Global Counsel

Lithium: the rare mineral that will determine the United States' green future

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Summary

Lithium's role in the United States' renewable energy transition and technological advancements is undeniable. Lithium is crucial to a successful increase in electric vehicle production that is necessary to meet net-zero goals, while the same can be said for meeting the ever-growing demand for wearable technology and augmented reality and virtual reality. However, policymakers have yet to confront glaring issues like lacklustre domestic lithium production and an overreliance on countries like China for lithium processing and battery manufacturing. Washington is taking steps to address these vulnerabilities, but political stagnation has pushed the tech industry to play an important role in everything from innovations to creating cleaner mining practices. With demand for lithium set to substantially outpace supply in the coming years, this metal will become an increasing topic of political debate in Washington and importantly, a likely recipient of additional government support and investment.

Mitigating the effects of climate change has spurred unprecedented innovation throughout the energy industry. From electric vehicles (EVs), to solar and wind farms, to hydrogen production, we are seeing new developments come to market at a rapid pace.

As demand for cleaner products continues to rise, however, underlying policy and capacity issues are beginning to emerge. For energy storage – crucial for products such as EVs, green technologies and portable electronics – one key challenge stems from a reliance on the third element on the periodic table: lithium. Without a steady supply of lithium and the ability to convert it into a component of batteries, President Joe Biden's goal to have 50% of car sales to be electric by 2030 will not be met, not to mention the myriad of other technologies that are reliant on lithium batteries that would be negatively impacted by a shortage of lithium.

The Biden administration is acutely aware of this risk, having commissioned a June 2021 100 Day Supply Chain Review that included a focus on large capacity batteries, and a 2021-2030 National Blueprint for Lithium Batteries from the Department of Energy (DOE), also released in June 2021. The findings, however, are alarming. The Supply Chain Review noted that the US "currently has virtually no domestic processing capacity" for lithium and globally there are expected lithium shortfalls as well (see Figs. 1 and 2).

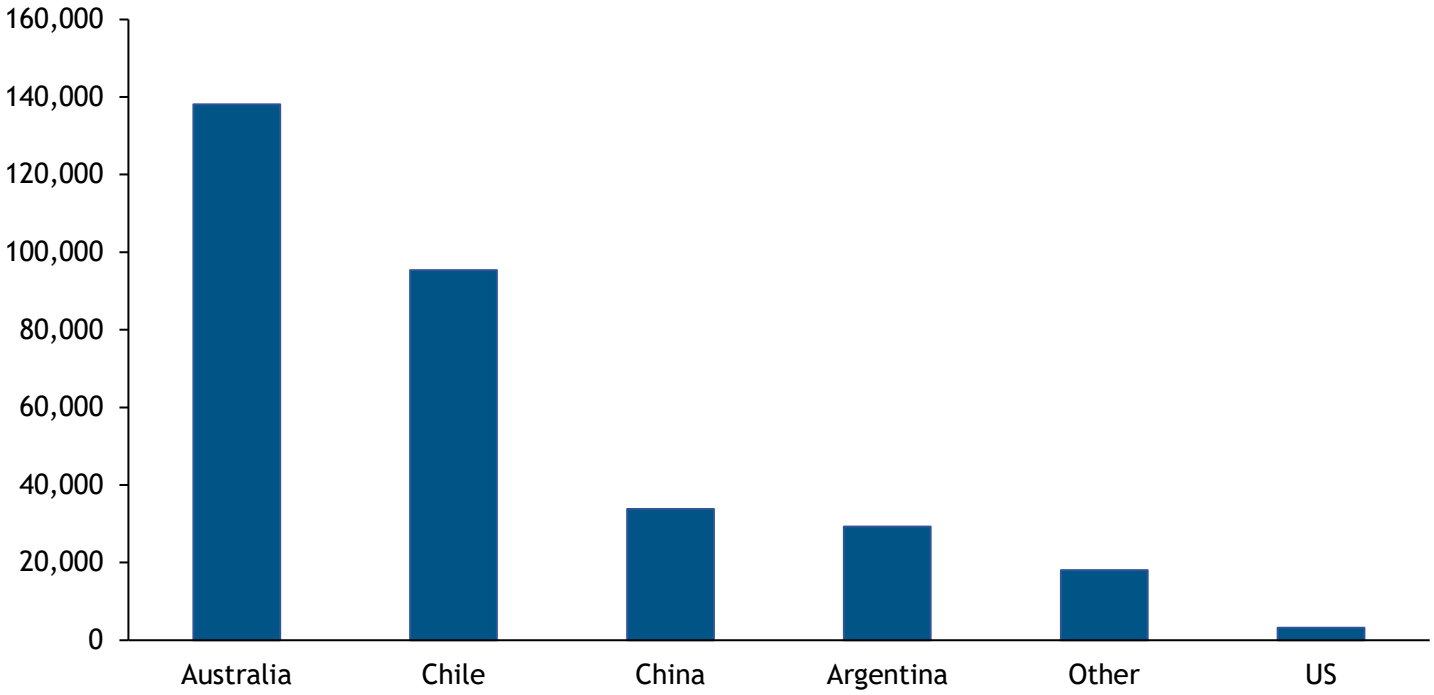
Although US lawmakers are aware of the supply vulnerabilities stemming from the lack of mining capacity and lack of manufacturing facilities, the potential for a lithium shortage has not yet reached the zeitgeist in Washington, DC. Even within the industrial economy, policymakers' focus has largely remained on more immediately pressing issues – shortages of covid-19 vaccines and medical supplies, supply-chain bottlenecks, support for the domestic semiconductor industry, etc.

