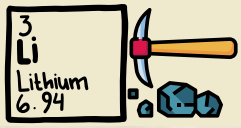
LITHIUM EXTRACTION FROM GEOTHERMAL BRINES

TEAM 6 -AMAN MEHTA / ARYA HARIA / ISHITA PURWAR
amanm2@illinois.edu / aharia2@illinois.edu / ipurwar2@illinois.edu - Key SDGs: 6,7 and 13

THE CHALLENGE



Lithium (Li), a non-renewable earth metal, is mined around the world for Lithium-Ion Batteries, at the expense of:

1. Water Usage - 2 million liters of water used for 1 ton of Lithium.
2. CO2 Emissions - 15 tonnes of CO2 for 1 ton of Lithium.
3. Soil, Land, Air and Water Contamination - Threat to indigenous communities.

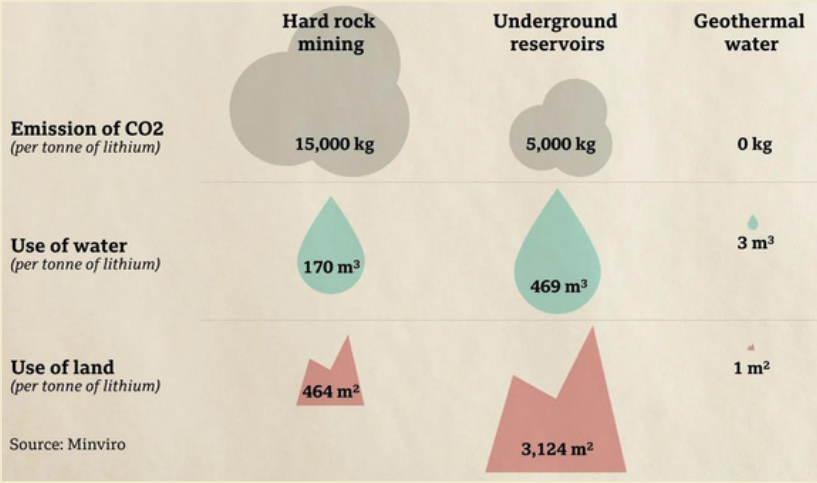


FIGURE 1 - ENVIRONMENTAL IMPACTS OF LITHIUM MINING, [BBC.COM]

IS LITHIUM REALLY THAT IMPORTANT?[YES!]

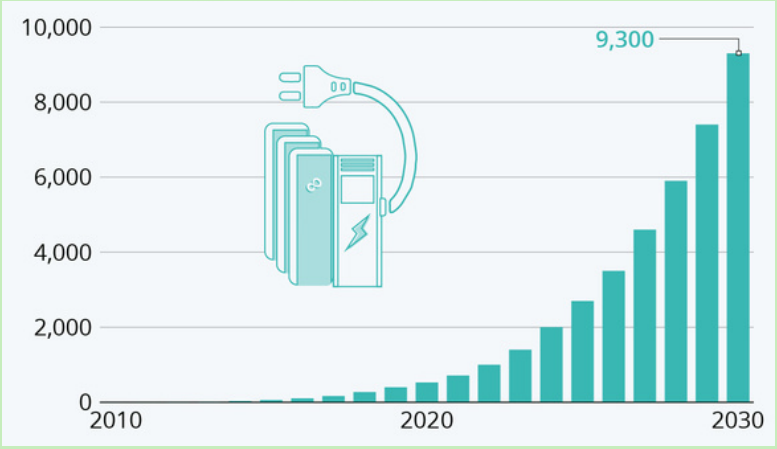
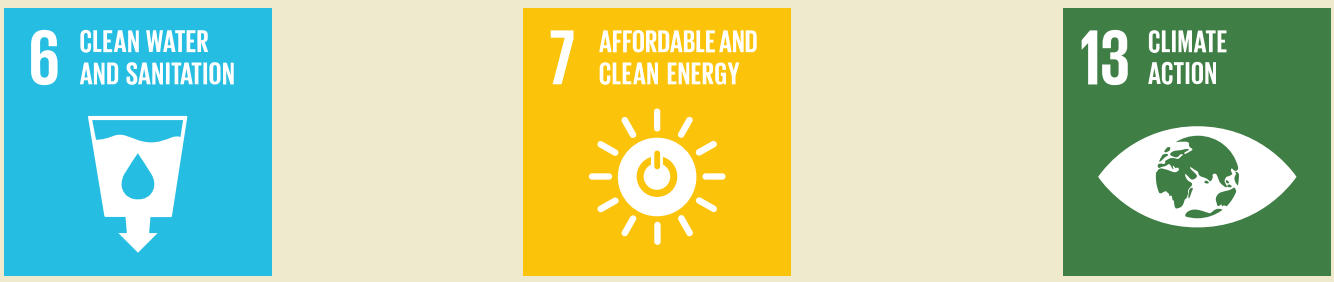


