

DOCKETED

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Lithium Recovery From Geothermal Brine

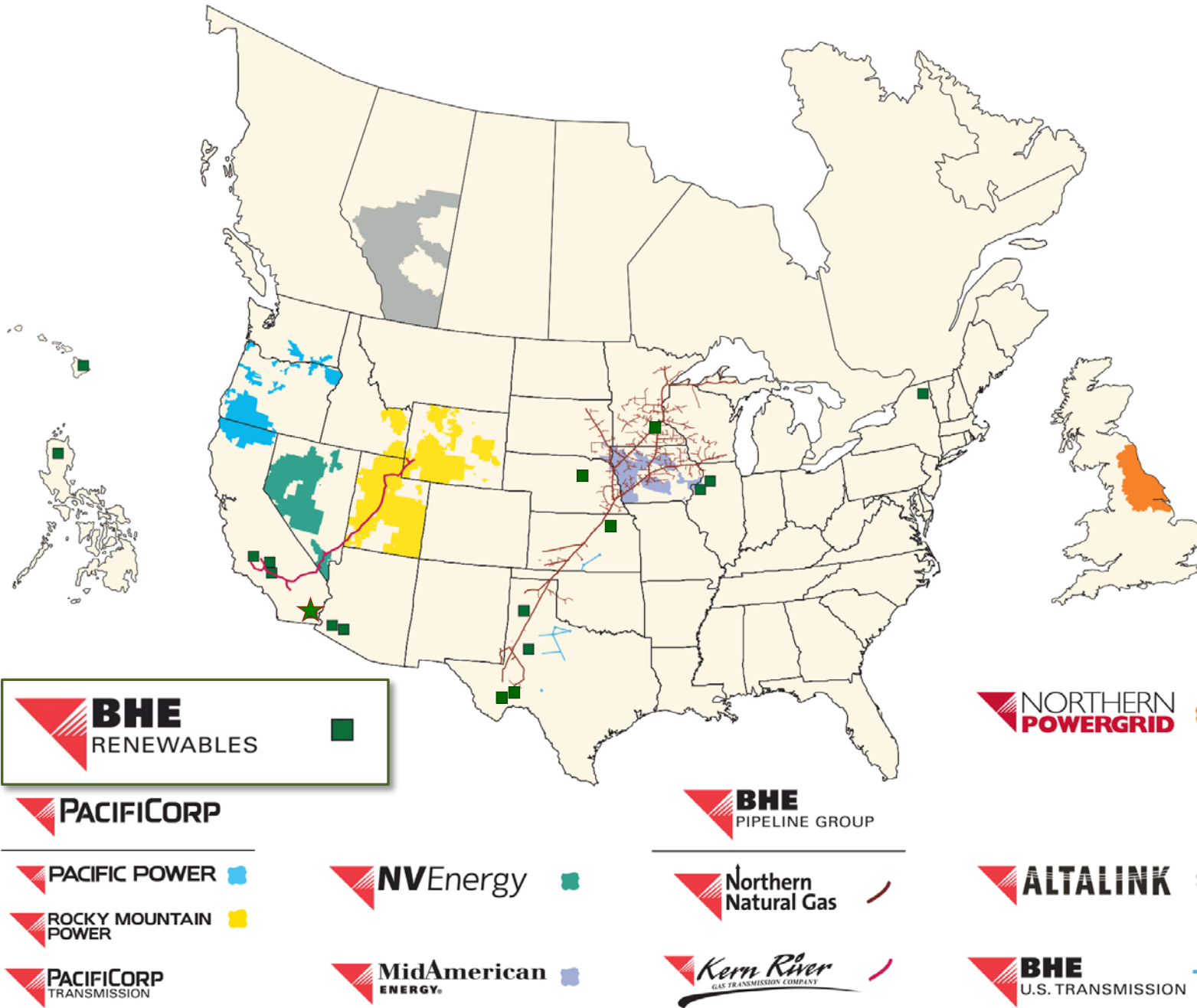
CEC Workshop and Discussion

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Berkshire Hathaway Energy Overview



- \$91 Billion in Assets
- 11.6 million customers worldwide
- 22,700 employees worldwide
- 33,500 miles of transmission lines
- 16,400 miles of natural gas pipeline
- 30,000 MW of owned generation capacity
- BHE Renewables – Independent Power Producer with approx. 4,000 MW capacity
- Including 350 MW of geothermal generation in Imperial Valley, California ★

CalEnergy Existing Operations



Power Production

- 10 power plants
- 350 MW Capacity

23 Production Wells:

- 2,900 to 8,700 feet deep
- 450 to 480 degrees Fahrenheit at wellhead
- 310 to 500 psi pressure
- Total flow 53,676 gpm
or
1.8 million barrels per day

