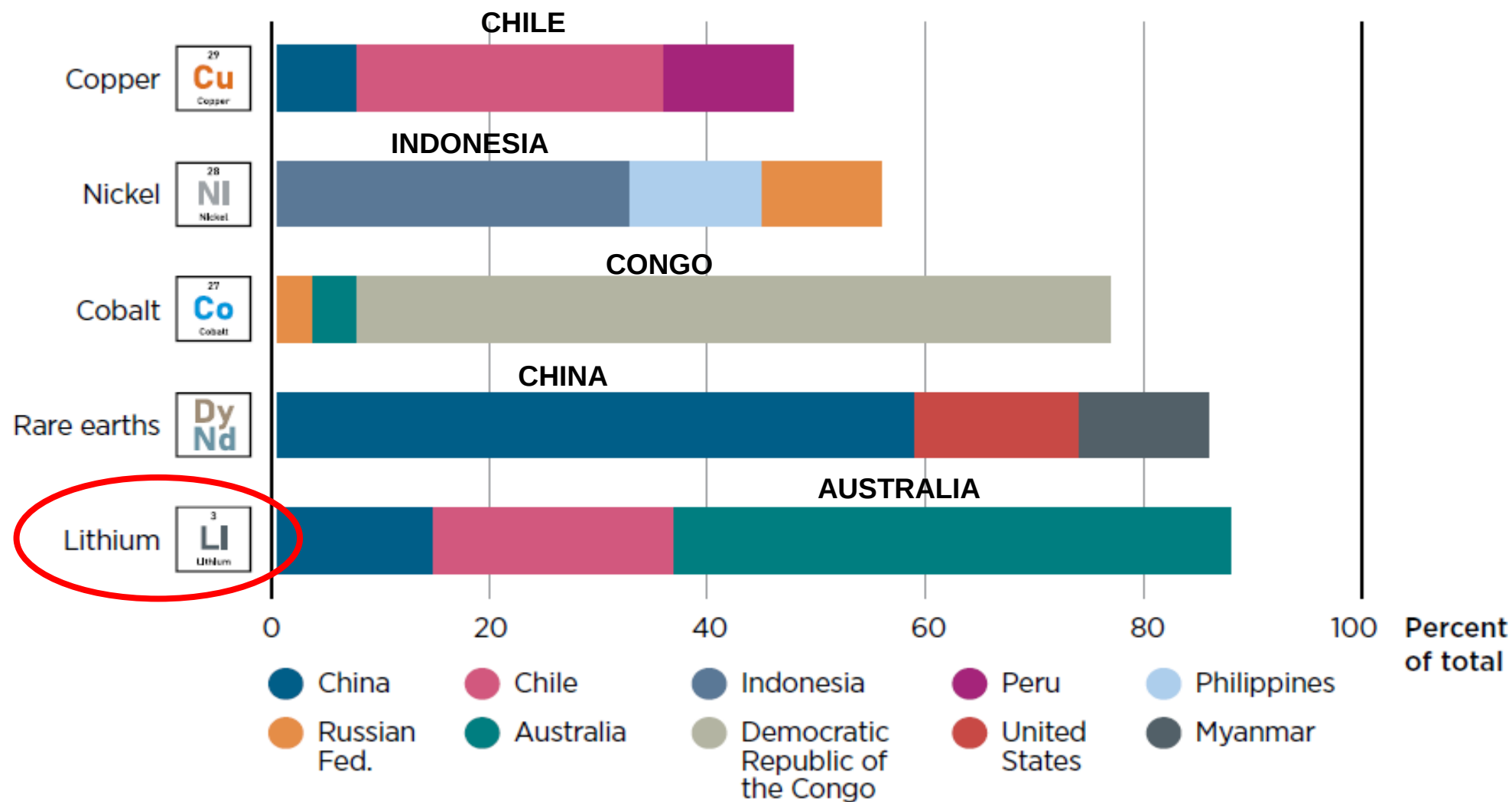
CAN WE ACTUALLY FORECAST THE COST OF LITHIUM-ION BESS ?



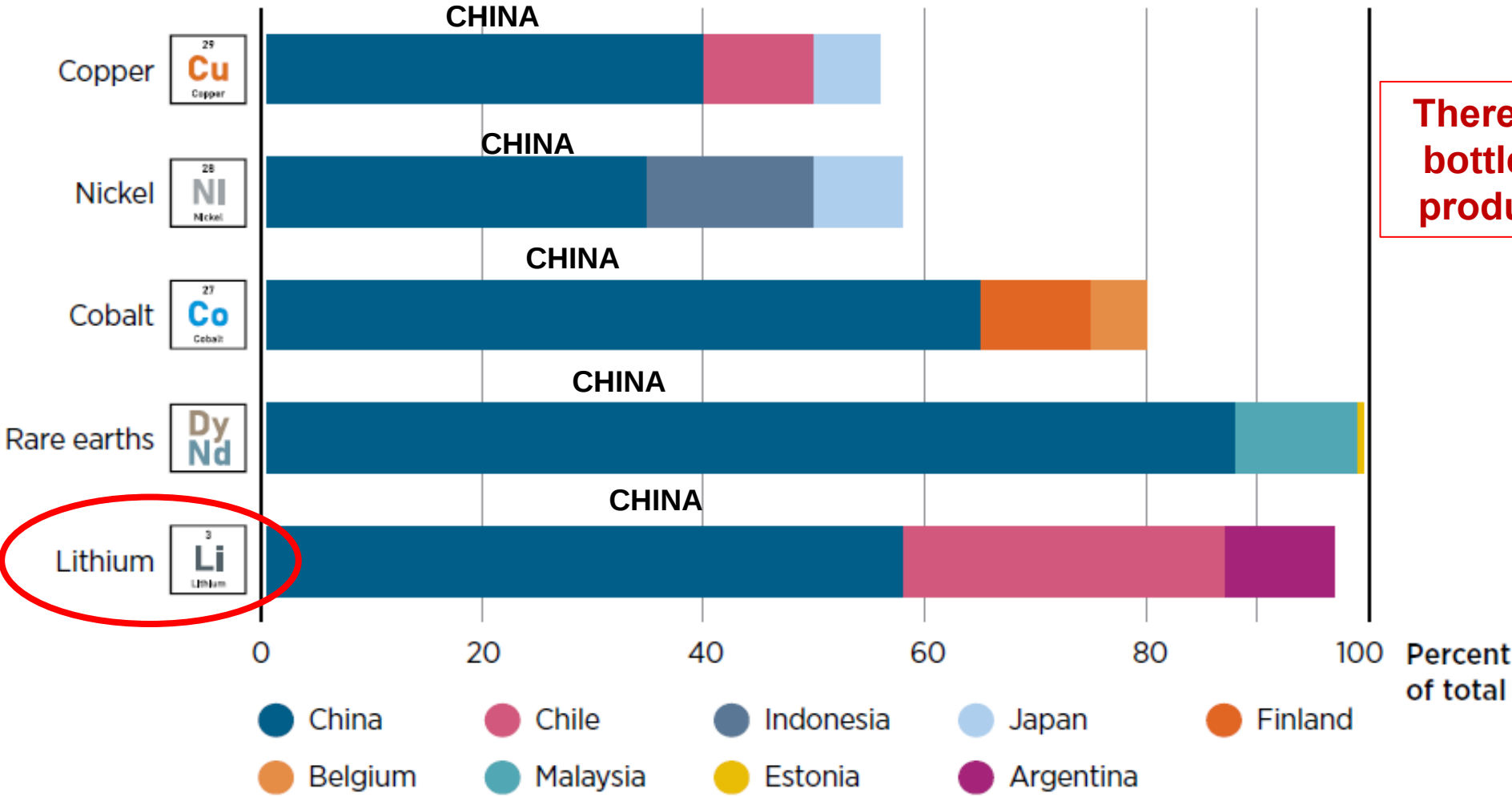
DEMAND FOR CRITICAL MATERIALS (1/2)

