

Grid Security & Energy Storage

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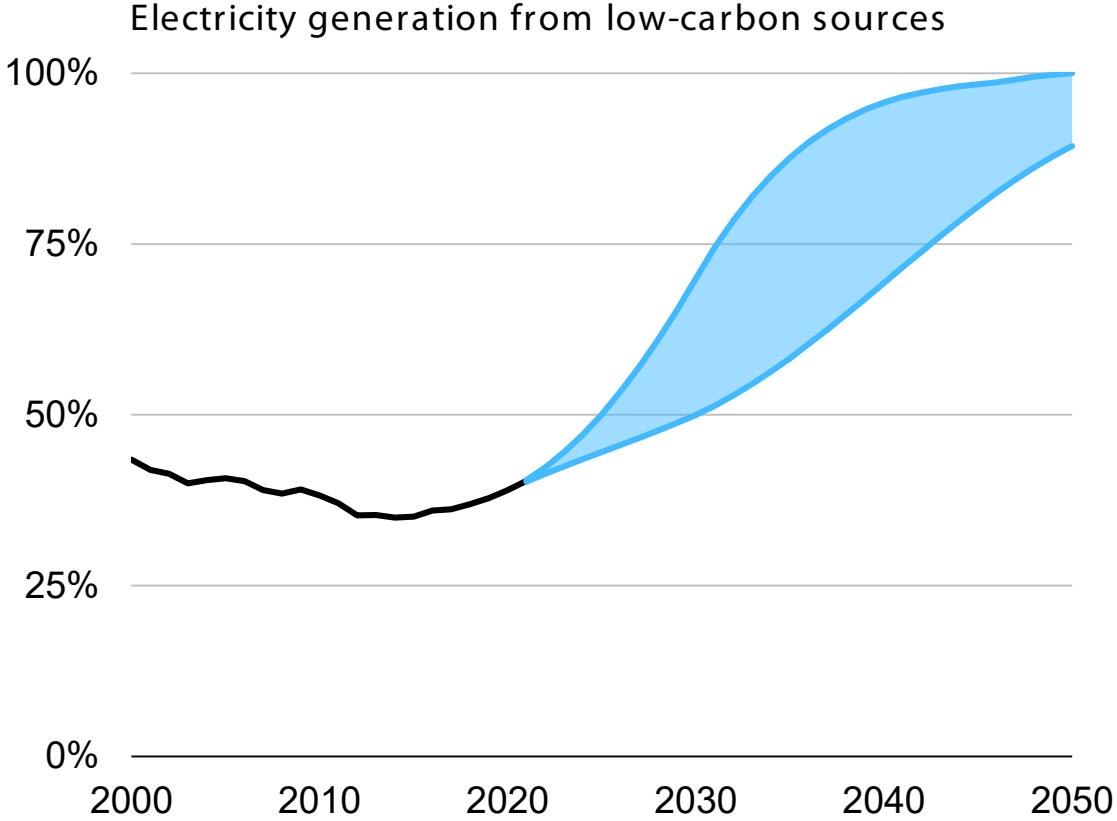
18th IAEE European
conference, Milan

27 July 2023



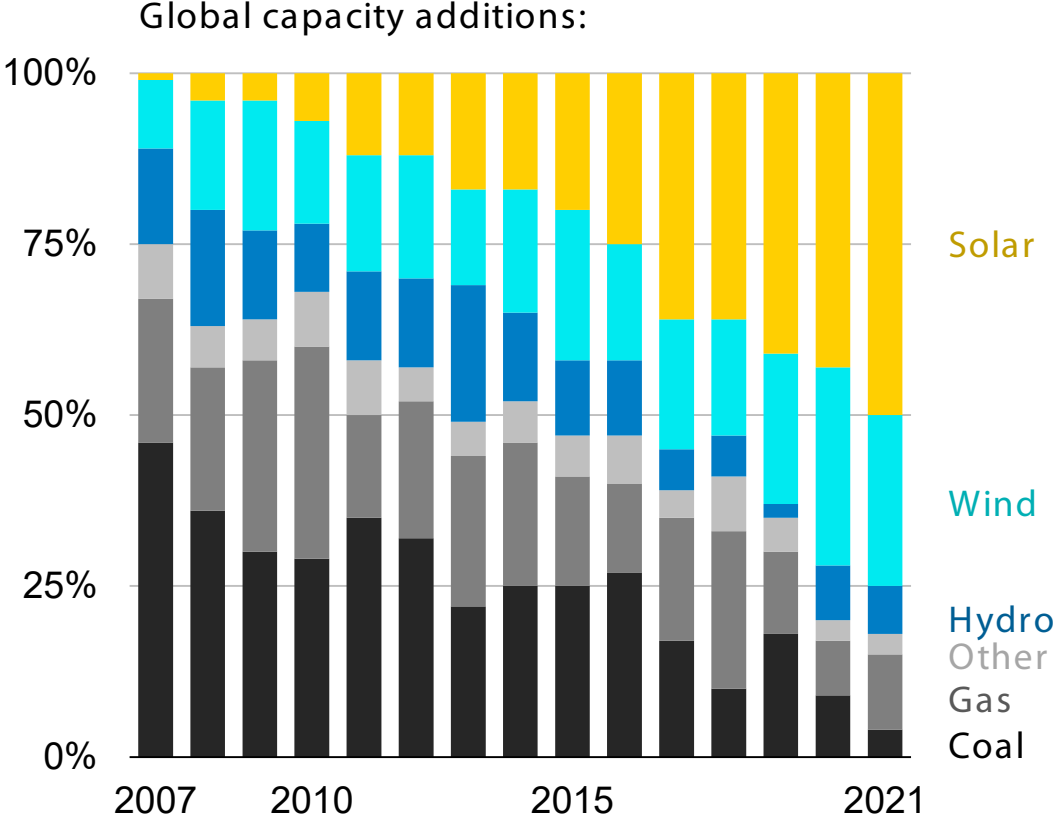
Renewables are the future of electricity generation

What will be needed:



Data from the [IPCC 6 Assessment Report](#)

What is already happening:

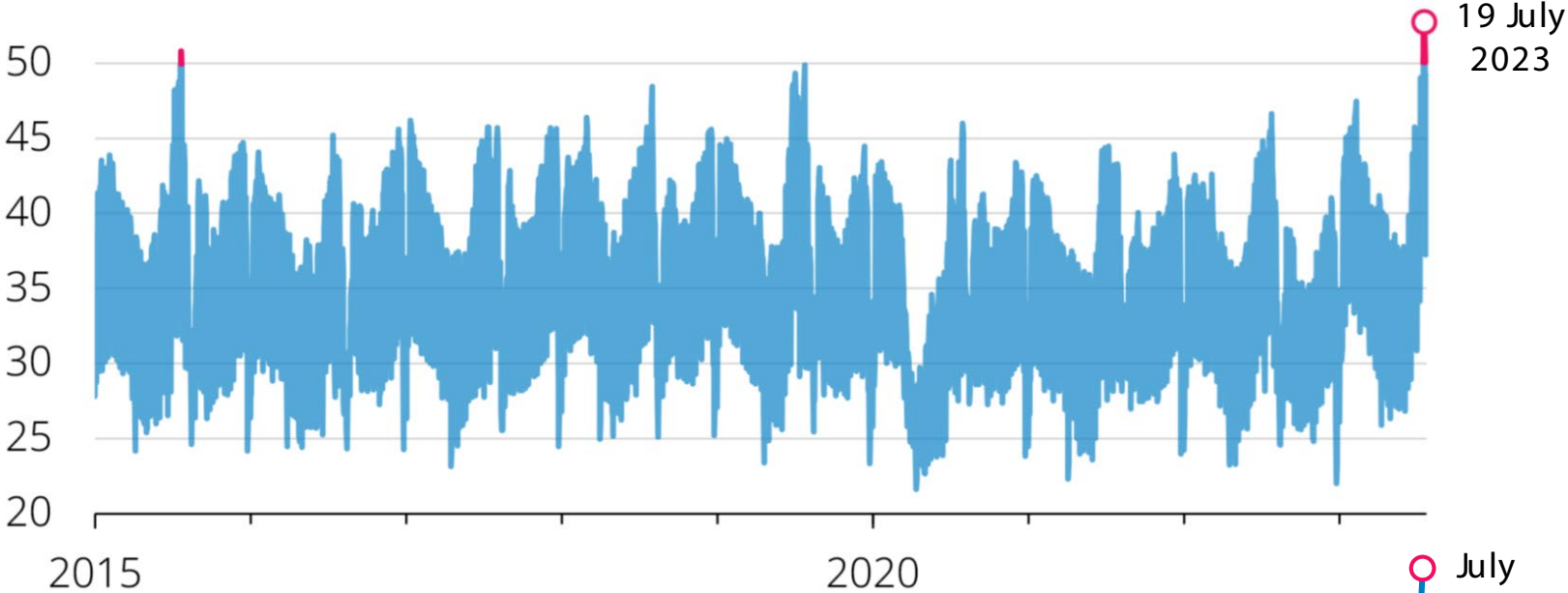


Data from [BloombergNEF](#)

