

Do we have a lithium supply problem?

IRENA's webinar series Critical Materials for the Energy Transition

7 September 2022

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WELCOME

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PRESENTATIONS

Presented by IRENA and Goldman Sachs

3

DISCUSSION

Q&A discussion with speakers from Goldman Sachs, Credit Suisse, the International Lithium Association, and Luna Lithium

Collaborative Framework & working groups

Aim: develop a set of activities to:

- support a better **understanding** of the role and market dynamics of critical materials to sustain the energy transition,
- facilitate **discussion** among the different groups,
- establish a **list of experts** across Members and stakeholders, and
- assist in systematizing and disseminating **knowledge**.

Observatory

Collect data that help **understand scarcity and potential supply shortages** that may affect the energy transition by 2030

De-risking supply

Develop and apply **strategies to de-risk supply**

ESG & mining

Develop strategies to **raise acceptance for new mining projects**



- IRENA Assembly January 2022 provided a mandate for Agency work on critical materials
- To date:
 - [Scoping paper – together with ENEL Foundation](#) – October 2021
 - [Technical paper critical materials](#) – November 2021
 - [Deep dive lithium](#) – February 2022
 - [Deep dive rare earth elements](#) – March 2022
 - Launch of the **Collaborative Framework**
 - Chapter 7 [World Energy Transitions Outlook 2022](#) – March 2022
 - [Nickel editorial](#)
 - Editorials on critical materials in [energy-post](#), [smart-energy](#) and [mining review](#)

➤ Upcoming:

- Deep dive into **EVs battery manufacturing** process report
- Deep dive **sustainable critical materials supply in Southern Africa** – with the World Bank
- Overview of **supply chain** of energy-related critical materials and minerals



Familiarity with
the topic

Areas of interest in the topic



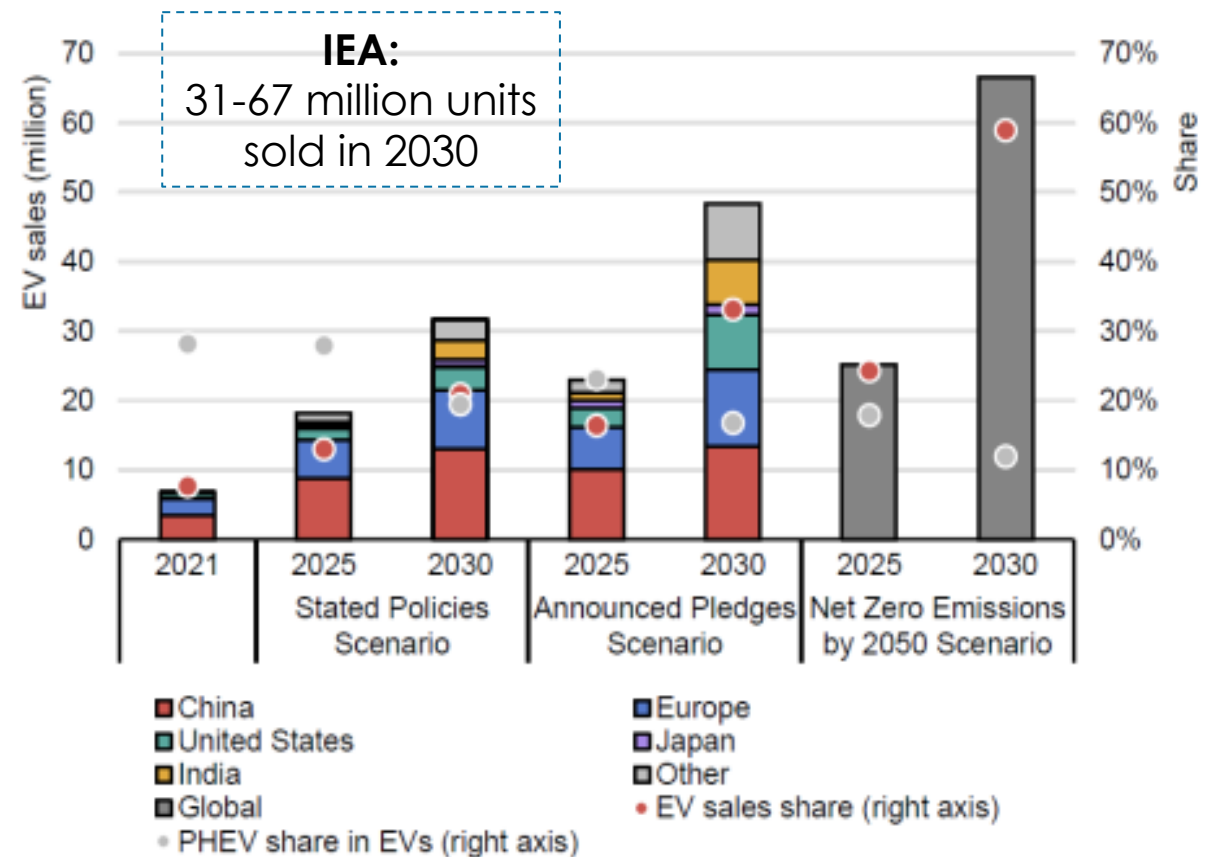
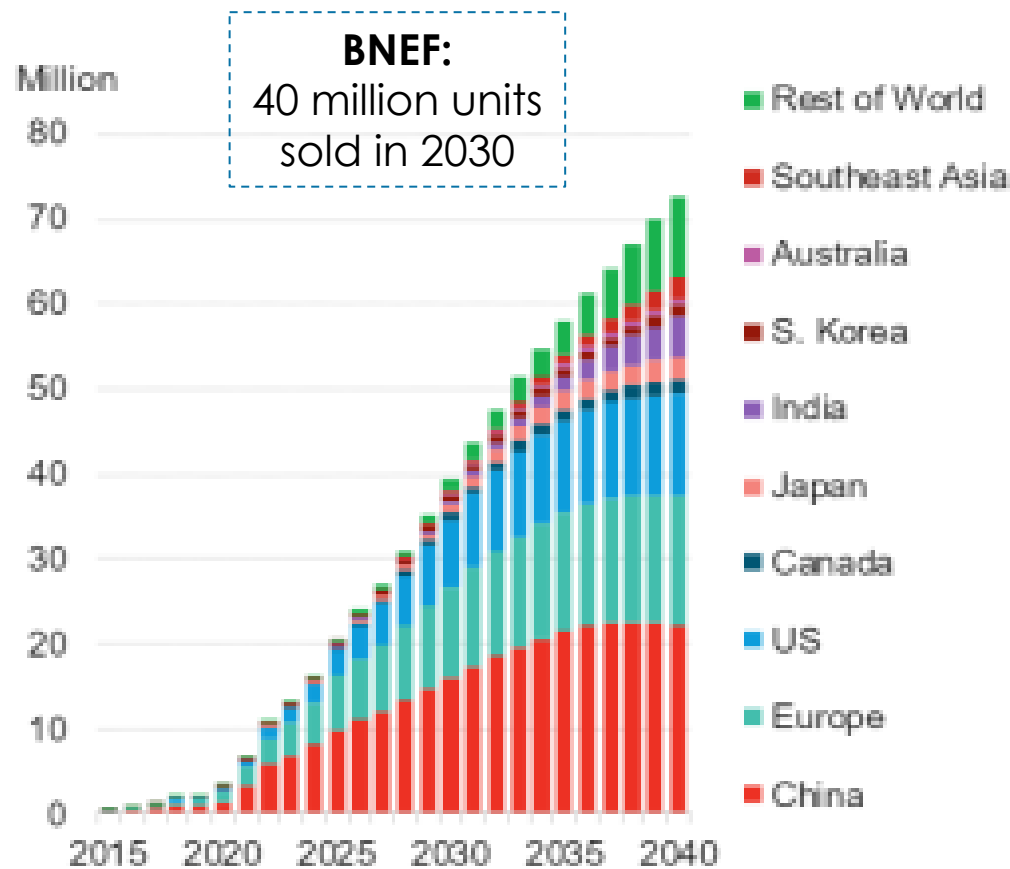
Part II: Presentations