Many of the recommendations outlined in the 100 Day Supply Chain Review and National Blueprint for Lithium Batteries will take a level of cooperation in Congress and across the government that is highly unlikely to occur in the current environment. And if Republicans retake the House following the November 2022 midterm elections, as they are likely to do, executing such whole-of-government type industrial plans becomes even harder.

The challenges facing lithium production, processing and battery manufacturing in the US are not insurmountable by any means. In fact, the current

Fig. 1: 2020 lithium production by country

metric tons



Source: Benchmark Mineral Intelligence

environment has been likened to the period of innovation leading up to the discovery of oil in the US in the 19th century. Lithium prices are certainly acting like oil at the beginning of a boom – up a staggering 280% YoY, according to Benchmark Mineral Intelligence. However, recognising and capitalising on this opportunity will require greater support and cooperation between policymakers and the private sector.

The state of play

In order to reach the US' high electric vehicle ambitions, a competitive battery manufacturing industry is crucial. However, despite relatively high levels of lithium reserves (see Fig. 3), US battery production falls woefully short. For context: US sales of EVs are estimated to reach 3.2m in 2028. Under the assumption that an average EV battery capacity is 100 kWh, lithium-ion battery production would have to reach 320 GWh to meet 2028 demand projects – these estimates only concern passenger EV sales too. Here comes the scary part - US lithium-ion battery production is estimated to reach only 148 GWh by that same year - less than 50% of projected demand. As such, bolstering US lithium production and battery manufacturing is a cornerstone of the Biden administration's environmental and national security strategies. Although the US sits on significant lithium deposits with exploration underway in states like Nevada, Arkansas, Oregon, California, and North Carolina, the US has only one lithium-producing mine at the moment – the Silver Peak Mine in Nevada, owned by Albemarle Corporation (ticker: ALB), a US-based chemical manufacturing company.

Lack of lithium mining infrastructure can be partly attributed to the slow-moving gears of bureaucracy. For example, Piedmont Lithium (ticker: PLL), a company which hopes to produce 22,700 tons per year of battery-grade lithium hydroxide in North Carolina, only filed its application for a North Carolina State Mining Permit last August.

Navigating the bureaucracy appears manageable, if lengthy. What will be more difficult to solve is a seemingly counterintuitive issue also at play: environmental concerns. Lithium mining has been subject to environmental protests both in the US and abroad. For example, water contamination and potential wildlife impacts are at the centre of concern a proposed project in Nevada, while Rio Tinto's lithium mine project in Serbia has been held up by protests. For Biden, who has prioritised environmental and climate issues as a candidate and now as president, these concerns are emblematic of the dichotomy that US lithium mining and widespread electric vehicle production face.

