

**DOCKETED**

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<b>Docketed Date:</b>	3/24/2021



# Lithium Valley Commission Meeting

March 25, 2021





# Housekeeping

- Meeting conducted remotely via Zoom
  - Recorded and transcribed by court reporter
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  - <https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=20-LITHIUM-01>



# Welcome and Roll Call

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# Agenda

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- Welcome and Roll Call
- Administrative Items
  - Approval of Past Meeting Action Minutes
  - Consideration of Rules of Order
  - Possible election of Vice Chair
- Goal Setting Discussion
- Lithium Valley Commission Report
  - General Report Structure
  - Establish Commissioner Workgroups
- Guest Presentation on the Global Lithium Market
- Panel Discussion by Industry and Academia on Active Lithium Recovery Facilities
- Media and Legislation Updates
- Determination of Agenda Topics, Speakers, and Presentations for Future Meetings
- Public Comment
- Adjourn



# Administrative Items

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- Approval of Past Meeting Action Items



# Public Comment

## Comment Instructions:

Limited to 3 minutes per comment

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# Administrative Items

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- Consideration of Rules of Order



# Public Comment

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# Administrative Items

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- Possible election of Vice Chair



# Public Comment

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# Goal Setting Discussion

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# Public Comment

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# Lithium Valley Commission Report

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- General Report Structure
- Establish Commissioner Workgroups



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# **Bagley-Keene Open Meeting Act and Sub-Bodies**

**Lithium Valley Commission**

**March 25, 2021  
California Energy Commission  
Chief Counsel's Office**



# Bagley-Keene Application to LVC:

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Applies to any Lithium Valley Commission (LVC) meeting where “a majority of the members congregate to hear, discuss, or deliberate” upon matters within LVC’s jurisdiction



# This Includes:

"An advisory board, advisory commission, advisory committee, advisory subcommittee, or similar multimember advisory body of a state body, **if created by formal action** of the state body or of any member of the state body, and if the advisory body so created **consists of three or more persons.**"

Gov. Code § 11121(c)



# What is “Formal Action?”

- When a body authorizes or directs an individual to create a new body, that new body is deemed to have been created by formal action of the body
- Motion, ordinance, resolution, designation of members, or any similar action



# When does Bagley-Keene Apply to Sub-Bodies?

- If LVC formally creates the sub-body – including by motion and vote or perhaps by direction of the chair in her official capacity – **AND**
- The sub-body has three or more members



# When does Bagley-Keene NOT Apply to Sub-Bodies?

- When the sub-body was not formally created by LVC, and has fewer than 7 members, **OR**
- When the sub-body has less than three members



# What's in a Name?

- It doesn't matter what the sub-body is called, could be "subcommittee," "advisory committee" or "subgroup"
- If it meets the criteria, the Bagley-Keene open meeting requirements apply



# Public Comment

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# Guest Presentation on the Global Lithium Market

- Logan Goldie-Scot, Head of Clean Power Research, BloombergNEF

# Global Lithium Update

California Lithium Energy Commission

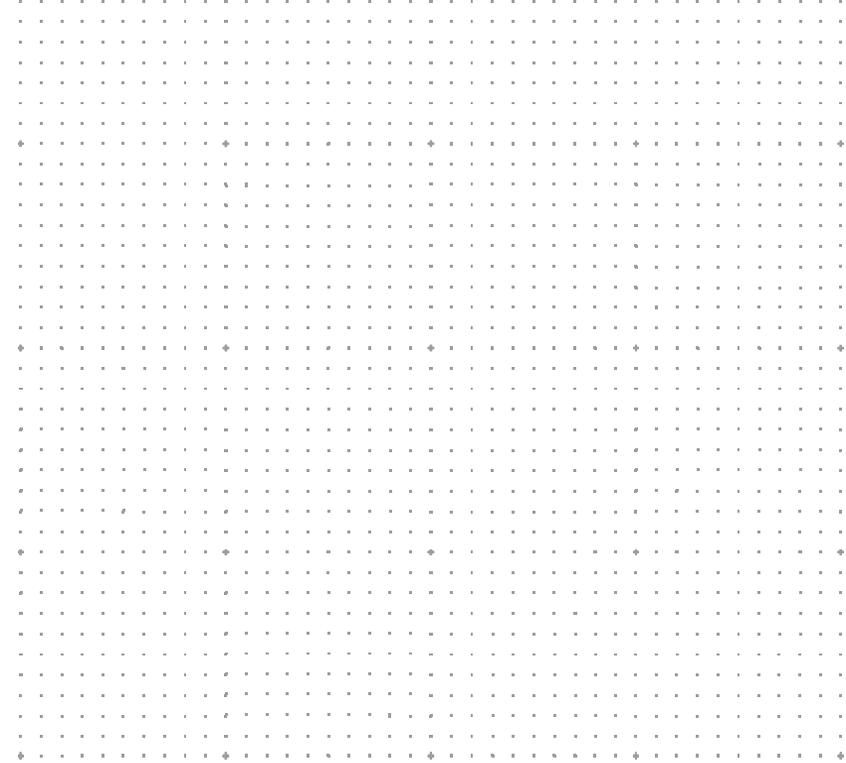
Logan Goldie-Scot

March 25, 2021



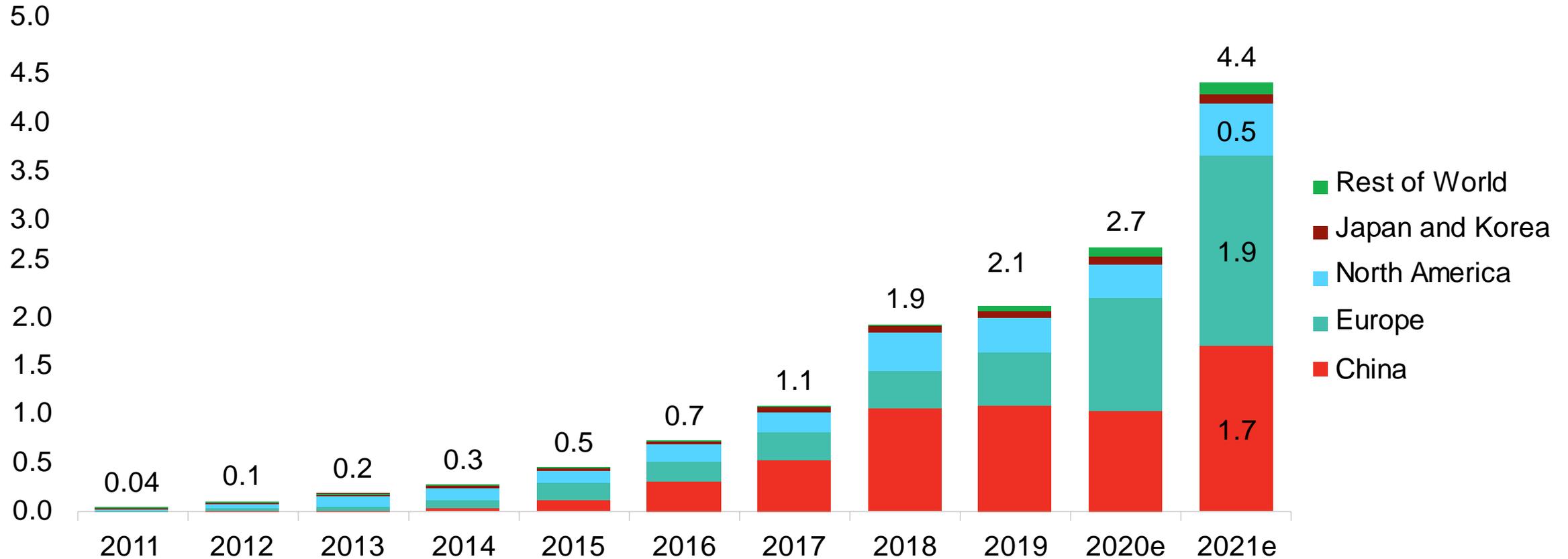
BloombergNEF

# Demand



# We expect 4.4 million passenger EVs to be sold in the U.S. in 2021

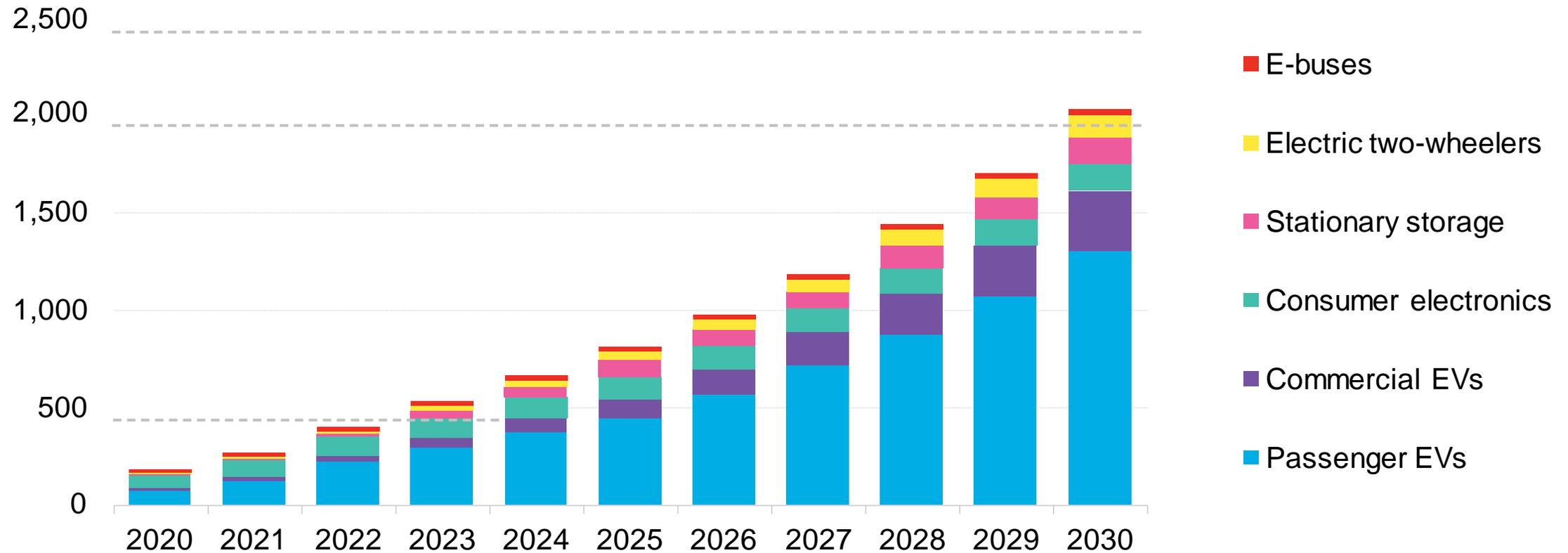
## Global passenger electric vehicle sales