FIGURE 2 - INCREASING DEMAND OF LITHIUM [STATISTA.COM]

1. Lithium demand is rising exponentially.
2. Lithium is in the epicenter of battery systems.
3. Battery Systems are used in Electric Vehicles (EVs) and grid scale energy storage.
4. Batteries facilitate a net-zero future.
5. Renewable energy implementation will be limited without batteries

SUSTAINABILITY DEVELOPMENT GOALS (SDGS)



The solution to the Lithium mining problem should be one which doesn't **contaminate water, doesn't emit carbon** and is still relatively **affordable.**

THE SOLUTION

LITHIUM EXTRACTION FROM GEOTHERMAL BRINE

GEOTHERMAL BRINE: Geothermal brine is a hot and concentrated saline solution, having circulated through the very hot rocks of geothermal areas, and is enriched with minerals, such as lithium, boron, and potassium.

THE IDEA:

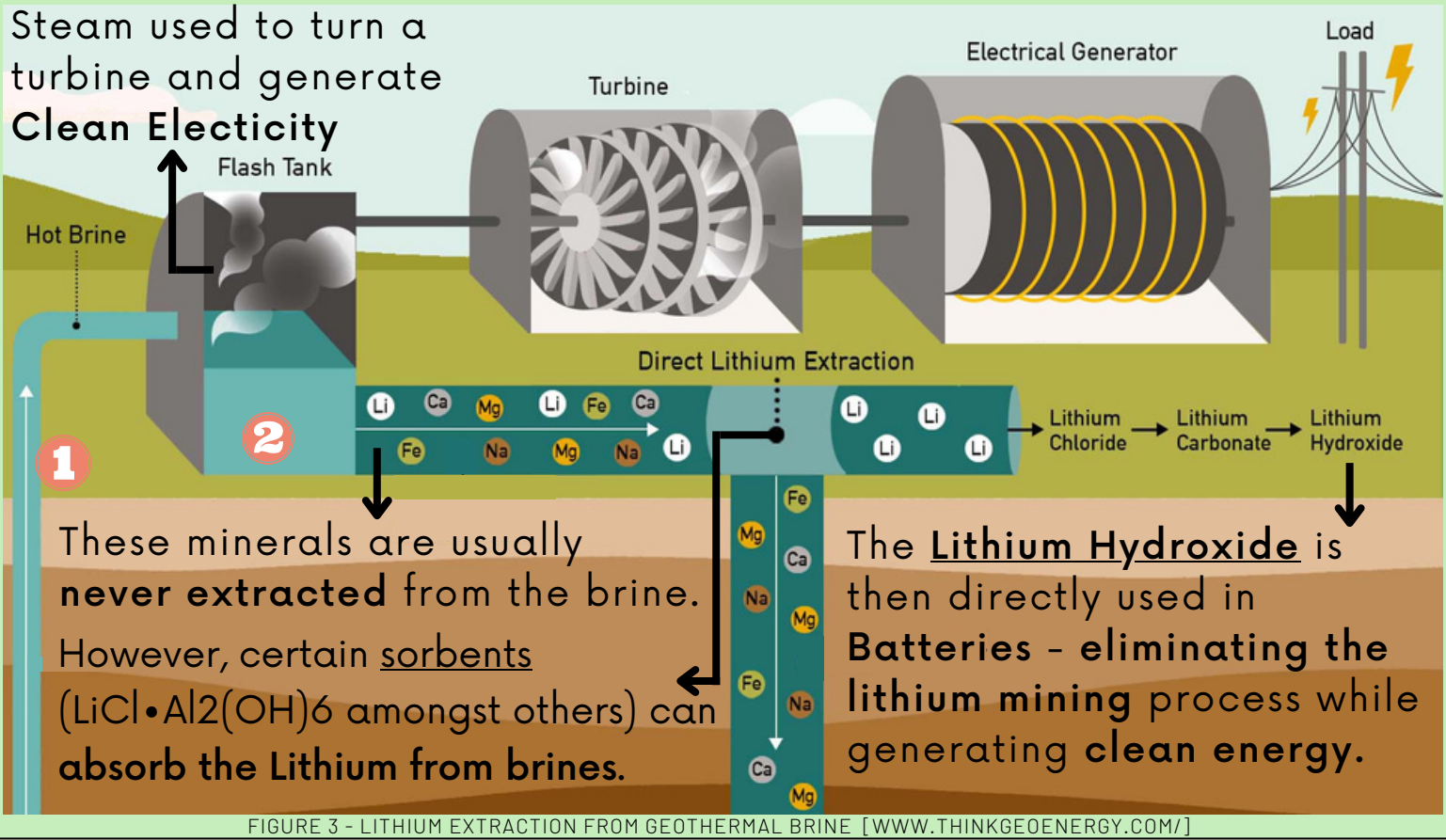


FIGURE 3 - LITHIUM EXTRACTION FROM GEOTHERMAL BRINE [WWW.THINKGEOENERGY.COM/]

6 CLEAN WATER AND SANITATION

- **Eliminating lithium mining** - reduced water wastage
- Reduced water, land and air **contamination**

7 AFFORDABLE AND CLEAN ENERGY

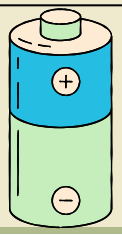
- **90% extraction efficiency** with **negligible loss** in absorption capacity over cycles
- **Clean energy** generated and passed to the grid

13 CLIMATE ACTION

- Reduced **carbon emissions** from conventional methods
- Overall, **lithium extraction becomes environmentally-friendly**

In context: $\frac{0.0005kg}{liter} \times \frac{420liters}{s} \times 91\% = \frac{0.19kg}{s}$ **of Lithium absorbed**

It takes 42s to absorb enough Lithium (8kg) for one EV battery.



IMPLEMENTATION

FEASIBILITY AND SCALABALITY :

FIGURE 4 - LITHIUM DEPOSITS AROUND THE WORLD

FIGURE 5 - GEOTHERMAL ENERGY PRODUCTION AROUND THE WORLD

The **correlation** between the Li deposits and the geothermal energy production shows the potential to **scale this technology and extract Li at each of those locations.** Given the **high impact and return on investment** of the above solution, governments are supporting this project to reach the **net-zero target** increasing the **feasibility of installation.**