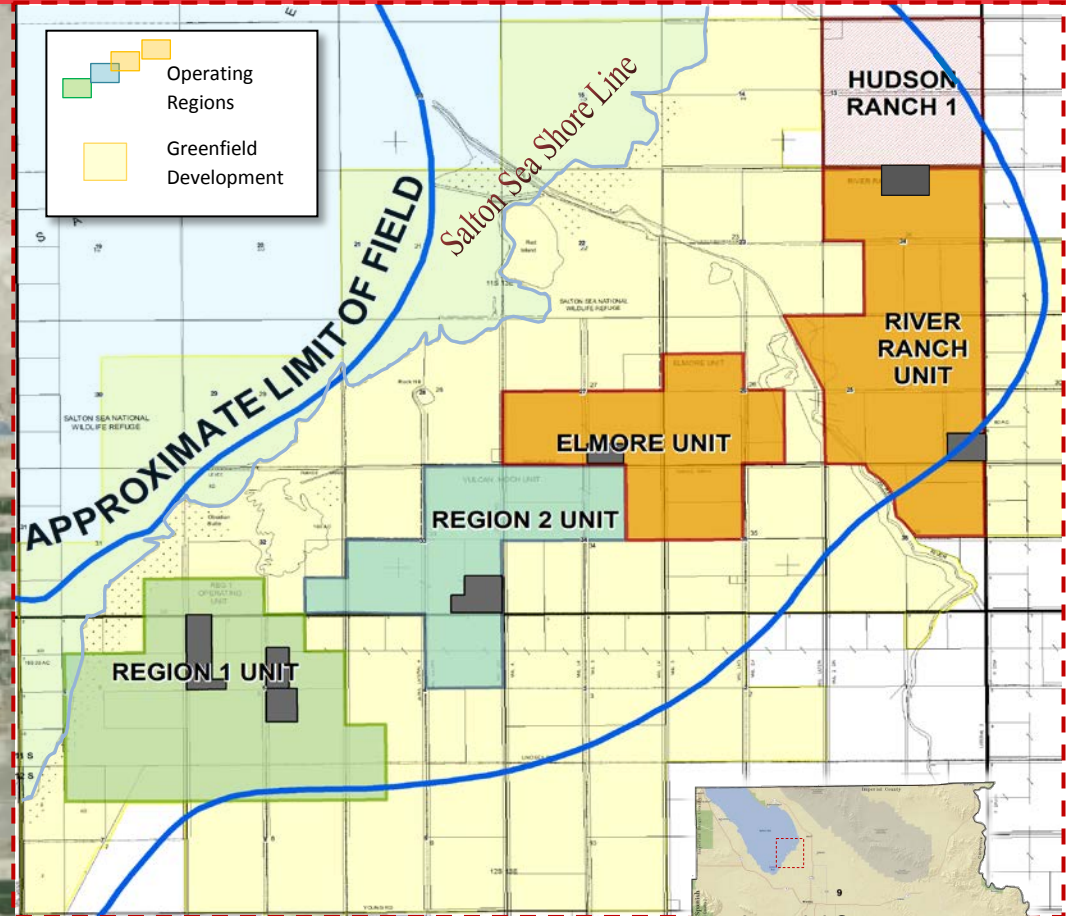
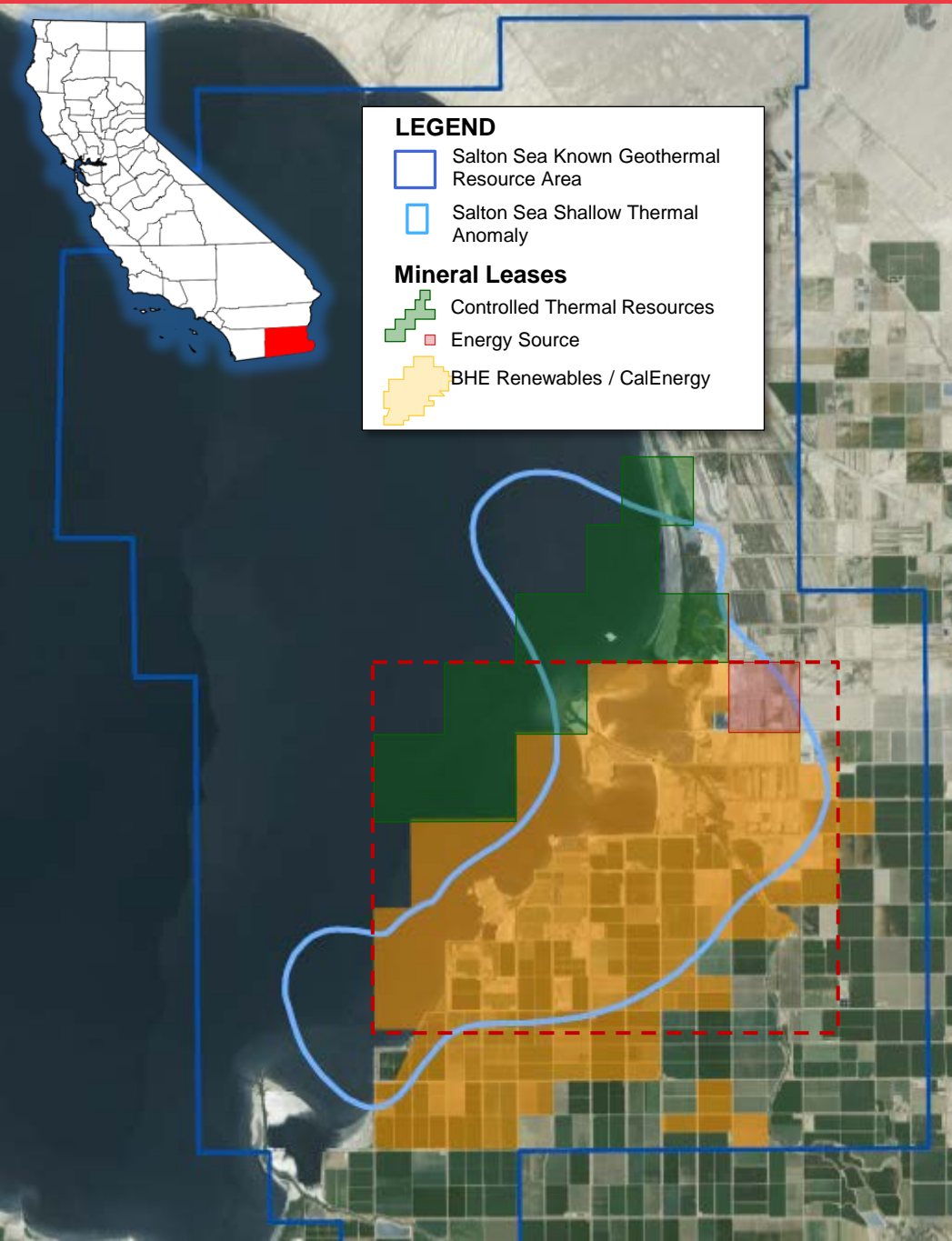
22 Injection Wells:

- 2,650 to 9,200 feet deep
- 205 to 230 degrees Fahrenheit at wellhead
- Total 41,785 gpm
or
1.4 million barrels per day

