



PACT RENEWABLES - TECHNOLOGY BASED SOLUTIONS TO REDUCE FOOTPRINT OF BRINE LITHIUM MINING PROJECTS

Overview of technology platform and applications to addressing environmental, operational and brine management challenges in brine lithium mining

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Introduction

Pact Renewables is the developer and proprietary owner of several technology platforms, that have undergone extensive development and improvements for application to a wide range of saline water and wastewater streams, including lithium-containing brine resources (continental, geothermal, and oilfield), and brine waste generated from existing and developing lithium extraction and refining processes. The Company is offering its proprietary technologies and advisory services, the latter drawing from in-house expertise developed over 30 years in dealing with various streams of saline water and wastewater generated by industries, seeking sustainable waste management solutions.

Challenges facing brine lithium mining industry

The lithium mining industry, particularly the sector related to lithium extraction from brine resources, is currently experiencing significant upside growth. Despite this, the brine lithium mining sector faces several environmental, operational, and waste management challenges, including:

- Improving the recovery rate of lithium from brine resources by controlling the quality and flow rate of the feed solution, whilst reducing landfilling requirements of solid and liquid waste streams.
- Recovery of mineral products from brine processing steps to generate additional revenue, whilst reducing volume of spent brine returned to evaporations ponds, to aquifers via reinjection wells, or landfilling of the solid waste and brine residues.
- Developing integrated process systems to support implementation of sustainable site/project-specific brine management schemes.

Technologies behind our brine treatment solutions

Our technologies (described below) collectively provide an enabling platform for reduction of brine volume and salt load through product recovery and water reclamation, allowing a reduction in operational and environmental footprint in industries including mining, energy generation, food production, desalination, and waste management. More information is available at www.pactrenewables.com/our-technologies

Salpro technology recovers commercial grade mineral and chemical compounds from various saline streams, using conventional process equipment, wherein the dissolved elements are extracted via sequential or selective precipitation, flocculation, and crystallisation, producing useful compounds in slurry, crystalline, and liquid forms. Closed processing and fluid flow circuits enable the saline stream to be exhaustively consumed, allowing saline effluent to be totally removed from the water cycle. Fixed or modular plant layouts enable technology deployment tailored to scale, specifications and configuration and operated in linkage with a wide variety of other processes.

Technologies (cont'd)

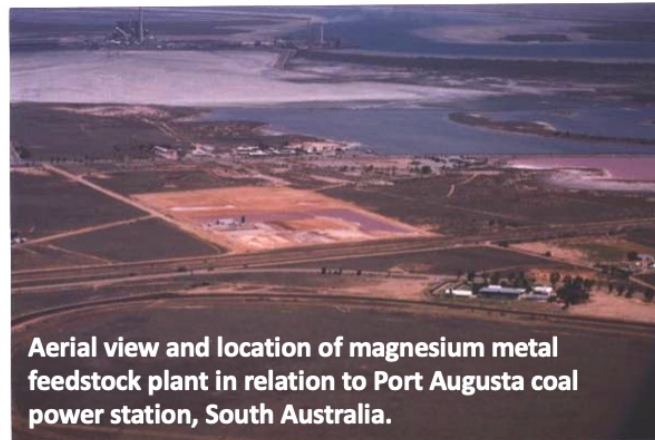
Example of Salpro technology applications



1996-99, Port Augusta, Australia:

A zero liquid discharge (ZLD) project accomplished for Takata Corporation of Japan, through staged feasibility studies and pilot scale production of a high purity feedstock for magnesium metal production and byproducts. Source brine was from cooling water system of Philip Playford coal-fired power station fed from seawater. A fixed 23,000 tpa salt load removal capacity plant was successfully accomplished, leading to licensing of Salpro technology.

High grade product in one tonne bulker bags ready to leave Port Augusta plant, destined for overseas production of magnesium metal.



Aerial view and location of magnesium metal feedstock plant in relation to Port Augusta coal power station, South Australia.

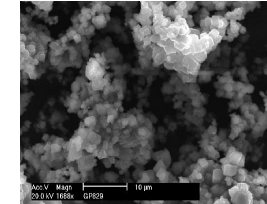


An independent evaluation in 2006 by the U.S. Bureau of Reclamation (CASS Report, 2006), comparing various technologies for saline water treatment, ranked Salpro as the best-fit zero liquid discharge (ZLD) brine solution at the time, in terms of technical and operational feasibility, environmental acceptability and economic potential.