Dolf Gielen
Director Innovation and Technology Centre
IRENA

EVs dominate battery use in coming years

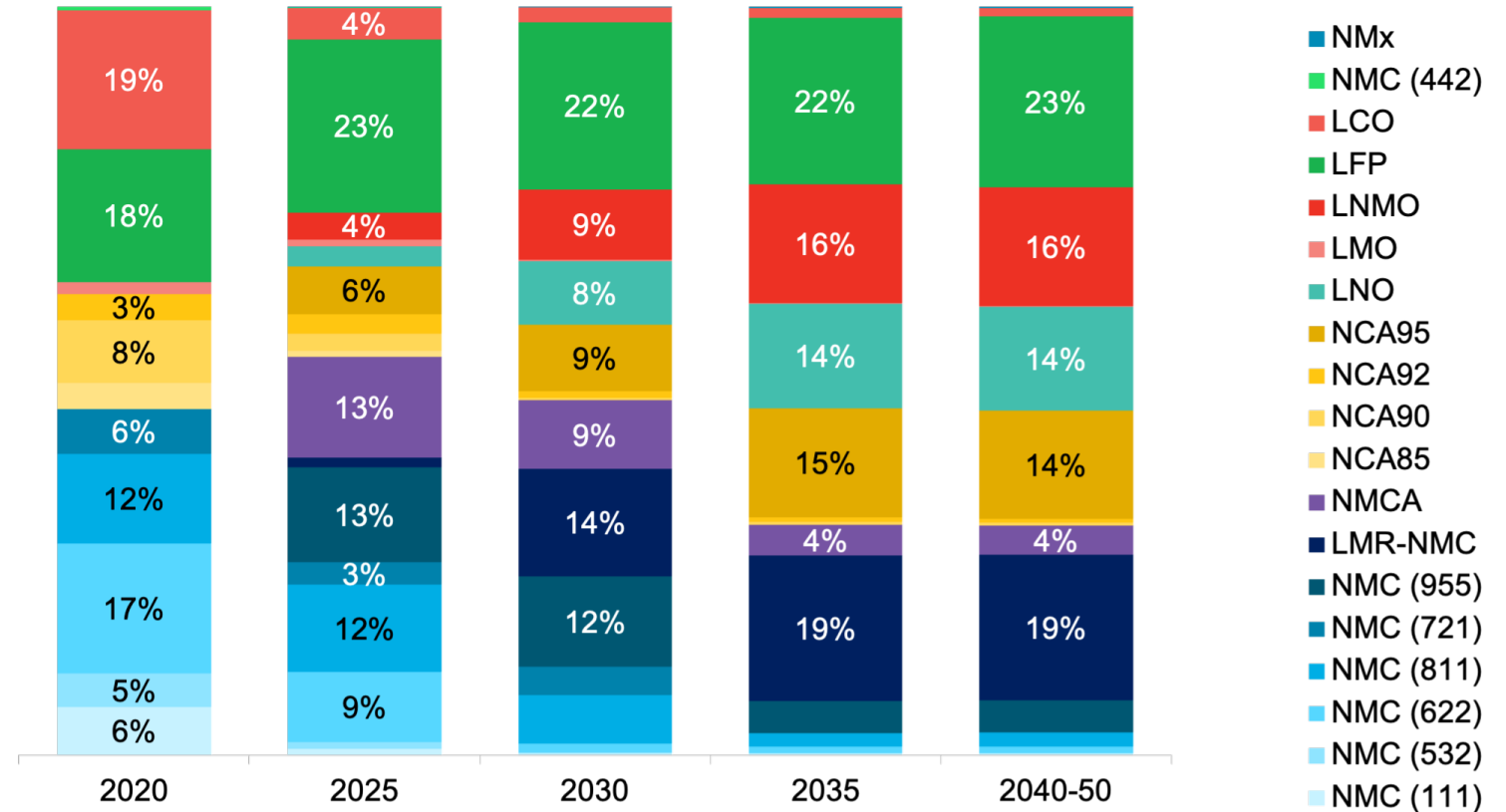
EV sales determine lithium and permanent magnet demand; **Access** to lithium and REE can potentially **limit EV market growth**