CalEnergy 50 MW Elmore Facility



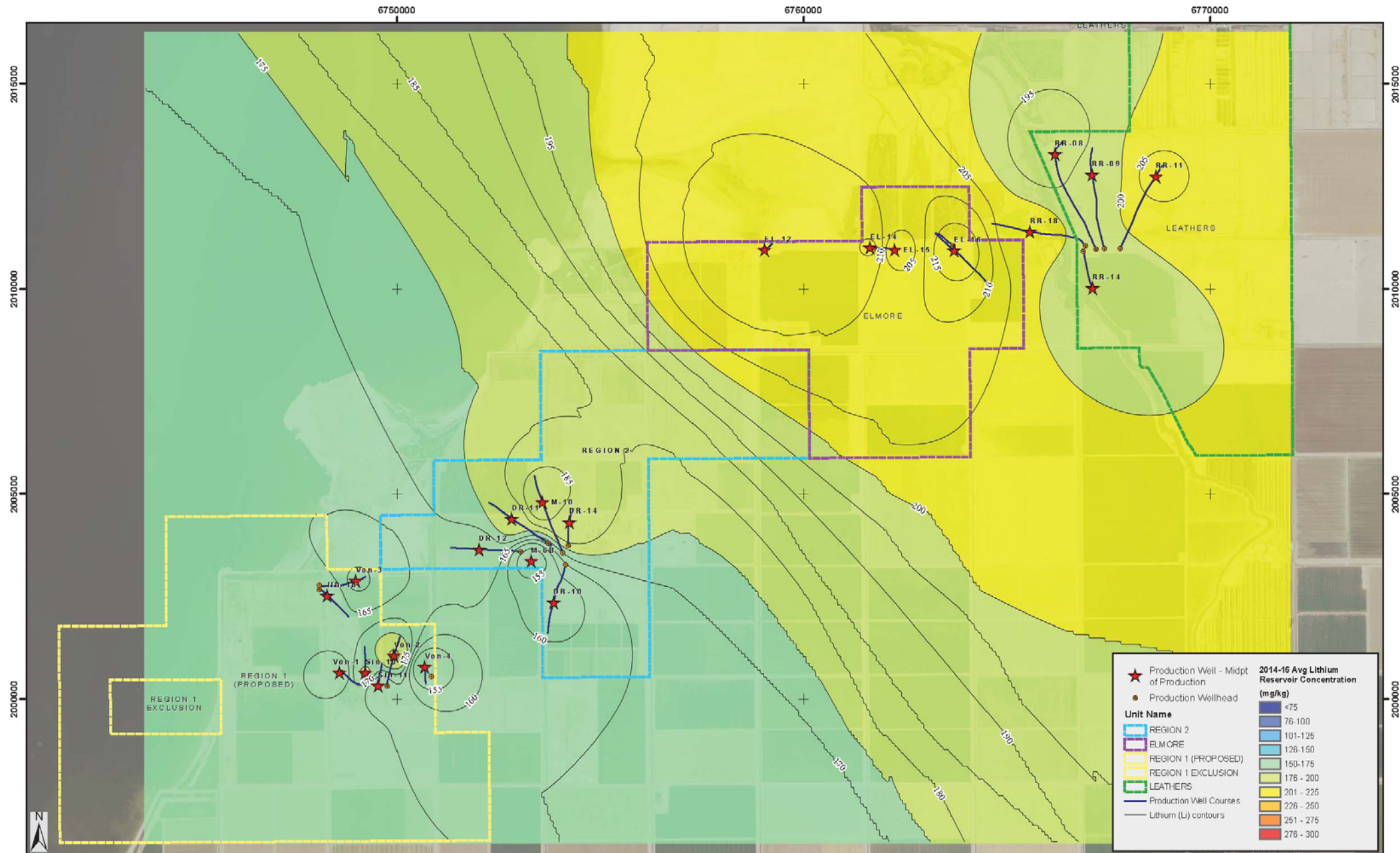
Salton Sea Geothermal and Mineral Resources



Key Mineral Quantities

CalEnergy Resources	Power MW	Potential Annual Mineral Production			
		Li ₂ CO ₃ (ktpa)	Zn (ktpa)	Mn (ktpa)	KCl (ktpa)
Operating	350	90	32	98	2,480
Greenfield	700	210	100	310	5,370

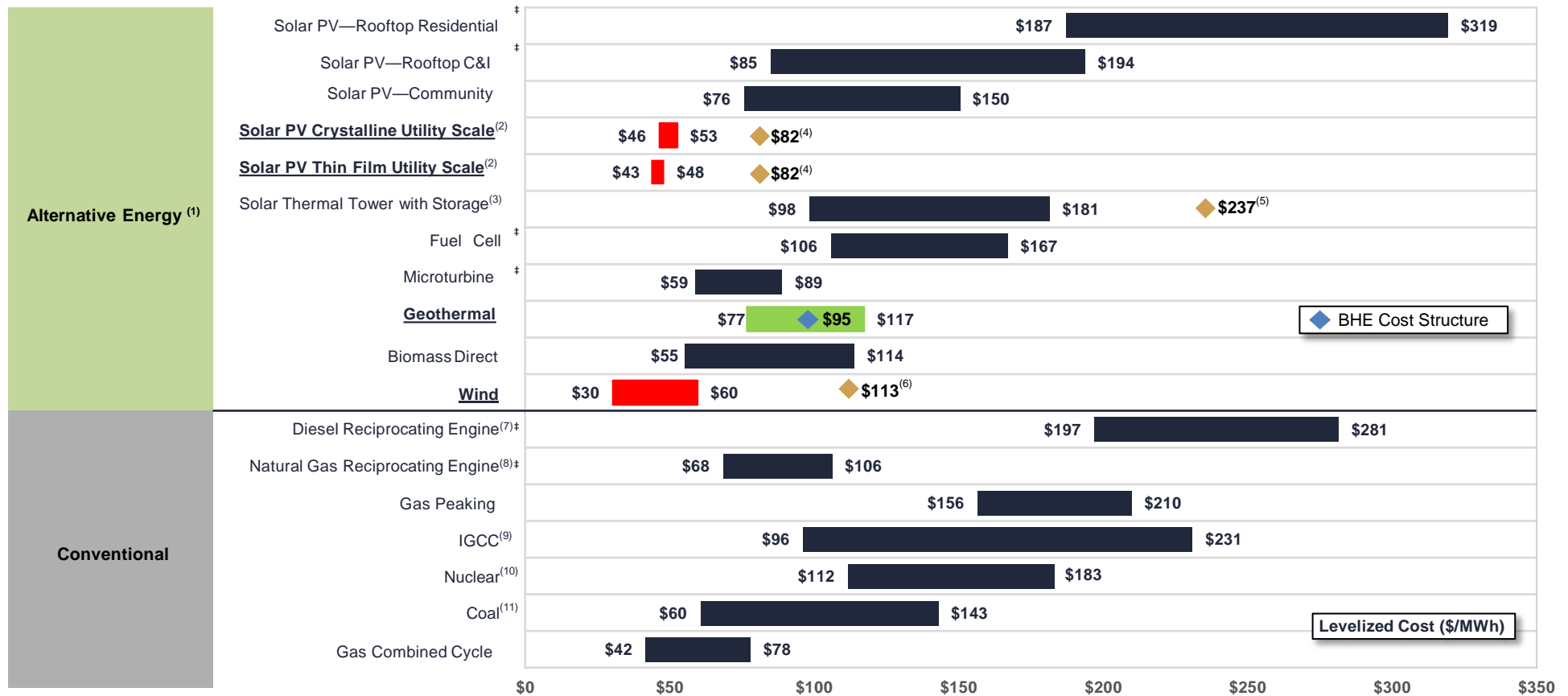
Lithium Concentrations within the Salton Sea Reservoir