Source: BloombergNEF, Marklines

# Battery demand will increase tenfold in a conservative scenario by 2030

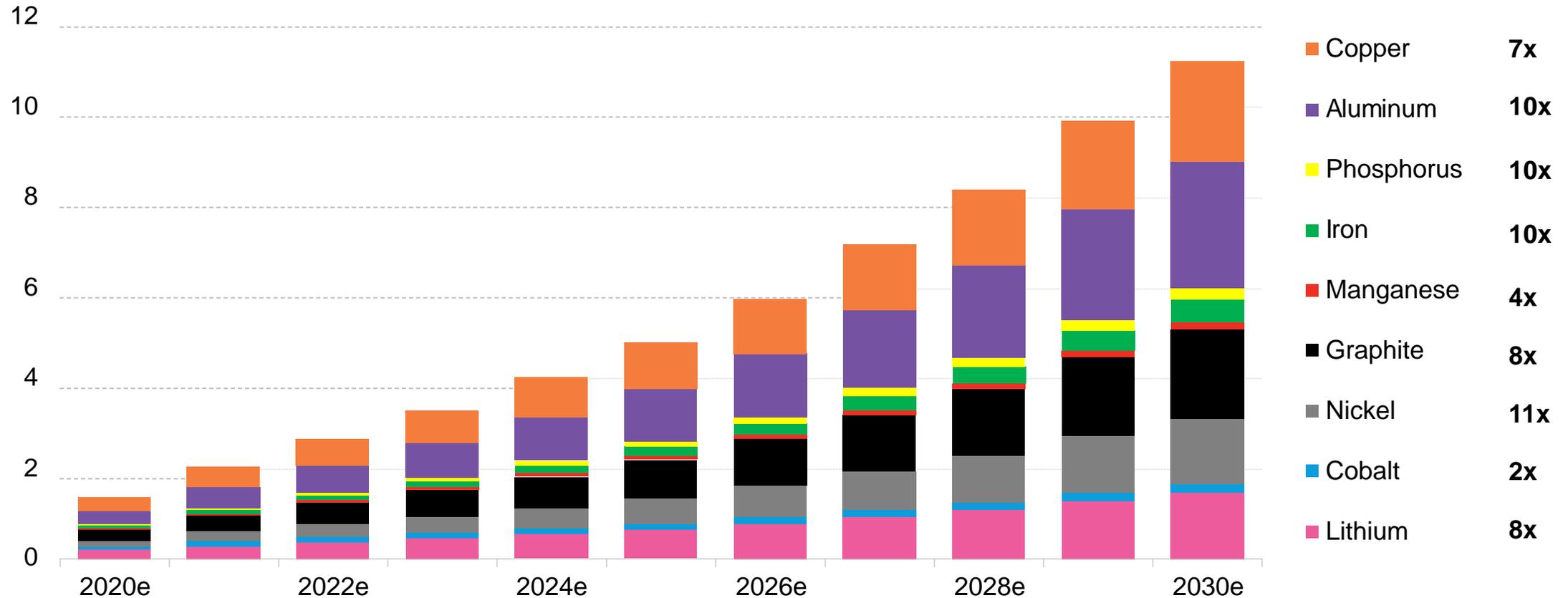
GWh/year



Source: BloombergNEF, Avicenne for consumer electronics data

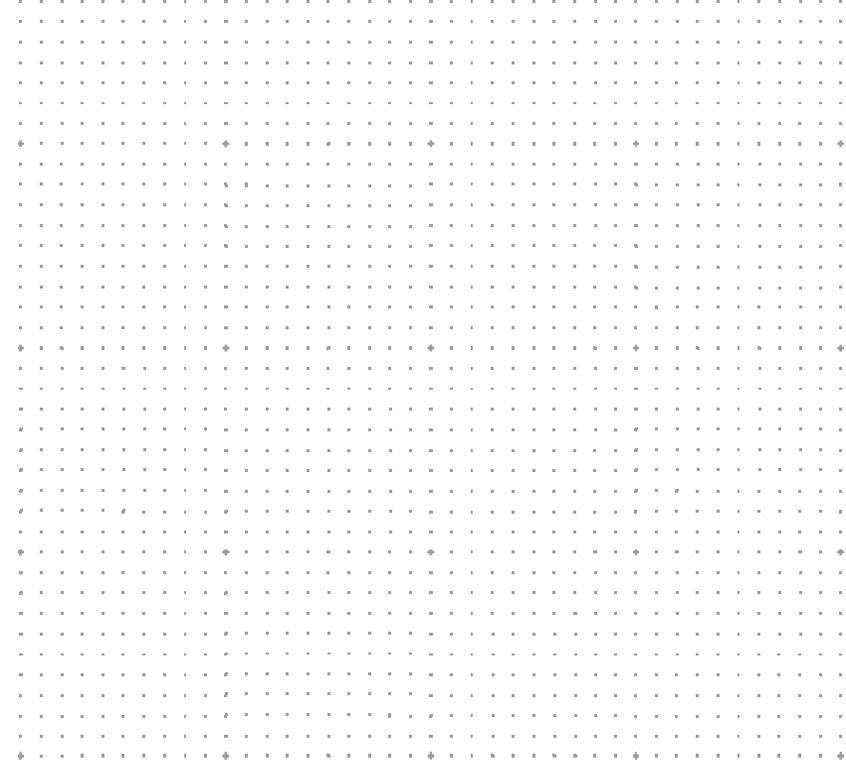
# Leading to a surge in demand for battery metals over the decade

2H 2020 forecast, Million metric tons

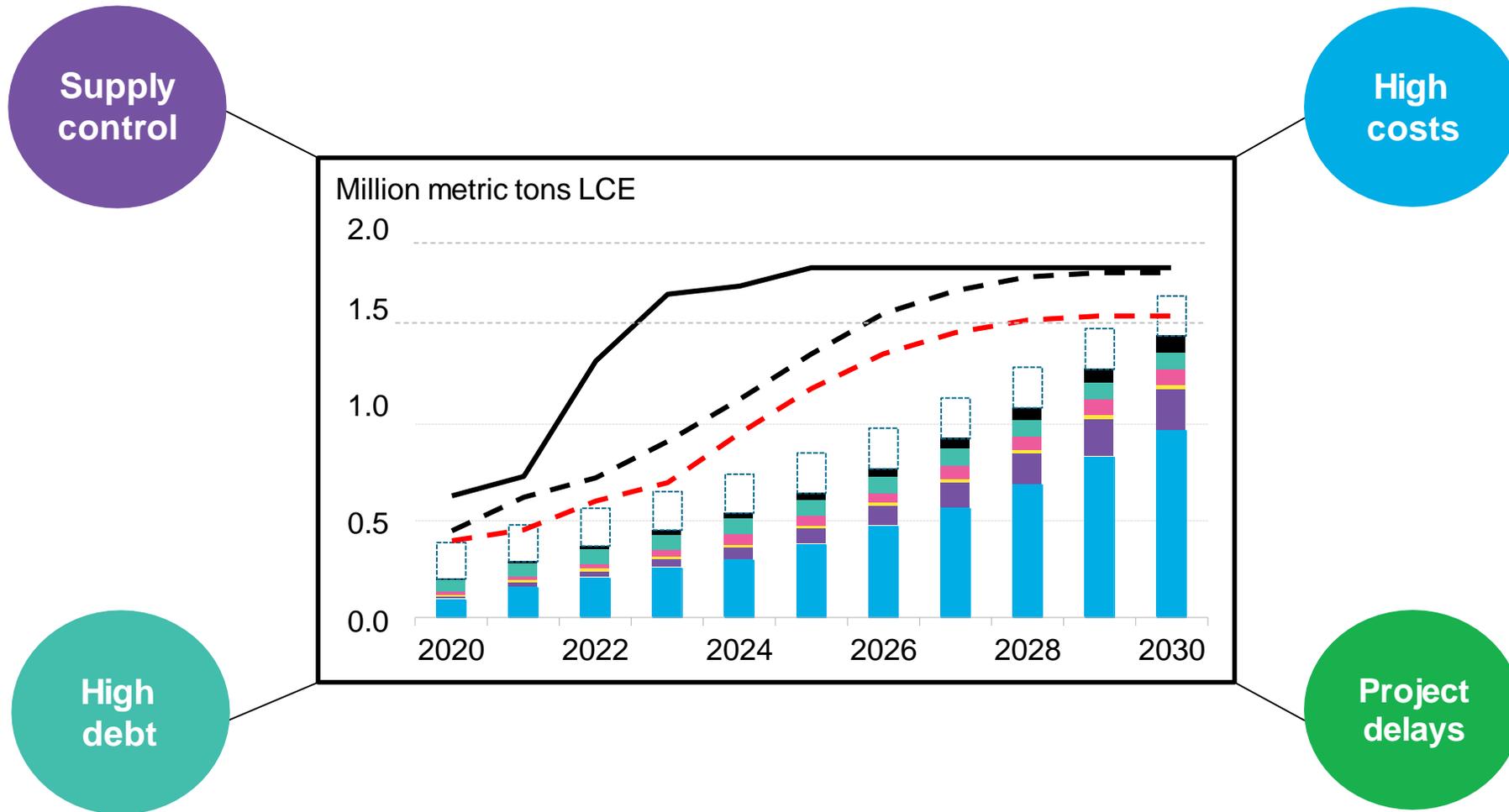


Source: BloombergNEF. Note: Metals demand occurs at mine mouth, one-year before battery demand. All metals expressed in metric tons of contained metal, except lithium is in lithium carbonate equivalent (LCE).

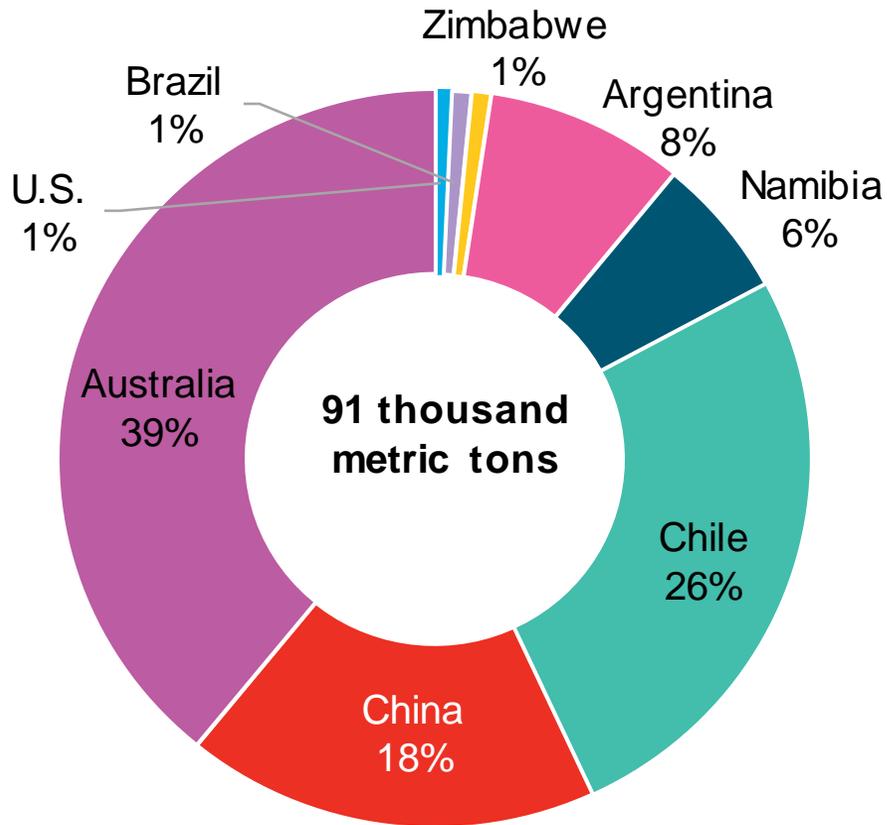
# Lithium market dynamics



# There are our risks facing the high-growth lithium market

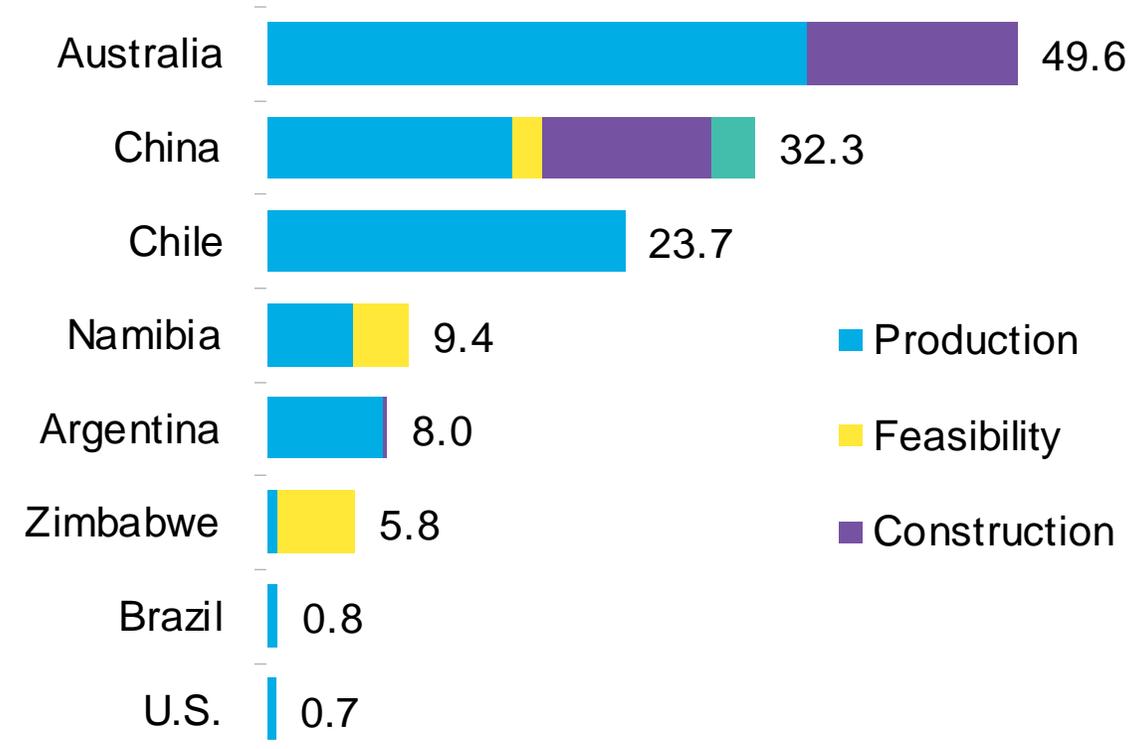


# Lithium-ion mining nameplate manufacturing capacity



Source: BloombergNEF. Note: Figure reflect global totals as of October 20, 2020.

