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Navigating Uncertainty: A Scenario Analysis of Imported Lithium for EV Batteries in the U.S.

by

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MASY1-GC 2000 Foundations of Business Analytics

Abstract

This paper explores what would probably happen if China stops exporting battery-grade lithium compounds, lithium hydroxide and carbonate, to the United States. The compounds are required in producing EV batteries, and America depends largely on imports to meet growing demand. And this is a possibility deserving of research attention especially due to the recent tariff incident between China and America. If the U.S. is unable to secure the lithium supply chain, it will hurt the EV industry and lead to delay of productions and loss of potential billions of revenues.

This paper evaluates the importance of lithium compound imports from China to the United States. Although China is not the largest supplier of lithium, it still plays a significant role, shown from consistently ranking among the top three exports to the U.S. This paper further investigates how the import price of lithium from Chile, the largest supplier, would be affected if the Chinese imports were cut off. The result shows that the price of lithium from Chile would increase after the China ban, and the U.S. would lose more than three million dollars if they were to use Chile as a backup option.

To minimize these risks, this paper suggests building in long-term partnerships with Chile and Argentina, using flexible inventory techniques like just-in-time (JIT) and EOQ models, and price protection using forward contracts. It also proposes the necessity to create local lithium refining and investing in recycling batteries so that it can build a more secure and reliable supply chain. While America still relies heavily on foreign sources for lithium compounds, this research shows that with proper planning, the U.S. can be more self-sufficient in the event of global uncertainty.

Introduction/Background:

The global electric vehicle (EV) market has surged over the past decade, with worldwide EV sales nearing 14 million, and growth is expected to accelerate (International Energy Agency [IEA], 2023). The U.S. EV market is expected to reach a revenue of $156.3 billion by 2029 (Statista, 2024). As demand rises, so does the need for critical battery materials, particularly lithium. Lithium-ion batteries power most EVs, making lithium essential for the clean energy transition (U.S. Department of Energy [DOE], 2023). However, the U.S. has limited domestic lithium production capacity and relies heavily on imports from China and Chile (U.S. Geological Survey, 2023; Benchmark Mineral Intelligence, 2023).

Growing geopolitical tensions and trade restrictions have raised concerns about potential export bans on lithium and other critical minerals from China. Such a scenario could severely impact U.S. battery production and slowing EV adoption(U.S. Geological Survey [USGS], 2023). Given the EV market's importance to the U.S. economy, understanding the vulnerability of this supply chain is crucial.

This paper conducts a scenario analysis to assess the potential impact of the Chinese EV-specialized lithium compounds export ban on the United States. It evaluates U.S. dependency on China, forecasts lithium price trends, and explores potential mitigation strategies. This paper will not cover broader macroeconomic factors such as the changing interest rate and currency fluctuations. Additionally, it is assumed that all other international trade policies and domestic regulations on lithium remain unchanged. This study aims to inform policymakers and industry leaders to navigate these global uncertainties.

Objectives:

O1: Evaluate China's current impact to U.S. regarding battery-grade lithium compound

O2: Evaluate the potential impact of a Chinese export ban on lithium price from Chile

O3:Identify mitigation strategies for supply chain resilience

O4:Analyze alternative lithium supply sources

Methods:

Dataset 1: U.S. Imports of Lithium Hydroxide

U.S. Imports of **Lithium Hydroxide** (HS Code 2825.20) by Exporting Country – Year **2014**				
Period	**Exported Country**	**Trade Value (US$)**	**Net Weight(kg)**	**Price Per Unit ($/kg)**
2014	Chile	$11,135,687	1,763,997	$6.31
2014	China	$878,965	129,364	$6.79
2014	Canada	$242,766	35,470	$6.84
2014	Belgium	$116,755	17,552	$6.65
2014	India	$71,873	9,530	$7.54
2014	Japan	$31,936	2,062	$15.49
2014	Singapore	$216	21	$10.29
2014	Switzerland	$437	12	$36.42
2014	Romania	$2,293	3	$764.33

Example Table a. U.S. Imports of Lithium Hydroxide (HS Code 2825.20) from World – Year 2014

- Includes U.S. imports of lithium hydroxide from top 9 supply countries each year, from 2014 to 2023

U.S. Imports of **Lithium Hydroxide** (HS Code 2825.20) from China – **2014 to 2023**					
Period	**Exported Country**	**Trade Value (US$)**	**Net Weight(kg)**	**Price Per Unit ($/kg)**	**Rank**
2014	China	$878,965	129,364	$6.79	2
2015	China	$1,855,760	242,100	$7.67	2
2016	China	$1,459,885	102,490	$14.24	2
2017	China	$8,716,624	528,208	$16.50	2
2018	China	$5,943,521	312,816	$19.00	2
2019	China	$2,122,764	122,800	$17.29	2
2020	China	$254,012	24,286	$10.46	3
2021	China	$226,130	22,977	$9.84	5
2022	China	$86,013	1,585	$54.27	7
2023	China	$722,336	17,662	$40.90	2

Example Table b. U.S. Imports of Lithium Hydroxide from China – 2014 to 2023

- Includes U.S. imports of lithium hydroxide from China and Chile from 2014 to 2023

Dataset 2: Lithium Chemicals Export Data by Country (2004-2023)

- Covers Lithium Chemicals export data of Chile, China, and Argentina, which are the main exporters of lithium, from 2004 to 2023

Example Table c - China Export Trade Data for Lithium (2004-2023)

	Year	TradeFlow	Partner	Trade Value 1000USD	Quantity	Quantity Unit	Value/Q	Unit_price
China	2004	Export	World	5237.63	1396210	Kg	0.003751319644	3.751319644
China	2005	Export	World	7826.69	1575700	Kg	0.004967119376	4.967119376
China	2006	Export	World	8429.52	1378760	Kg	0.006113841423	6.113841423

Example Table c: including the volume and value of China export lithium, from 2004 to 2023

Example Table d - Chile Export Data for Lithium (2004-2023)

	Year	TradeFlow	Partner	e Value 1000	Quantity	Quantity Uni	Value/Q	Unit_price
Chile	2004	Export	World	52.17	14900	Kg	0.0035013	3.5013423
Chile	2005	Export	World	657.98	148840	Kg	0.0044207	4.4207202
Chile	2006	Export	World	17350.82	3499550	Kg	0.004958	4.9580146