2014-2016 Average Lithium (Li) Concentration Corrected to Reservoir (Pre-Flash) Conditions (mg/kg)

Unsubsidized Cost of Energy Comparison

- Taking into consideration capacity factors and operating costs, LCOE of geothermal is still considerable higher than wind and solar but competitive when coupled with storage
- Recent RFPs have resulted in solar PV plus storage bid prices below \$50/MWh for 2:1 solar:battery peak generating capacity (with 4 hour discharge rate), based on speculation that battery storage costs will continue to improve significantly over the next 5 years

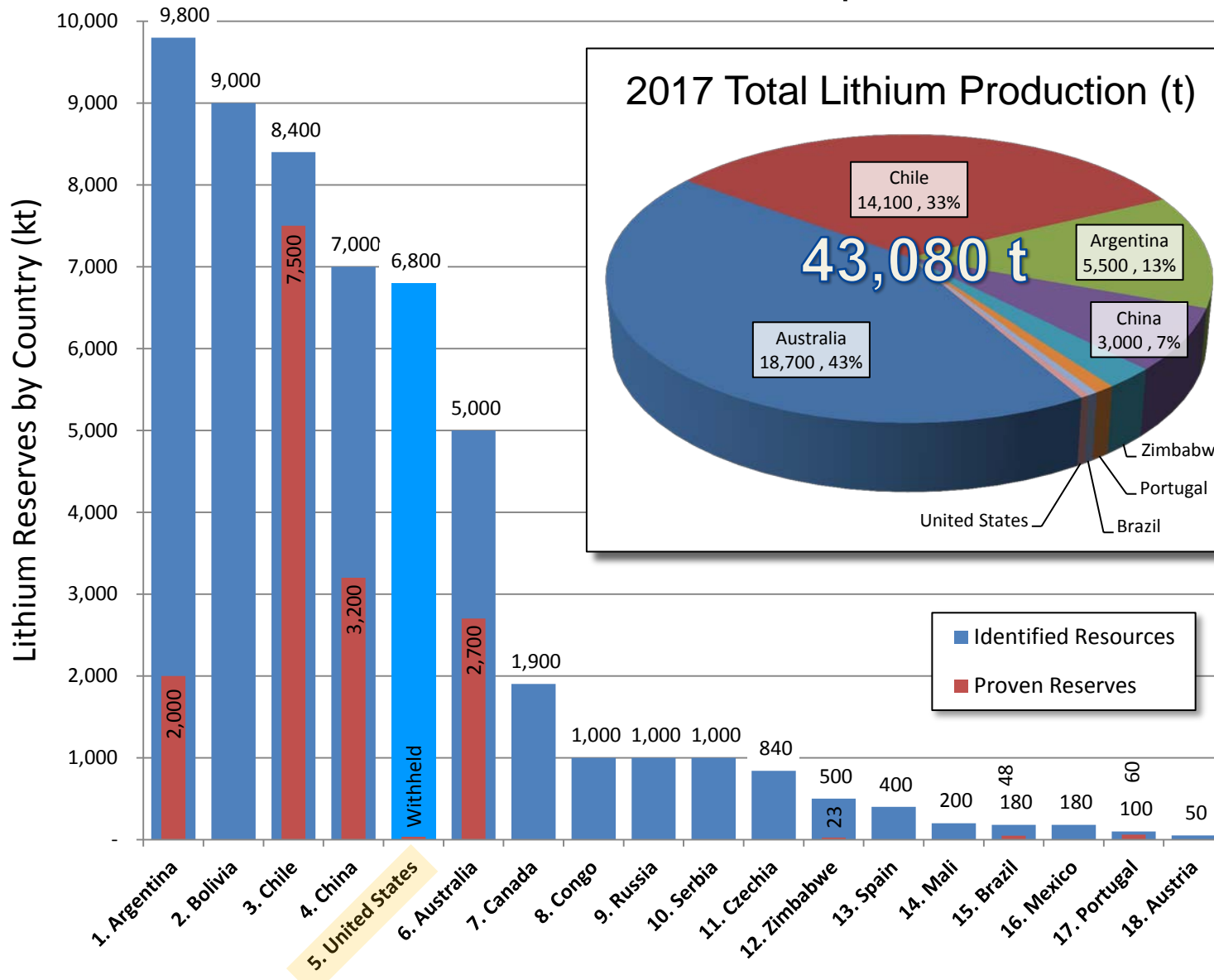


Source: <https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf>

Lithium Reserves



Global Lithium Reserves as Reported Jan. 2018



- 2017 Proven Reserves: 15,566 kt (red bars)
- 2017 lithium demand: 43 kt (43,080 Metric Tons)
- 2017 Identified Resources: 53,350 kt (blue bars)
- 2025 lithium demand fcst: 180 kt (950 kt LCE)

Resource Life - Lithium
 @ 2025 fcst production rate:

- 90 yrs. (proven reserves)
- 300 yrs. (identified resource)

Resource Life - Oil & Gas
 2017 proven reserves
 @ 2017 production rates:

- 90 yrs. (N.A Natural Gas)
- 70 yrs. (Global Oil)

Conclusion:

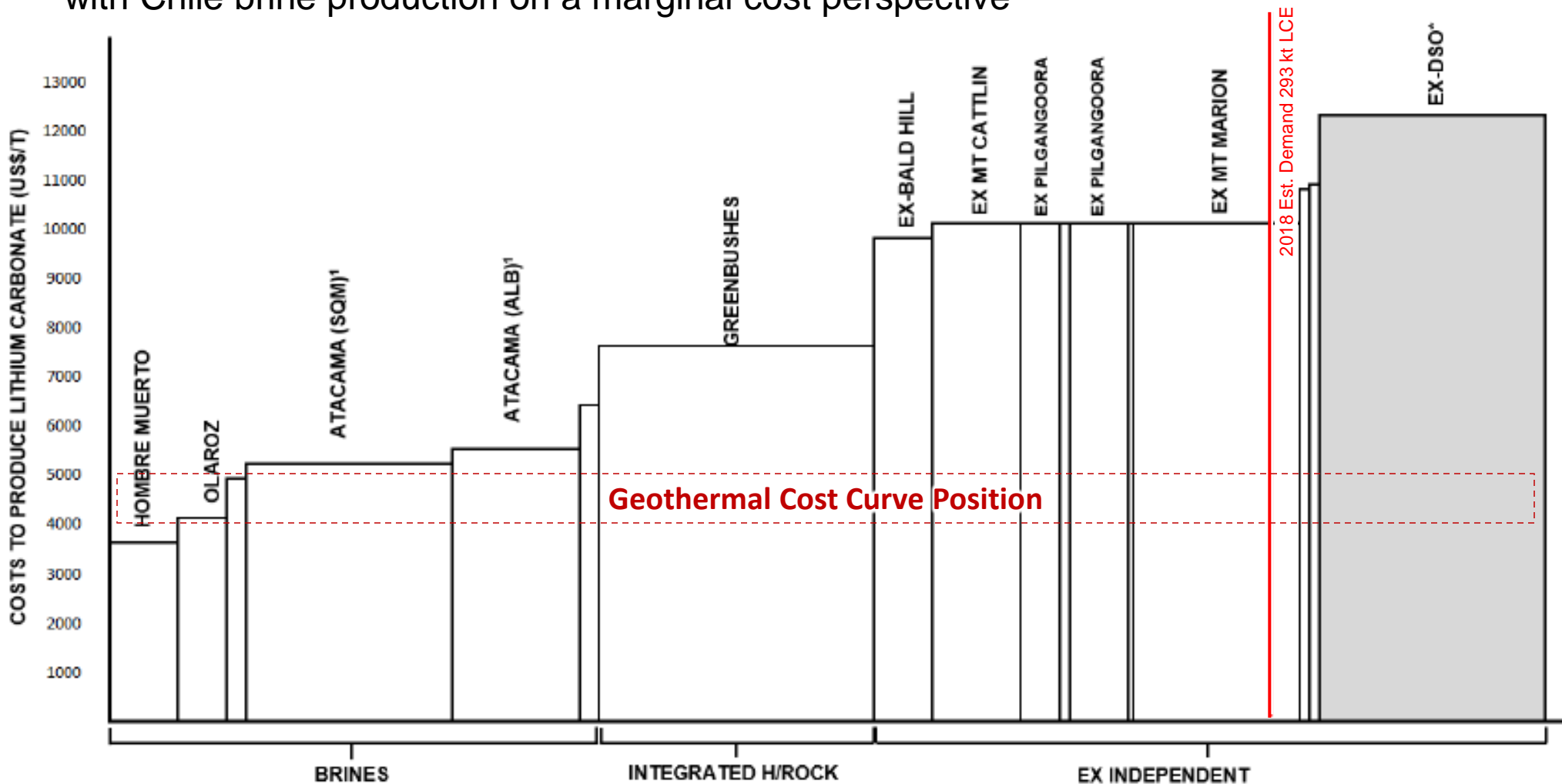
- No shortage of resource
- Regional Production will be determined based on:
 - Production Cost
 - Location relative to market
 - Quality

Source: U.S. Dept. of the Interior – U.S. Geological Survey, Mineral Commodity Summaries 2018