The weather is also making demand more difficult to handle

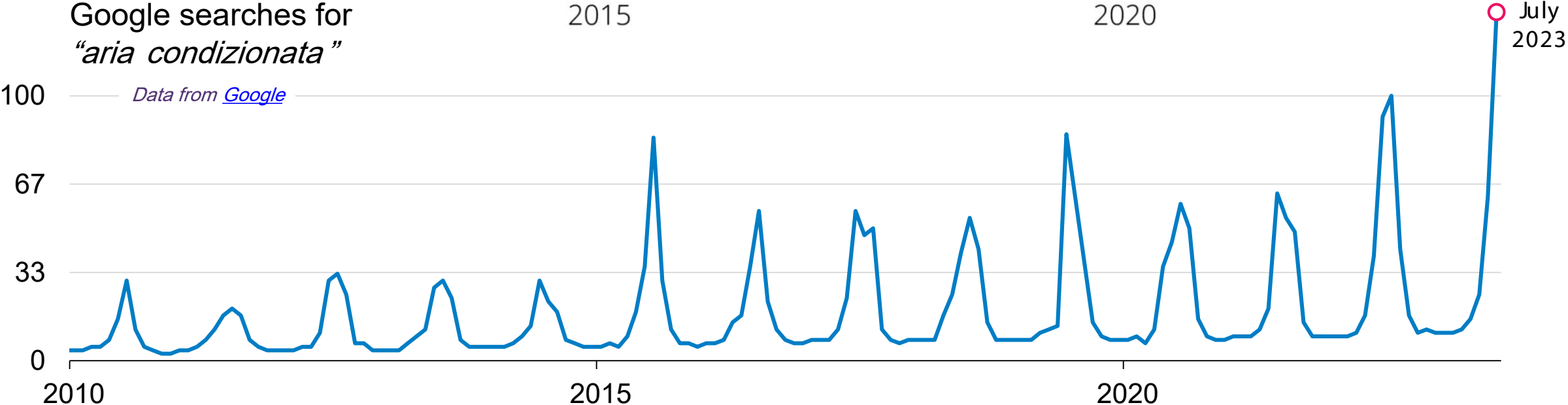
Italy's daily peak electricity demand (GW)

Data from [ENTSOE](#)



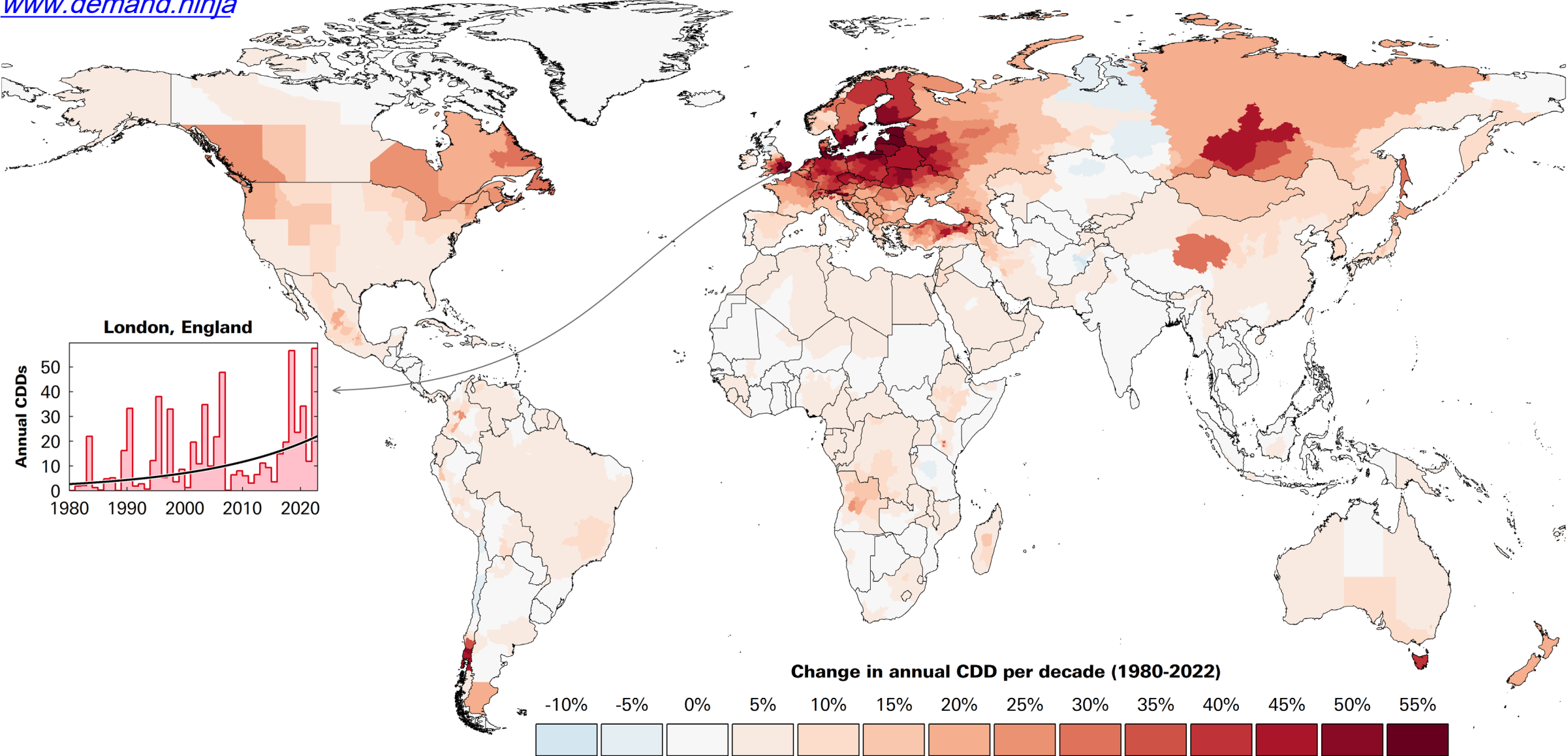
Google searches for "aria condizionata"

Data from [Google](#)