Battery chemistry trends

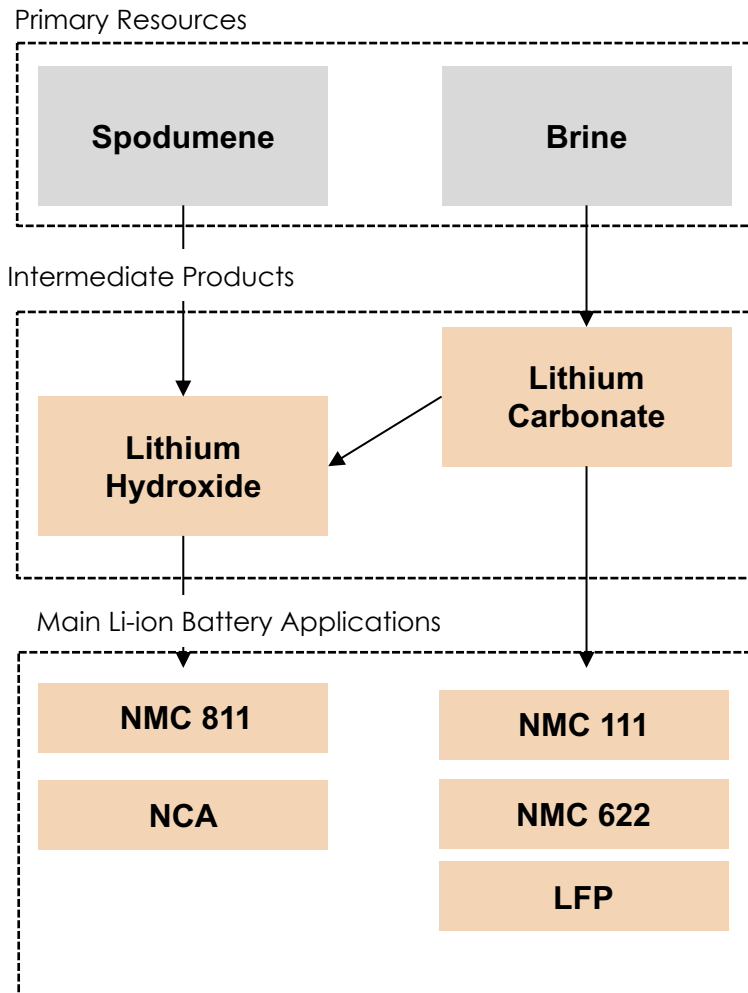
- The battery technology landscape is changing quickly to LFP, LMNO, NCA, and NMC chemistries.
- **Lithium-ion batteries** are expected to continue playing a **dominant role this decade**.
- But **innovation** may change this landscape **to reduce or eliminate lithium** requirements (i.e., **solid-state and sodium-ion**).

Chemistry Demand Across all Battery Sectors



Source: BNEF

Lithium Mining, Processing, and Applications for Batteries



There are **two main types of lithium resources**: spodumene and brine.

Each accounts to about half of lithium deposits globally.

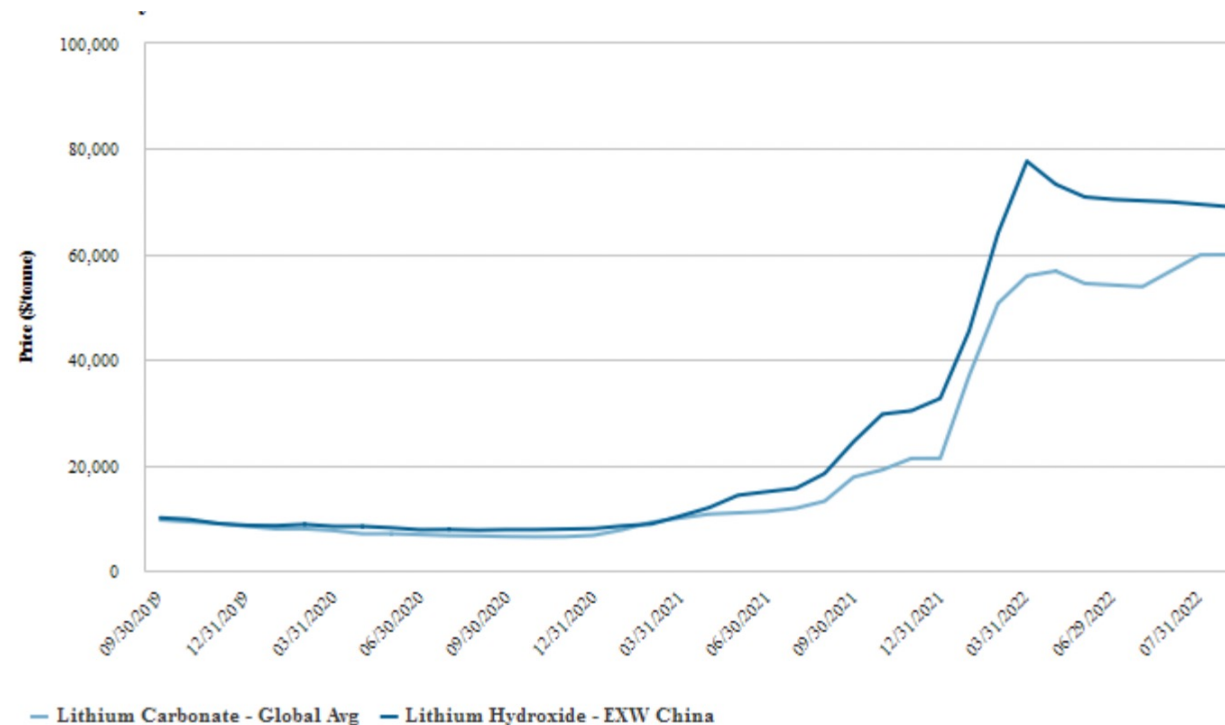
The availability of battery grade lithium products poses a large risk.