2018 Lithium Cost Curve



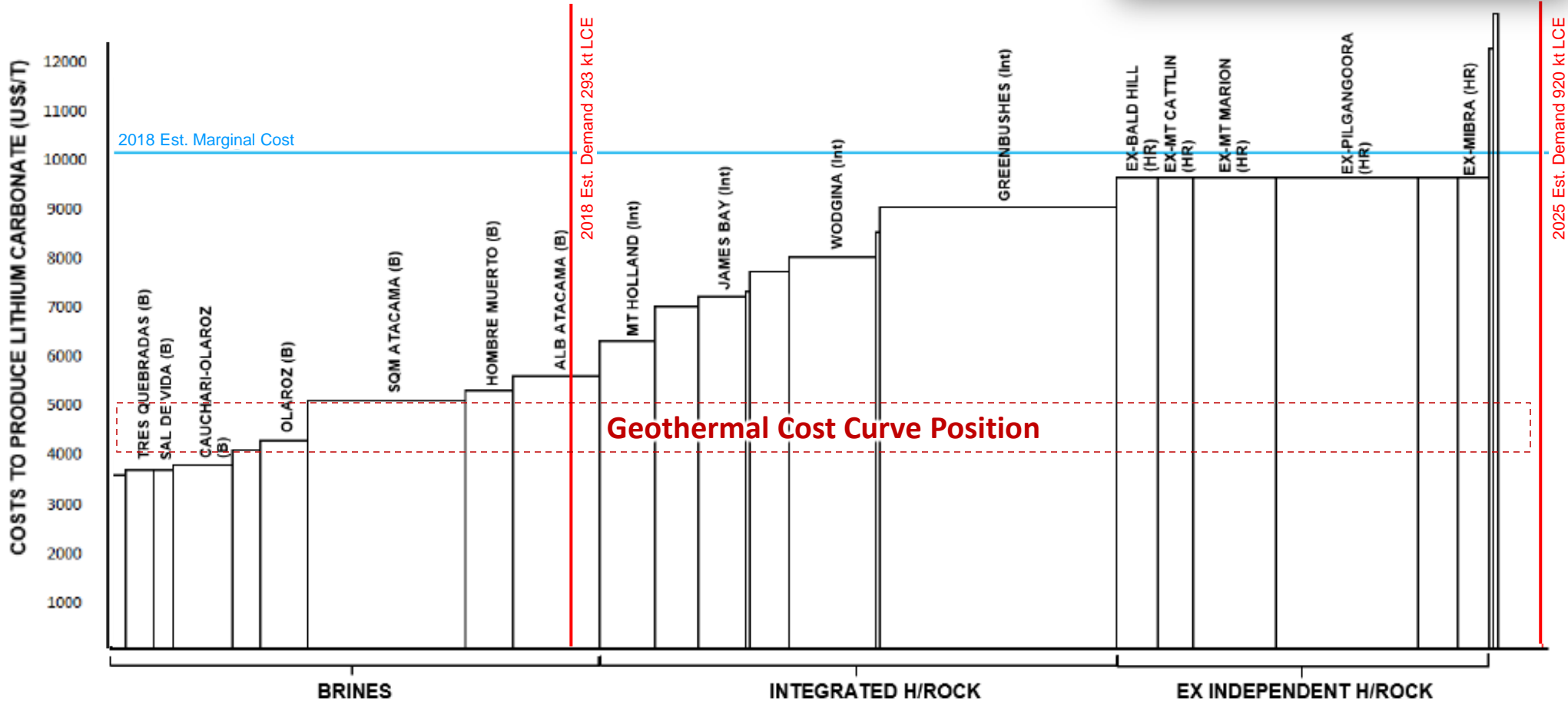
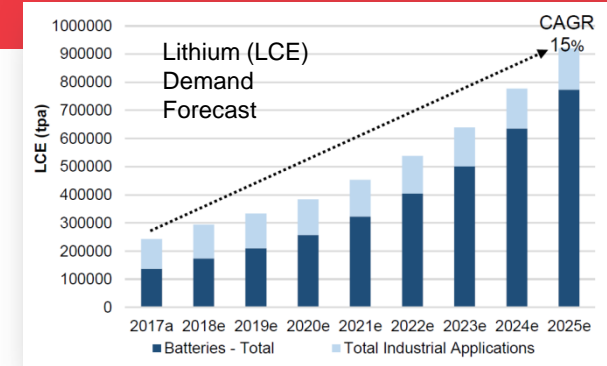
- Lithium in high demand and growing rapidly
- High market prices set by marginal cost of hardrock lithium mining
- Geothermal brine expected to be competitive with Chile brine production on a marginal cost perspective



2025 Lithium Cost Curve



- Demand forecast to triple by 2025
- BHE existing operations capable of producing 90 ktpa of lithium carbonate
- Salton Sea Known Geothermal Resource Area capable of producing over 600 ktpa of lithium carbonate

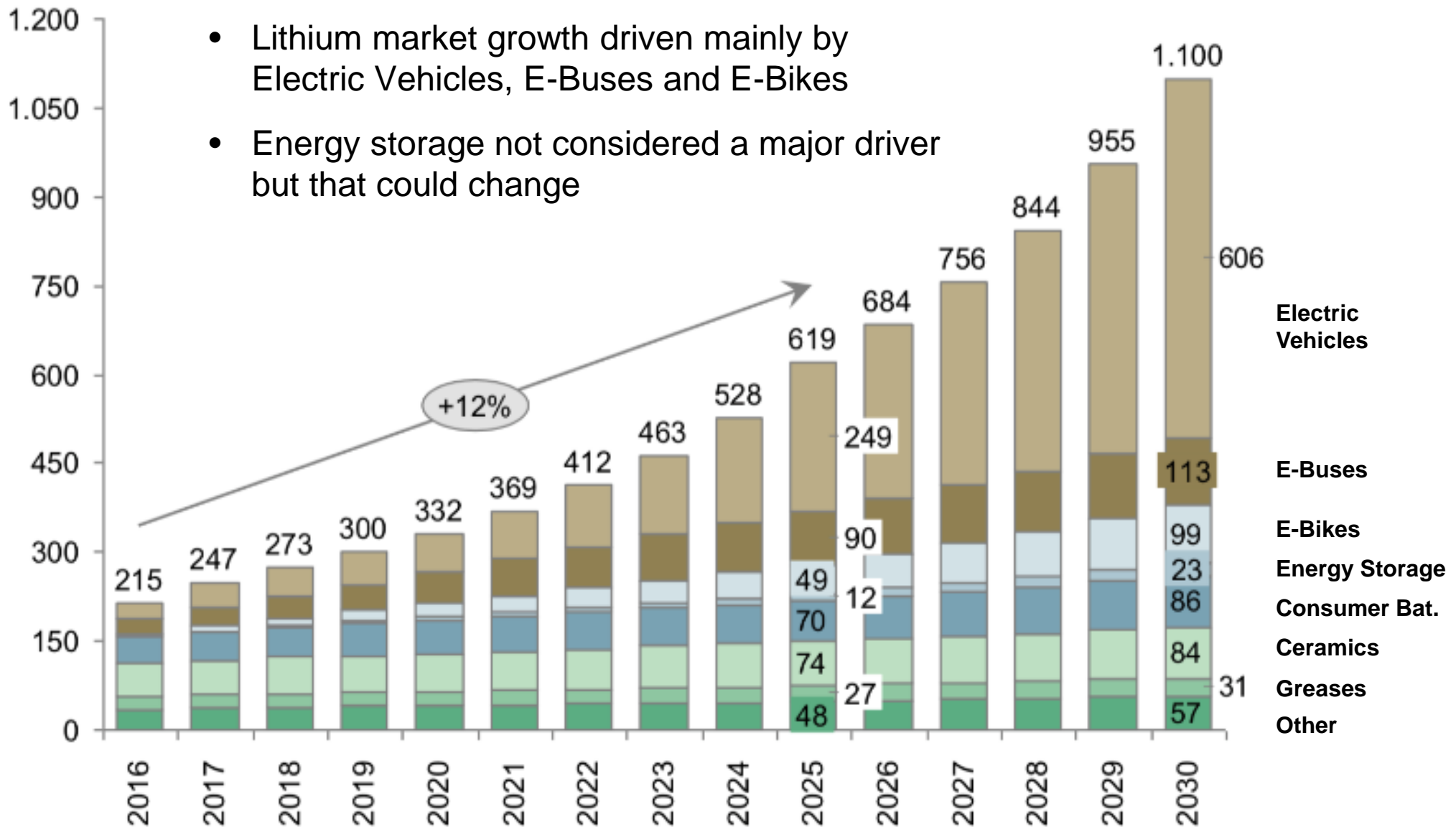


Lithium Demand Forecast by End Application



Demand (LCE kt)