In the meantime, the US will remain reliant on allies like Australia, which produces a whopping 49% of the world's lithium; and Chile, which produces 22%. But even these partners, allies of the US in many ways, might not be a sure bet. Chile is currently in the process of writing a new constitution, with environmental concerns at the heart of the debate. Mining companies could be subject to a whole host

Fig. 2: Committed mine production and primary demand for lithium

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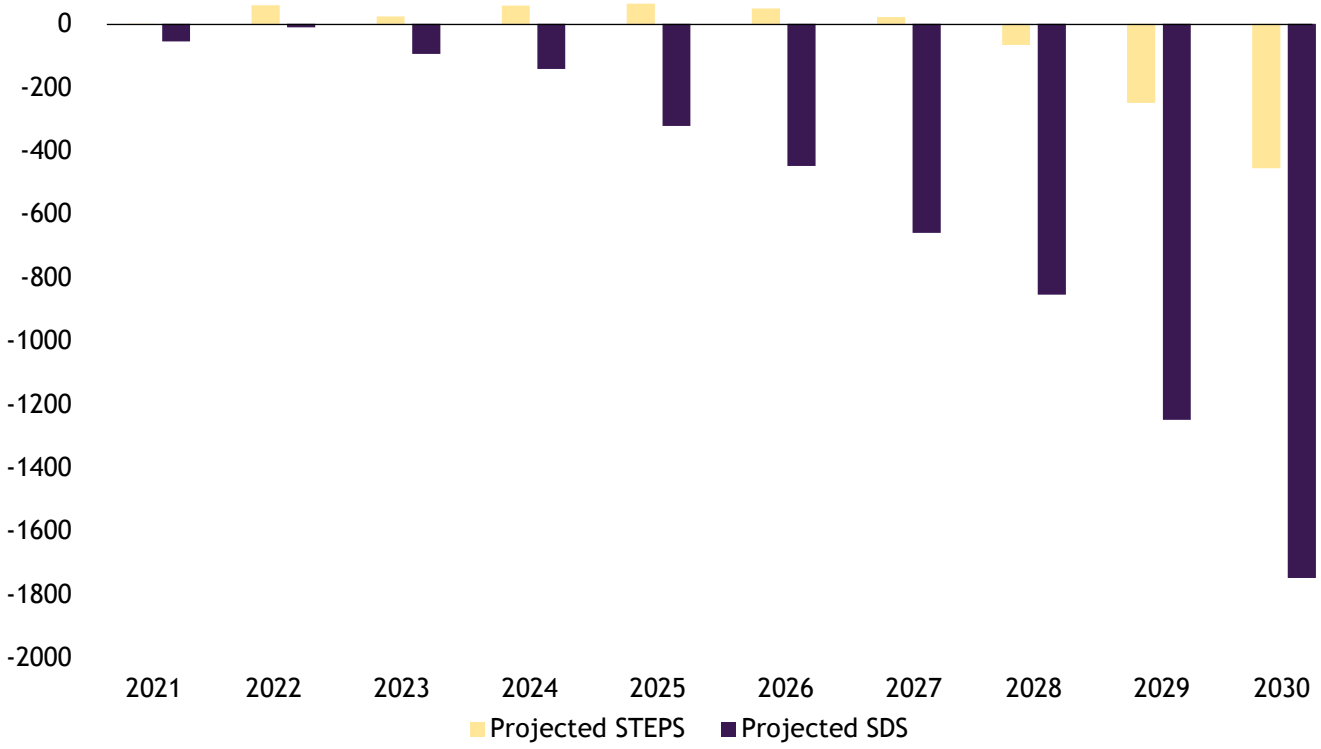
The global capacity of lithium mines and ability to process lithium into batteries is expected to fall short of the rising demand fueled by anticipated growth in EV battery production.