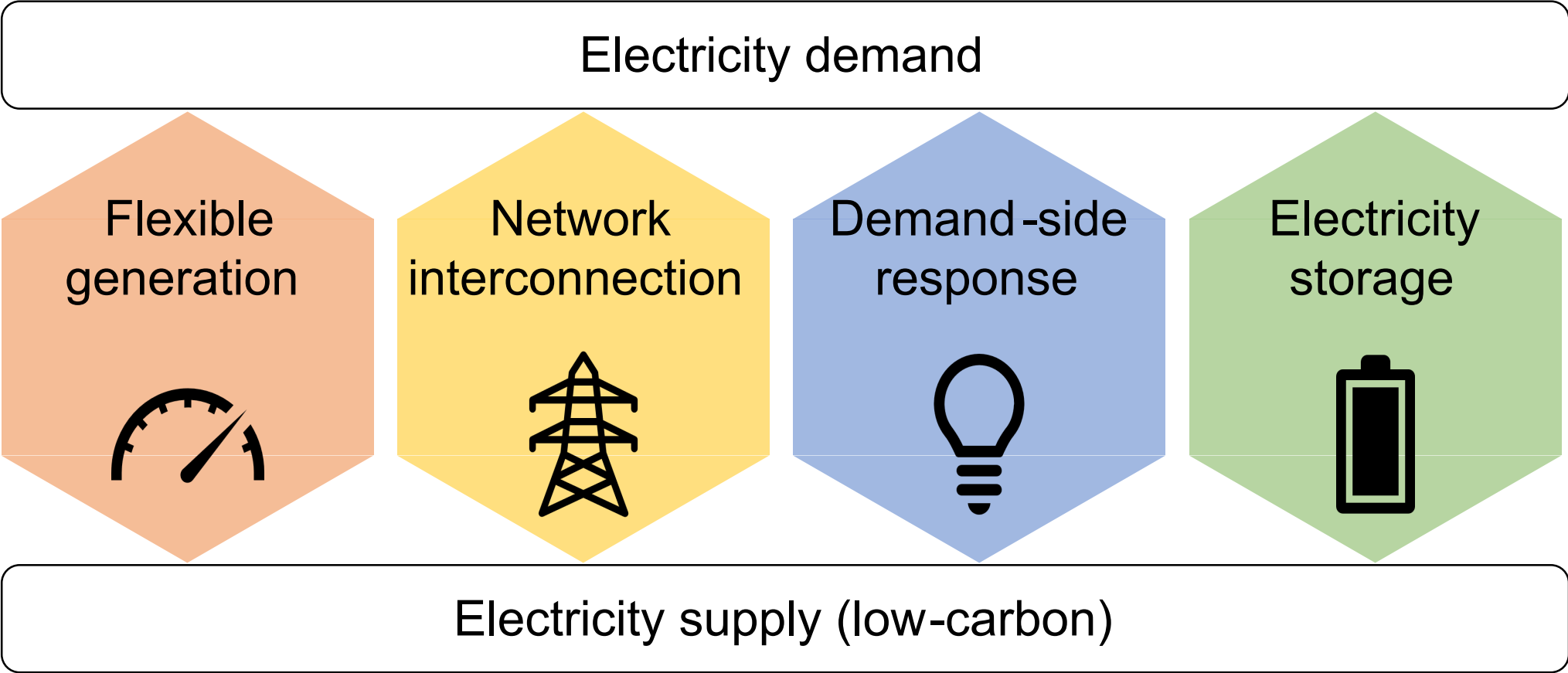


Cooling is going to reshape European electricity demand

www.demand.ninja

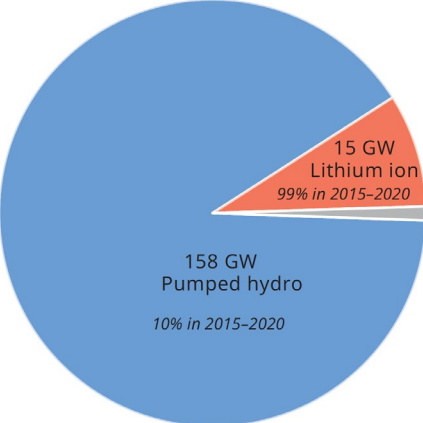


Flexibility is needed to match RE supply and demand

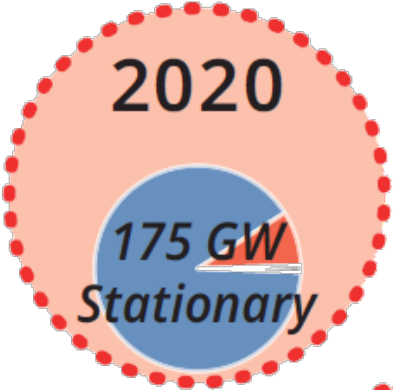
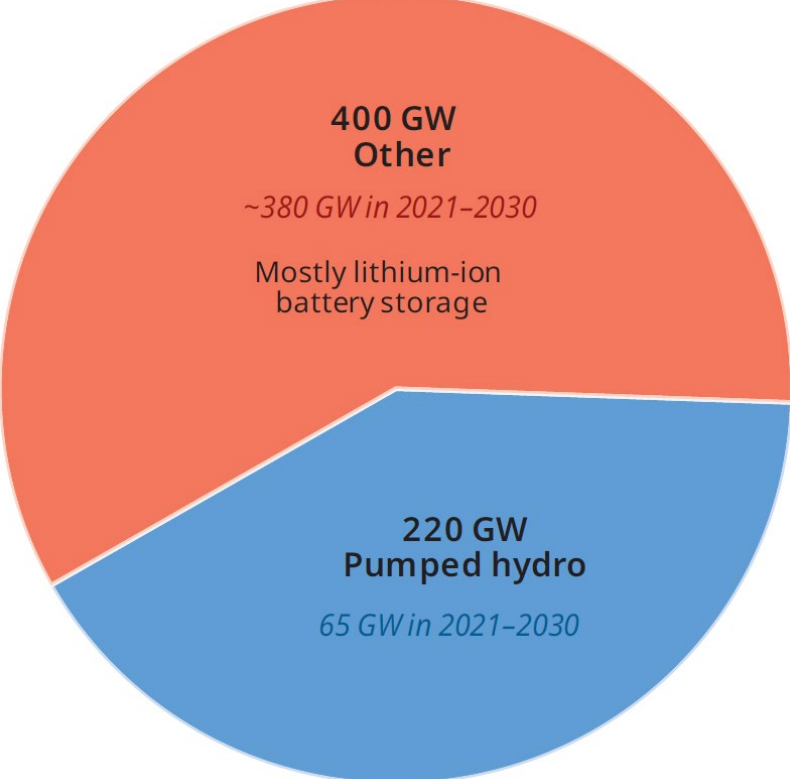


The energy storage market is expected to grow very rapidly

2020 stationary storage:

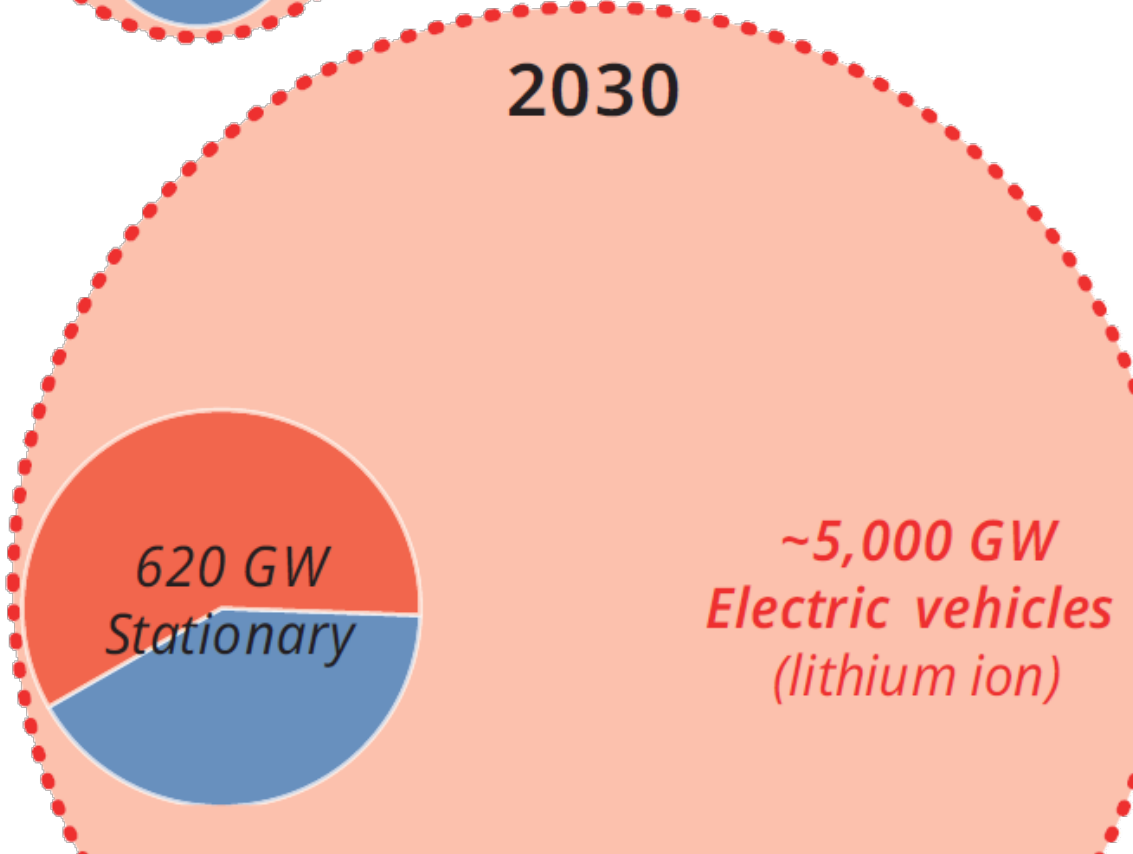


2030 stationary storage:



~500 GW Electric vehicles (lithium ion)