Material		Demand in 2021 (Mt/year)	Demand in 2050 (Mt/year)
	Copper	 30 Mt/yr	 50-70 Mt/yr
	Nickel	 2.77 Mt/yr	 5-8 Mt/yr
	Lithium	 0.3 Mt/yr	 2-4 Mt/yr
	Neodymium	 0.03 Mt/yr	 0.2-0.5 Mt/yr

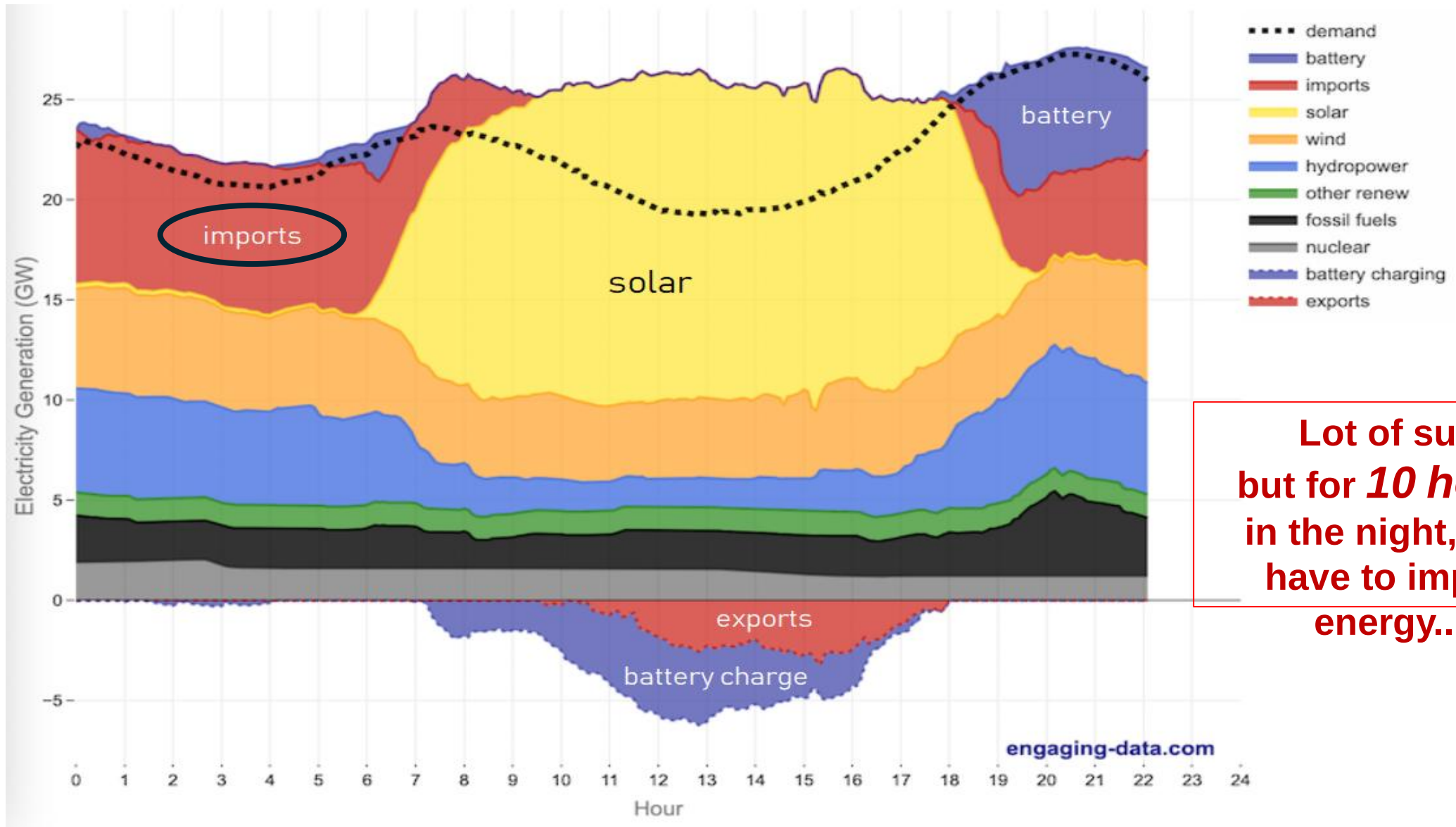
Critical materials: TOP PRODUCERS



Critical materials: TOP PROCESSOR



HOUSTON WE HAVE A PROBLEM.....IN CALIFORNIA (May 2024)