Source: International Energy Agency (IEA)

STEPS = Stated Policies Scenario, an indication of where the energy system is heading based on a sector-by-sector analysis of today's policies and policy announcements. SDS = Sustainable Development Scenario, indicating what would be required in a trajectory consistent with meeting the Paris Agreement goals.

of new regulations if, for example, the authors of the new constitution decide that brine (saltwater found under the desert from which lithium is extracted), should not be governed by the mining code as it is now, but rather should be considered water and thus potentially a public good. Environmental concerns aside, the real policy issue is not that there is not enough lithium to mine, it is what comes next – transforming the mined lithium into batteries.

Battery-cell manufacturing is overwhelmingly dominated by China, which, largely due to looser environmental and regulatory restrictions than much of the world, manufactures more than 80% of all battery cells (see Fig. 4).

Simply put, if the US wants to reach its EV goals, addressing this problem will require substantial cooperation from the public and private sectors. In the current era of intense partisan gridlock in the US, federal lawmakers can only do so much. The bipartisan Infrastructure Investment and Jobs Act that passed into law last year included $6bn in loans and grants to spur battery material processing and manufacturing. This funding, while already inadequate to meet demand, is likely the limit of what lawmakers in Washington can accomplish for the foreseeable future. Even energy and manufacturing tax credits – which could be included in whatever stripped-down version of the Build Back Better Act that Democrats are able to pass (if they can pass it at all) – will still not be enough.

The role of technology

This is where the private sector will need to step in. There is no doubt that investments around lithium mining and processing could be profitable. Piedmont Lithium's stock price rose from $11 to $80 per share following the announcement that it would supply Tesla with lithium in September 2020. However, Piedmont's inability to secure proper mining permits in North Carolina forced its deal with Tesla to be postponed indefinitely, highlighting that for lithium production and manufacturing to truly take off, public-private cooperation is crucial. Note that Piedmont Lithium's stock traded at $52 per share as of mid-January on hopes of future deals similar to the one struck with Tesla, giving the company a market cap of some $825m.

The tech industry must play an important role in

the production of lithium and the manufacturing of batteries. Almost all portable electronic devices rely on lithium batteries. While EVs are undoubtedly the largest consumer of lithium batteries, the tech industry has a lot at risk here as well. Wearable technology is expected to hit almost $117 bn in sales by 2025, rising at a CAGR of 17% over the next four years, according to Koncept Analytics. This growth is projected to be fuelled by rising popularity of fitness trackers as well as in augmented reality/ virtual reality (AR/VR), all of which rely on lithium batteries to operate. As a major end-user of lithium batteries, the tech industry is incentivised to help the sector meet growing demand.

Rising consumer demand and increasing salience among policymakers means there are plenty of opportunities for the private sector to support the expansion of the lithium supply chain in the US. Technologies that use machine learning and artificial intelligence to map geological resources can advise on the best areas in the US to survey for lithium resources. (it's no surprise that Bill Gates and Jeff Bezos have backed one such firm – privately held KoBold Metals).