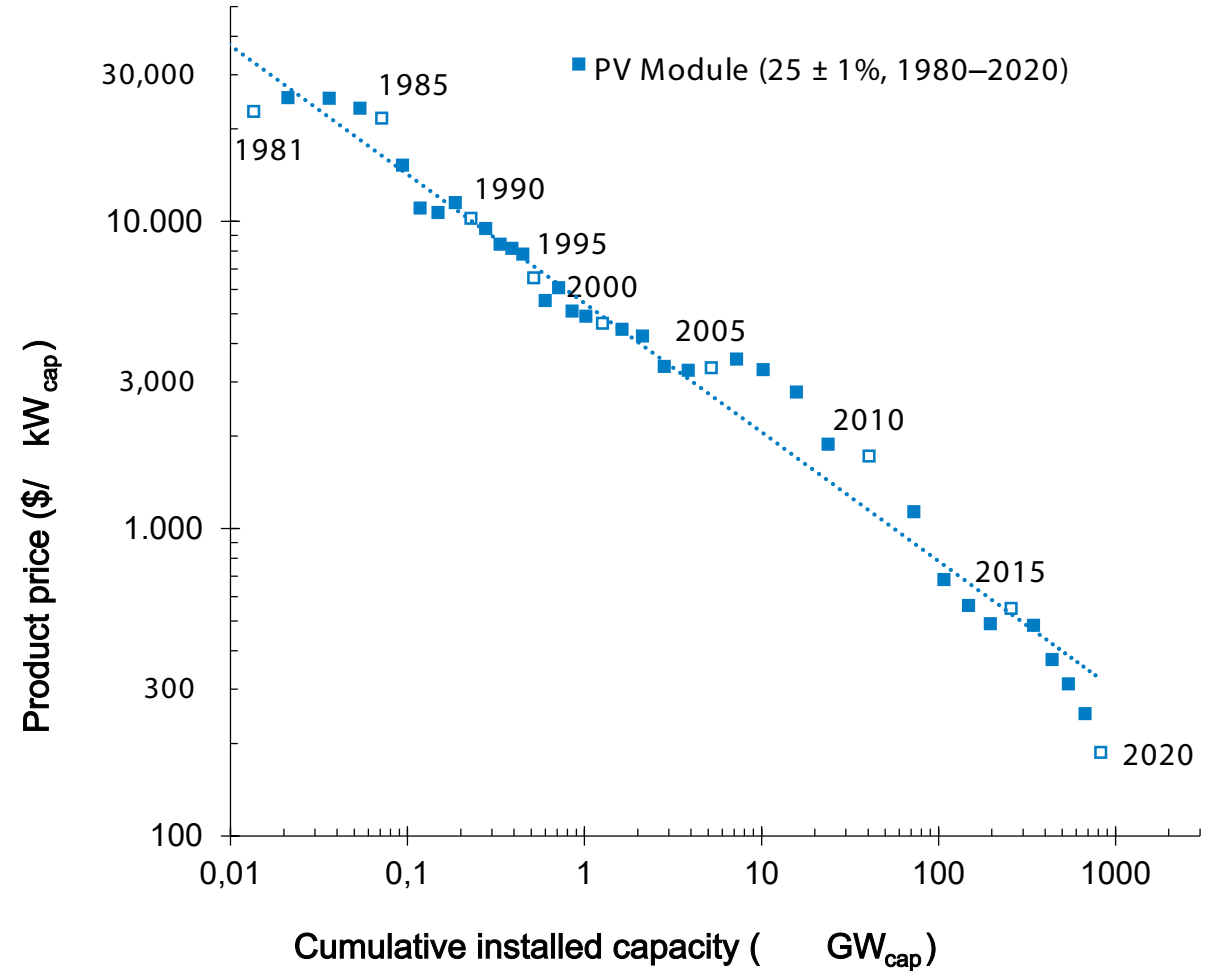
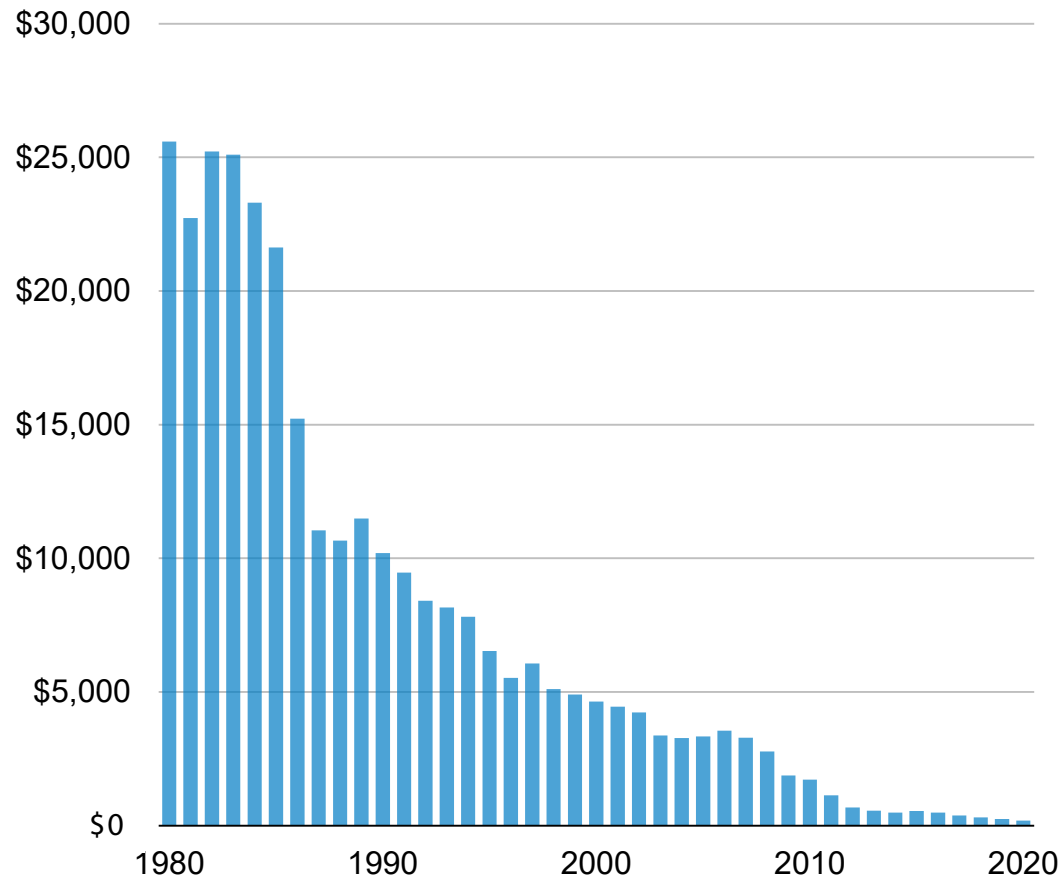
Stationary vs. Transport:



~5,000 GW Electric vehicles (lithium ion)

