

Direct Lithium Extraction

PEP Review 2026-03

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Glossary

\$/t	Dollars per metric ton
Ad	Adsorption
AOGC	Arkansas Oil and Gas Commission
atm	Atmosphere(s)
Bcm	Billion cubic meters
BHE	Berkshire Hathaway Energy Renewables
BFD	Block flow diagram
BLI	Battery limits investment
BOP	Balance of plant
Btu	British thermal unit(s)
CAGR	Compound annual growth rate
capex	Capital expenditure
cP	Centipoise
cf/ft ³	Cubic feet
CIP	Clean in place
CLP	Central lithium plant
CPF	Central processing facility
CTR	Controlled Thermal Resources
DFS	Definitive feasibility studies
DLE	Direct lithium extraction
DLS	Direct lithium sorption
DOE	Department of Energy
ESS	Electric storage systems
EV	Electric vehicles
FO	Forward osmosis
g	Gram(s)
gpm	Gallons per minute
GWh	Gigawatt-hour(s)
h	Hour(s)
HPRO	High-pressure reverse osmosis
IEA	International Energy Agency
iFO	Industrial forward osmosis
IX	Ion exchange
IXM	Ion-exchange media
JV	Joint venture
kg	Kilogram(s)
kg/m ³	Kilograms per cubic meter
kJ	Kilojoules
kPa	Kilopascals
KTPA	Kilotons per annum
KTS	Koch Technology Solutions
LADH	Lithium-aluminum layered double hydroxides
LCE	Lithium carbonate equivalent
LHM	Lithium hydroxide monohydrate
LIBs	Lithium-ion batteries
LPRO	Low-pressure reverse osmosis
LSS	Lithium selective sorption
mΩ·cm	Milliohm-centimeters
mg/L	Milligrams per liter
Mgal	Thousand gallons
Mlb	Thousand pounds
Mscf	Thousand standard cubic feet
MMgal	Million gallons
MMt	Million metric tons
MMt/y	Million metric tons per year

Mt	Thousand metric tons
mol%	Molar percent
mPa	Megapascals
NF	Nanofilters
NPV	Net present value
OARO	Osmotically assisted reverse osmosis
opex	Operating expenditure
ORP	Oxidation-reduction potential
PFD	Process flow diagram
PEA	Preliminary economic assessment
ppb	Parts per billion
ppm	Parts per million
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
RO	Reverse osmosis
ROI	Return on investment
s	Second(s)
scf	Standard cubic feet
scm	Standard cubic meter(s)
SWA	Southwest Arkansas Project
SX	Solvent extraction
t	Metric ton(s)
TBP	Tributyl phosphate
TDS	Total dissolved solids
t/y	Metric tons per year
TFC	Total fixed capital
TRL	Technology readiness level
TWh	Terawatt-hour(s)
URBVF	Upper Rhine Valley Brine Field
USGS	United States Geological Survey
vol%	Volume percent
w/w	Weight for weight

Abstract

Lithium use, for lithium-ion batteries, is skyrocketing as the need for electric vehicles (EVs) and energy storage systems increases. Continued increase in demand makes it impossible to meet future demand via traditional lithium extraction methods using lithium ore and Salar brines in South America.

As a result, the industry and universities are pursuing technologies related to direct lithium extraction from multiple brine resources. This review examines multiple direct lithium extraction (DLE) technologies that are in early stages of commercialization, and new technologies being developed.

Apart from industry status and technology review, the review examines process economics of a sample DLE plant. It includes material balance, PFDs, and sized equipment list, along with variable costs, capital expenditure (capex), operating expenditure (opex), and overall production costs.

The economic evaluation presented by the Process Economics Program (PEP) is an independent interpretation of the commercial process based on information presented in open literature and discussions with several individuals. While this assessment may not reflect the actual plant data fully, we do believe that these sources are sufficient to represent the process and process economics within the range of accuracy necessary for economic evaluation of a conceptual process design.

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