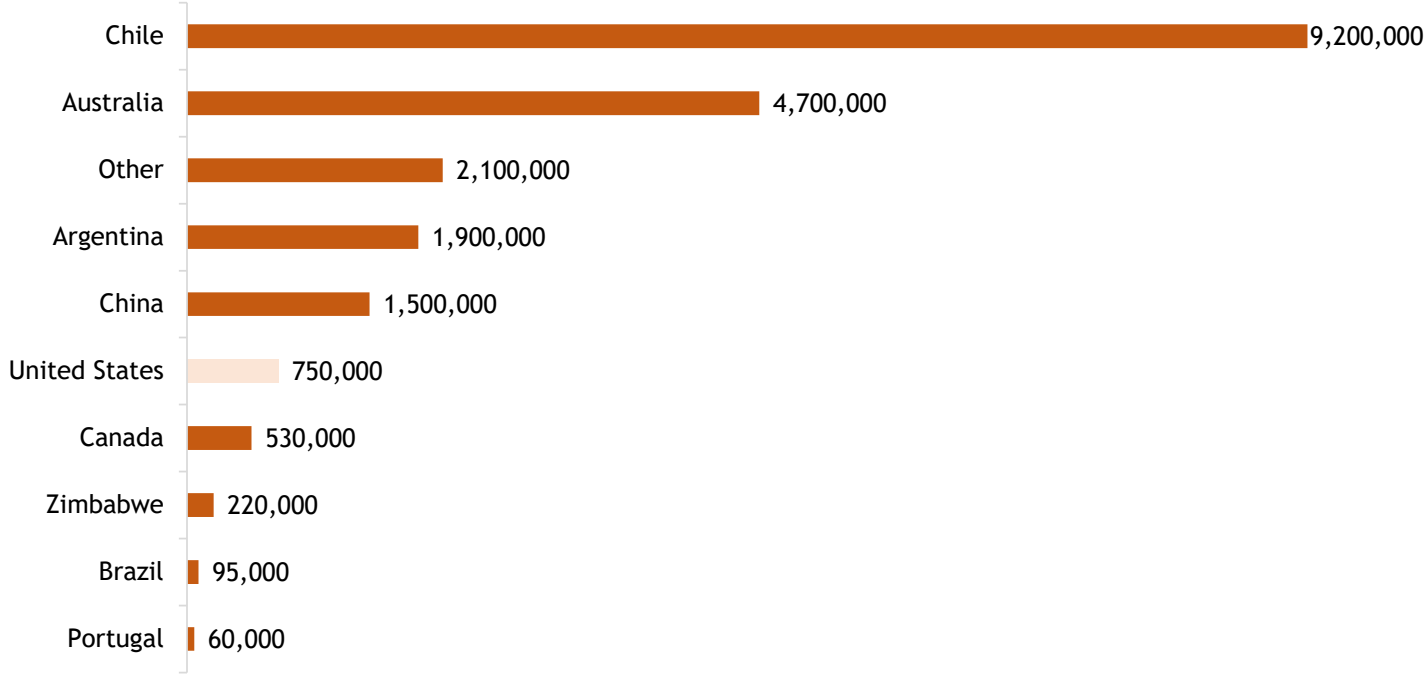
Technology will be essential in identifying lithium-rich areas. The industry should also look for how technology can be leveraged to make the mining processes cleaner and more efficient. Companies like Medaro Mining (ticker: MEDAF), Lilac Solutions, and Mangrove Lithium are all working on innovative technologies to make lithium extraction and processing easier. If these technologies can be proven and commercialised, they can help address two of the key policy challenges to the rising demand for lithium: the processing time and the environmental footprint of the commodity.

Another major challenge for policymakers outlined by both the Department of Energy and the White House is the need to reduce the end-of-life costs. Recycling batteries will be important if the US hopes to meet demand given capacity gaps in production infrastructure. Using recycled materials can also decrease the cost of battery production by 40% according to DOE. That said, the US has a spotty record at best in its ability to identify the right incentive mix for recycling of materials. Costs to recycle batteries are quite high, as EV batteries are classified as hazardous waste, which amounts to half of the cost of recycling lithium batteries. Outside of the cost there are also challenges to collecting, sorting, and processing recycled batteries as well as developing processing technologies to reintroduce these materials into the supply chain. The DOE has listed these as near-term objectives; the Biden administration will be looking for ways through regulation and financial incentives (if Congress can agree) to meet its objective of achieving 90% recycling of consumer electronics and batteries by 2030.

Supporting advancements in battery technology, such as solid-state batteries, is a key component of the Department of Energy's National Blueprint for Lithium Batteries. Solid-state batteries which use electrodes instead of liquid electrolytes used in traditional lithium batteries provide higher energy density, longer life span and increased safety. These