Lithium Prices

The price of lithium, expressed in LCE, has experienced **steep changes in recent years**.

Since early 2021, prices have seen a **450%-480% increase**, with lithium hydroxide reaching USD 76/kg and lithium carbonate USD 60/tonne in September 2022

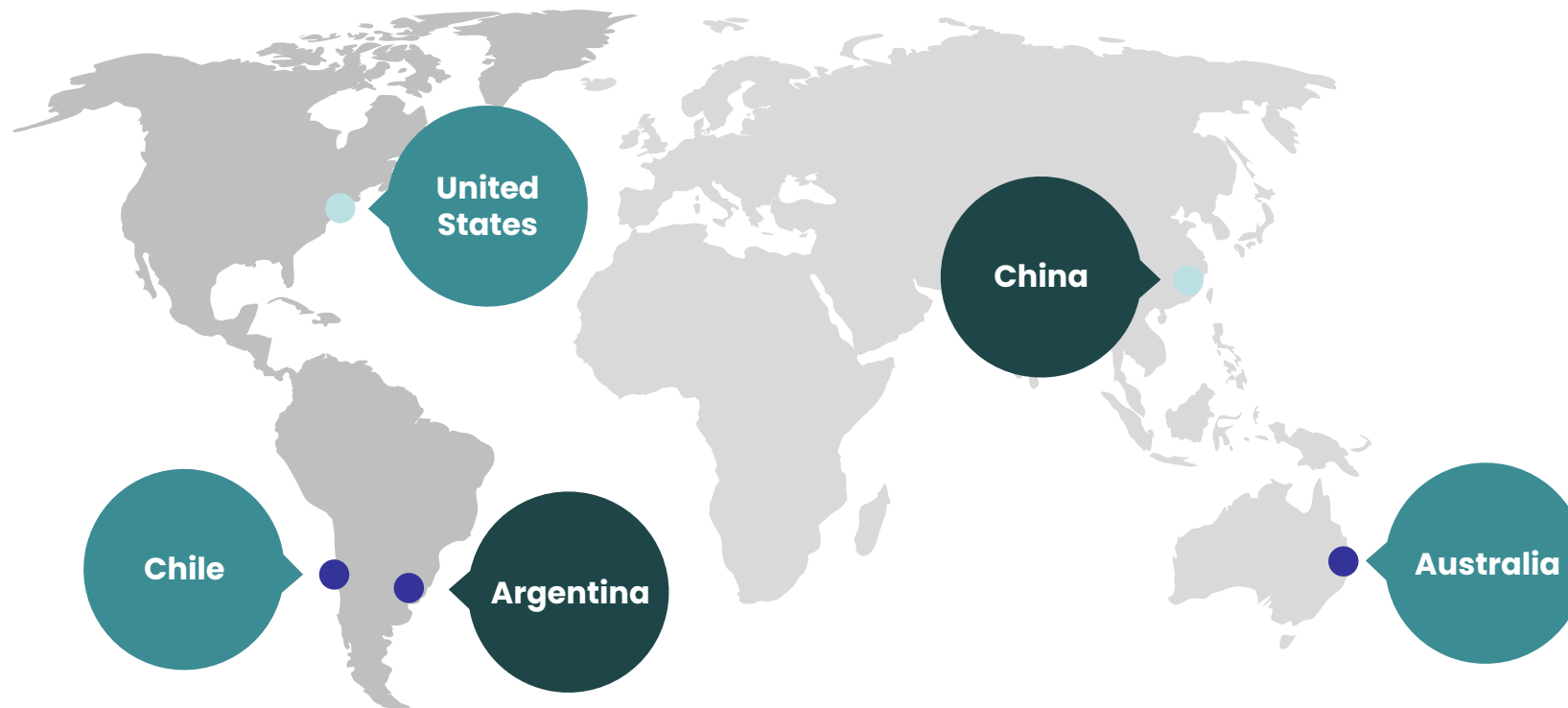
Lithium Carbonate and Lithium Hydroxide Prices Sep 2019 – Sep 2022



Source: S&P

Lithium resources and reserves

- The **global lithium reserves** are estimated at **22 Mt.**
- The identified **global lithium resources** have increased substantially to **89 Mt.**
- Many reserves and resources are found in countries which have not yet commercialized its production.



COUNTRY	RESERVES 2022
Chile	9.2 Mt
Australia	5.7 Mt
Argentina	2.2 Mt
China	1.5 Mt
United States	0.75 Mt
Other Countries	2.65 Mt

Source: USGS

Lithium production and demand in 2021

Lithium production by country in 2021

Country	Production (Mt)
Australia	0.055
Chile	0.026
China	0.014
Argentina	0.006
Brazil	0.001
Other Countries	0.002
Total	0.100

Source: USGS

Lithium supply and demand in 2021

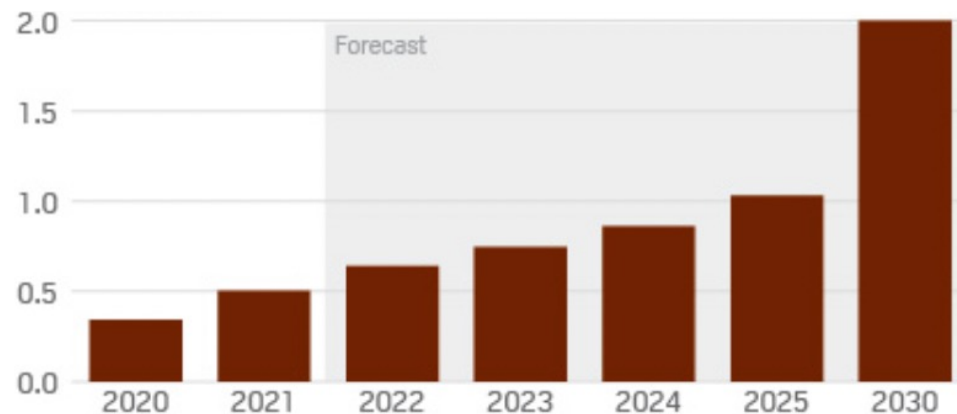
Lithium production reached 0.10 Mt, or ~0.532 Mt LCE, **21% higher than 2020.**

Lithium demand reached 0.09 Mt, **33% higher than 2020.**

Supply and demand forecasts

Demand

Lithium Demand Forecast 2022-2030



Source: S&P

- The **electrification** of the **automotive sector drives** demand for lithium, as all existing battery chemistries use it
- S&P expects lithium **demand** to reach **2 Mt by 2030**, McKinsey expects **it to surpass 3 Mt by 2030**.