Technologies (cont'd)

Synpotash is a sustainable technology for production of high-value, high demand variable solubility potash fertilisers and potash compounds for manufacturing alkaline-based fuel cell batteries using a variety of potassium containing brine streams, using a proprietary mineral conversion process and conventional processing equipment. The most recent project completed under contract to Ragn-Sells AB, Sweden, involved Synpotash technology optimisation for treatment of saline leachates from flyash of European waste-to-energy plants to produce fertiliser quality potash salts. Following extensive on-site piloting and detailed feasibilities studies, a large commercial production facility was inaugurated in 2023, near Sollentuna in Sweden.

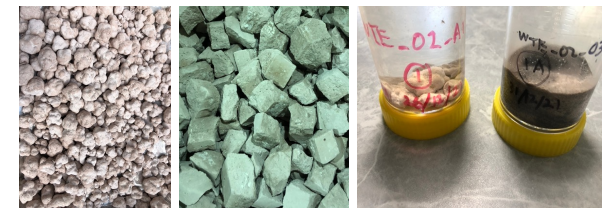
Climedec is a unique sustainable technology for management of hard-to-abate waste streams (including solid waste and bittern residues) via encapsulation methods using proprietary mineral-based composites (MBC), with precursor minerals mostly obtainable from treating saline water and waste brines. Encapsulation of various waste streams can be via aggregation or granulation processes, prior to safe landfilling of encapsulated material in mono-fills or regulated landfills.



Technical grade sulphate of potash (SOP) product from treatment of a saltlake brine in Synpotash process. Currently reported weighted average market prices: >US\$580/ton.

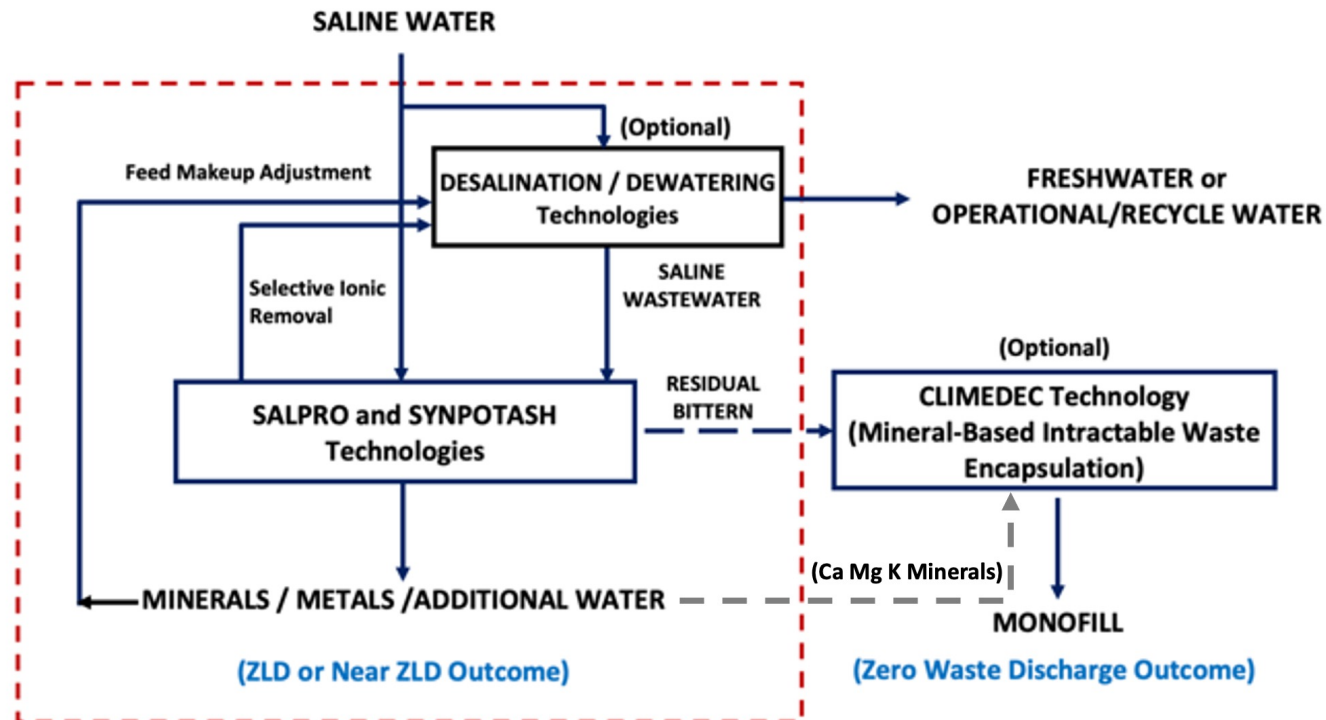


Field trial of MBC composites as a sustainable alternative media for pond and landfill lining.