Thousand metric ton lithium metal

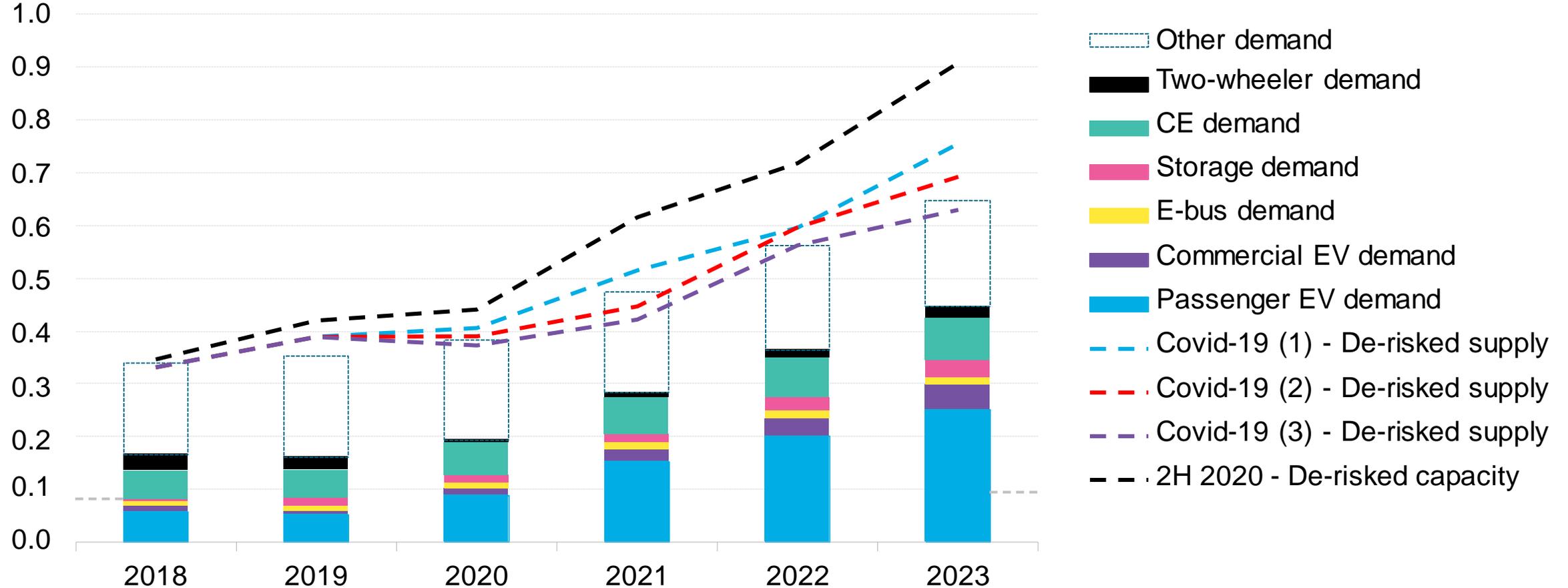


Source: BloombergNEF. Figures reflect global lithium mining capacity as of 3Q 2020. Note: Production is when the project is operating, feasibility is when it has published a definitive feasibility study, development follows feasibility and is when contracts are issued

# Global lithium supply appears in balance in the near-term



Million metric tons LCE

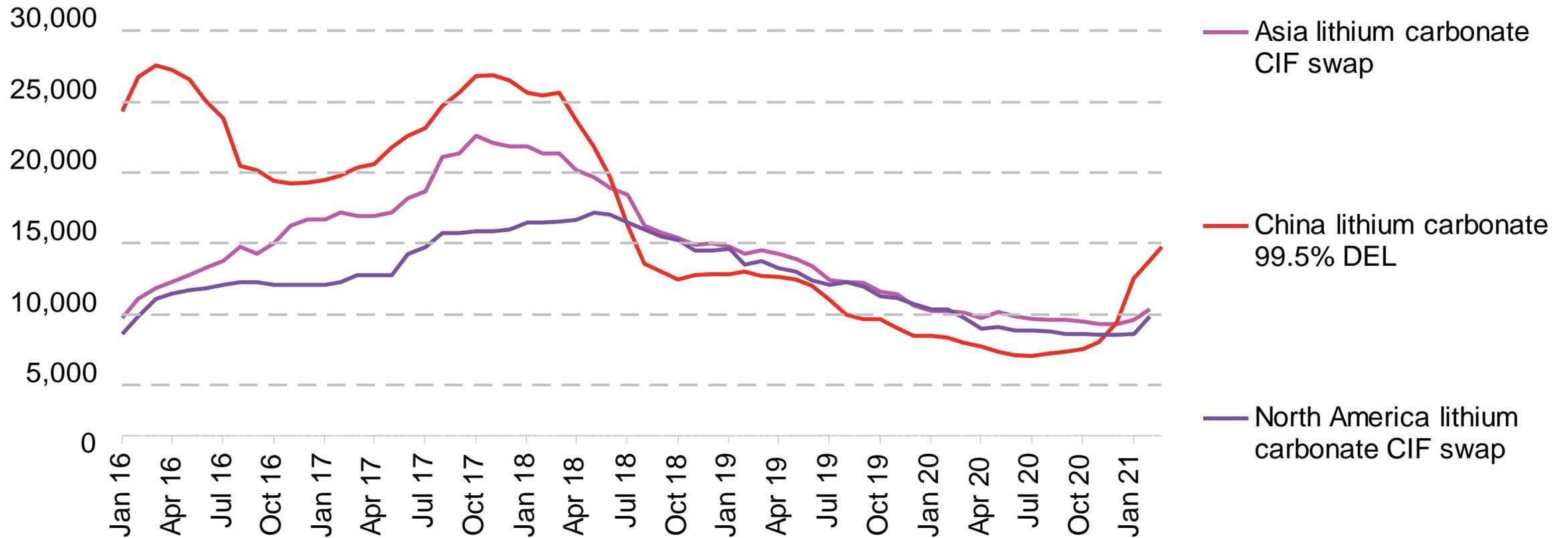


Source: BloombergNEF

# Prolonged low prices give way to signs of a lithium resurgence

High costs

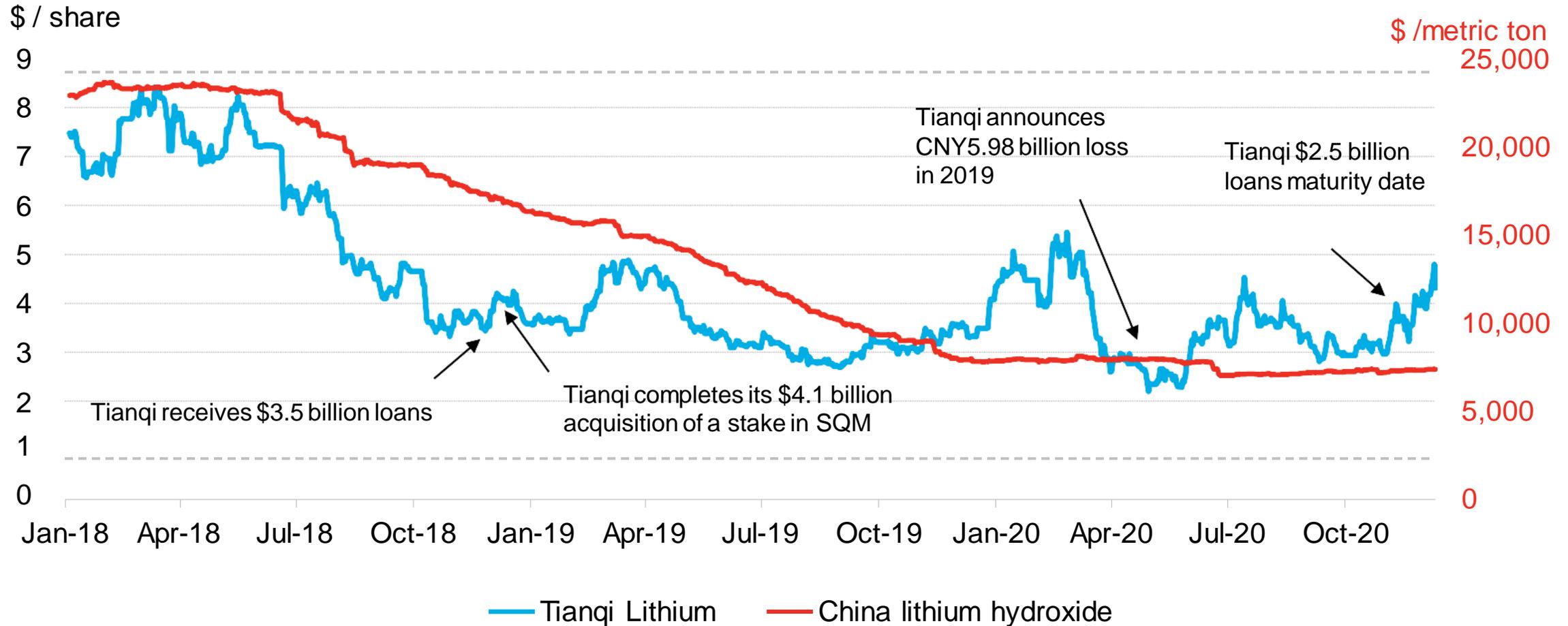
Actual data point (\$/metric ton)



Source: Benchmark Mineral Intelligence, Asian Metal Inc, BloombergNEF

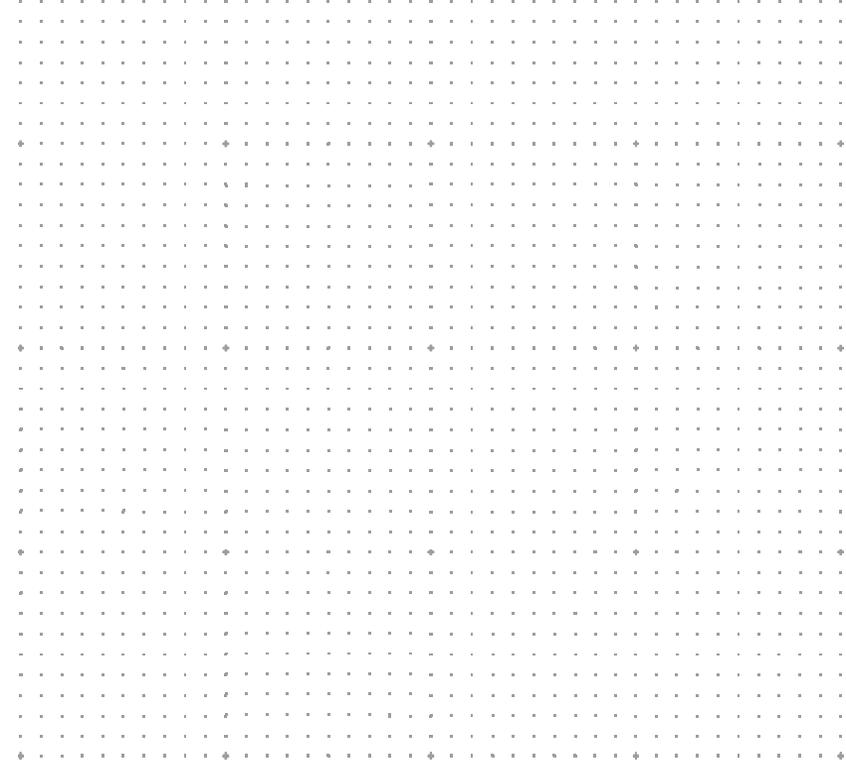
# Many leading lithium producers accumulated debt, amid low prices