Supply

Future mine capacity and their outputs by 2030

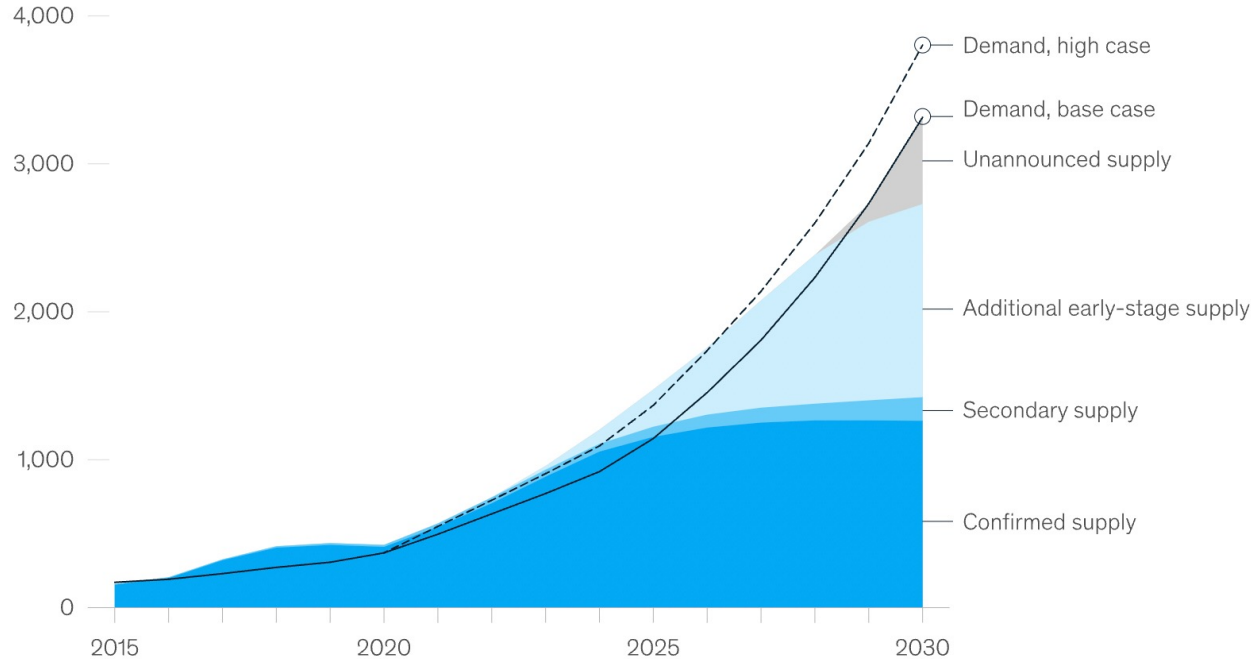


Source: S&P

- Lithium supply is expected to **triple by 2025**.
- **Australia** is set to maintain dominance – production is expected to **increase by 139% towards 2025**.
- **South American** production is expected to **increase by 200%** in the same time period.
- **China** holds 80% of battery manufacturing capacity

Supply and demand balance towards 2030

Global lithium supply and demand (kt LCE)



Source: McKinsey

- **Current and planned projects** are expected to come online **to meet demand between now and 2025**.
- There is a **high probability** of a **tight lithium supply** between 2025 and 2030.
- Lithium supply can likely **switch to deficit** if additional projects are not added to the pipeline to meet 2030 demand.
- Lithium **production must quadruple between 2020 and 2030** to meet growing demand, from 0.345 Mt in 2020 to 2 Mt in 2030.

IT COULD TAKE ALMOST A DECADE FOR A MINING PROJECT TO REACH CAPACITY



Source: S&P

Moving forward – ramping up supply

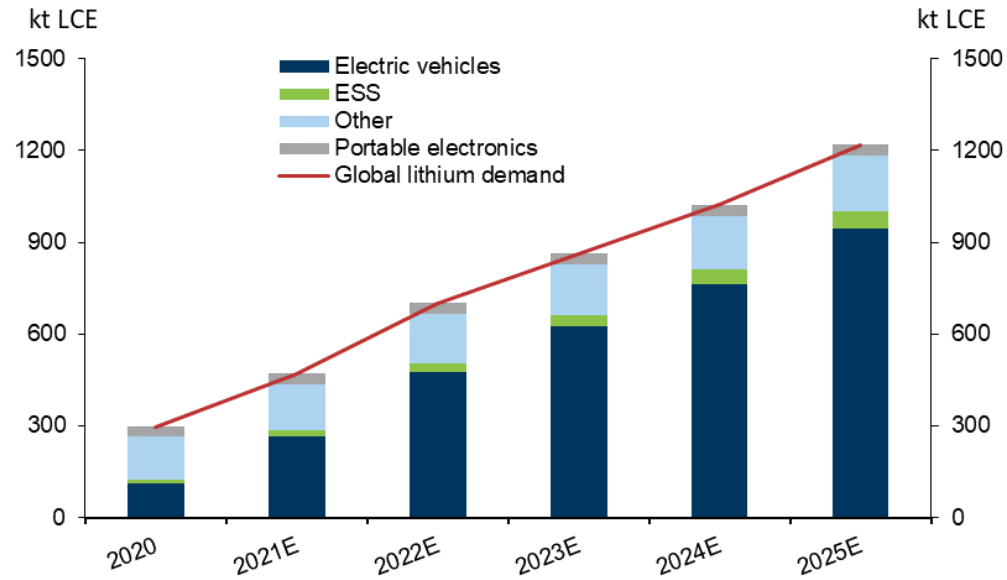
- **Investment** in lithium production needs to be increased.
- Critical to **ramp up exploration and production** now, considering the lengthy timeline for lithium mining projects to meet increasing demand.
- Necessary to invest in **technological advancements** to reach **previously inaccessible resources, improve recovery rates and speed.**
- 90% of exploration permits in 2021 were in China, Chile, and Australia. **Expanding exploration to other countries may result in new mines.**
- Need to **improve communication** between OEM's and mining companies.
- Need to ensure the **development of skilled workers** to avoid bottlenecks.
- Long term outlook will be impacted by heighten consumers' priority into sustainable supply chain (sustainable and just extraction, , including recycling.