Example Table c: including the volume and value of Chile export lithium, from 2004 to 2023

Example Table e - Argentina Export Data for Lithium (2004-2023)

	Year	TradeFlow	Partner	Value 100	Quantity	uantity Uni	Value/Q	Unit_price
Argentina	2004	Export	World	57.89	27525	Kg	0.002103	2.103179
Argentina	2005	Export	World	0.22	25	Kg	0.0088	8.8
Argentina	2007	Export	World	0.33	29	Kg	0.011379	11.37931
Argentina	2010	Export	World	1.15	50	Kg	0.023	23

Example Table e: including the volume and value of Argentina export lithium, from 2004 to 2023

Dataset 3: Trade Data of Lithium Hydroxide for Global Countries (2004-2023)

- Provides global export data for refined lithium compounds, mainly lithium hydroxide, from 2004 to 2023, including export value and quantity. We calculated unit prices by country and focused on China, Chile, and Argentina, the U.S.'s main import sources.

Example Table f: Trade Data for Lithium Oxide and Hydroxide by Exporting Countries (2023)

Reporter	TradeFlow	ProductCode	Product Description	Year	Trade Value 1000USD	Quantity	Quan	Value/Q	Unit_price
China	Export	282520	Lithium oxide and hydroxide	2023	6217397.98	1.30017e+008	Kg	0.04782	47.81988
Chile	Export	282520	Lithium oxide and hydroxide	2023	1010433.28			#VALUE!	#VALUE!
United States	Export	282520	Lithium oxide and hydroxide	2023	314853.72	8.64933e+006	Kg	0.036402	36.40209
European Union	Export	282520	Lithium oxide and hydroxide	2023	142310.18	2.32915e+006	Kg	0.0611	61.09962

Example table f: including trade data for export lithium oxide and hydroxide for global sourced countries. Countries for different years vary, from 2004 to 2023.

Results:

Objective 1

Evaluate China's current impact on the U.S. regarding battery-grade lithium compounds.

Given that China is recognized as a key supplier of refined battery-grade lithium compounds, Lithium Carbonate and Lithium Hydroxide, to the U.S., our first step is to take a closer look at China's role and assess the extent of its impact on U.S. supply.

We collected data on U.S. imports of lithium hydroxide from 2014 to 2023 using the UN Comtrade database. Please see an example table from 2014 at *Table 1.1* attached below. The original dataset includes the top nine exporting countries each year, along with corresponding trade values (USD), and net weights (kg). In addition, I have calculated the price per unit (USD/kg) for each year and added it to the table. This is the formula:

Price per Unit = Trade Value / Net Weight

U.S. Imports of **Lithium Hydroxide** (HS Code 2825.20) by Exporting Country – Year **2014**				
Period	**Exported Country**	**Trade Value (US$)**	**Net Weight(kg)**	**Price Per Unit ($/kg)**
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2014	China	$878,965	129,364	$6.79
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2014	Singapore	$216	21	$10.29
2014	Switzerland	$437	12	$36.42
2014	Romania	$2,293	3	$764.33

Table 1.1. U.S. Imports of Lithium Hydroxide (HS Code 2825.20) from World – Year 2014

Next, to better understand China's position over time, I compiled a table gathering all available data on U.S. lithium hydroxide imports from China between 2014 and 2023, and added a column indicating China's export rank to the U.S. for each year (See *Table 1.2*).

U.S. Imports of **Lithium Hydroxide** (HS Code 2825.20) from China – **2014 to 2023**					
Period	**Exported Country**	**Trade Value (US$)**	**Net Weight(kg)**	**Price Per Unit ($/kg)**	**Rank**
2014	China	$878,965	129,364	$6.79	2
2015	China	$1,855,760	242,100	$7.67	2
2016	China	$1,459,885	102,490	$14.24	2
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2020	China	$254,012	24,286	$10.46	3
2021	China	$226,130	22,977	$9.84	5
2022	China	$86,013	1,585	$54.27	7
2023	China	$722,336	17,662	$40.90	3

Table 1.2. U.S. Imports of Lithium Hydroxide (HS Code 2825.20) from China – 2014 to 2023

As shown in *Table 1.2*, China has consistently remained among the top five suppliers of lithium hydroxide to the U.S. over the past decade (2014 to 2023). Notably, China held a strong position as the second-largest supplier from 2014 to 2019, demonstrating its significant role in the U.S. refined lithium supply chain during that period. However, a noticeable decline occurred between 2020 and 2022, caused by the start of the COVID-19 pandemic. It was severely harmful to global trade, particularly between Asia and North America due to long travel time. Even though the pandemic played a negative role in the lithium trade market, China showed a strong rebound in 2023, climbing from rank 7 to rank 3. This upward trend suggests that both economies are gradually recovering and international trade flows are stabilizing. If the recovery continues, China is likely to regain a more dominant position in the U.S. lithium supply chain in the coming years.

Objective 2

Evaluate the potential impact of a Chinese export ban on lithium price from Chile.

For this section, we want to investigate how a Chinese export ban targeting only the U.S. would affect lithium prices from the top one supplier, Chile, to the U.S. I will be using the table with Chile's trade values (USD), net weights (kg), and price per unit (USD/kg). See *Table 2.1*.

U.S. Imports of **Lithium Hydroxide** (HS Code 2825.20) from China – **2014 to 2023**				
Period	**Exported Country**	**Trade Value (US$)**	**Net Weight(kg)**	**Price Per Unit ($/kg)**
2014	Chile	$11,135,687	1,763,997	$6.31
2015	Chile	$10,148,698	1,444,092	$7.03
2016	Chile	$7,068,117	811,710	$8.71
2017	Chile	$11,006,176	684,723	$16.07
2018	Chile	$6,260,354	351,216	$17.82
2019	Chile	$5,126,620	479,070	$10.70
2020	Chile	$5,309,733	650,384	$8.16
2021	Chile	$9,932,198	1,061,979	$9.35
2022	Chile	$71,148,384	1,436,187	$49.54
2023	Chile	$39,881,503	861,023	$46.32

Table 2.1 - *U.S. Imports of Lithium Hydroxide (HS Code 2825.20) from Chile – 2014 to 2023*

We will be first using a price elasticity model to evaluate how responsive the quantity of supply is to the price changes of refined lithium from Chile.