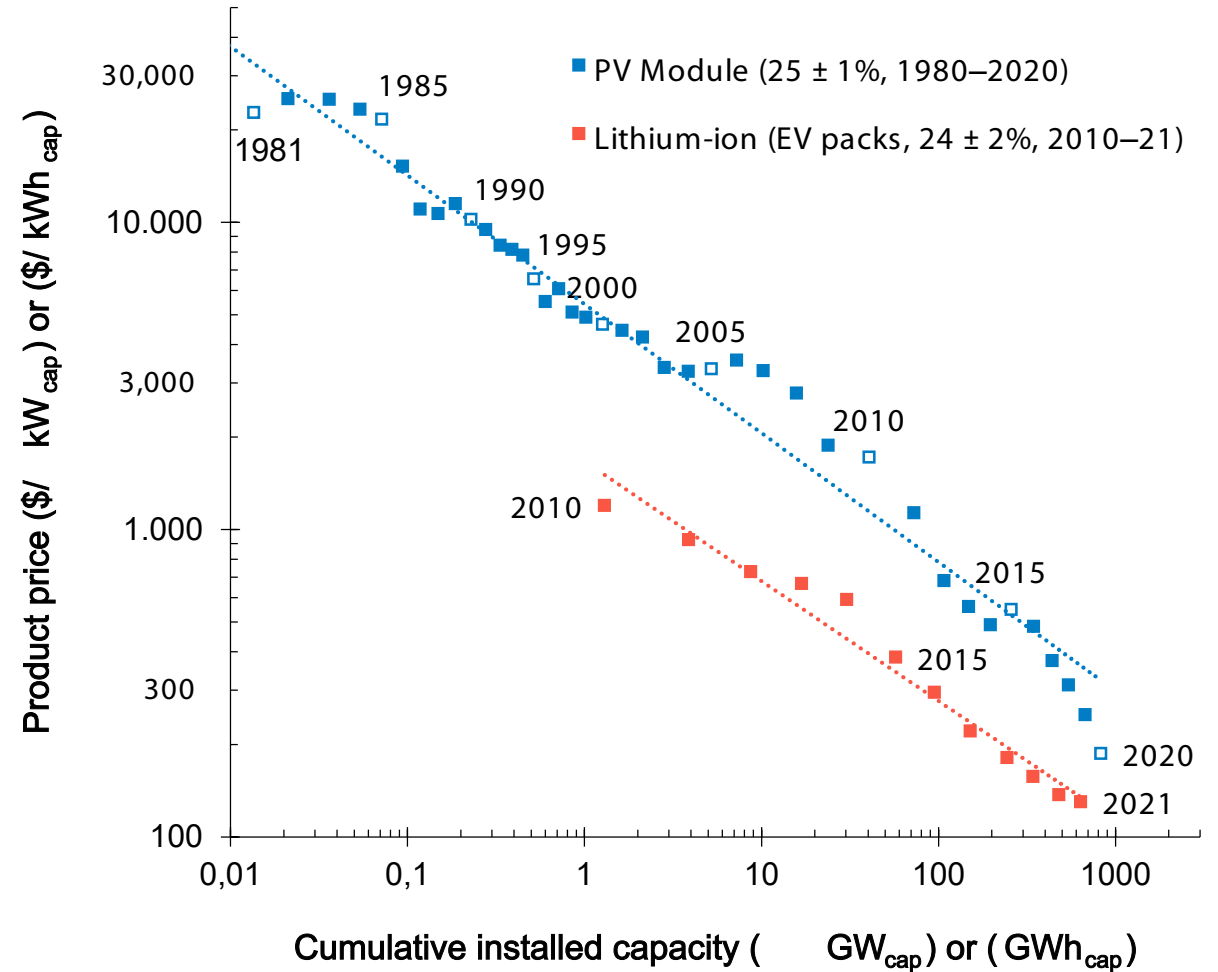
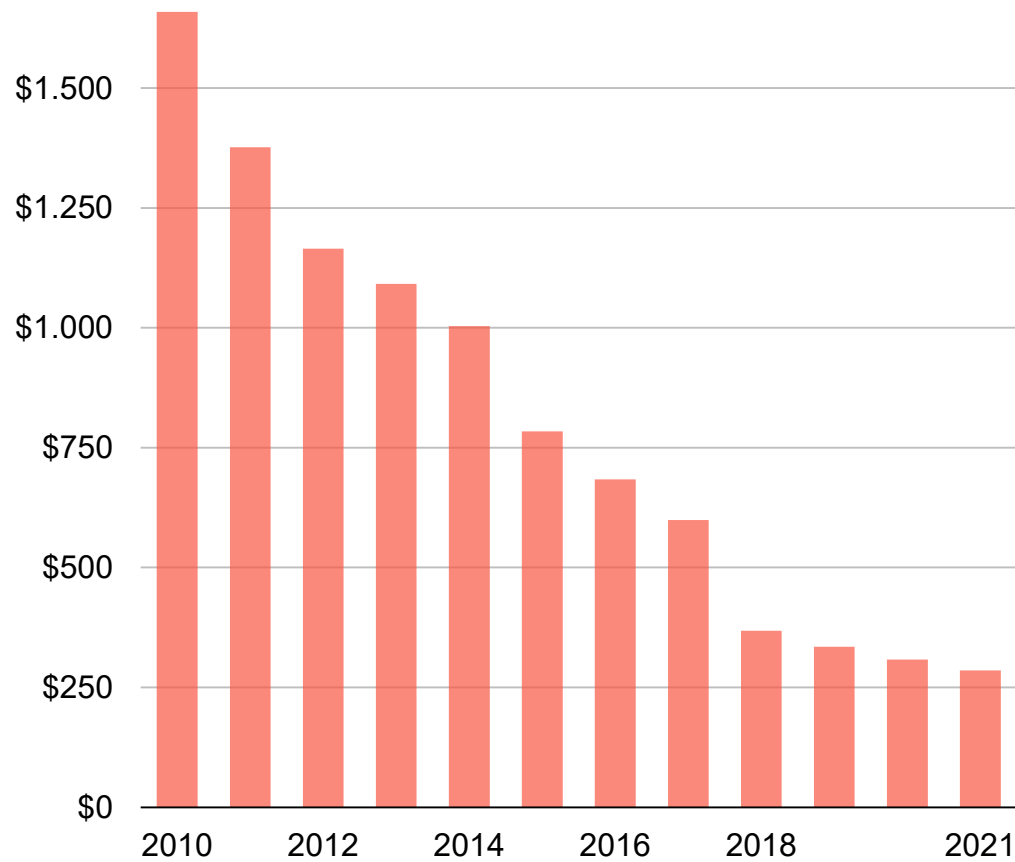
Solar PV has become mainstream as prices fell by 99%

Solar PV modules (\$/kW)



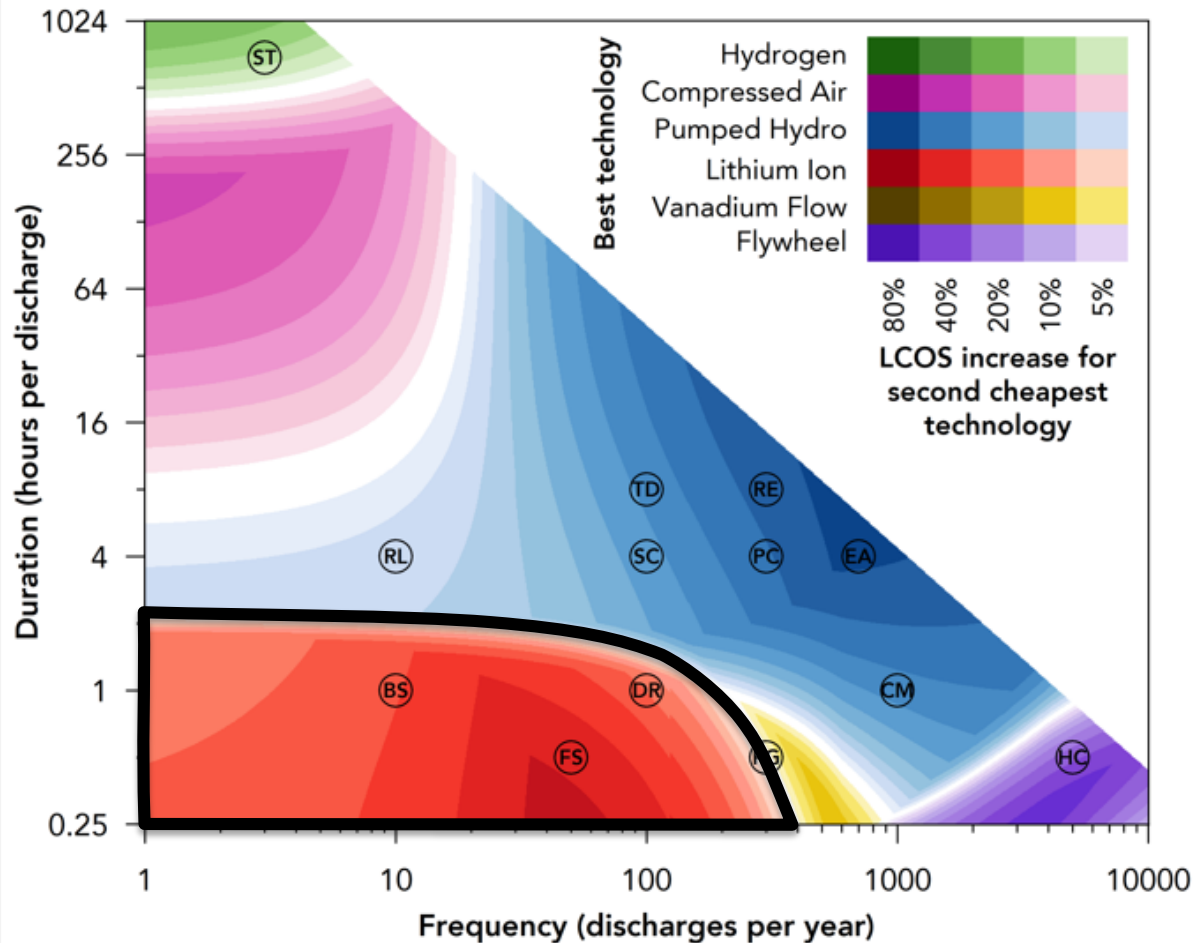
Lithium-ion prices are falling at a similar rate as solar PV