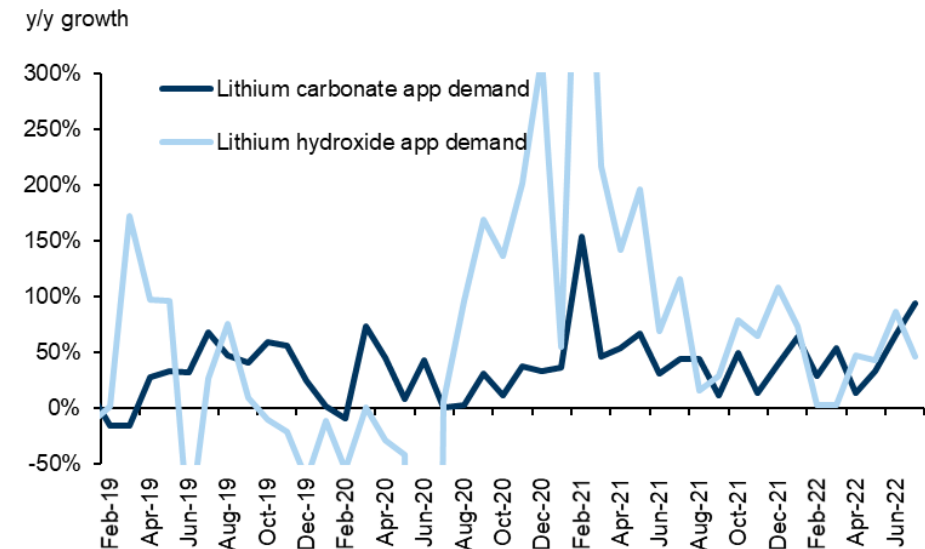
Aditi Rai
Metals Strategist
Goldman Sachs

Lithium demand has remained healthy through China's lockdowns and will almost double by 2025