High debt

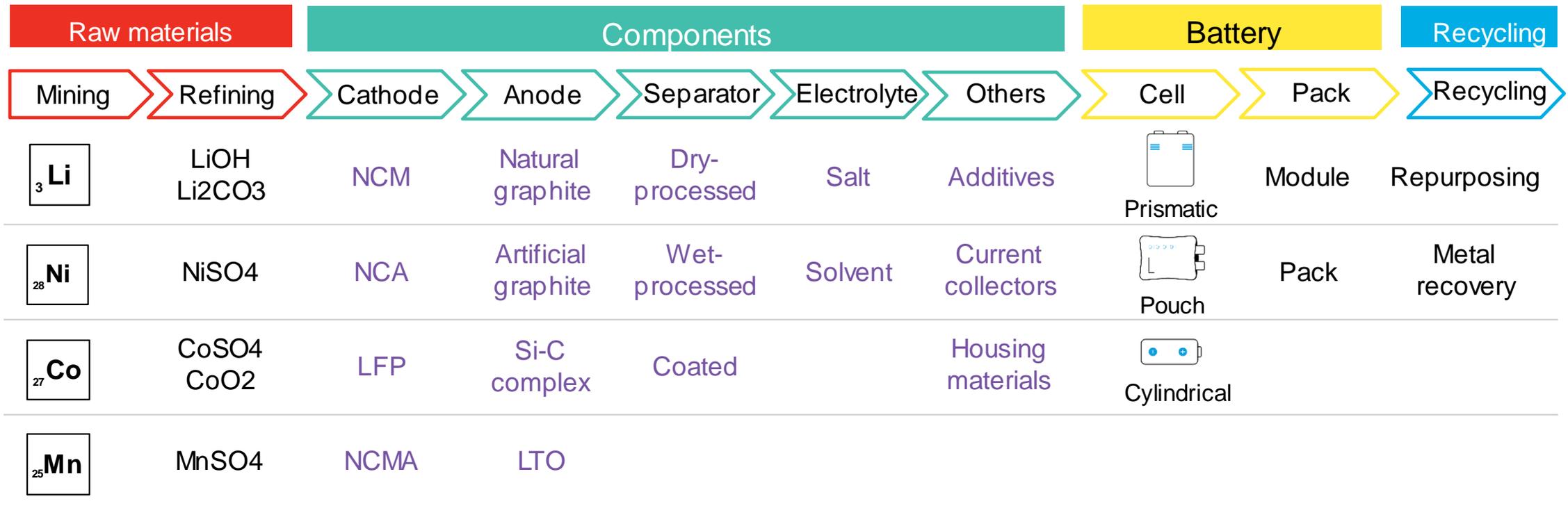


Source: BloombergNEF

# Strategic investments

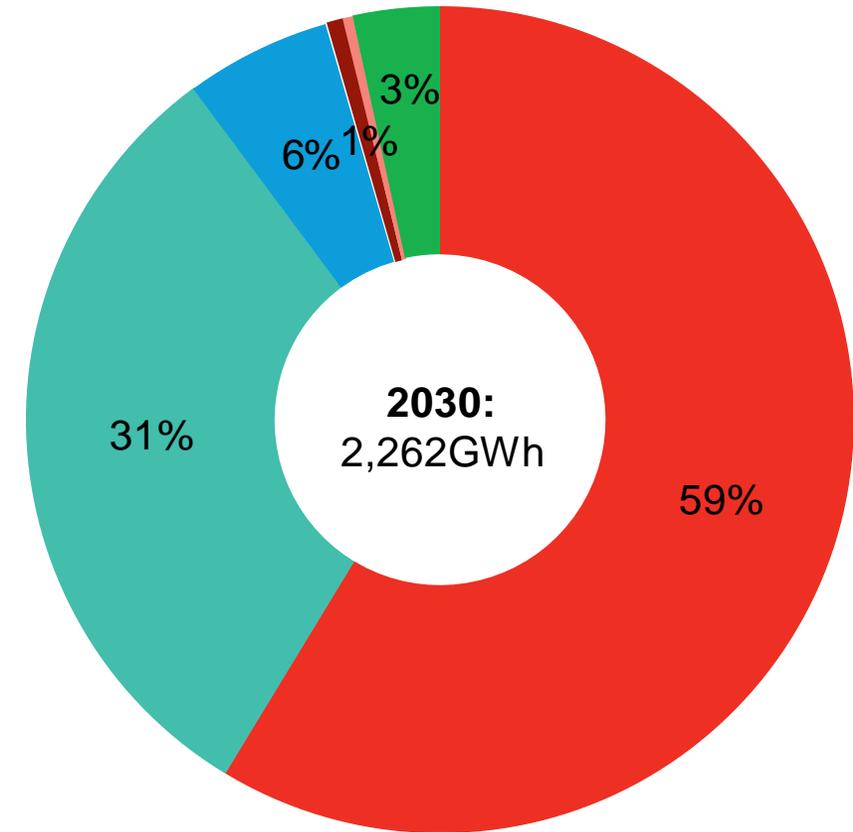
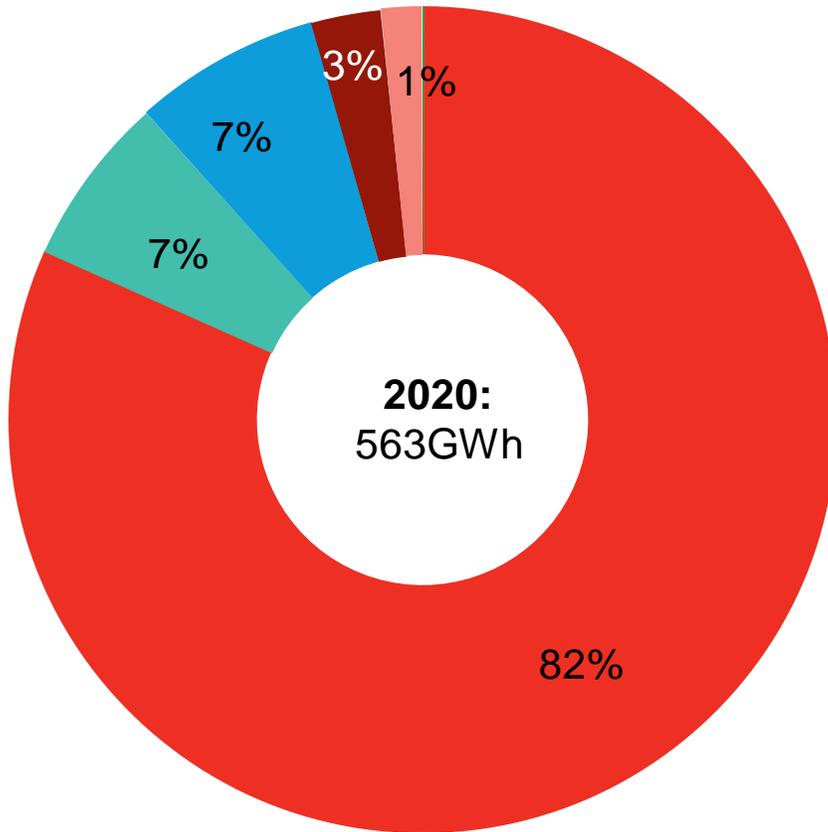


# The battery production value chain



Source: BloombergNEF. Note: NMC is lithium nickel manganese cobalt oxide. NCA is lithium nickel cobalt aluminum oxide. LFP is lithium iron phosphate. NCMA is lithium nickel manganese cobalt aluminum oxide. LTO is lithium titanium oxide. Si-C complex is silicon-carbide inorganic complex compound.

# Cell manufacturing capacity is due to quadruple based on existing announcements

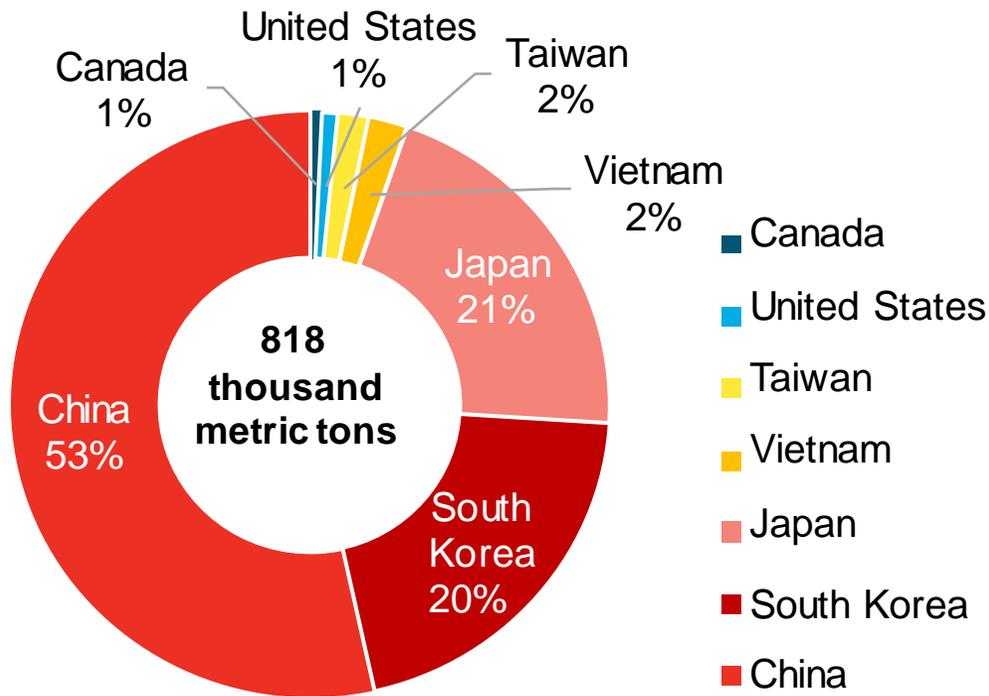


■ China    ■ Europe    ■ U.S.    ■ Korea    ■ Japan    ■ Other

Source: BloombergNEF

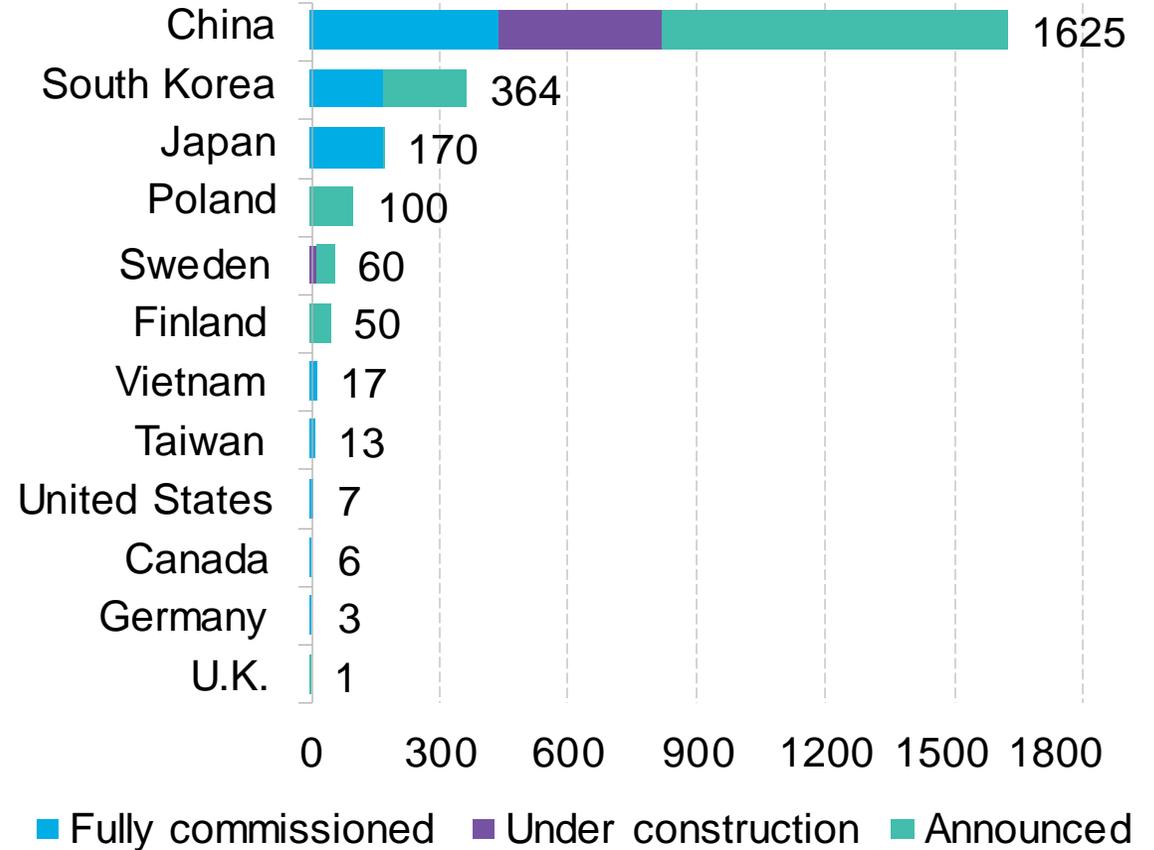
# Asia Pacific nations control most cathode processing capacity today