- Lithium market growth driven mainly by Electric Vehicles, E-Buses and E-Bikes
- Energy storage not considered a major driver but that could change



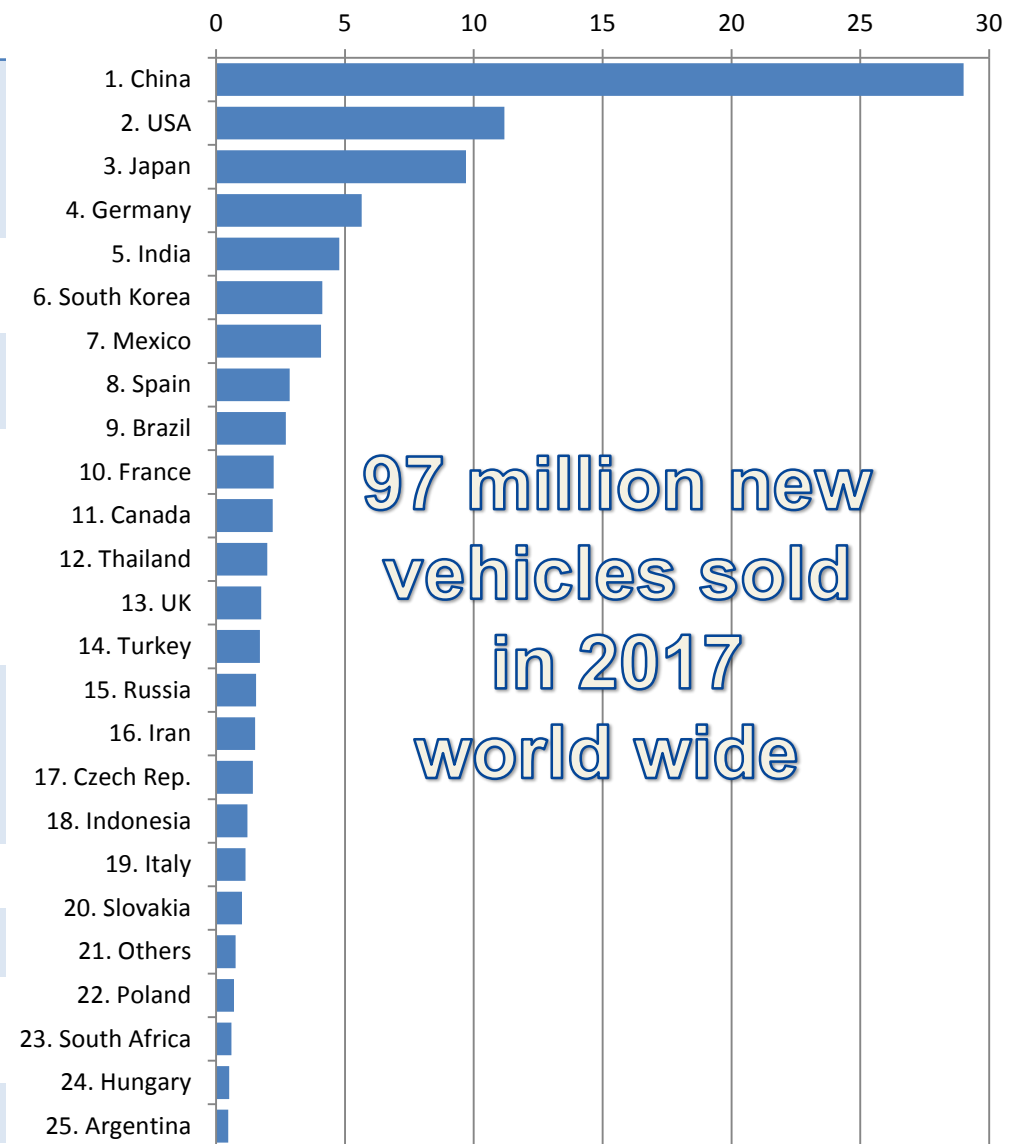
Electric Vehicle Market – Demand Drivers



Government Policy/Targets

Country	Target
China	<ul style="list-style-type: none"> Share of alternative fuel vehicles of at least 20 percent of sales in 2025, which would correspond to more than 7 million cars Target of 2 million electric car sales in 2020
India	<ul style="list-style-type: none"> Ban of petrol and diesel cars by 2030 has been revised down to 30% reduction by 2030
Germany	<ul style="list-style-type: none"> Goal of one million electric vehicles by 2020 Ban of petrol and diesel car sales by 2030
United States (30%) CA/CT/ME/MD/M A/NY/NJ/OR/RI/VT	<ul style="list-style-type: none"> California Clean Vehicle Incentives Zero Emission Vehicle Regulations adopted by 9 states representing 30% of all new car sales On track for ZEV and plug-in hybrids in California to amount to 8% of all sales by 2025
European Union	<ul style="list-style-type: none"> EV chargers at parking spaces of 10 percent of buildings by 2023 Emission reduction target for new cars of 95 gCO₂ per km by 2021
France	<ul style="list-style-type: none"> Ban of petrol and diesel car sales by 2040
Netherlands	<ul style="list-style-type: none"> Ban of petrol and diesel car sales by 2030
UK	<ul style="list-style-type: none"> Ban of petrol and diesel car sales by 2040 Scottish government target by 2032
Norway	<ul style="list-style-type: none"> Ban of petrol and diesel car sales by 2025