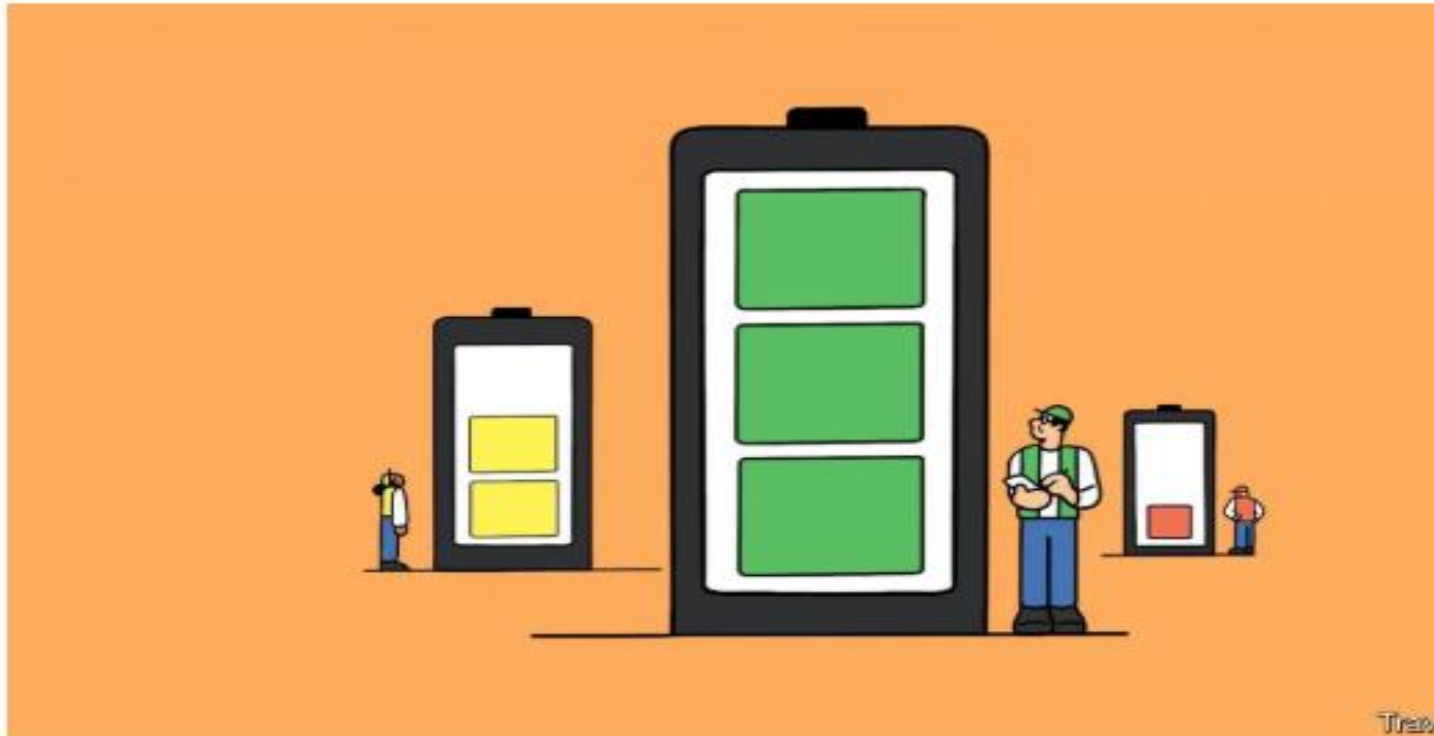
Lot of sun,
but for **10 hours**
in the night, they
have to import
energy....



Technology Quarterly | Beyond batteries

Decarbonisation of electric grids reliant on renewables requires long-duration energy storage

Share



**LDES is
coming...**

Batteries: short vs long duration

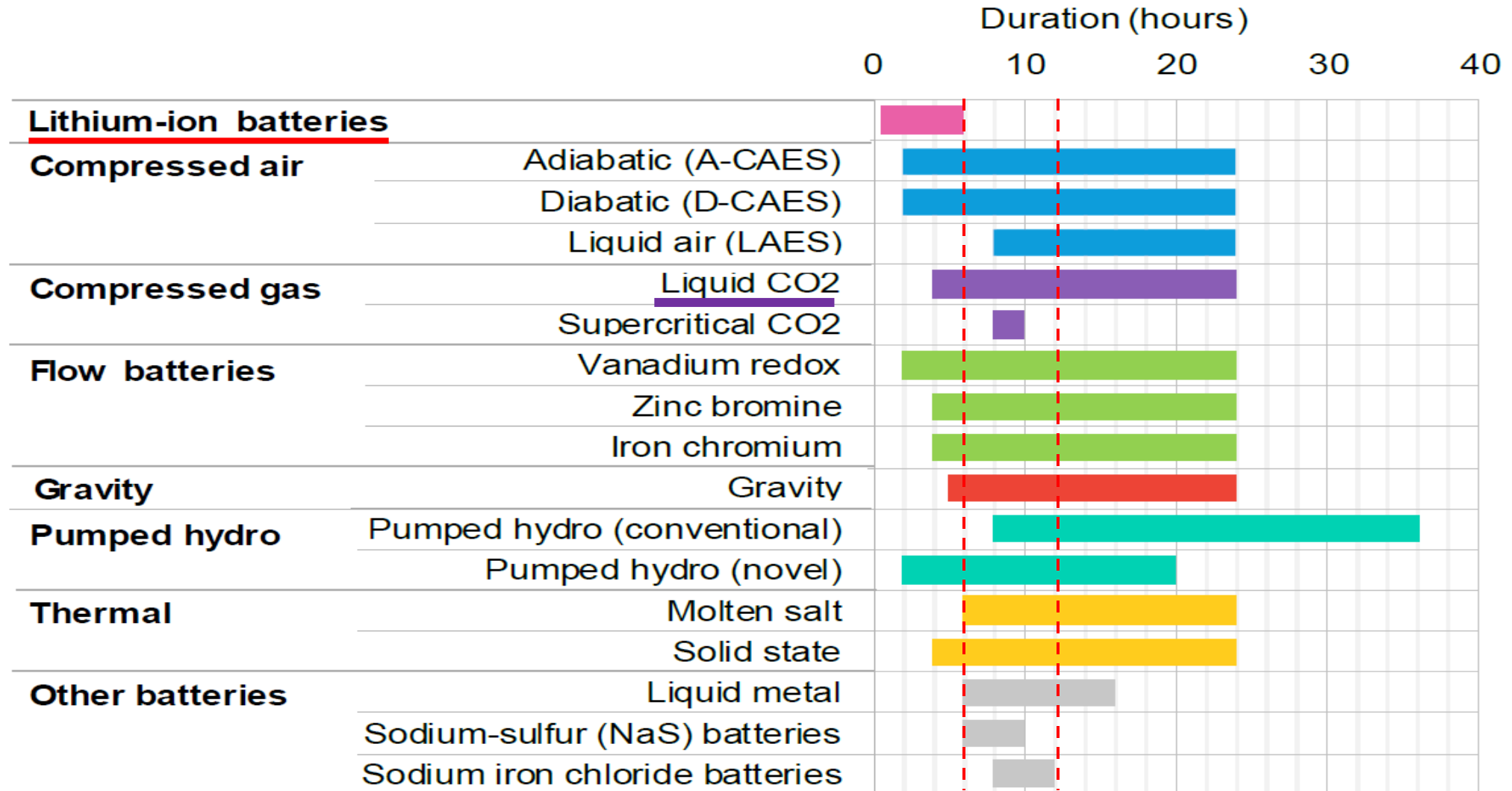
- Interest in **Long-Duration Energy Storage (LDES, > 8 hours)** is growing globally, as the demand for **clean, firm and long-duration** capacity increases compared to lithium batteries
- Nonetheless, LDES technologies are – in many cases - **still more expensive** than standard Lithium-Ion batteries made in China
- LDES technologies have a better **chance of competing in non-Chinese markets**, due to the relatively higher costs of lithium-batteries outside China
- **Technology development** and **support policies/regulations** are essential to reduce costs & create industrial opportunities for LDES