Commissioned cathode processing capacity



Source: BloombergNEF. Note: As of October 2020

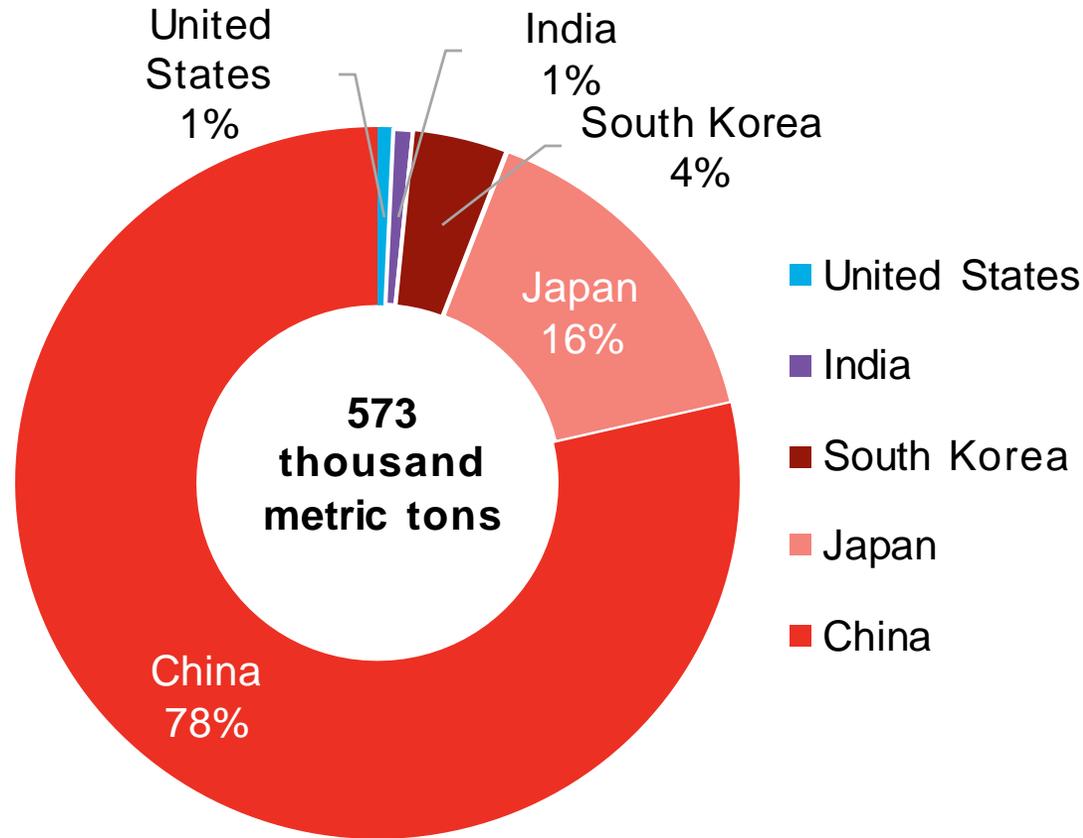
Thousand metric tons



Source: BloombergNEF. Note: As of October 2020

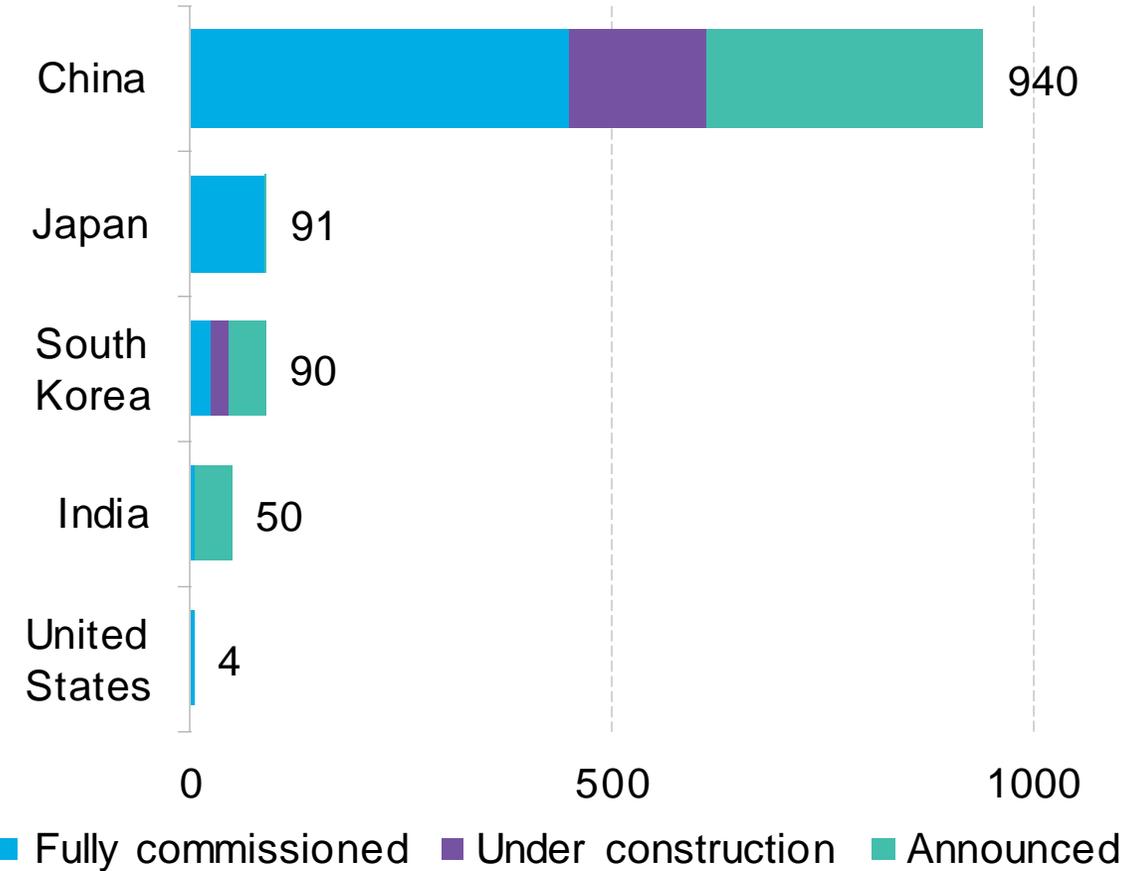
# Asia Pacific nations control most anode processing capacity today

Commissioned anode processing capacity



Source: BloombergNEF. Note: As of October 2020

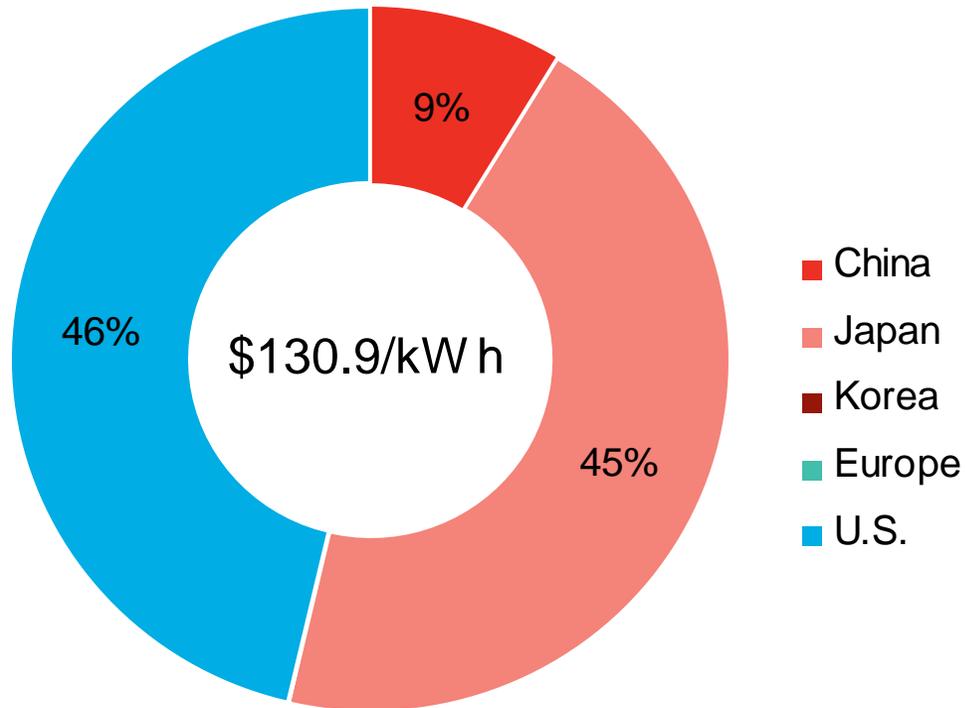
Thousand metric tons



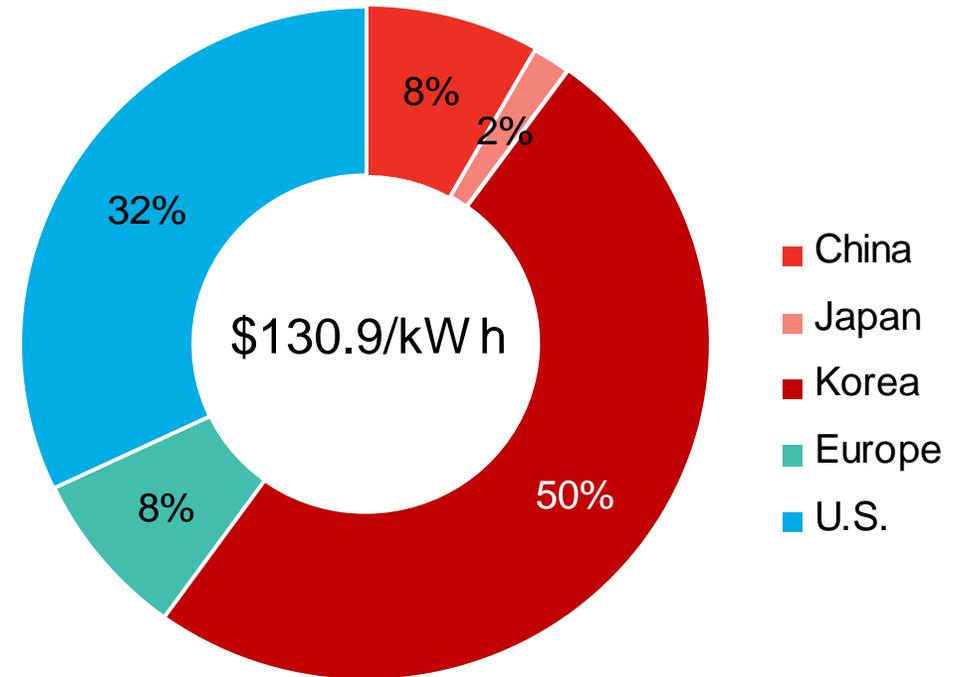
Source: BloombergNEF. Note: As of October 2020

# Estimated value break-out of a typical battery made in the U.S.

Tesla / Panasonic



Korean manufacturer in the U.S.



Source: BloombergNEF. Note: Both cost calculations are based on a 60Ah prismatic cell using NMC (622) chemistry. The cells are assumed to be produced at a 10GWh plant, which operates 330 days/year, 24 hours/day. Cell costs include cathode, anode, separator, electrolyte, labor, manufacturing and depreciation.

# The U.S. lags APAC in attractiveness as a battery supply chain destination

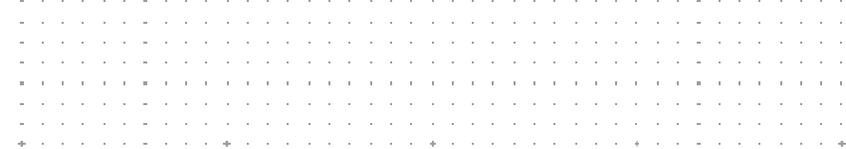
Global lithium-ion battery supply chain ranking, 2020

Rank	Country	Rank	Country	Rank	Country
1	China	6	U.S.	16	
		11	Australia		

Key: AMER, APAC, EMEA

Source: BloombergNEF

# Five criteria underpin BloombergNEF's global battery supply chain ranking



Raw materials



Components and cells



Environment



## Regional rankings



Regulations, Infrastructure & Innovation

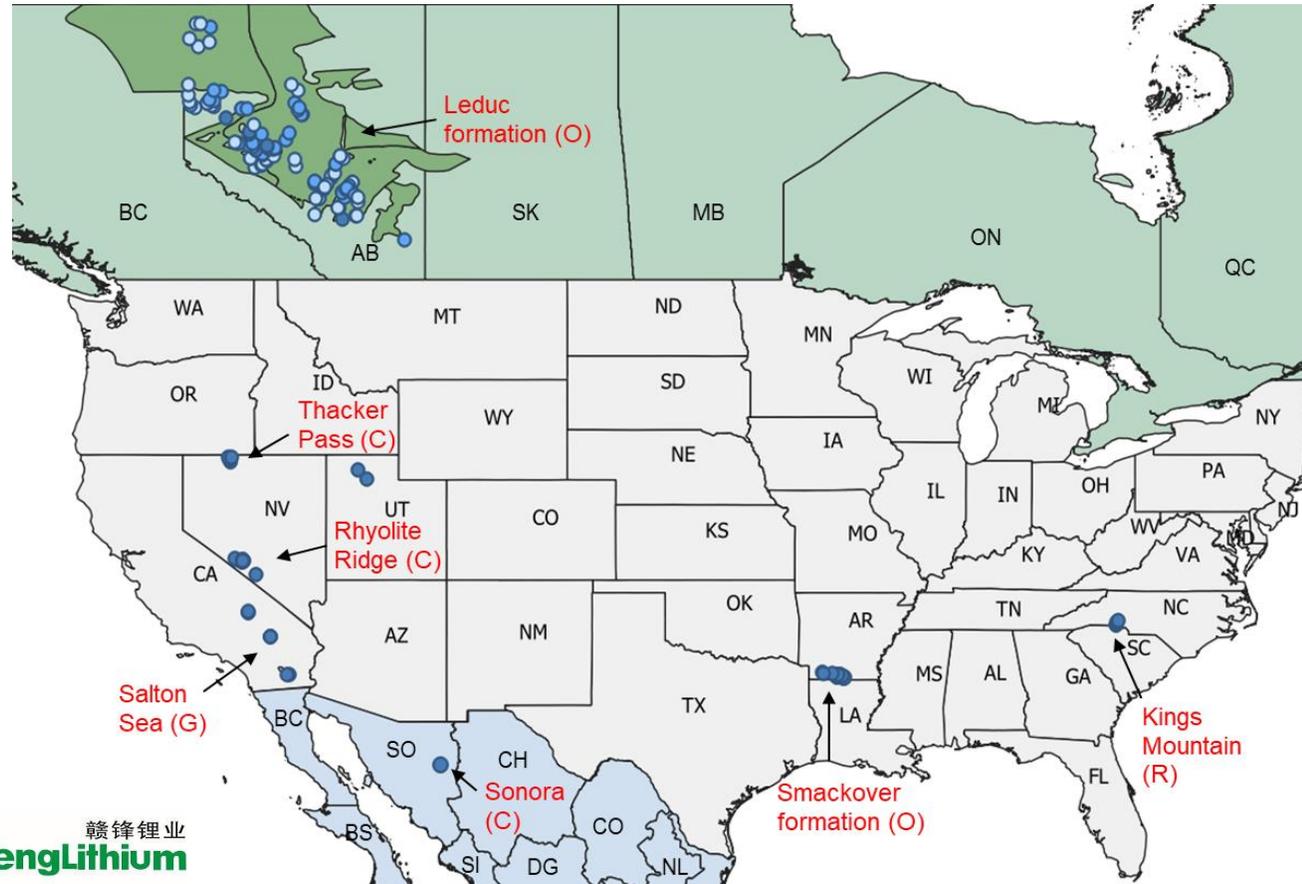
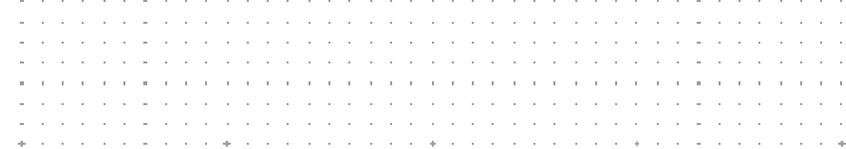


Demand



Source: BloombergNEF. Note: Green is first, yellow is second place and red third.