The formula of price elasticity of supply (PES) is:

$$PES = \frac{\%\Delta Q_s}{\%\Delta P}$$

ΔQ_s : Change in quantity supplied.

ΔP : Change in price.

This model measures how much demand changes when price changes. To calculate PES, I will be using the difference of net weight from Chile between two adjacent years, and the difference between price per unit from Chile between two adjacent years for each PES. Then, I will take the average of all PESs to drive to the final result.

See *table 2.2* for change in quantity supplied in each year from Chile and the final average.

See *table 2.3* for change in price in each year from Chile and the final average.

Year	%ΔQ_s
2015	-22.15%
2016	-77.91%
2017	-18.55%
2018	-94.96%
2019	26.69%
2020	26.34%
2021	38.76%
2022	26.06%
2023	184.11%
Average %ΔQ_s	**9.82%**

Table 2.2 - Year-over-Year Change in Supply from Chile

for the U.S. Lithium Hydroxide Imports from Chile (2015–2023)

Year	%ΔP
2015	10.24%
2016	19.29%
2017	45.80%
2018	9.82%
2019	-66.54%
2020	-31.13%
2021	12.73%
2022	81.13%
2023	-6.95%
Average %ΔP	**8.26%**

Table 2.3 - Year-over-Year Change in Price

for the U.S. Lithium Hydroxide Imports from Chile (2015–2023)

By using the PES formula, we drive the final PES to be 1.1883.

The formula of price elasticity of demand (PED) is:

$$PED = \frac{\%\Delta Q_d}{\%\Delta P}$$

ΔQ_d : Change in quantity demanded.

ΔP : Change in price.

This model measures how much demand changes when price changes. To calculate PED, the same method of calculating PES is applied here – calculating the difference of net weight and price per unit from China, then taking the average of all PEDs to get the final result.

See *table 2.4* for change in quantity demanded from the U.S. to China and the final average.

See *table 2.5* for change in price of China import in each year the final average.

Year	%ΔQ_s
2015	46.57%
2016	-136.22%
2017	80.60%
2018	-68.86%
2019	-154.74%
2020	-405.64%
2021	-5.70%
2022	-1349.65%
2023	91.03%
Average	**-211.40%**

Table 2.4 - Year-over-Year Change in demand from U.S. to China

for the U.S. Lithium Hydroxide Imports from Chile (2015–2023)

Year	%ΔP
2015	11.36%
2016	46.19%
2017	13.68%
2018	13.15%
2019	-9.91%
2020	-65.27%
2021	-6.28%
2022	81.86%
2023	-32.69%
Average	**5.79%**

Table 2.3 - Year-over-Year Change in Price

for the U.S. Lithium Hydroxide Imports from China (2015–2023)

By using the PED formula, we drive the final PED to be -36.53.

$$\%\Delta Q_{US} = \frac{Quantity\ lost\ from\ China}{Total\ U.S.\ imports}\ x\ 100\%$$

This formula calculates the percent change in U.S. lithium supply due to the China export ban. In 2023, the total lithium import in the U.S. was 940,795kg, and China contributed 26,714kg. The final result is calculated to be 2.84%.

The formula of Partial Equilibrium Price Impact Model is:

$$\%P_{US} = \frac{\%\Delta Q_{US}}{PES_{Chile} + |PED_{US}|}$$

$\%\Delta Q_{US}$: % loss of lithium supply to the U.S. due to China's export ban

This model estimates the percentage change in price required to rebalance the market after a shock of supply or demand. The final result is calculated to be 0.0753. This result shows that the import price from Chile to the U.S. would increase by approximately 0.0753 given 2.84% supply loss.

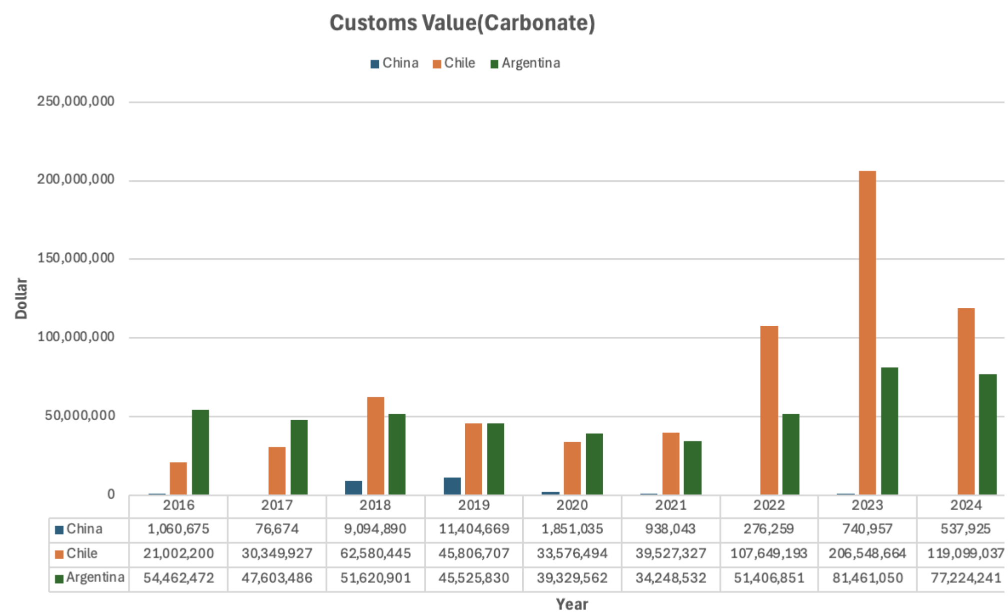
In 2023, the U.S. imported 842,292kg lithium hydroxide from Chile at the price of $50.98/kg, 26,714kg from China at the price of $45.81/kg. With the price inflation, the U.S. would need to spend $3,233,385 (50.98 * 0.0753 * 842,292) more to purchase the same amount of lithium hydroxide from Chile, and $240,660((50.98 * 1.0753 - 45.81) * 26714) more to compensate for the supply loss from China. The total extra cost is $3,474,045.

Objective 3

Identify mitigation strategies for supply chain resilience

1) **Analysis on the U.S. Import Data**

For current EV batteries, the U.S. mainly imports lithium carbonate and lithium hydroxide, both of which are processed heavily in China, Chile, and Argentina.