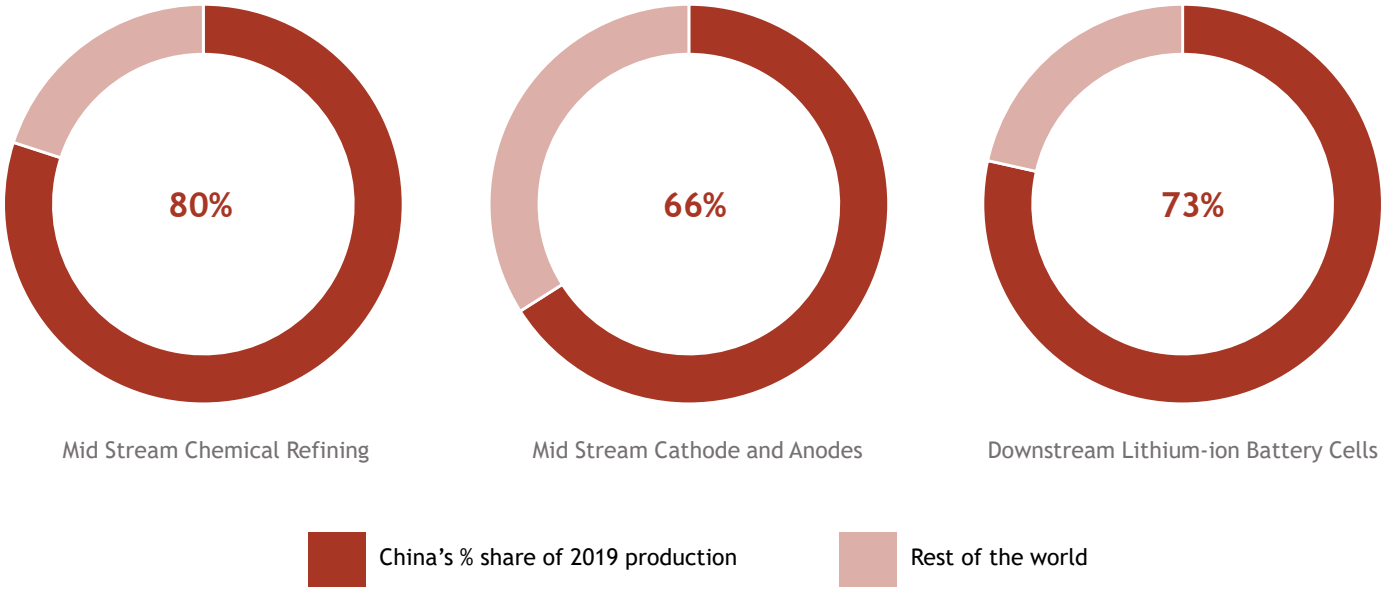
Fig 3. Global lithium reserves

Tonnes (2020)



Source: US Geological Survey, 2021

Fig 4. China's dominance in the lithium battery supply chain (2019)



Source: Benchmark Mineral Intelligence

have been used in pacemakers, but wearables and EVs also provide a great use case for these batteries. The DOE's report calls for increased R&D investment in novel material, electrode, and battery cell-manufacturing methods to support US leadership in developing this emerging technology. The private sector is already well on its way. Young companies like QuantumScape (ticker: QS) and Solid Power (ticker: SLDP) have already made names for themselves in production of solid-state batteries, not to mention behemoths like Toyota, which recently announced a $13.6 bn investment in battery technologies, including solid state batteries.

Conclusion

Biden has used his time in office to generate buzz about how EVs and emerging technologies are important keys to unlocking a cleaner and greener future. But without a reliable pipeline to support lithium battery production, efforts to spur EV uptake faces an uphill battle.

To add to these challenges, the automobile sector in the US is already under immense strain. Throughout the covid-19 pandemic demand has outpaced the supply of vehicles and the global semiconductor shortage has exacerbated this problem. (The average car can use up to 1,000 semiconductors, but EVs often need more than twice that number.) Automakers have had to shut down production because of the chip shortage. The same systemic vulnerabilities that have plagued the semiconductor industry may soon be seen in the lithium battery industry, meaning back-to-back shortages of critical components for car manufacturers.

Policymakers in the US are slowly beginning to wake up to the expected shortfall of lithium and the need to build out better infrastructure and processing capacity for the entirety of the lithium battery lifecycle. But executive branch strategy documents and meagre federal investments, such as those discussed above, will not help the US hit the mark. The impacts of the US' inability to keep up with demand for lithium will have far reaching effects. EVs will undoubtedly be hit hardest, but everything from smartwatches to tablets to e-scooters will feel the effects too. To mitigate these risks, public-private partnerships will be essential. The tech sector in particular should look for how it can leverage developments in AI and machine learning to identify solutions.

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