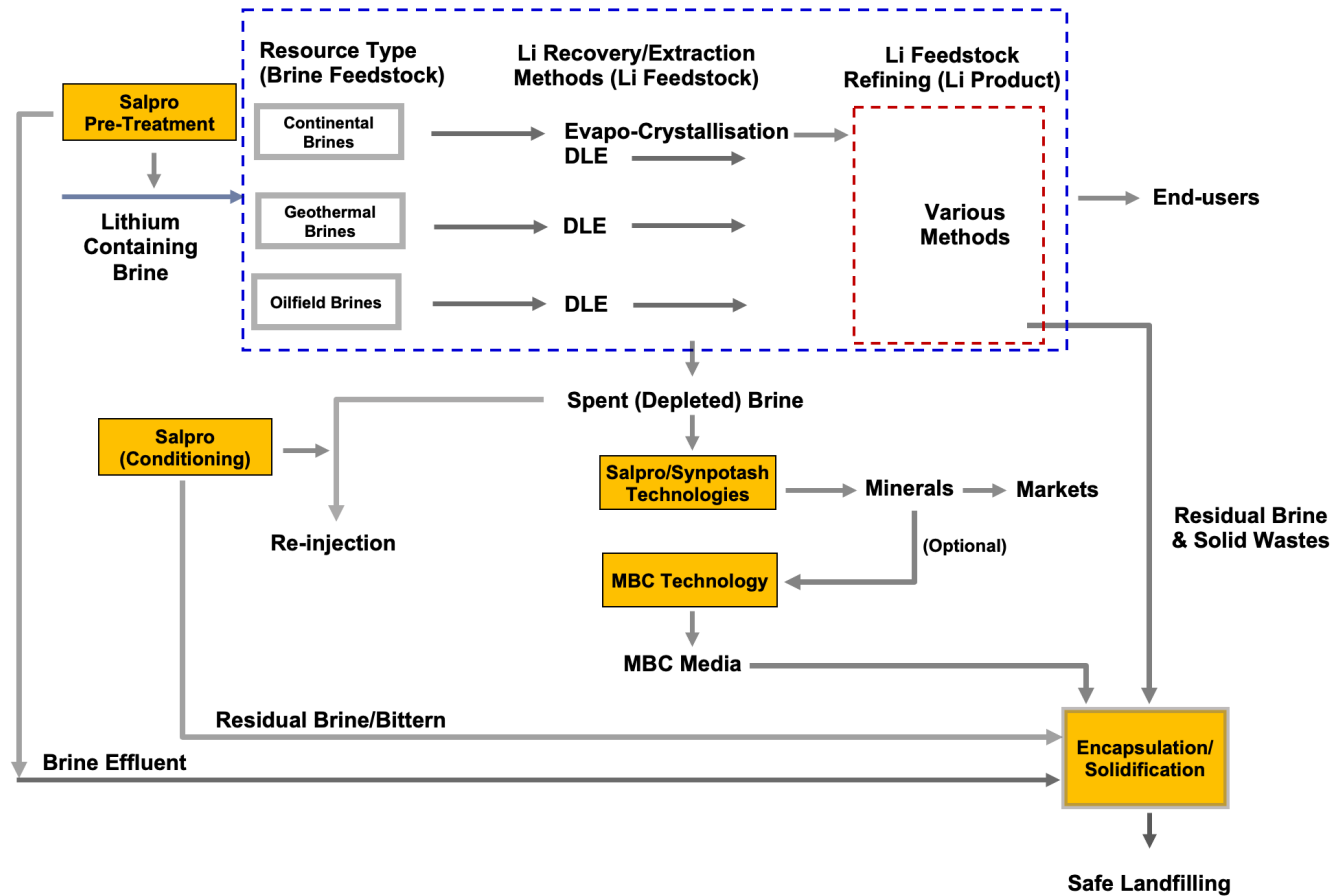


Hazardous waste streams (solid and liquid) from various industrial sources, encapsulated in granular and aggregate forms, using MBC formulations, have been subjected to long-term performance evaluations for integrity, strength and leachability of the encapsulated material.