- Global lithium demand

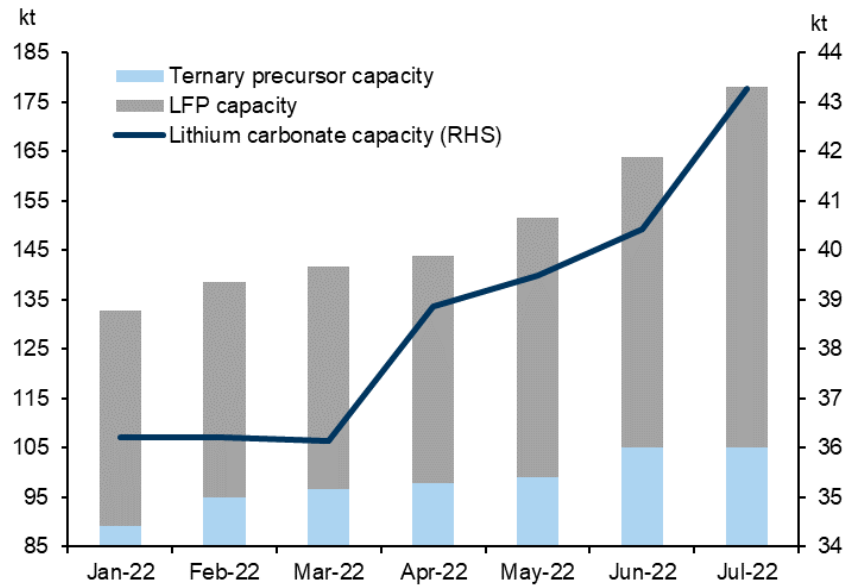


- China lithium apparent demand

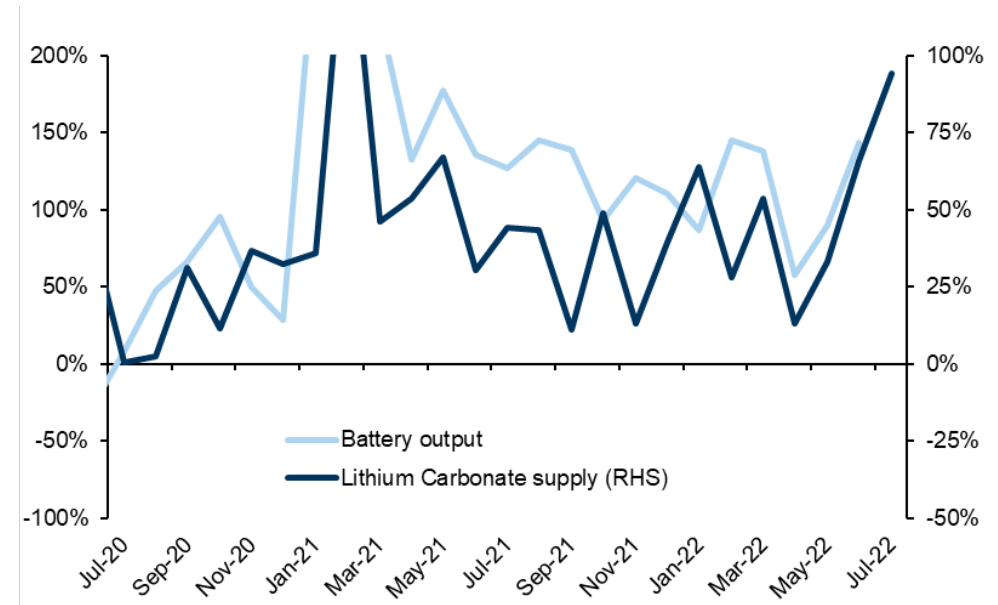


LFP capacity growth has sustained prices until now

China carbonate, LFP & ternary precursor capacity

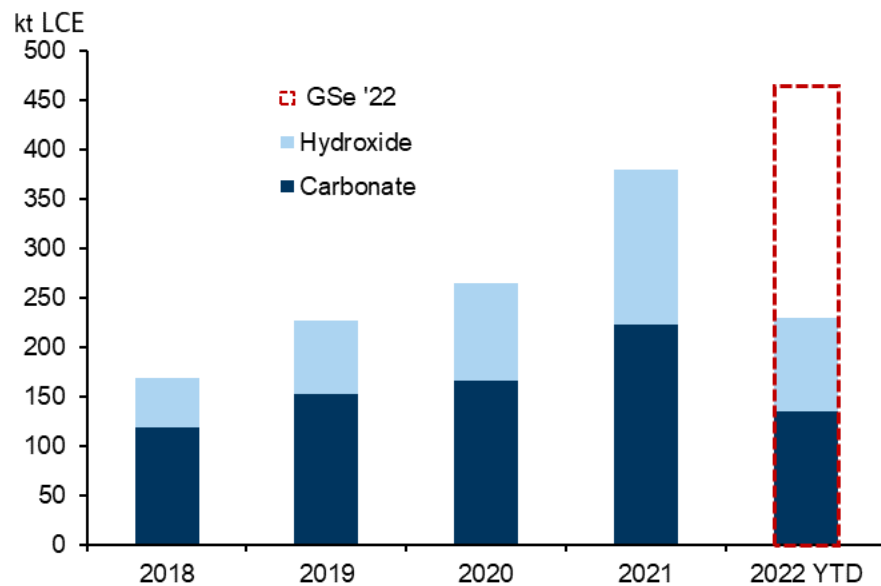


China lithium carbonate and battery supply y/y growth



China & ex-China lithium supply is in line with expectations

- China carbonate & hydroxide output

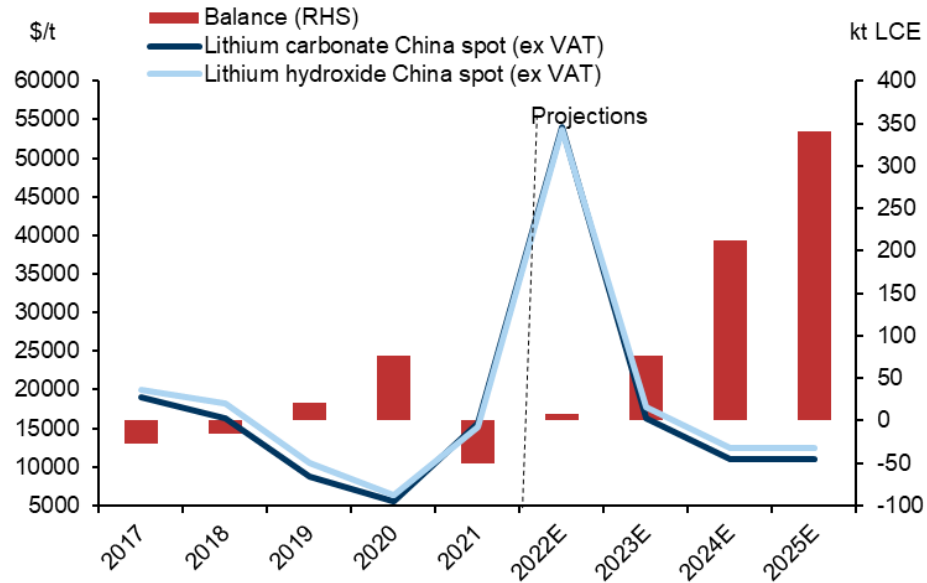


- China lithium concentrate imports

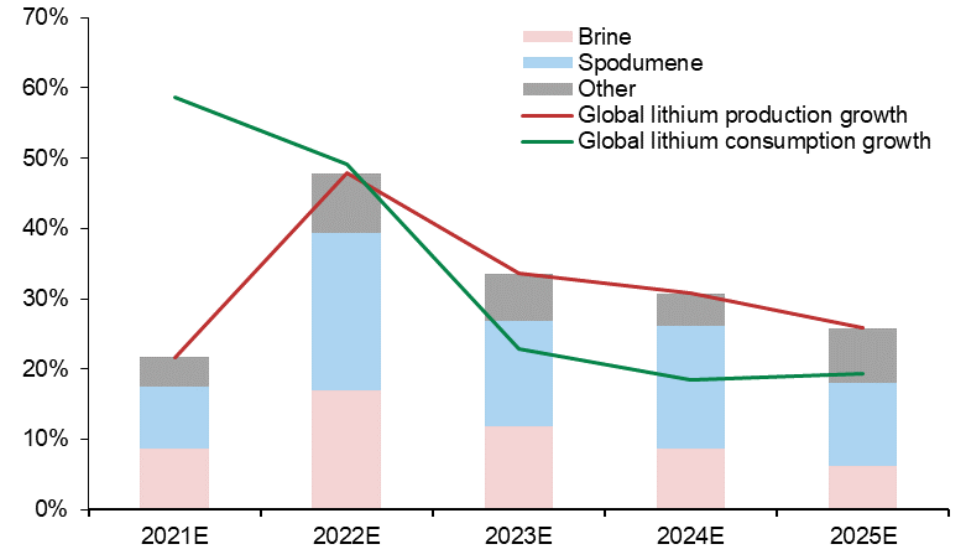


The supply has front run the demand, materially softening the market from 2022

- Lithium price and balance

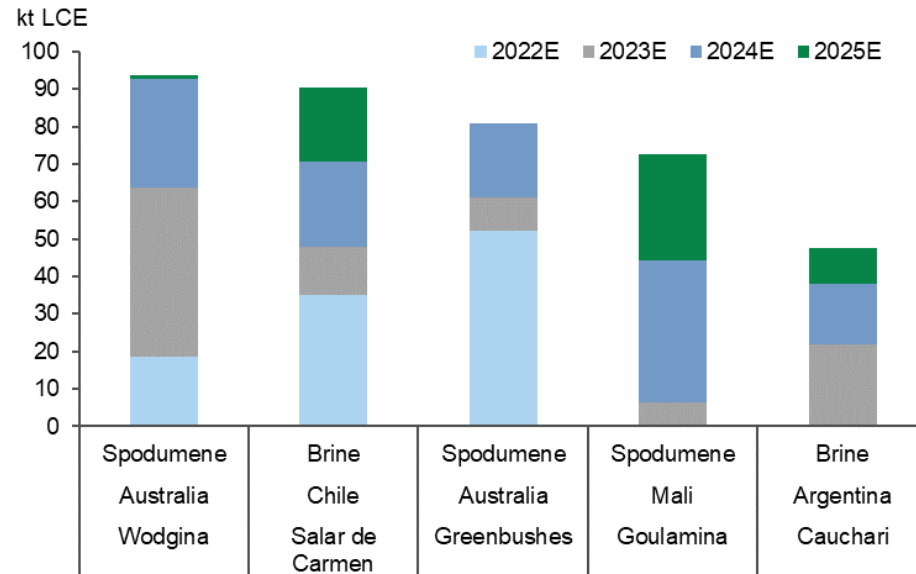


- Global lithium production y/y growth

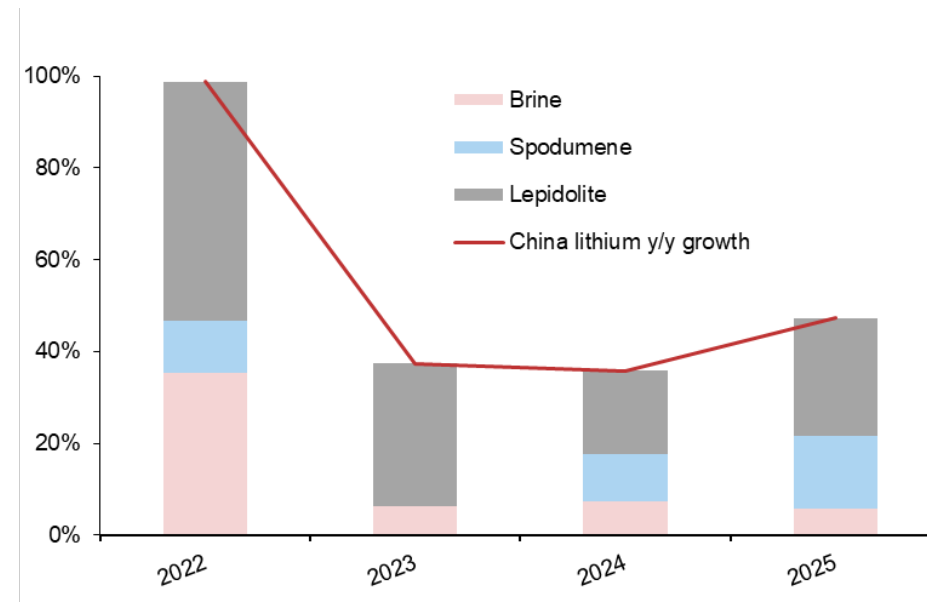


Australia spodumene and China lepidolite to be the main driver of supply growth

• Ex-China lithium projects annual additions



• China lithium production y/y growth



• Woodmac, Company data, Goldman Sachs Global Investment Research

GS Lithium supply-demand balance

Li ('000 tonnes LCE)	2020	2021E	2022E	2023E	2024E	2025E
Global demand						
Consumption - batteries	169	336	562	720	876	1070
% change y/y	7%	99%	67%	28%	22%	22%
EV	95	243	446	585	721	895