	2016	2017	2018	2019	2020	2021	2022	2023	2024
China	1,060,675	76,674	9,094,890	11,404,669	1,851,035	938,043	276,259	740,957	537,925
Chile	21,002,200	30,349,927	62,580,445	45,806,707	33,576,494	39,527,327	107,649,193	206,548,664	119,099,037
Argentina	54,462,472	47,603,486	51,620,901	45,525,830	39,329,562	34,248,532	51,406,851	81,461,050	77,224,241

Table 2.1 - The customs value for the imported lithium carbonate from China, Chile and Argentina (2016-2024)

Chile and Argentina are major global suppliers of lithium carbonate, a critical material used in both lithium iron phosphate (LFP) and nickel manganese cobalt (NMC) battery chemistries. Table 2.1 shows a large portion that Chile and Argentina take as the suppliers of Carbonate.

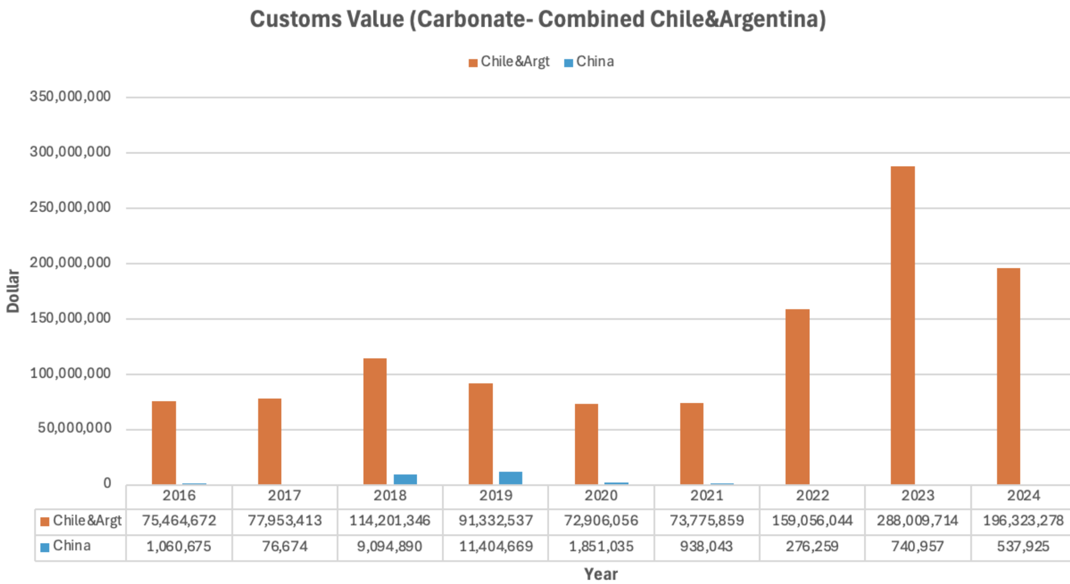


Table 2.2 - Edited from Table 2.1 by combining the customs value of Chile and Argentina and compare it with that of China (2016-2024)

Furthermore, Table 2.2 shows that the customs values for U.S. imports of lithium carbonate from Chile and Argentina together are higher than those from China, and this difference is statistically significant (two-sample t-test, $p = 0.00098$). This result indicates that, on average, lithium carbonate from Chile and Argentina is imported at a higher per-unit value, possibly reflecting higher quality, processing standards, or market pricing dynamics. Coupled with their strong and stable export volumes, these findings support the conclusion that Chile and Argentina are well-positioned to replace China as primary suppliers of lithium carbonate, particularly as the global demand for battery materials continues to rise.

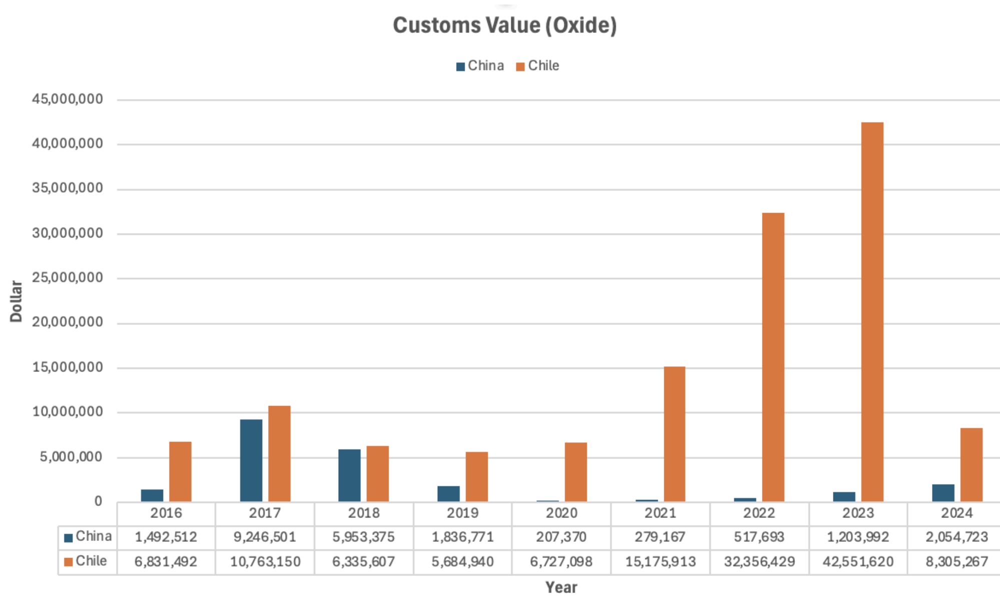


Table 2.3 - The customs value of imported lithium oxide and hydroxide from China and Chile (2016-2024; data for Argentina is not available)

China dominates lithium refining and produces key materials like lithium hydroxide, $LiPF_6$, and LFP cathodes. Trade data (Table 2.3) shows that since 2019, the customs value of U.S. imports from Chile has surpassed China's, indicating growing U.S. reliance on Chile for lithium oxide and hydroxide. This shift may be driven by the rise of LFP batteries, which use lithium carbonate instead of hydroxide, reducing demand and import values for the latter.

While Chile appears capable of replacing China as a supplier of lithium hydroxide, future demand remains uncertain as LFP adoption grows. With Chile and Argentina meeting much of the lithium carbonate demand, China's dominance may gradually decline, though continued market analysis is needed to track the long-term effects of changing battery chemistries.