Lithium-ion battery packs (\$/kWh)

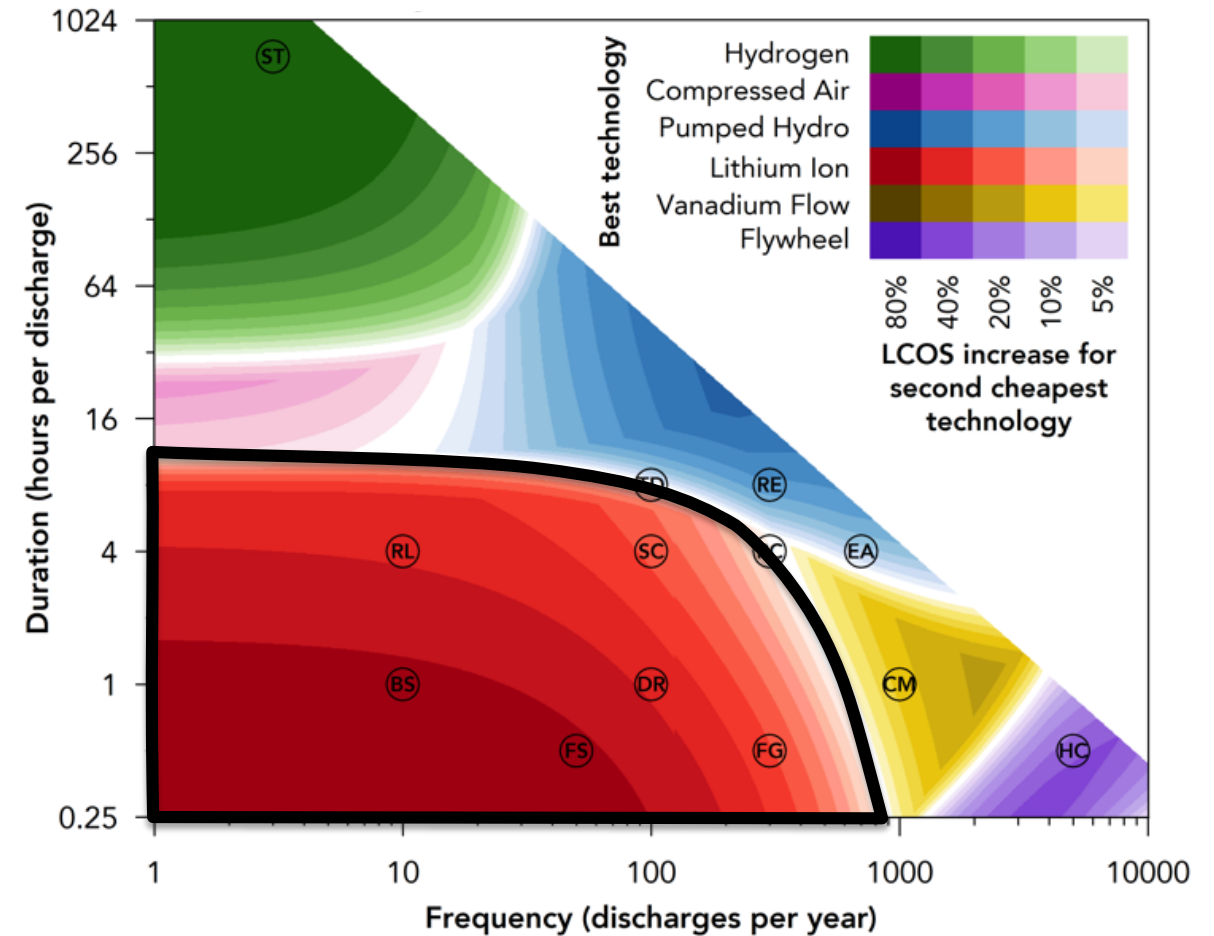


Rapid cost reduction means lithium-ion will become the most competitive storage technology for many applications

2020:



2030:



Circles denote typical power system applications: (ST) Inter-seasonal storage (*not currently monetized*)— (RL) Power reliability — (TD) Transmission & distribution investment deferral — (RE) Renewables integration — (SC) Increasing self-consumption — (PC) Peaking capacity — (EA) Energy arbitrage — (BS) Black start — (DR) Demand charge reduction — (CM) Congestion management — (FS) Frequency response (ramping / inertia) — (FG) Frequency regulation (power quality) — (HC) High cycle (*not currently monetized*)

But, will batteries replace *grid operation* risks for *geopolitical* and *supply chain* risks?