How our technologies work together to minimise brine waste through recovery of values and safe disposal of intractable waste



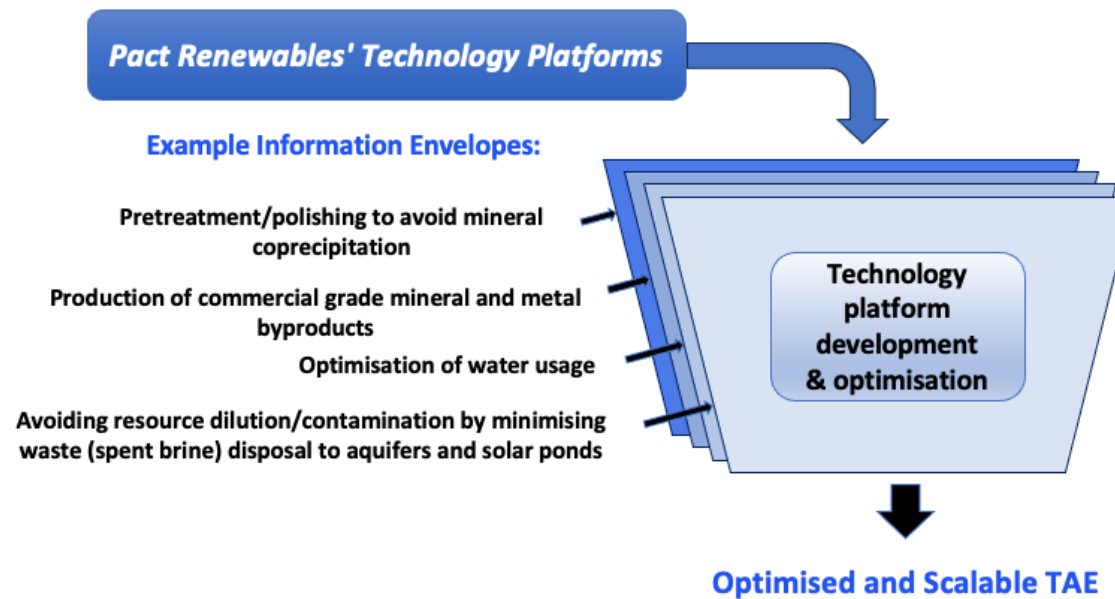
Schematics of our solutions to support sustainable lithium recovery from brine resources



Developing and optimising a technology applicability envelope (TAE) for brine lithium extraction and refining