Lithium Materials For EV Batteries

	Lithium Material	Primary Source Coun	Importance in EV Batteries
1	Lithium Carbonate (Li_2CO_3)	Chile, Argentina, China	Used in LFP and some NMC batteries
2	Lithium Hydroxide (LiOH)	China, Chile, Australia	Essential for high-nickel NMC/NCA batteries
3	Lithium Iron Phosphate ($LiFePO_4$)	China	Main cathode material for LFP batteries
4	Lithium Hexafluorophosph ate ($LiPF_6$)	China, Japan, South Korea	Key lithium salt in electrolytes
5	Lithium Metal (Li)	China, USA	Future solid-state battery material

Table 2.4 - Lithium materials for EV batteries and the source country (*Generated by Chatgpt*)

In addition, beyond lithium carbonate and lithium hydroxide, China continues to play a dominant role in supplying other key lithium compounds, including lithium iron phosphate (LFP), lithium hexafluorophosphate ($LiPF_6$), and lithium metal. Further research into trade data for these lithium compounds is necessary to fully understand China's impact on the global lithium supply chain.

2) Feasibility Assessment of Scaling Up Supply from Chile

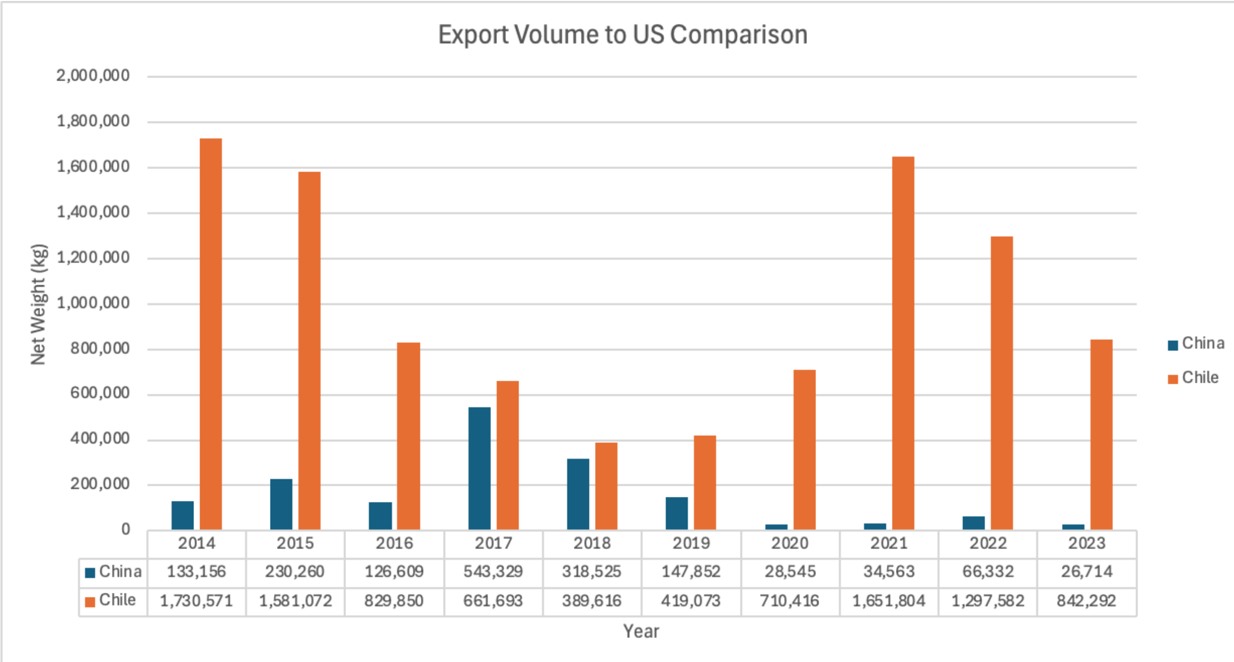


Table 2.5 - Export volume of lithium hydroxide from China and Chile to the U.S. (2014-2023)

To assess whether Chile could feasibly replace China as a supplier of lithium hydroxide to the U.S., we analyzed U.S. import data from both countries between 2014 and 2023. The findings clearly show that Chile has exported higher volumes of lithium hydroxide than China throughout this period.

As shown in Table 2.5, Chile supplied over six times more lithium hydroxide to the U.S. than China in most years, with peaks reaching nearly 1.8 million kg in 2015 and over 1.4 million kg in 2022.

E.g. - Export Volume of Chile / Export Volume of China:

Y 2014: 1,763,997/129,364=13.6;

Y 2015: 1,444,092/242,100=6.0;

Y 2023: 861.023/17,662=48.8

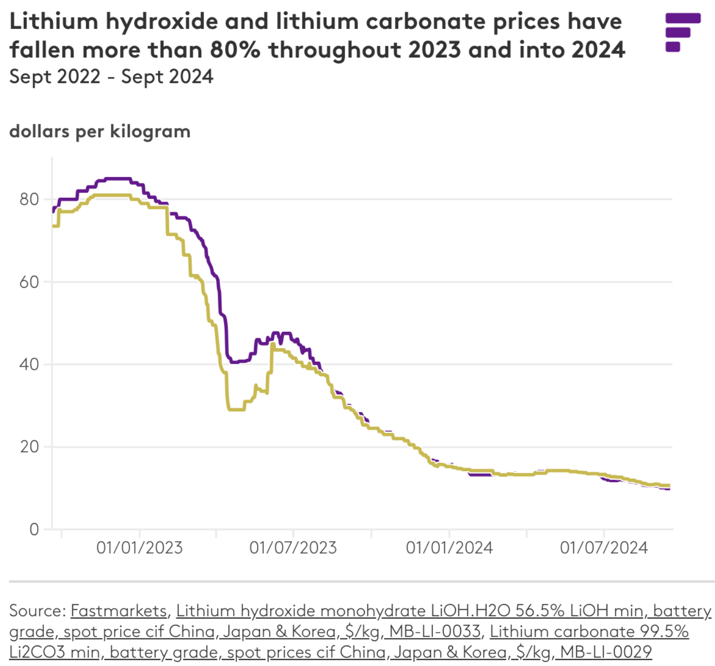
In contrast, China's exports have steadily declined, falling to just 1,585 kg in 2022 and 17,662 kg in 2023. On average, Chile exported around 954 metric tons per year, while China averaged only 150 metric tons.