ESS	10	18	26	37	49	58
E-buses, two-wheeler EVs	17	24	31	38	43	50
Portable electronics	32	34	35	36	36	37
Other	14	17	23	23	27	30
Consumption - ex batteries	128	135	140	143	146	149
% change y/y	-4%	5%	4%	2%	2%	2%
Ceramics	32	33	34	35	36	37
Glass-ceramics	26	27	29	29	30	31
Other	70	74	77	78	79	81
Global Consumption	296	471	702	863	1022	1219
% change y/y	2%	59%	49%	23%	18%	19%
Global Refined Supply						
Brine	175	209	291	375	457	533
China	38	41	69	79	95	112
Ex-China	137	168	222	296	362	421
Spodumene	207	241	349	455	621	768
China	10	7	16	16	38	84
Ex-China	197	234	332	438	582	684
Other	13	30	71	119	162	259
China	13	30	71	119	158	233
Ex-China	0	0	0	0	4	26
World output	395	481	711	949	1240	1561
% change y/y		22%	48%	34%	31%	26%
Total output (adj. for disruption)	395	481	693	902	1178	1483
% change y/y		22%	44%	30%	31%	26%
Battery Scrap Supply	3	9	18	37	55	77
% change y/y		2%	3%	4%	5%	5%
Global Balance	77	-51	8	76	212	341
as % of global supply	19%	-11%	1%	8%	18%	23%
Cash Prices (annual average)						
Current dollar (\$/t)	5538	15656	53982	16372	11000	11000
Current dollar (c/lb)	251	710	2449	743	499	499

Part III: Discussion



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Thank you for your attention!

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