CHALLENGES

Economical and social: **Heavy monetary investment** to set brine and factories. Geothermal exploration can be expensive. Both **can become cheaper** over the long run and if done on a **large enough scale. Geographical relocation of communities and land** to install plants.

Technological: Salt ions in brine **interfere** with extraction process, however, current **research is improving** those methods.

FUTURE PROSPECTS

Alongside Li, **other metals** such as **Nickel and Cobalt** which are required for battery production can also be extracted from geothermal brines. Additionally, **instead of using coal energy**, geothermal energy can now be used by the battery manufacturing factories to reduce the total emissions in the manufacturing process.

Bibliography:

1- Can geothermal energy solve the lithium shortfall? Energy.gov. (n.d.). Retrieved November 20, 2022, from https://www.energy.gov/eere/geothermal/articles/can-geothermal-energy-solve-lithium-shortfall

2 - Will the real lithium demand please stand up? challenging the 1MT-by-2025 orthodoxy. BloombergNEF. (2019, October 28). Retrieved November 20, 2022, from https://about.bnef.com/blog/will-the-real-lithium-demand-please-stand-up-challenging-the-1mt-by-2025-orthodoxy/

3- California's in-conduit hydropower implementation guidebook. (n.d.). Retrieved November 21, 2022, from https://www.energy.ca.gov/sites/default/files/2021-05/CEC-500-2020-030.pdf

4 - Castelvecchi, D. (2021, August 17). Electric cars and batteries: How will the world produce enough? Nature News. Retrieved November 20, 2022, from https://www.nature.com/articles/d41586-021-02222-1#:~:text=Amounts%20vary%20depending%20on%20the,figures%20from%20Argonne%20National%20Laboratory

5 - Aral, H., & Vecchio-Sadus, A. (2011). Lithium: Environmental pollution and health effects. Encyclopedia of Environmental Health, 499–508. https://doi.org/10.1016/b978-0-444-52272-6.00531-6

Sincerest Thanks to: Prof. Leon Liebenberg, Prof. Lili Cai, Arpit Dwivedi, Prof. John R. Abelson