The gradual withdrawal of Chinese lithium supply to the U.S. over the past decade appears to be driven by a combination of factors. Rising domestic demand in China, fueled by its rapidly expanding EV and battery industries, has likely redirected more lithium toward internal use（*McCarthy, 2018*). Additionally, geopolitical tensions and trade uncertainties between the U.S. and China may have discouraged exports. China has also prioritized strategic resource control, channeling lithium through regional partnerships and joint ventures rather than direct exports (*Wang, 2017)*.. These trends have contributed to the U.S.'s declining lithium imports from China and highlight the growing importance of reliable partners like Chile to ensure supply chain stability.

Besides, the sustained volume, combined with higher average trade value and stable U.S.–Chile trade relations, suggests that Chile is well-positioned to scale up and replace China as a key lithium hydroxide supplier. The data supports the conclusion that Chile has both the capacity and reliability to meet U.S. lithium demand during supply chain disruptions.

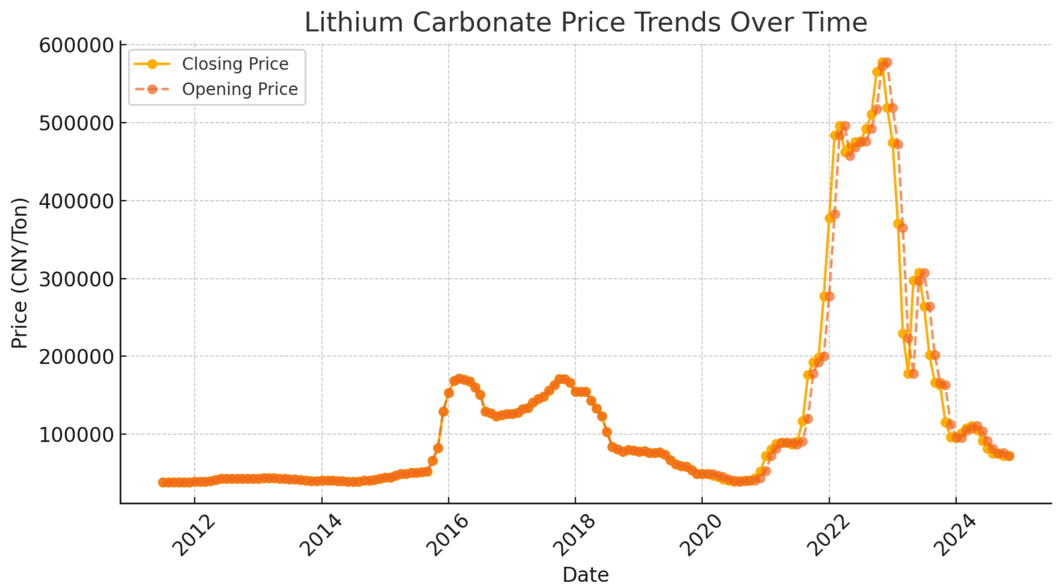
However, scaling up Chilean imports would come at a cost premium. Based on 2023 trade volumes and pricing, our model estimates this would result in an additional $3.47 million in procurement costs for the U.S. (From *Objective 2* analysis). While Chile is a feasible alternative, these figures highlight the importance of balancing cost with reliability, and further justify complementary strategies like forward contracts, domestic refining, and battery recycling to manage financial risks and build a more resilient supply chain.

3) Historical Transaction Data Analysis



Lithium carbonate and lithium hydroxide are the two main lithium compounds used in batteries, but they serve different roles. Lithium carbonate is used in LFP batteries for its safety and lower cost, while lithium hydroxide is used in nickel-rich batteries like NMC and NCA, preferred for long-range EVs due to their higher energy density. Lithium hydroxide is usually more expensive, as it requires further processing from lithium carbonate.

The prices of the two compounds are closely linked, since hydroxide is often derived from carbonate (CME Group). Due to limited price data for lithium hydroxide, we used lithium carbonate price trends to inform our inventory management analysis.



(99.5%Min Lithium Carbonate Spot - China)

The historical price data for lithium carbonate shows high volatility, with a standard deviation of 125,147 CNY/Ton, indicating frequent price fluctuations. (Calculated from *Transaction Price Data* file)

One of the most significant price spikes occurred in May 2023, when the closing price surged to 297,500 CNY/Ton, reflecting a 67.6% increase from the opening price of 177,500 CNY/Ton. (From *Transaction Price Data* file). This sharp rise was likely driven by China's Environmental Restrictions, Mining Delays in South America, Government Incentives for EVs in China or increasing demand for lithium carbonate in the EV battery market.

Conversely, the largest price drop occurred in March 2023, when prices declined by 38.1%, falling from 365,500 CNY/Ton at the opening to 229,500 CNY/Ton at closing. This decline may have been caused by oversupply, changes in government policies, or Increased Adoption of Alternative Battery Chemistries.

4) Forecasting Analysis on Transaction Data

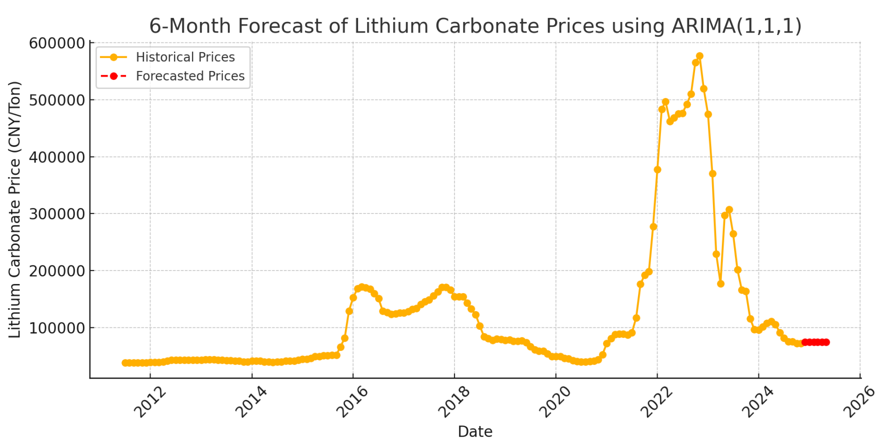
To forecast future lithium carbonate prices, we used the ARIMA (Auto-Regressive Integrated Moving Average) model, which is commonly applied in financial and commodity markets. However, ARIMA requires the data to be stationary. After testing with the Augmented Dickey-Fuller (ADF) method, we found the price series was non-stationary.