Long Duration Energy Storage (**LDES**): technologies

Storage type	Technology	
Electrochemical	Flow batteries	Other battery technologies
	• Vanadium redox (VRB) • Zinc bromine (ZBB or ZNBr) • Iron chromium (Fe/Cr batteries)	• Liquid metal batteries • Sodium-sulfur (NaS) batteries • Sodium iron chloride batteries
Mechanical	Compressed air and liquid air energy storage	Gravity energy storage
	• Diabatic compressed air (D-CAES) (Natural cavern) • Adiabatic compressed air (A-CAES) (Natural cavern) • Adiabatic compressed air (A-CAES) (Man-made cave) • Adiabatic compressed air (A-CAES) (Tank) • Liquid air (LAES)	• Rail-based • Tower solid • Underground piston-based • Underground shaft-based
	Compressed gas energy storage	Novel pumped hydro
	• <u>Liquid CO2 (CCES)</u> • Supercritical CO2 (SCES)	• High-density fluid
Thermal	Thermal energy storage	
	• Molten salt • Solid state	

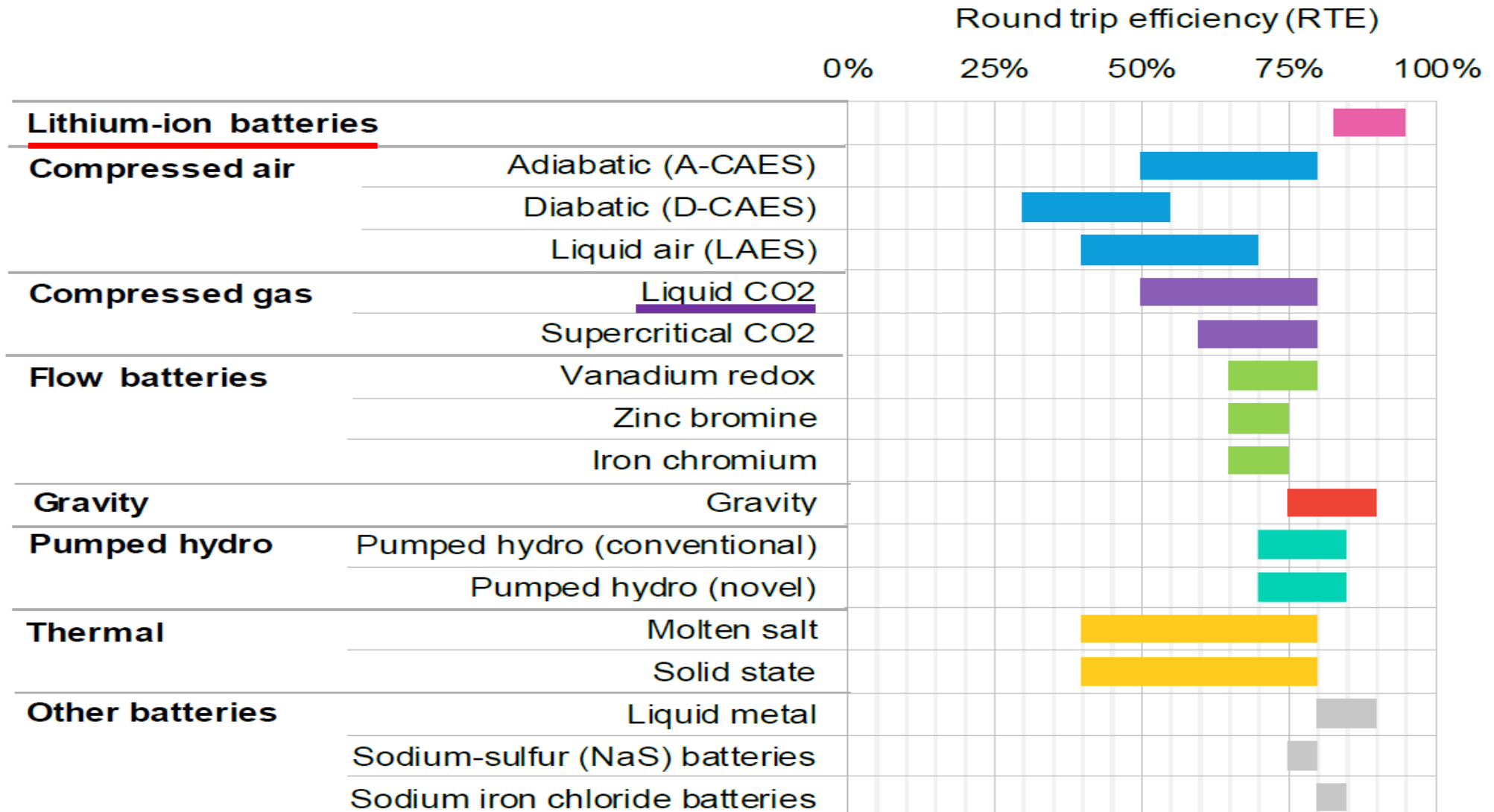