# Rapidly growing demand creates opportunities for lithium in the U.S.



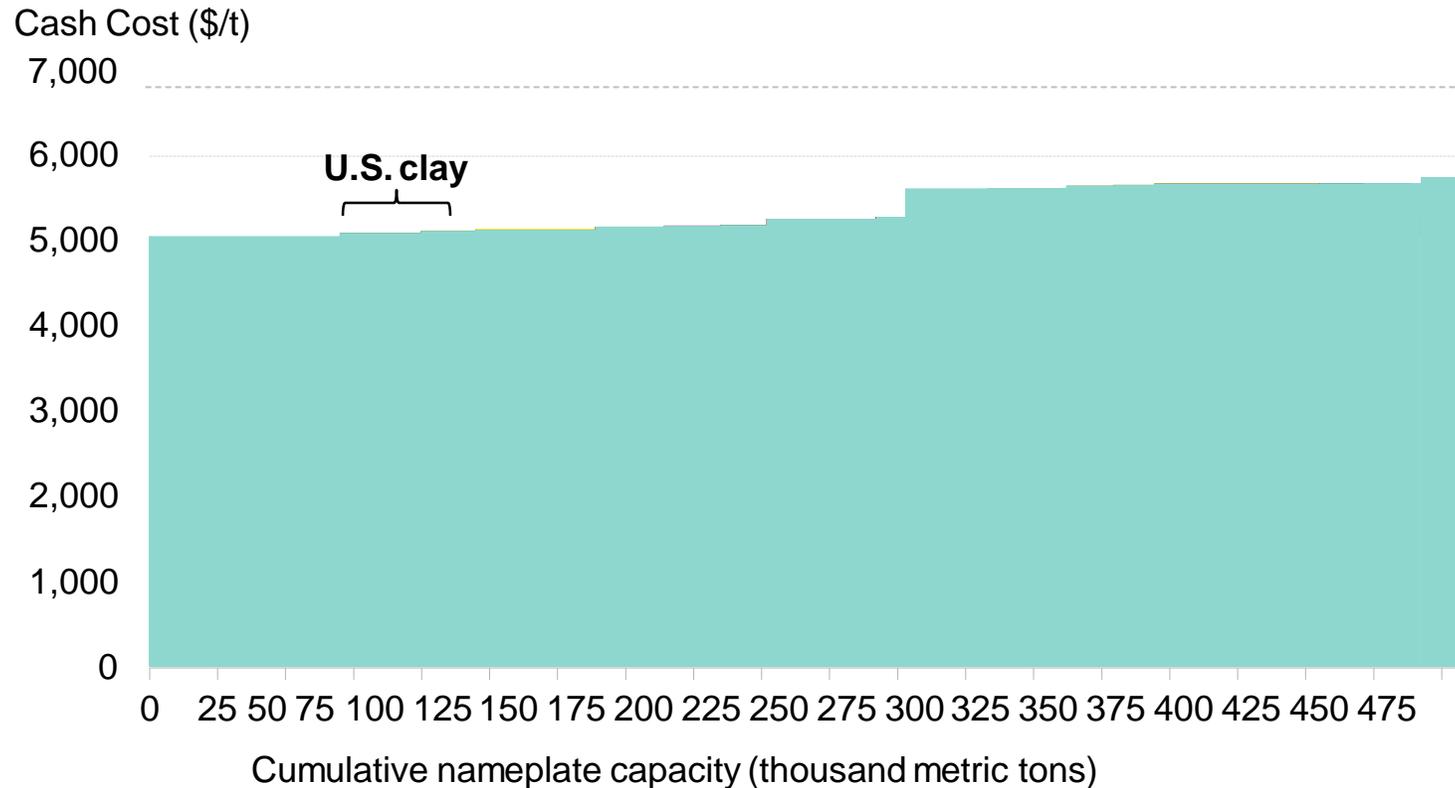
LithiumAmericas



Source: BloombergNEF, USGS, company reports. Note: (C) = clay, (G) = geothermal, (O) = oilfield, (R) = hard rock. In Canada, darker dots mean higher lithium.

# U.S. clay can be competitive on a cash cost basis

## 2H 2020 lithium cash cost curve



- **Factors to consider:**
  - Local royalties and taxes
  - Environmental permitting
  - Best practice on indigenous & community rights
  - Job opportunities and labor reconfiguration (as other industries are impacted)
- **Other routes to consider:**
  - In-house mining vs. allies and investing abroad
  - In-house mining vs. specializing in refining or manufacturing

Source: BloombergNEF Note: LCE = lithium carbonate equivalent; costs estimated with [BNEF's Lithium Cost Calculator](#)

# The U.S. appears on track to improve its supply chain ranking

## Global lithium-ion battery supply chain ranking, 2025

Rank	Country	Rank	Country	Rank	Country	Rank
1	China	6	Germany (▼2)	11	Australia	16
2	Japan	7	Finland (▲1)	12	Brazil	16
3	U.S. (▲3)	8	U.K. (▼1)	13	Poland (▼1)	16
4	Sweden (▲6)	8	S. Korea (▼5)	14	Chile (▲3)	16
5	Canada (▼1)	10	France (▼2)	15	Hungary (▼3)	20

Key: AMER, APAC, EMEA

Country	Rank	Country
Czechia (▼1)	20	S. Africa (▼1)
Argentina (▲4)	22	Thailand (▲1)
India	23	Vietnam (▼5)
Mexico (▲6)	24	Philippines (▲1)
Indonesia (▲1)	25	D.R.C (▼1)

Source: BloombergNEF

# Thank you

Email: [lgoldiescot@bloomberg.net](mailto:lgoldiescot@bloomberg.net)



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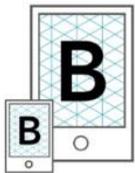
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# Guest Presentation on the Global Lithium Market

- Logan Goldie-Scot,  
Head of Clean Power Research,  
BloombergNEF



# Public Comment

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# Panel Discussion

- Michael McKibben,  
UC Riverside
- Jonathan M. Weisgall,  
Berkshire Hathaway Energy (BHE)
- Rod Colwell,  
Controlled Thermal Resources (CTR)

# Salton Sea geothermal lithium: reserves and comparison with other lithium resources

Michael A. McKibben, Ph.D.

Economic Geologist and Geochemist

Chair, Dept. of Earth and Planetary Sciences

U. C. Riverside

[michael.mckibben@ucr.edu](mailto:michael.mckibben@ucr.edu)

*Disclosure: I have been and am a consultant to some commercial parties on metallic resources in SSGF brines*

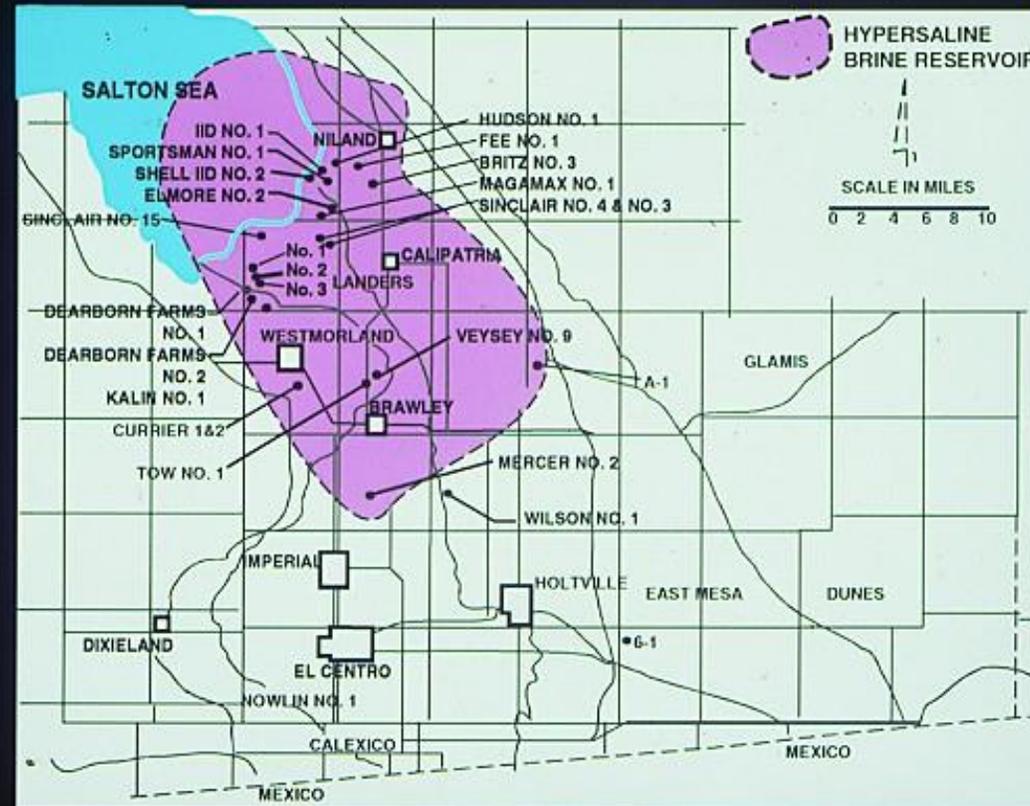
“Bathtub ring” of tufa (limestone) from high stand of ancient Lake Cahuilla.



M. McKibben

- Hundreds to thousands of such episodes of lake formation and evaporation have occurred over millions of years in the northern part of the Imperial Valley.
- Have led to accumulation of a deep basinal NaCl brine pool beneath the Valley.

## HYPERSALINE GEOTHERMAL BRINE IN THE NORTHERN SALTON TROUGH (Rex, 1985)



Hot brines in the Salton Sea geothermal field (SSGF) are relatively shallow and easy to exploit because they have been heated and brought near the surface by igneous processes (magma at depth).

As it ascends, chemical reaction of the hot NaCl brine diapir with the delta and lake sediments results in a Na-Ca-K-Cl metamorphic brine that is spectacularly enriched in valuable metals such as Fe, Mn, Zn, Pb and Li. Other brine diapirs may exist under the Imperial/Brawley areas.

**Table 7.1.** Representative flash-corrected chemical compositions of geothermal reservoir fluids in the Imperial and Mexicali Valleys (McKibben and Hardie, 1997).

	<i>Field: Salton Sea</i>	<i>Imperial</i>	<i>Cerro Prieto</i>	<i>East Mesa</i>	<i>Heber</i>
<i>Well:</i>	S2-14	L2-28	M-5	6-1P	5
<i>Temperature(°C):</i>	330	275	300	~ 190	195
<i>Depth (m):</i>	2500-3220	3290-4270	~ 1200	~ 2164	~ 1800
Na	54,800	50,466	5,004	6,362	4,019
Ca	28,500	18,140	284	759	750
K	17,700	9,555	1,203	1,124	333
Fe	1,710	3,219	<1	NA	NA
Mn	1,500	985	1	NA	NA
SiO <sub>2</sub>	>588	465	569	257	237
Zn	507	1,155	NA	NA	NA
Sr	421	1,500	NA	NA	41
B	271	217	11	NA	4
Ba	~ 210	2,031	NA	NA	4
Li	209	252	13	NA	7
Mg	49	299	<1	9	2
Pb	102	>262	NA	NA	NA
Cu	7	>1	NA	NA	NA
Cd	2	4	NA	NA	NA
NH <sub>4</sub>	330	NA	NA	NA	6
Cl	157,500	131,000	9,370	11,668	7,758
Br	111	NA	31	NA	NA
CO <sub>2</sub>	1,580	30,000	2,400	NA	186
HCO <sub>3</sub>	NA	NA	NA	221	NA
H <sub>2</sub> S	10	>47	180	NA	1
SO <sub>4</sub>	53	NA	4	51	66
TDS	26.5%	25.0%	1.6%	2.2%	1.3%



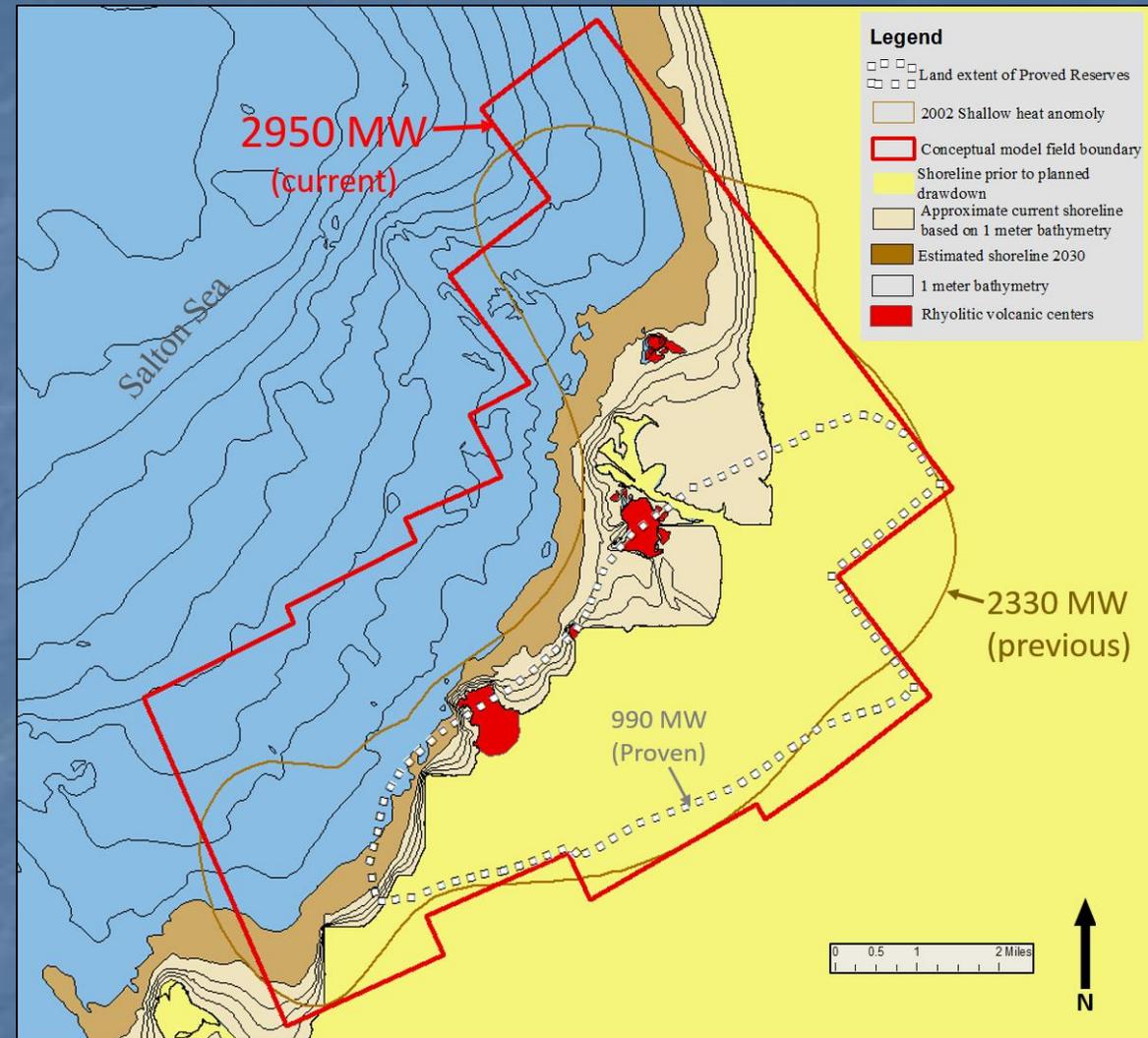
# What is the volume of the hot SSGF brine reservoir?