To choose the best model, we compared different ARIMA setups using the Akaike Information Criterion (AIC), which helps balance model fit and complexity. **ARIMA(1,1,1)** had the lowest AIC and was selected as the best option.

This model works by combining:

- **AR (1)**: uses one past value to predict the present,
- **I (1)**: differences the data once to stabilize it,
- **MA (1)**: includes one past forecast error to improve accuracy.

Forecasting: 6-Month Forecast of Lithium Carbonate Prices using ARIMA(1,1,1)



Here is the **6-month forecast** for lithium carbonate prices using the **ARIMA(1,1,1)** model:

Month	**Forecasted Price (CNY/Ton)**
Dec 2024	74,330
Jan 2025	74,729
Feb 2025	74,815
Mar 2025	74,834
Apr 2025	74.838
May 2025	74,839

Interpretation

The forecast shows that lithium carbonate prices are expected to stabilize at around 74,800 CNY per ton over the next six months. The projected increase is minimal, indicating that the market may be reaching a plateau. This trend likely reflects a situation where supply and demand are balancing out, following earlier periods of price volatility.

5) Inventory Management Advice for Lithium Carbonate

With lithium carbonate prices showing signs of stabilization but remaining historically volatile, companies need strategic inventory management to control costs and reduce risk. A Just-in-Time (JIT) approach can lower holding costs while maintaining a steady supply. Balancing short-term imports from China with long-term contracts from Chile and Argentina helps diversify risk. Additionally, using forward contracts can lock in prices and provide cost stability in a fluctuating market.

To further optimize inventory levels, companies should apply the Economic Order Quantity (EOQ) model, which helps determine the most cost-effective order size by balancing ordering and holding costs.

Formula: $EOQ = \sqrt{\frac{2DS}{H}}$

where:

- **D** = Demand (units per year)
- **S** = Ordering cost per order
- **H** = Holding cost per unit per year

Economic Order Quantity (EOQ) helps determine the optimal order quantity that minimizes both ordering and holding costs. This prevents excessive inventory accumulation while ensuring sufficient stock for production needs. (*EOQ strategy recommended and explained by Chatgpt*)

6) Mitigation Strategies for Supply Chain Resilience

Since Chile can replace China as a supplier of lithium carbonate and hydroxide, companies and policymakers should focus on building a diversified and stable supply chain. This includes using Just-in-Time (JIT) inventory strategies, forward contracts to manage price risks, and long-term agreements with Chile, Argentina, and other emerging producers to reduce dependence on any one country.

At the same time, investing in domestic refining and expanding battery recycling will strengthen long-term supply. Staying informed on market and policy changes will help companies adjust strategies and improve resilience against disruptions.

Objective 4

Analyze alternative lithium supply sources.

1) Cost-Effectiveness Assessment of Replacing China with Chile

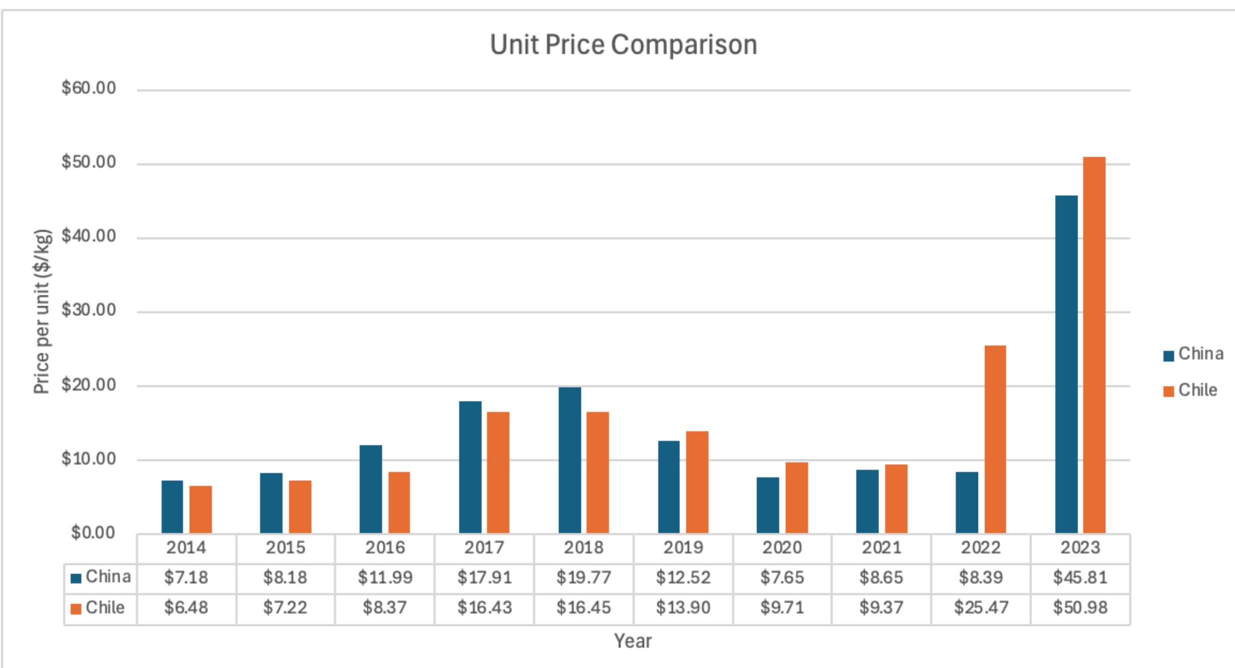


Table 3.1 - Unit price comparison of imported lithium hydroxide from China and Chile (2014-2023)

To assess the feasibility of replacing China with Chile as a lithium hydroxide supplier, we compared their historical unit prices from 2014 to 2023. Over this period, Chile's average price was $18.00/kg, slightly lower than China's $19.70/kg. Although Chile's price rose above China's in 2023, this appears to reflect short-term market shifts.

As shown in Table 3.1, Chile's prices were generally lower or similar to China's before 2022, and Chile consistently exported much higher volumes—averaging 950 metric tons per year, compared to China's 150. This suggests Chile is not only cost-competitive, but also a more reliable supplier.