DISCHARGE DURATION

DISCHARGE TIME FOR SYSTEM'S MAXIMUM OUTPUT POWER



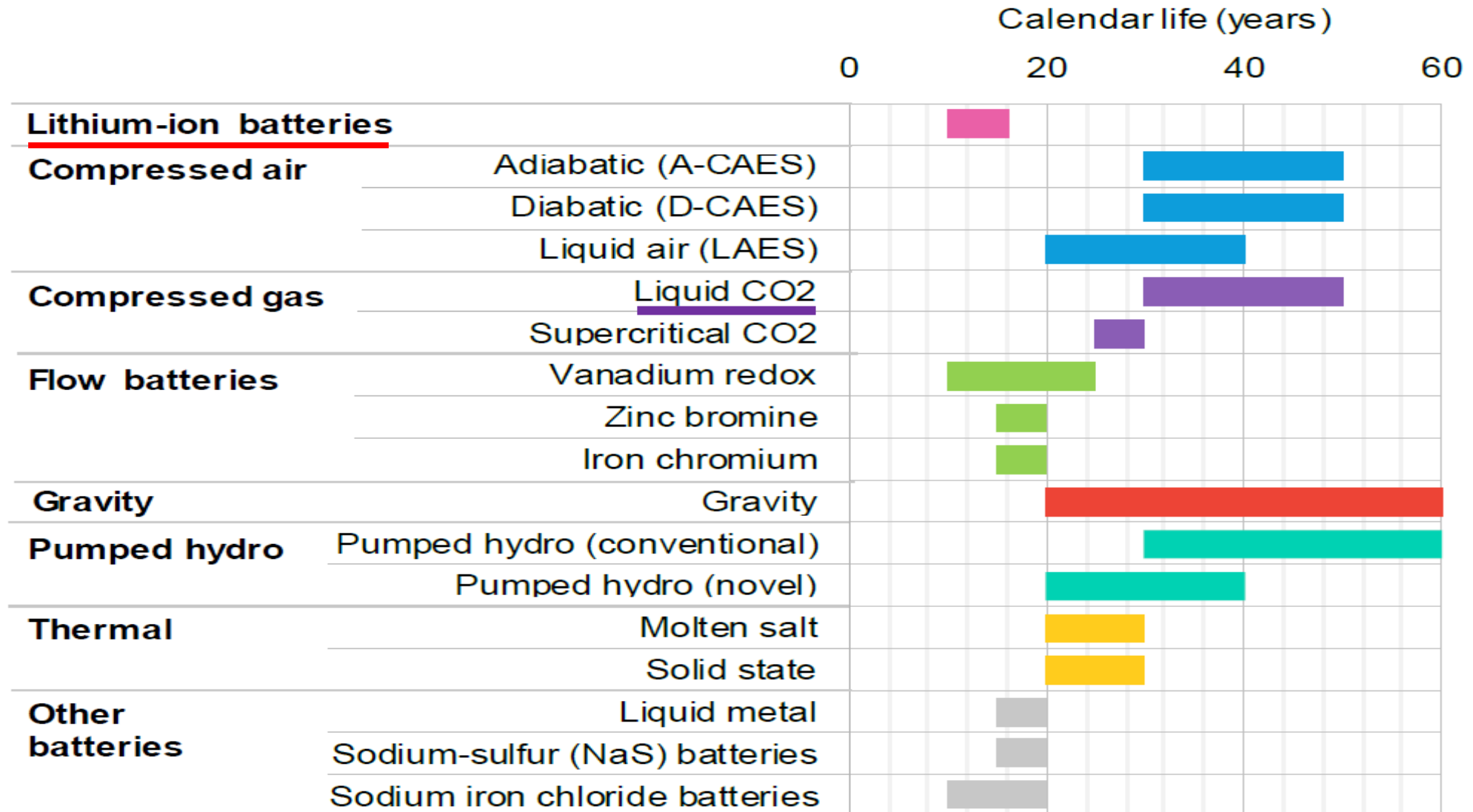
ROUND TRIP EFFICIENCY

output/input energy Ratio, during CHARGE/DISCHARGE CYCLE



CALENDAR LIFE

*max operational time of the system, before its **end-of-life***



LDES without Critical Minerals:

The challenge of ENERGY DOME

Google invests in long-life batteries made in Italy

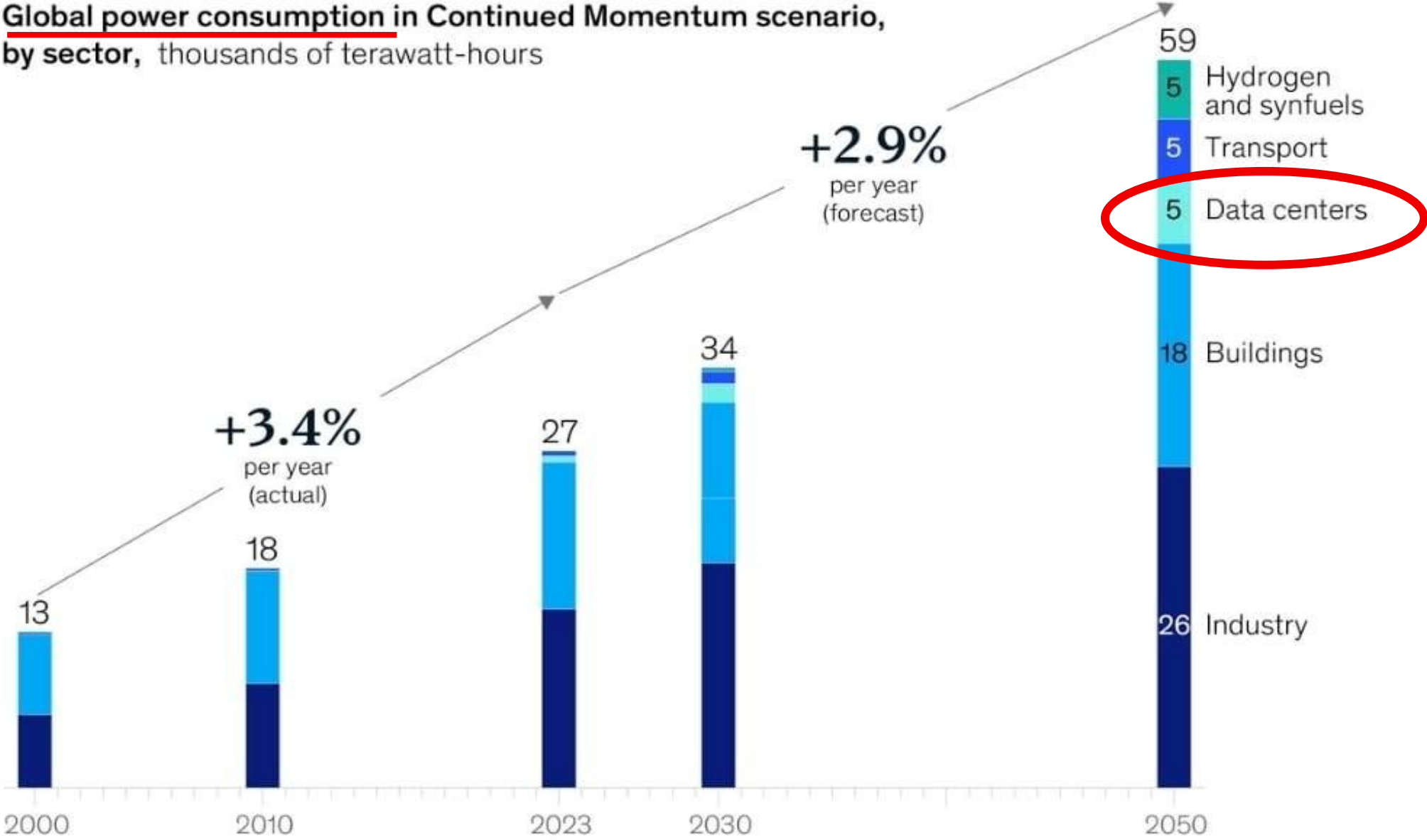
by Alexis Paparo

20 August 2025



Energy Dome's first commercial plant in Sardinia goes into operation

**Global power consumption in Continued Momentum scenario,
by sector, thousands of terawatt-hours**



Investors backing Energy Dome – € 150 MM raised



ENERGY DOME: 10+ GWh Commercial Pipeline Worldwide



CO2 Battery Market Strategy

We solve real problems with real solutions

Data Centers

The CO2 Battery can meet data center customers' needs for:

- ✓ Rapid timelines for access to high demand, high capacity factor electricity
- ✓ Desire to meet load with **clean** energy resources
- ✓ Desire for **24/7 hourly load** matching
- ✓ Mitigating **cross-subsidization** between large load customers and other ratepayers

Utilities

The CO2 Battery can meet utilities needs to:

- ✓ Address growing capacity needs
- ✓ Optimize energy availability from **intermittent generation** and nuclear baseload resources to meet evolving grid needs
- ✓ Ensure adequate grid-balancing and **ancillary services**
- ✓ Deliver cost containment and electricity **cost stabilization**



The CO2 Battery

The only viable alternative for long-duration energy storage

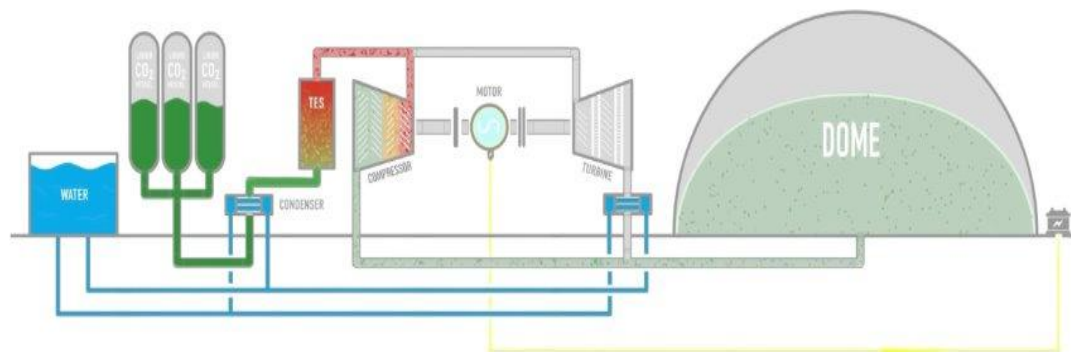
Our technology uses a thermodynamic cycle, charging by drawing carbon dioxide from a 'Dome' gasholder, storing it under pressure, and then dispatching it by evaporating and expanding the gas through a turbine back into the gasholder.



How does the CO2 Battery Work?

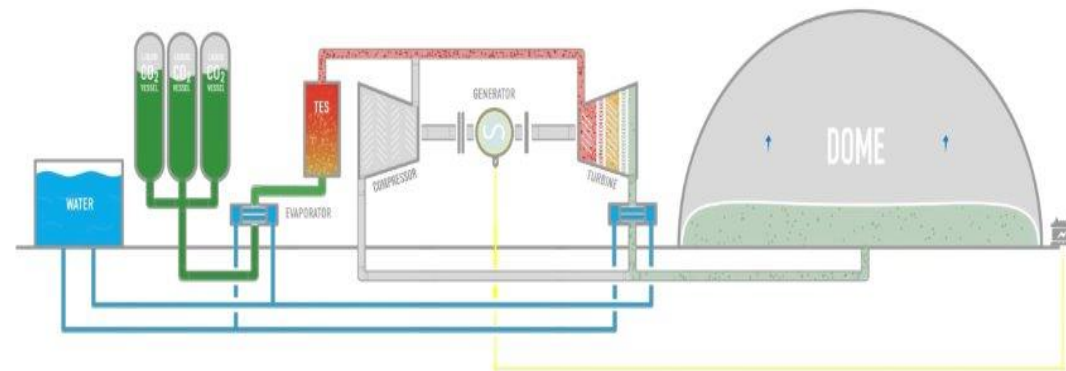
The battery **manipulates CO2 between the liquid and gas phases** to generate electricity

CHARGE



To charge, the CO2 is withdrawn from an atmospheric gasholder, the dome, and compressed into an inter-refrigerated compressor driven by a motor. The heat generated from the compression is stored in a thermal energy storage system, whereas the CO2 is liquefied and stored in vessels under pressure at ambient temperature with zero atmospheric emissions.

DISCHARGE



To discharge electricity to the grid, the CO2 is heated, evaporated and sent into an expander before flowing back into the dome. In doing so, the expander drives the generator to feed electricity to the grid.

Economic and Operational Benefits

The CO2 Battery's economic and operational benefits make it the obvious choice for grid-scale batteries



Efficient

Round-trip efficiency (75%+)
AC-AC and MV-MV



Cost-effective

Highly competitive CAPEX and
OPEX and able to optimize for
energy arbitrage



Flexible

CO2 Batteries can be constructed
almost anywhere



Proven

MW-scale plant already
operational and grid-
connected



Durable

No degradation of capacity or
performance over 30+ years



Reliable

Off-the-shelf
components



Independent

No dependence on rare
metals such as lithium

Off-the-Shelf Components

All equipment is **off-the-shelf**, well-known and reliable as it's been used in the Oil & Gas industry for a long time.