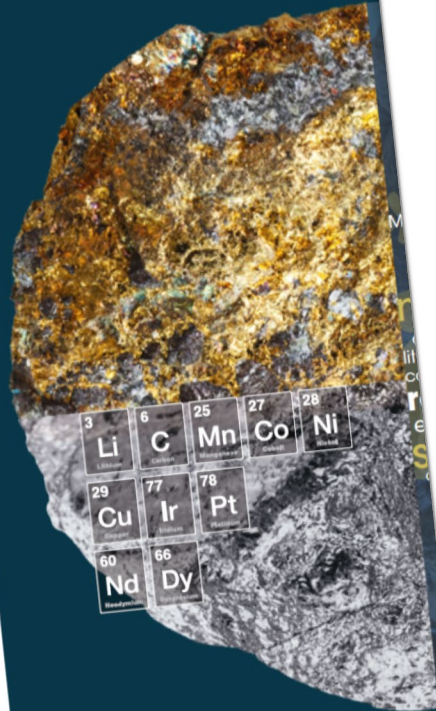
Critical Materials Assessment

U.S. Department of Energy

May 2023



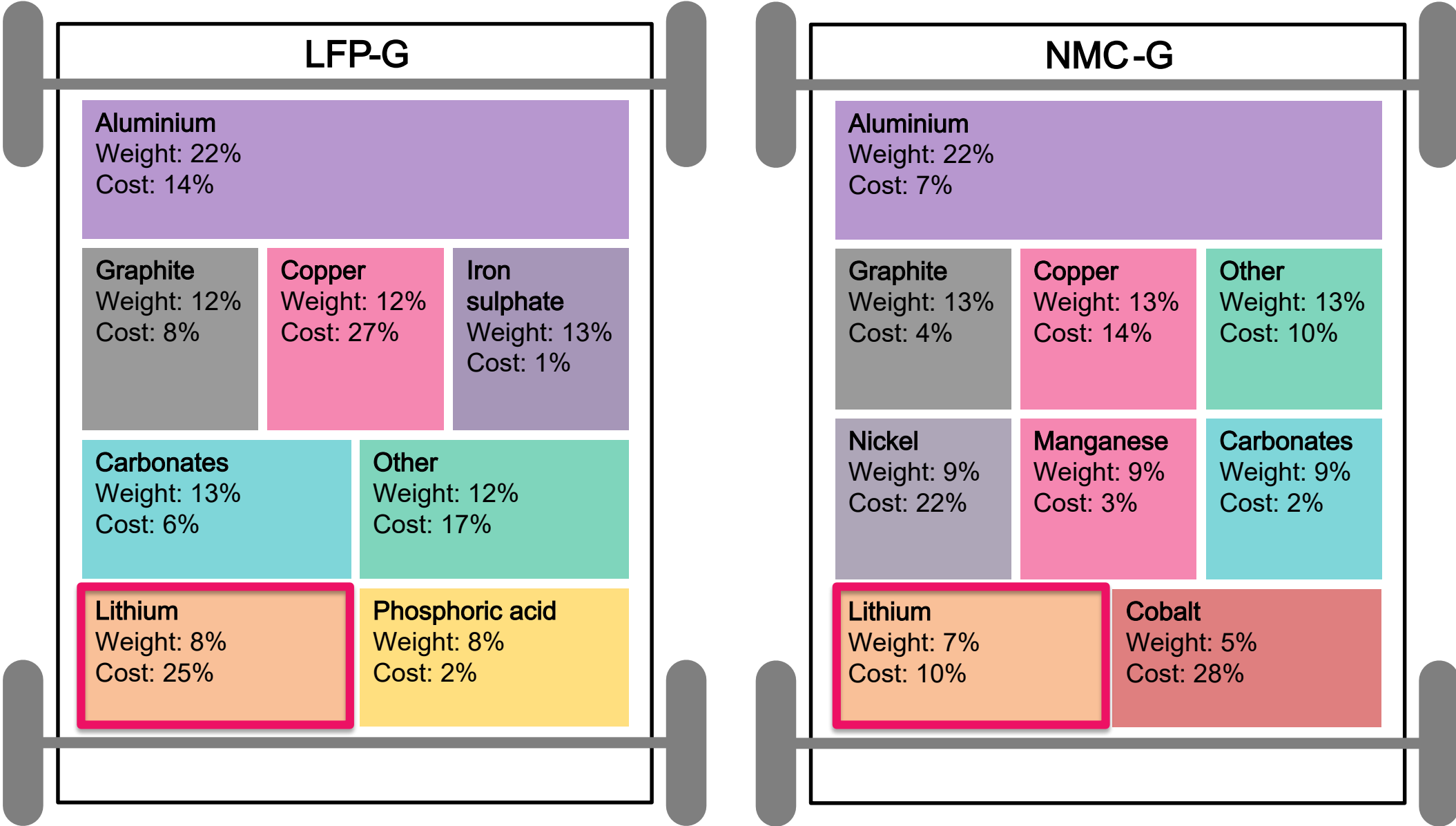
GEOPOLITICS OF THE ENERGY TRANSITION CRITICAL MATERIALS



Critical Minerals Market Review 2023

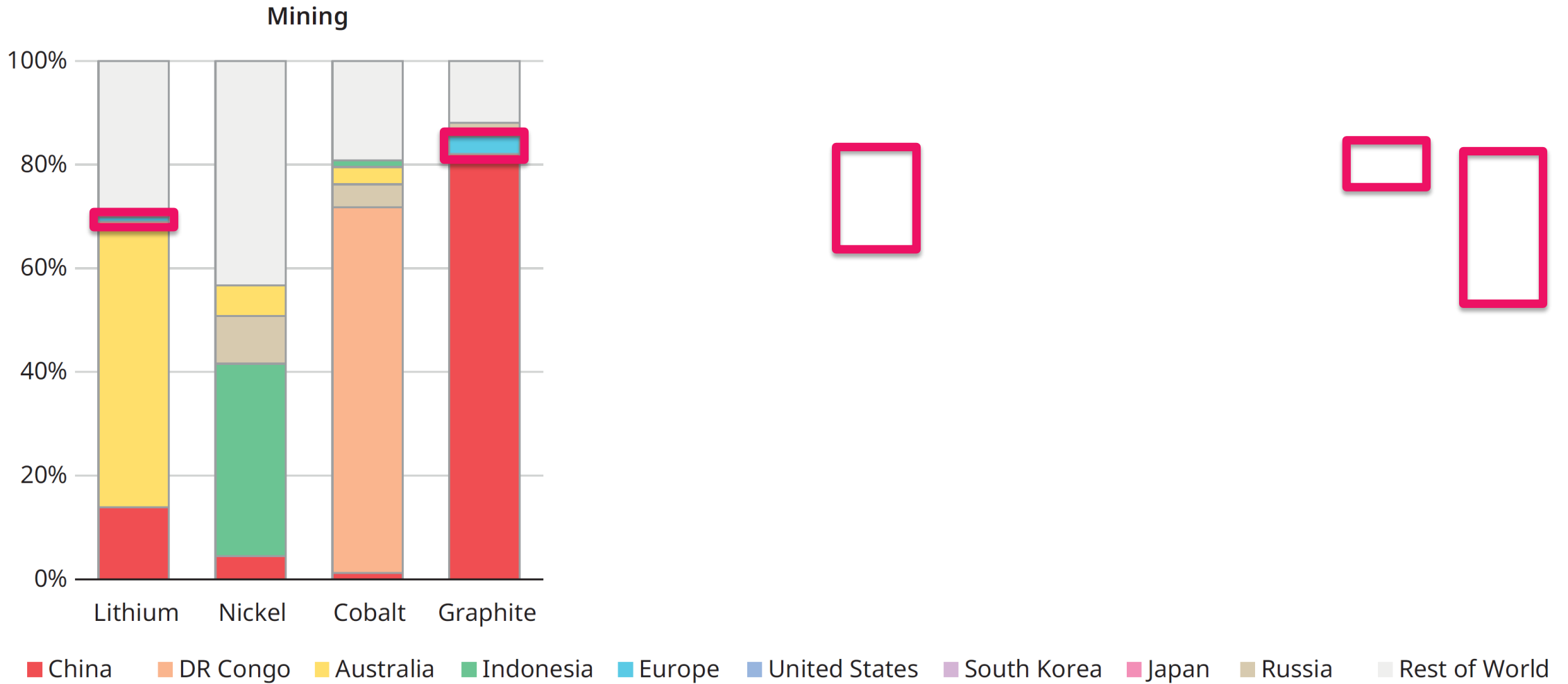


Lithium-ion batteries use surprisingly little lithium



... but China dominates much of the lithium

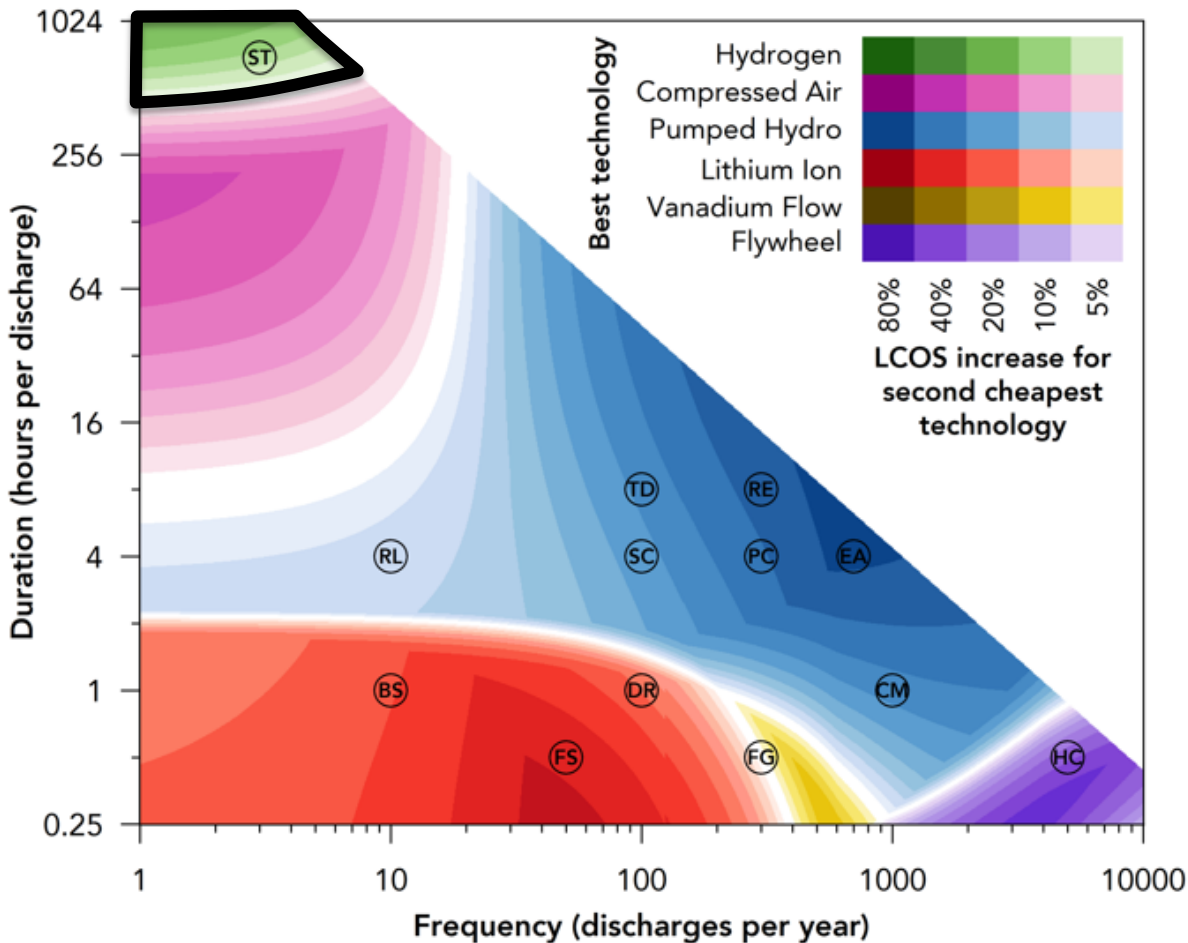
-ion value chain



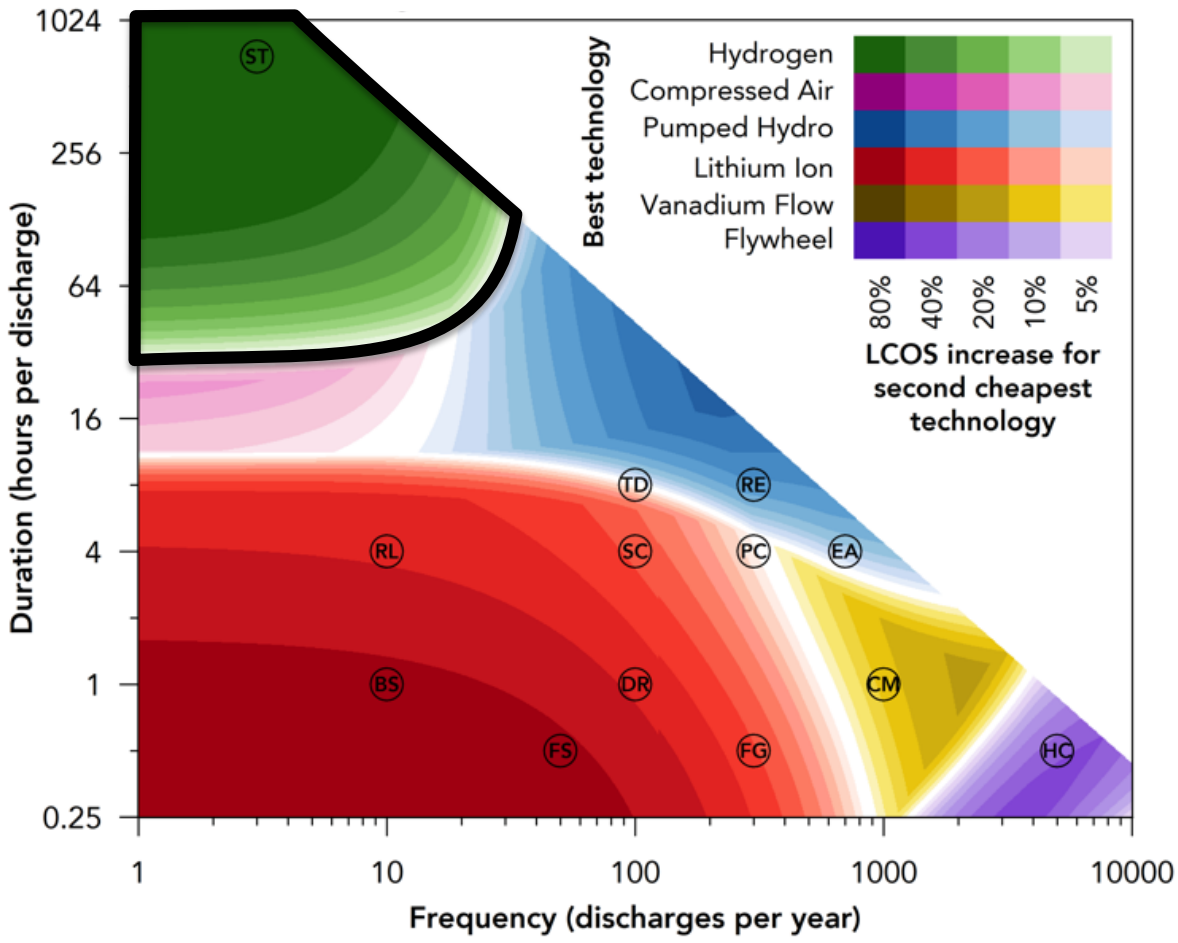
Data from [the IEA](#)

We will need more than just lithium to fully decarbonize

2020:



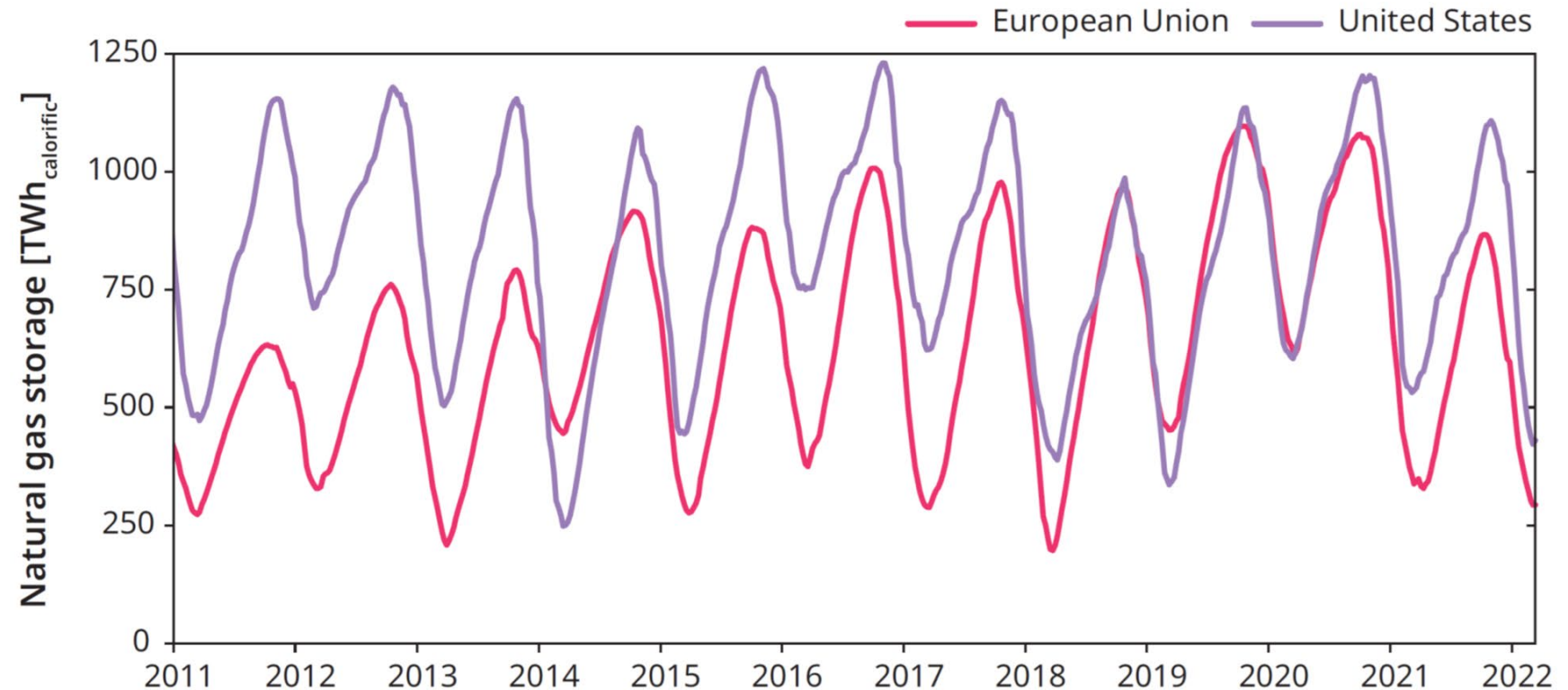
2030:



Circles denote typical power system applications: (ST) Inter-seasonal storage (*not currently monetized*)— (RL) Power reliability — (TD) Transmission & distribution investment deferral — (RE) Renewables integration — (SC) Increasing self-consumption — (PC) Peaking capacity — (EA) Energy arbitrage — (BS) Black start — (DR) Demand charge reduction — (CM) Congestion management — (FS) Frequency response (ramping / inertia) — (FG) Frequency regulation (power quality) — (HC) High cycle (*not currently monetized*)

We need to some way to decarbonize the *PWh-scale* fossil fuel storage that our energy systems rely on

US & EU seasonal natural gas storage:



To recap:

- The energy transition will make grid security more interesting than ever
- Energy storage could go a long way to solving grid security issues
- Europe is playing catch-up to China and the US on supply-chain security

Further reading

“Essential for me as an investor to navigate this complex, fast-paced energy storage industry.”

Gerard Reid, Alexa Capital

“Ground-breaking – an essential read”

Professor Dan Kammen, UC Berkeley

“You will come back over and over again to learn from this wonderful map and guide book. Incredibly written, conceived, documented and illustrated”

Professor Jean-Michel Glachant, IAEA

Explore the analysis yourself:

www.Renewables.ninja

www.Demand.ninja

www.EnergyStorage.ninja