Overall, Chile is a feasible and cost-effective alternative to China, with stable trade ties, strong capacity, and long-term pricing advantages that support a more resilient lithium supply chain.

2) Establish long-term strategic partnership with Chile

Given Chile's strong export volume and reliability as a major supplier of lithium carbonate and hydroxide, Chile is a great alternative resource for the U.S. after the ban from China. However, according to the result from objective 2, the substitute comes at a much higher cost, and it will not be a feasible strategy for a long run. The U.S. could use it as a short term urgency solution to prevent production delay. However, in the long run, the U.S. should pursue a long-term strategic partnership with Chile to secure their supplies and get better pricing. This will further assist the U.S. to reduce their dependence on China without extending the budget excessively.

a. Joint Investment in Lithium Refining Facilities

One strategy is joint investment in refining facilities in Chile, which would reduce transportation costs and improve processing efficiency. This could be supported by U.S. government financing through agencies like the DFC. Still, such ventures would require careful coordination and commitment from both public and private sectors.

b. U.S.–Chile Clean Energy Trade Partnership

A U.S.–Chile Clean Energy Trade Partnership could go further, fostering cooperation not only in lithium but also in battery manufacturing, recycling, and clean energy R&D. This broader approach would enhance sustainability and innovation but requires strong policy alignment and shared long-term goals.

c. Technology Transfer & Skills Development Program

Technology transfer and workforce development programs could help both countries improve lithium extraction and refine advanced compounds like $LiPF_6$, which is still dominated by Chinese producers. While promising, success would depend on research funding and institutional collaboration.

d. Tax Incentives or Fast-Track Permits for U.S. Companies Investing in Chile

Finally, the U.S. government could incentivize private sector investment in Chile's lithium value chain by offering tax incentives or fast-track permits to American companies. It would facilitate and incentivize companies investing in the region and thus contribute to long-term access to its critical materials.

3) Developing Local Lithium Refining

In the long term, achieving a resilient and self-sufficient lithium supply chain requires greater investment in domestic lithium refining capacity and related technologies. To support this, the U.S. government should implement incentive policies that encourage the growth of the refining sector. These could include tax reductions, startup grants, and support with financing and permitting. Such measures would lower barriers to entry and attract more private investment into the lithium refining industry. Over time, this would strengthen domestic processing capabilities and reduce reliance on foreign suppliers, particularly China. According to the *International Energy Agency (2024*), expanding midstream capabilities such as refining is critical for reducing vulnerability to geopolitical risks and ensuring long-term supply chain security.

4) Investing in Battery Recycling Programs

Battery recycling is another key strategy for ensuring a sustainable lithium supply. Retired EV batteries can be recycled to recover lithium and other valuable materials. Although U.S. recycling capacity is still limited, it's growing quickly with support from government funding and private innovation. Expanding recycling infrastructure can reduce dependence on imports and help build a circular, long-term supply chain.

Discussion

This study evaluates the extent of U.S. dependence on lithium compound imports from China and the feasibility of sourcing alternatives. Over the past decade, political tensions between China and the United States have made their trade relationship increasingly fragile. Historically, the two countries had limited overlap in the energy sector, as fuel-powered vehicles dominated the U.S. market (Nicholson, 2025). However, with the rapid rise of EVs, the U.S. has become more reliant on lithium-based energy materials, many of which are imported from China. Recent studies have shown that, while lithium trade between the two nations has generally remained stable, recent tariff disputes and the ongoing trade war have raised concerns about potential disruptions (Large Power, 2025). These rising tensions make the scenario of a Chinese export ban more plausible. In fact, even though this paper explores a situation where China initiates the ban, it is also possible that the U.S. may voluntarily reduce imports due to increasingly high tariffs.

A recent study by Large Power provides a detailed analysis of how U.S. tariffs on Chinese lithium compounds are affecting the electric vehicle (EV) market, battery prices, and policy responses. Specifically, the tariff on lithium compounds has increased from 7.5% in 2023 to 175% in 2025, leading to significantly higher prices in the U.S. market and causing ripple effects such as increased market competition and the risk of retaliatory tariffs (Large Power). In response, policymakers are working to reduce dependency on China by developing domestic manufacturing and investing in clean energy technologies. However, building local production capacity is a long-term effort and cannot be achieved quickly. As a result, the U.S. urgently needs short-term solutions while continuing to develop local infrastructure.

These findings align closely with our study. We identified Chile and Argentina—already among the top suppliers of lithium compounds to the U.S., as potential alternative sources in the event of supply disruptions from China. However, this substitution would come at a higher cost. Since relying on a higher budget is not sustainable in the long run, investing in domestic manufacturing is not only necessary but also beneficial for building long-term resilience in the lithium supply chain.

Conclusions:

This report explores the impact of a potential Chinese ban on exports of EV battery-grade lithium compounds and examines how to strengthen the U.S. lithium supply chain. This study explains that China has been a key supplier to the U.S., consistently ranking in the top two in the non-pandemic years, and regained momentum in recent years. If imports from China were stopped, the U.S. would be able to turn to Chile as an alternative source but at a far higher cost. Since reliance on high-cost imports is unsustainable in the long term, alternative mitigation options are also considered in this research. These include the establishment of domestic manufacturing capacity, long-term trade agreements with Chile, and battery recycling investment. These actions would reduce U.S. dependence on foreign supplies of lithium and enhance supply chain stability in the long term.

In conclusion, a balanced approach of short-term solution in purchasing lithium materials from Chile and long-term solution in investing in infrastructure and cooperation with Chile will be vital in building a more resilient and independent lithium supply chain. These findings offer practical recommendations to policymakers and business leaders amid ongoing global uncertainties.

Limitations:

This analysis focuses only on battery-grade lithium carbonate and lithium hydroxide, not raw lithium. These materials need to be highly pure (≥99.5%) for utilization in EV batteries.

There is little doubt about several limitations, one of which is data availability — some trade and price data are old, incomplete or behind paywalls.

We assume that Chile can scale up production, but logistical or political issues may affect this. Geopolitical uncertainty also adds risk. The impact of a Chinese export ban depends on evolving global trade dynamics. In addition, we focus only on lithium and do not account for other critical battery materials like cobalt and nickel, which could also disrupt EV production.

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- ChatGPT assisted with refining the language and checking grammar and wording.