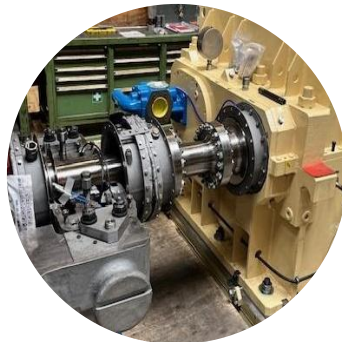
DOME



LIQUID CO2 VESSELS



COMPRESSOR



TURBINE



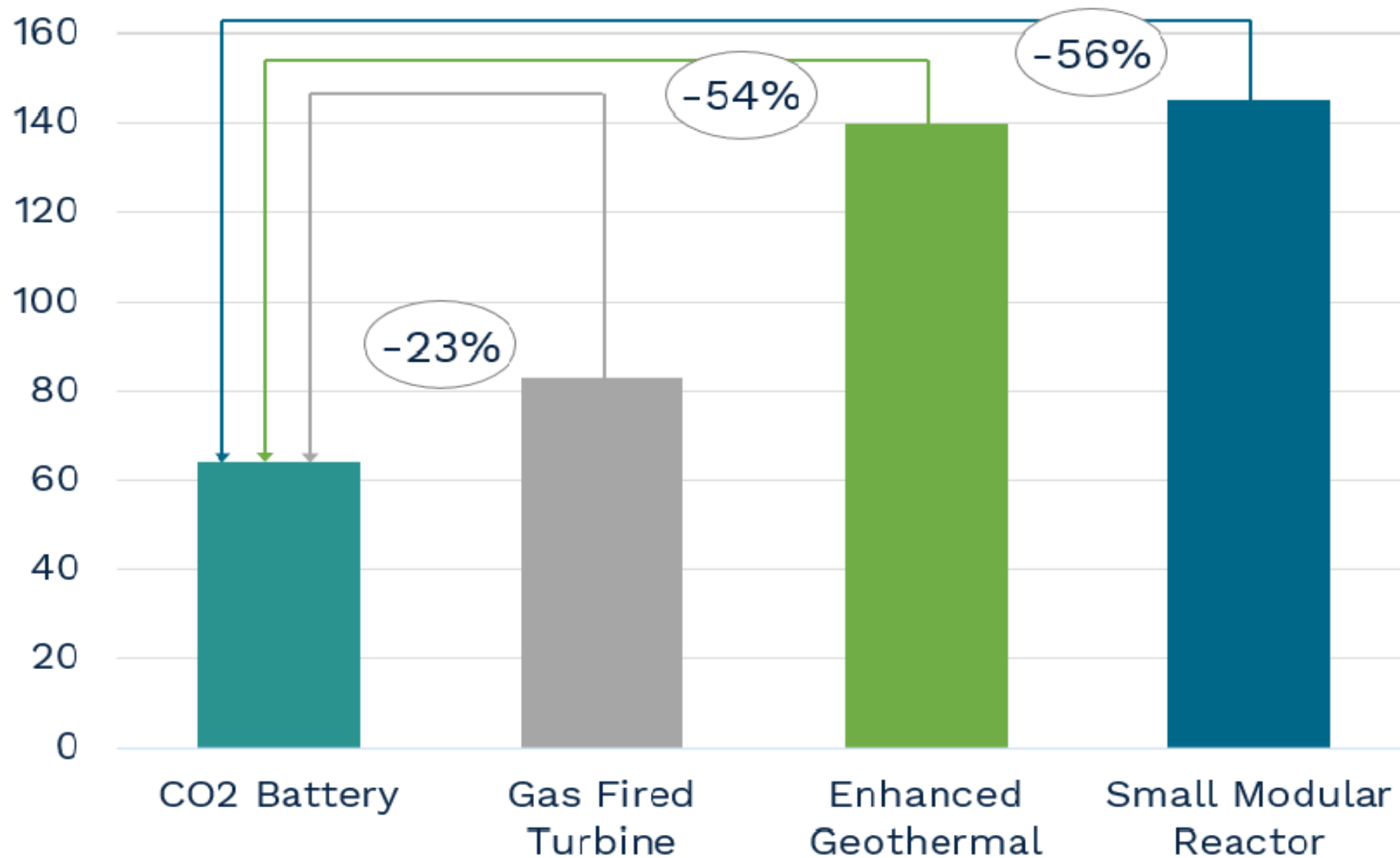
TES VESSELS



Our **global supply chain** shows the **resilience** and **safety** of the CO2 Battery.

Baseload Technologies Cost Comparison

Levelized Cost of Energy (\$/MWh)



FoaK CO2 Battery – offtaker: ENGIE

IN OPERATION . Location: Ottana, Sardinia, Italy

BOO Contract signed with **ENGIE** for the offtake of the storage capacity.

Energy Dome will own and operate the CO2 Battery

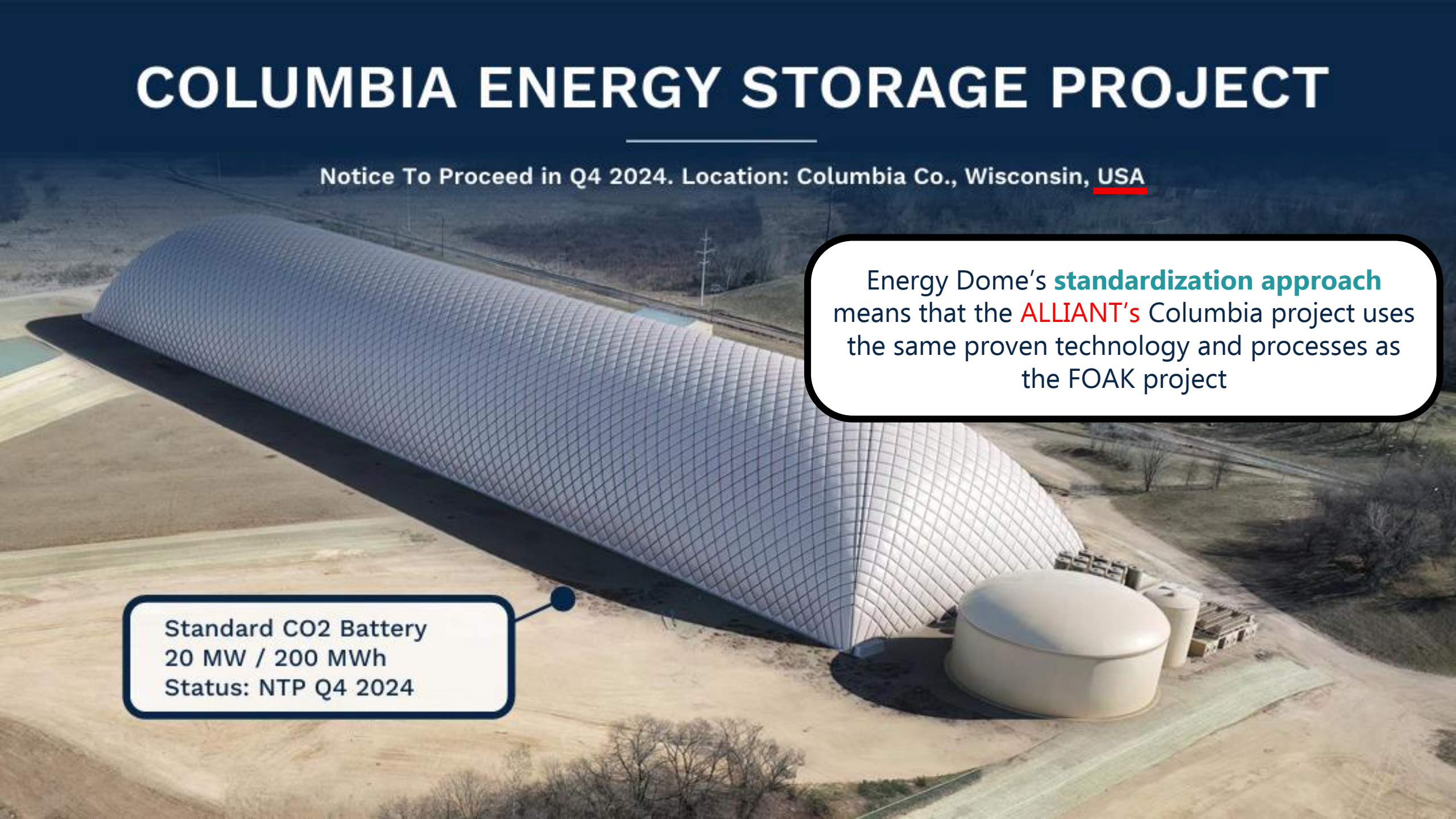
ENGIE will leverage its market expertise to optimize and dispatch the stored energy in the Italian power markets

COLUMBIA ENERGY STORAGE PROJECT

Notice To Proceed in Q4 2024. Location: Columbia Co., Wisconsin, USA

Energy Dome's **standardization approach** means that the **ALLIANT's** Columbia project uses the same proven technology and processes as the FOAK project

Standard CO2 Battery
20 MW / 200 MWh
Status: NTP Q4 2024



NTPC ORDERS FIRST CO2 BATTERY

Standard CO2 Battery 20MW / 160MWh. Location: Kudgi, Karnataka, INDIA



Standard CO2 Battery
20 MW / 160 MWh
Status: NTP Q1 2025
COD: Q3 2026



Technological Development – **Giga-Scale**



Driven by requests from existing partners and the market, a GWh-scale CO₂ Battery has been designed. Firm equipment supply offers are available today.