Installed capacity:  
414 MW

Ultimate capacity:  
2330-2950 MW  
(6 times installed)

Porosity: 10 to 20%

5.5 to 33 km<sup>3</sup> of brine



Kaspereit et al., 2016

# SSGF Li “reserves” calculations (McKibben et al., 2021):

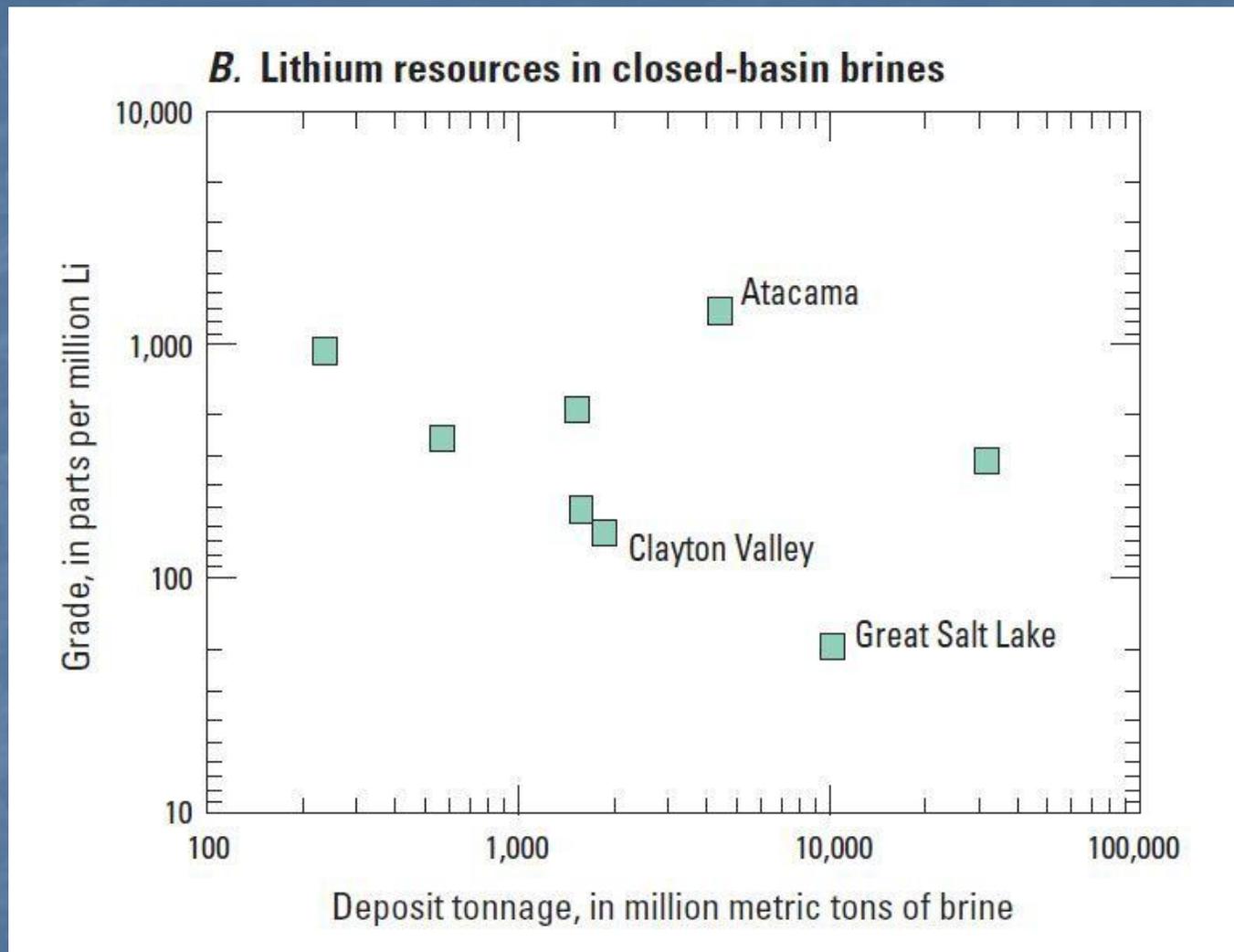
1 million to 6 million metric tons of lithium equivalent reserves.  
Far more than total U.S. reserves of Li from traditional sources.  
Comparable to the reserves of the four major global producers:

**World Mine Production and Reserves:** Reserves for Argentina, Australia, Canada, Chile, China, the United States, Zimbabwe, and other countries were revised based on new information from Government and industry sources.

	Mine production		Reserves <sup>5</sup>
	2019	2020 <sup>e</sup>	
United States	W	W	750,000
Argentina	6,300	6,200	1,900,000
Australia	45,000	40,000	<sup>6</sup> 4,700,000
Brazil	2,400	1,900	95,000
Canada	200	—	530,000
Chile	19,300	18,000	9,200,000
China	10,800	14,000	1,500,000
Portugal	900	900	60,000
Zimbabwe	1,200	1,200	220,000
Other countries <sup>7</sup>	—	—	2,100,000
World total (rounded)	<sup>8</sup> 86,000	<sup>8</sup> 82,000	21,000,000

**World Resources:**<sup>5</sup> Owing to continuing exploration, identified lithium resources have increased substantially worldwide and total about 86 million tons. Lithium resources in the United States—from continental brines, geothermal brines, hectorite, oilfield brines, and pegmatites—are 7.9 million tons. Lithium resources in other countries have been revised to 78 million tons. Lithium resources are Bolivia, 21 million tons; Argentina, 19.3 million tons; Chile, 9.6 million tons; Australia, 6.4 million tons; China, 5.1 million tons; Congo (Kinshasa), 3 million tons; Canada, 2.9 million tons; Germany, 2.7 million tons; Mexico, 1.7 million tons; Czechia, 1.3 million tons; Serbia, 1.2 million tons; Peru, 880,000 tons; Mali, 700,000 tons; Zimbabwe, 500,000 tons; Brazil, 470,000 tons; Spain, 300,000 tons; Portugal, 270,000 tons; Ghana, 90,000 tons; and Austria, Finland, Kazakhstan, and Namibia, 50,000 tons each.

SSGF has the largest “tonnage” of any known Li brine deposit



Bradley et al. (2017)

## SSGF production and depletion scenarios:

Besseling (2018) – Production from CalEnergy/BHE plants:

Current capacity (350 MW)

17,000 metric tons per year lithium equivalent

Future capacity (700 MW)

40,000 metric tons per year lithium equivalent

<u>Reserves</u>	<u>Annual depletion rate</u>		<u>Years of production</u>	
	<u>350 MW</u>	<u>700 MW</u>	<u>350 MW</u>	<u>700 MW</u>
1 M tons	1.7%	4.0%	59	25
<b>6 M tons</b>	0.28%	0.67%	<b>353</b>	<b>150</b>

So Li production appears **sustainable**, but we need a **far more dynamic Li reservoir model** that takes into consideration more factors such as **re injection and Li replenishment**.

# Improved quantification of Li resources for Lithium Valley – A research proposal

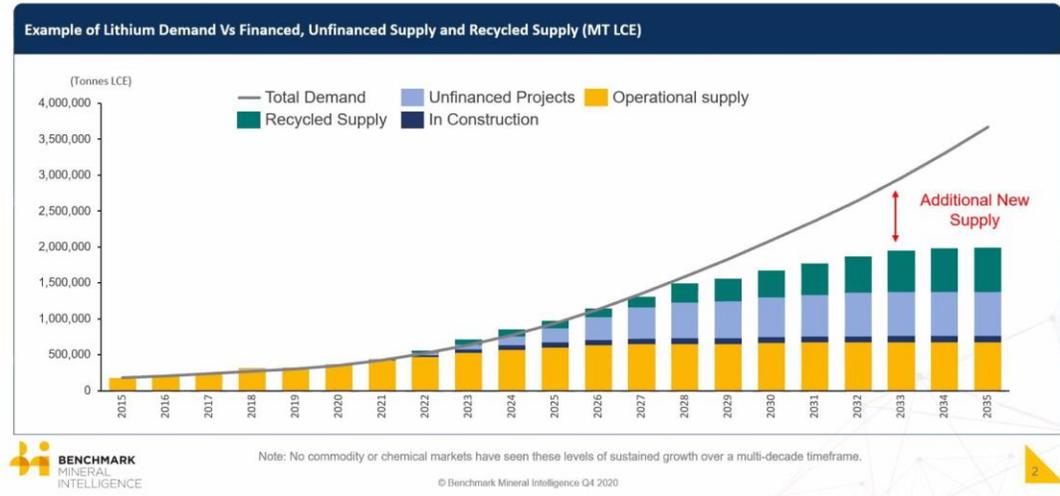
Pat Dobson, Eric Sonnenthal, Will Stringfellow (LBNL), Mike McKibben (UC Riverside), Sabodh Garg (Geologica)

Key questions:

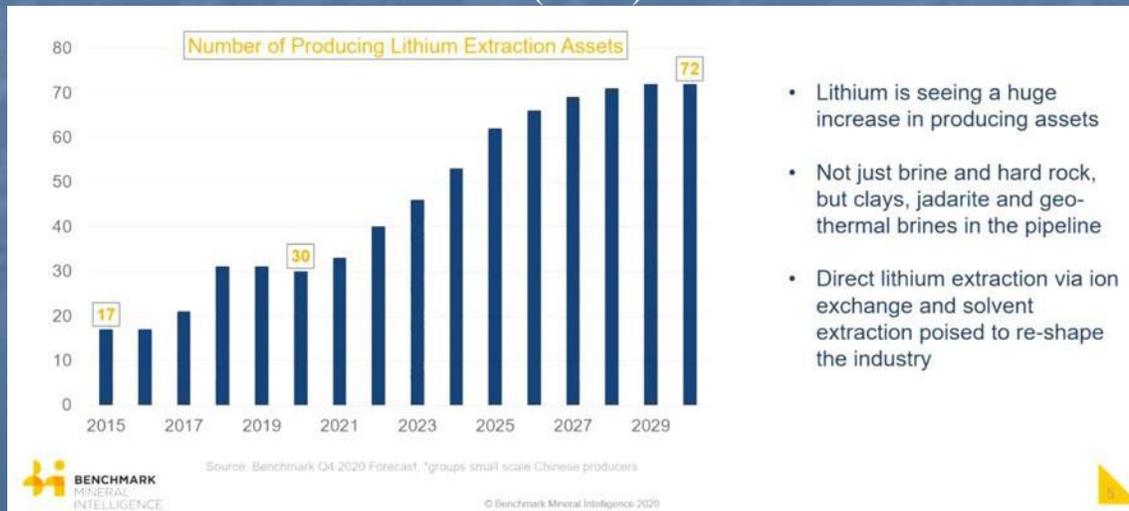
1. **How much Li is present** in the Salton Sea geothermal reservoir?
  - Li resource estimates from brine production rates and Li contents
  - Li resource estimates from reservoir volume and Li contents
2. How much Li is **recoverable** (depends in part on extraction technology)?
3. How rapidly will the **Li concentration of the brine decrease** as Li is recovered and spent brine is reinjected (resource sustainability)?
4. Would Li in reservoir rocks “**recharge**” geothermal brines?

# Salton Sea Li can clearly help fill the **looming supply gap**:

**Background:** There's no geological shortage of lithium – and no shortage of customers, but there is a shortage of financing, and increasingly, a shortage of time...



BMI (2021)



But there will be cost competition, especially from *similar* **Direct Lithium Extraction (DLE)** brine projects that are coming online.

e.g. **Clayton Valley, NV** – Schlumberger New Energy - DLE pilot plant to *replace* traditional evaporation/precipitation process by end of 2021.

DLE as a “bolt-on technology” to existing brine flow operations:

## Smackover Formation, Arkansas Alberta oilfield brines

(Standard Lithium/LAXNESS)

Add-on to **existing** extraction of bromine from warm oil field brines  
Fiberglass tanks, PVC pipes

590,000 tons Li under 150,000 acres

Target production is 13,000 tpa Li

Clearwater Project  
(E3 Metals Corp)

1,300,000 tons Li  
Target 25,000 tpa Li

E3MC (2021)



**A Sustainable Solution**  
**LiSTR**  
Direct Lithium Extraction

- Selectively extracts lithium ions from raw brine (no pre-concentration)
- Flexible Bolt-on process to existing brine operations waste stream
- More efficient Li >90% recovery vs <50% with evaporation ponds
- Not weather dependent
- Faster – Li recovery in hours not months
- Minimal environmental footprint – dozens of acres compared to thousands
- Higher purity final product

The diagram illustrates the LiSTR process. It shows a cross-section of a brine reservoir. On the left, 'Pumped Raw Brine' is drawn into a 'Bromine Extraction' unit. The brine then flows to a 'Lithium Extraction' unit. Finally, 'Re-injected brine' is returned to the reservoir. Below the diagram is a photograph of industrial equipment, including large white cylindrical tanks and blue structural frames.