2017 Total New Vehicle Sales (millions)



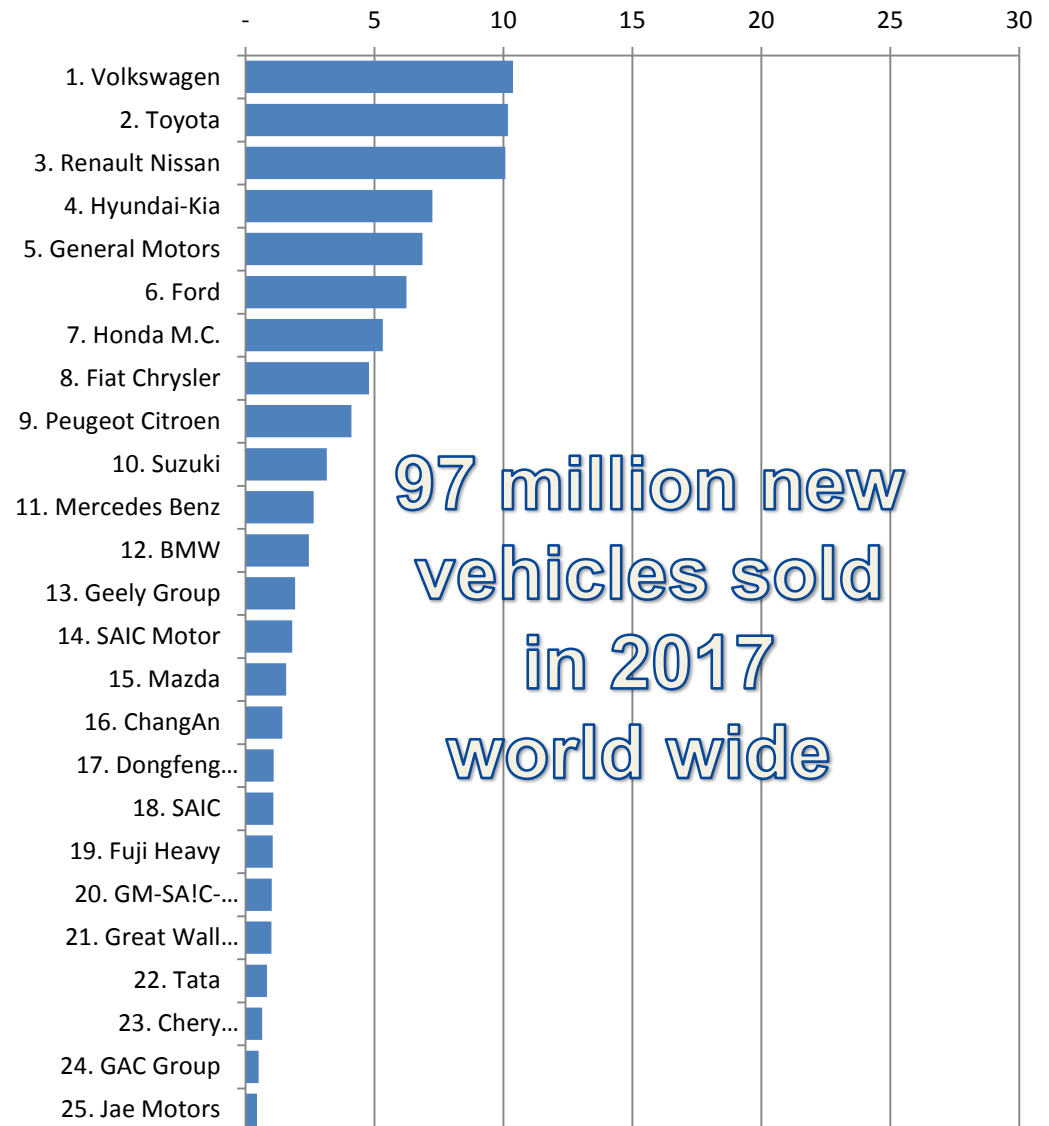
Electric Vehicle Market – Supply Response



Auto Industry Production Plans

Carmaker	Announcement
BMW Group	<ul style="list-style-type: none"> 100,000 electric vehicles sales in 2017 15-25 percent electric vehicle share by 2025
Chevrolet	<ul style="list-style-type: none"> 30,000 electric vehicle sales by 2017
Chinese OEMs	<ul style="list-style-type: none"> 4.52 million electric car sales by 2020 100,000 electric car sales by 2020 15-20 percent electric vehicles share of sales by 2025
Daimler / Mercedes Bends	<ul style="list-style-type: none"> Hybrid electric vehicles 10% share of sales in 2025 10 new electric vehicle models by 2022 Investments of EUR 10 billion until 2022 into electric vehicles
Ford	<ul style="list-style-type: none"> 13 new electric car models by 2020
Honda	<ul style="list-style-type: none"> Electric vehicle sales = two thirds of sales by 2030
Renault-Nissan	<ul style="list-style-type: none"> 1.5 million electric car sales by 2020 Investments of EUR 4 billion into electric cars as announced in 2009
Tesla	<ul style="list-style-type: none"> 500,000 electric vehicle sales by 2018 1 million electric vehicle sales by 2020
Volkswagen	<ul style="list-style-type: none"> 2-3 million electric car sales by 2025 with 30 new battery-powered car models, which would correspond to 25 percent of vehicle production Investments of EUR 9 billion until 2022 into EV
Volvo (Geely Group)	<ul style="list-style-type: none"> 1 million electric car sales by 2025 No new cars without an electric motor from 2019 on

2017 Total New Vehicle Sales (millions)



Potential Economic Development Benefit to Imperial County



All Dollars are in US\$'000

Construction Employment

Construction Period	48 Months
Peak monthly employment	730 workers
Average monthly employment	230 workers

Full Time Employment

Operations	220
Maintenance	130
Management & Administration	50
	400 Employees

Construction Expenditure

Engineering	\$108,000
Procurement	\$918,000
Construction Management	\$72,000
Construction (Disciplines)	\$702,000
	<u>\$1,800,000</u>

Contractor Expenditure

\$18,000 per year

Lease Holder Royalties

\$4,500 per year

Imperial County Taxes

\$20,000 per year

Cost of Production

Annual Cost of Capital (20%)	\$ 360,000
Annual Operating Expense (\$4000 / t)	\$ 360,000
	<u>\$ 720,000</u>

Annual Revenue

vs (90,000 t x \$10,000 per tonne)
\$ 900,000

Project
Value
Proposition



 **BHE**
RENEWABLES
A Berkshire Hathaway Energy Business