The design is currently undergoing multiple feasibility studies and has been offered for a **3 GWh project in OMAN** for a green steel manufacturer is in negotiation (LOI Signed).

Key Market Offerings

- Significant specific **cost reduction**, when compared with the 20MW system
- Large enough to support key industries
 - 24/7 **baseload renewables** (Solar + Storage)
 - Green steel production
 - Green hydrogen production
- Mature supply chain with NTP to COD in approx. 24 months



ITALY - The MACSE initiative

MACSE is a **regulatory initiative** aimed at fostering the growth of electricity storage capacity in Italy.

A forward procurement scheme where **Terna** (the Italian **TSO**) **contracts storage capacity via competitive auctions** to unlock new electricity storage that integrates growing non-programmable RES

The players involved are:

- **ARERA/MASE** – Rules and targets
- **Terna** procures storage capacity
- **GME** runs the time-shifting market platform
- **Storage operators** build and operate assets and allocate capacity



MACSE Process: 2 types of auctions

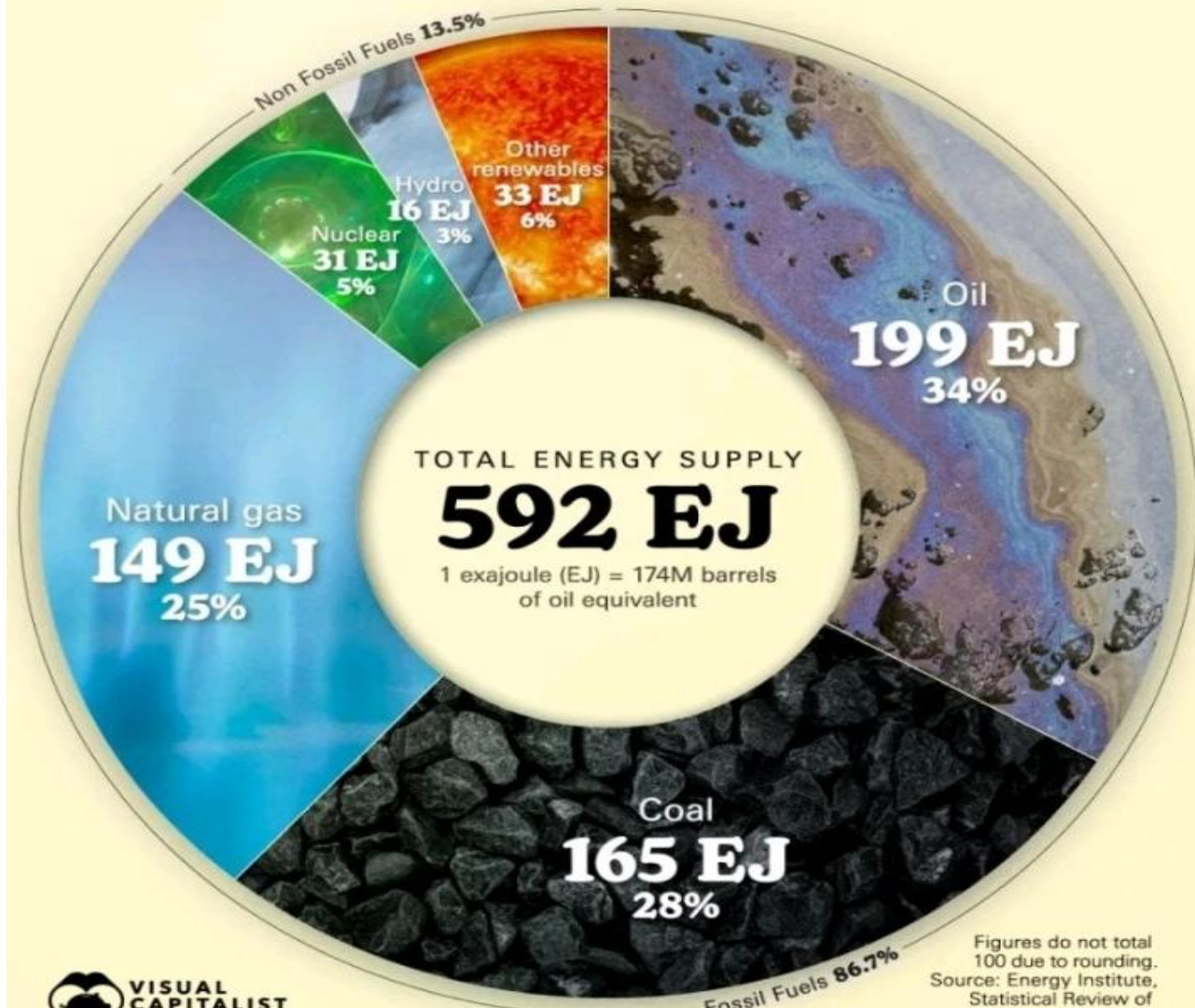
SHORT AUCTION (Li-ion BESS)

- planning horizon **2 years**, delivery **15 years**.
- **Demand Curve:** Terna publishes requirements & national/area quotas (inelastic demand)
- **Bid & Supply Curve:** Projects bid **MWh** and **€/MWh-year**, Terna applies performance coefficients (e.g., duration, efficiency) to form the merit order,
- Winners receive the **pay-as-bid premium** monthly.

LONG AUCTION (PHydro + other LDES)

- planning horizon **5 years**, delivery **30 years**.
- Awarded projects **receive a fixed annual premium** (of *awarded price x qualified capacity*).
- In addition, the operator will retain **20% of revenues from participation in ancillary service market**
- The payments are settled **monthly, for a 30-year contract period**.

What Powered the World in 2024?



Substituting the (fossil..) **baseload** energy, is the real challenge of the world energy transition



Our World Can't Wait.

Prof. Manlio F. Coviello
President
ENERGY DOME Latam

The only viable alternative for long-duraton energy storage