**Standard LITHIUM** TSXv: SLL - OTCQX: STLHF - FSE: S5L

8

R. Mintak (2021)

Smackover and Alberta projects are already surrounded by existing oil field and chemical processing infrastructure as well as a skilled workforce population.



# **Lithium Valley Commission March 25, 2021 Meeting BHE Renewables Update**

**Jonathan Weisgall**  
**Vice President, Government Relations**  
**Berkshire Hathaway Energy**

# CalEnergy Geothermal Plants Imperial Valley



# CalEnergy 50 MW Elmore Facility



# Status and Timelines



- California Energy Commission grant May 2020
  - \$6 million: demonstration project to recover lithium from geothermal brine
  - Match with at least \$4 million of corporate funds
  - Groundbreaking April 2021
  - Goal to be in service January 2022
- Department of Energy grant January 2021
  - \$14.9 million: (1) demonstration project to convert lithium chloride into battery-grade lithium hydroxide; (2) fund engineering for full-scale commercial operations
  - Match with \$14.9 million of corporate funds
  - Sign contract spring 2021
  - Goal to be in service fall 2022

# Hard Rock Mining (Western Australia)



Photo credit: FollowCN

# Hard Rock Mining (Western Australia)



Photo credit: John Banagan

# Lithium Brine Pools in Atacama Desert, Chile



Photo credit: Matjaž Krivic

# Lithium Brine Pools in Atacama Desert, Chile



Photo credit: Reuters



 **BERKSHIRE HATHAWAY  
ENERGY**

# The **POWER** of California's



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# Lithium Valley



4,000+  
Jobs

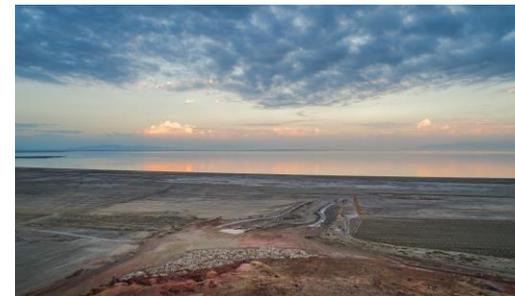


Reliable  
Clean Energy



New Lithium  
Economy

Salton Sea  
Repair



# Hell's Kitchen Lithium and Power

- Located in the largest known geothermal resource in the world.
- The Salton Sea Geothermal Field in Imperial Valley, California represents a proven and defined geothermal power and mineralized brine resource.



## Project Snapshot

Hell's Kitchen Power – Stage 1: 2023

**49.9 megawatts**

Hell's Kitchen Lithium – Stage 1: 2023/2024

**20,000tpa LCE**

Future stages developed to meet market demands

Total Hell's Kitchen Lithium capacity:

**~300,000 tonnes LCE per annum**

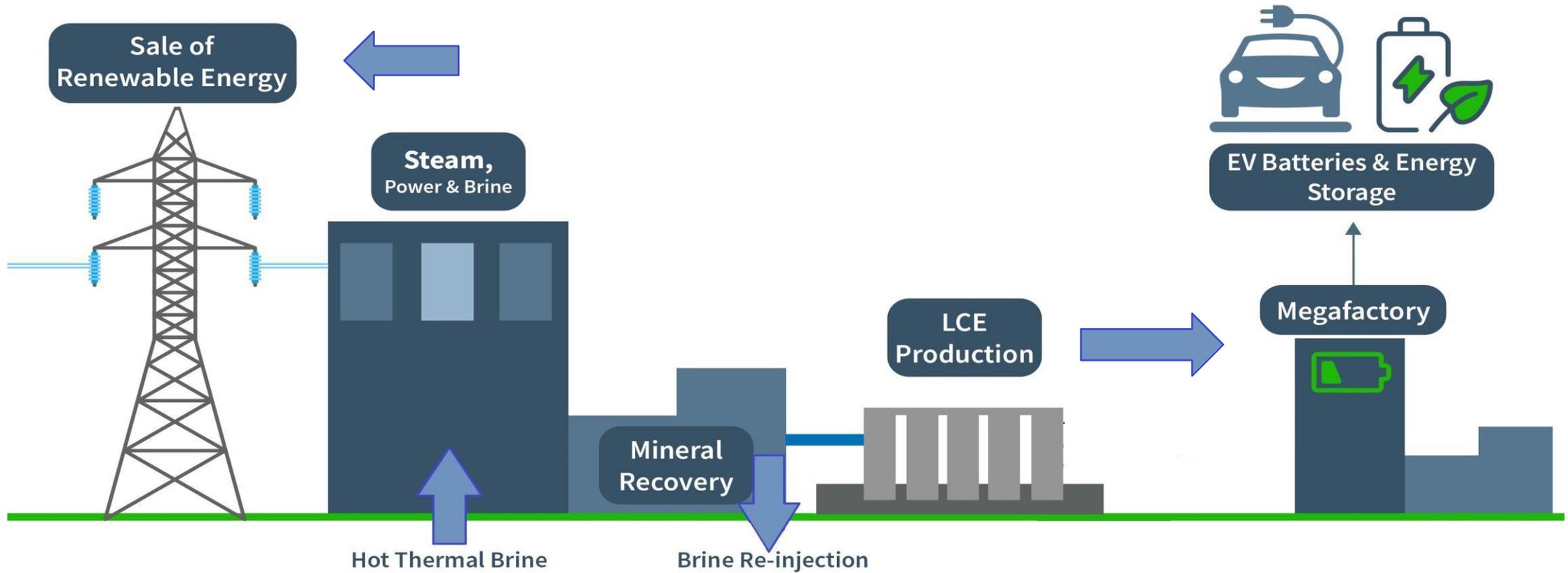
Total Hell's Kitchen Power capacity:

**~1,100 megawatts**

Geothermal operations have operated in this field for over 35 years

Additional mineral resources include potassium, zinc, manganese, iron and rubidium

# The power to re-imagine and evolve



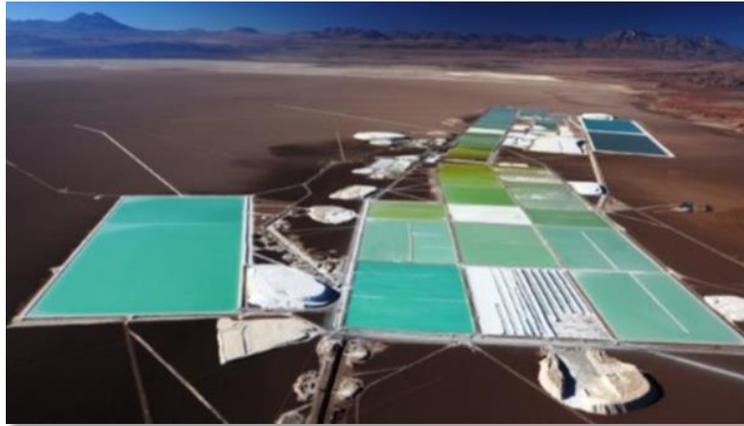
# A sustainable process, eliminating high impact mining.

## GEOTHERMAL BRINE LITHIUM



- + Small physical footprint
- + No open-pit mining
- + No evaporation ponds
- + Powered by renewable energy
- + Ideal for OEM sustainability

## SALARS (EVAPORATION PONDS)



- Large physical footprint
- Requires evaporation ponds
- Residual salt waste can be toxic
- Large amounts of water lost
- Longer production lead times

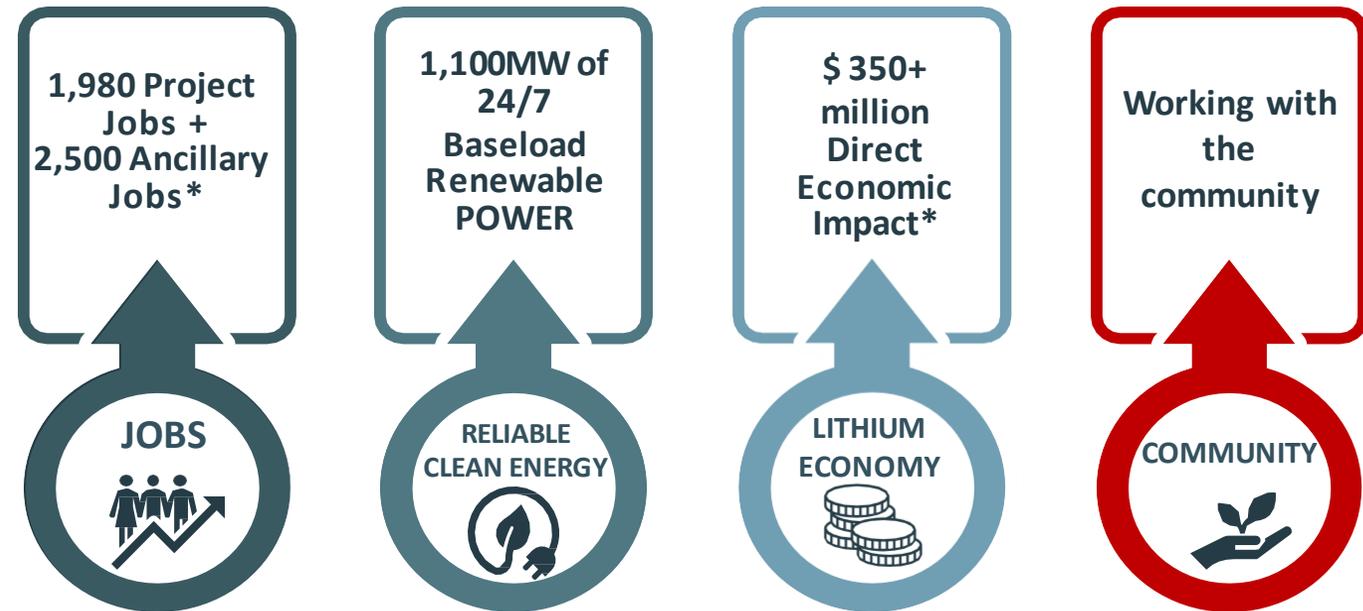
## OPEN PIT MINING (SPODUMENE / CLAYS)



- Large physical footprint
- Permanent environmental effects
- Large amounts of tailings
- Generally processed overseas
- Longer production lead times

# Key benefits

- Creates new union project and construction jobs and ancillary jobs for the California economic recovery from the COVID-19 State of Emergency
- Develops Critical U.S. Energy Infrastructure
- Provides Critical U.S. Minerals
- Dust abatement in an area designated as an Imperial County State of Emergency



\*Source: Imperial Valley Economic Development Corporation – Hell’s Kitchen Lithium and Power Project: Economic Impact Analysis (Total Capacity)

# Hell's Kitchen Development Timeline



**Site Control and Development – COMPLETED:**

- Large geothermal leasehold secured including all minerals rights
- Seismic Survey and Geophysical Model
- 43-101 Preliminary Economic Assessment with Hatch
- Interconnection Studies and Queue Position
- Delineation Drilling Permits
- Secured grants from California Energy Commission for mineral extraction

**Power Purchase Agreement signed with IID**

**Power 1 and Lithium 1A Construction**

**Power 1 and Lithium 1 Operations**

**Future Expansion**

# CHALLENGES



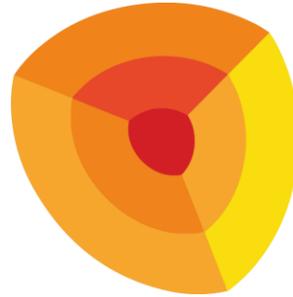
Hell's Kitchen Lithium and Power Site

- Investment in large scale mining projects is challenging due to the length of time for permitting and approvals.
- California's complex requirements can create challenges to project timelines, cost efficiencies and future development.
- Incentives to attract manufacturing (which creates thousands of jobs) is highly competitive in other states.
- There is no standardized mechanism for companies to contribute to the Salt on Sea mitigation efforts.

# SOLUTIONS



- Activate federal support to streamline permitting at the administrative level, including potentially declaring Lithium Valley as "high priority" or "major infrastructure projects."
- Expand Environmental Leadership Projects to include geothermal power, enabling CEQA streamlining.
- Establish a Lithium Valley "Opportunity" or "Enterprise" zone and actively support Bills – AB 1397 and AB 1161
- Encourage State and Federal support to incentivize the development of cathode and battery manufacturing to create the world's first Clean Energy & Auto Hub.



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# Panel Discussion

- Michael McKibben,  
UC Riverside
- Jonathan M. Weisgall,  
Berkshire Hathaway Energy (BHE)
- Rod Colwell,  
Controlled Thermal Resources (CTR)



# Public Comment

## Comment Instructions:

Limited to 3 minutes per comment

**By computer:** use the “raise hand” feature in Zoom

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# Media and Legislation Updates

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# Public Comment

## Comment Instructions:

Limited to 3 minutes per comment

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# Future Meetings Discussion

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- Determination of:
  - Agenda Topics
  - Speakers
  - Presentations



# Public Comment

## Comment Instructions:

Limited to 3 minutes per comment

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# Adjourn

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**Webpage:** <https://www.energy.ca.gov/data-reports/california-power-generation-and-power-sources/geothermal-energy/lithium-valley>

**List Serv:** Lithium Valley Commission

# Thank you!

[LithiumValleyCommission@energy.ca.gov](mailto:LithiumValleyCommission@energy.ca.gov)



# Break

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