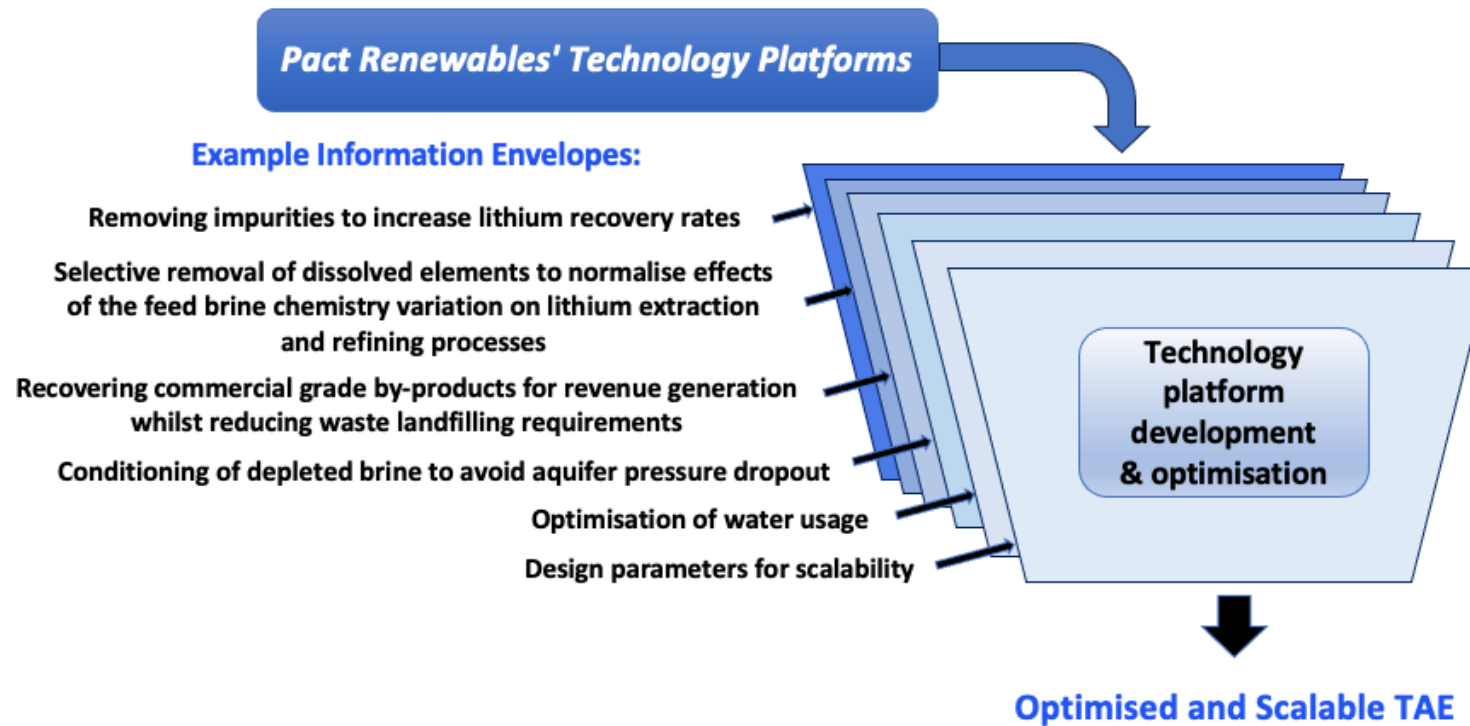
Brine processing for lithium extraction and refining is not completed until a pure solid product is obtained. Our TAE solution, once optimised, provides integrated information sets (envelopes) to assist lithium project developers to achieve their desired outcomes.

Conventional lithium recovery from continental brines



Developing and optimising a technology applicability envelope (TAE) for brine lithium extraction and refining (cont'd)

Lithium recovery from geothermal and oilfield brines using DLE technologies



Examples of applications of minerals and compounds recovered from processing of lithium containing brines and spent brines using Salpro and Synpotash technologies

- De-icing, dry ice production, and thermal/chemical energy storage
- Mining, mineral, and metal processing
- Separation of metal contaminants, such as manganese and zinc, by flocculation
- Stack gas scrubbing
- Water and wastewater treatment
- Odour control in sewerage/sanitary sewer systems
- Neutralisation and corrosion control
- Metal finishing
- Pharmaceuticals and nutrition
- Rubber and plastics production
- Lubricant and fuel additive
- Refractories, ceramics, glass, and foundries
- Specialty pulp and paper manufacturing
- Agriculture and stockfeed
- Speciality cements
- Chemical intermediates
- Heating and cooling
- Magnesium metal and hydrides production
- Fire flame retardation
- Light-weight building material
- Separation of rare earth elements from brine resources
- Control of chemical/acid spills
- Acidic vapour suppression
- Textile and leather treatment
- Mineral-based composites for wide ranging industrial and environmental applications

The quality of several products recovered previously from various saline streams, using Salpro and Synpotash technologies, have been verified through pilot production runs and certified independently, with detailed process flowsheets available for their use in expediting new projects.

Technology advantages

- Salpro technology has been proven and licensed through piloting up to 23 ktpa salt load reduction capacity
- Technology platform backed by many patents and patents pending
- Reduction of risk of well head pressure loss
- Scalable through modular design and compatible with proposed DLE processes and operations
- Increased lithium recovery efficiency of the total system
- Utilised as a shared facility
- Beneficial reuse of refinery waste by-products (mixed salts)
- Technologies to leverage proposed DLE process to achieve the desired operations and cost efficiency objectives of both technology providers and end-users
- Polishing of feed brine to improve efficiency of lithium hydroxide recovery in DLE processes
- Pre-treatment of spent brine to avoid blockage of injection wells by incongruent formation of diagenetic minerals
- Treatment of wash water from reagent washing to minimise reinjection and therefore brine contamination potential
- Robust process and product flowsheets available for process and major mineral products from most reported brine types, to enable expediting lithium projects.

Key benefits to brine lithium project developers

- Significant footprint reduction and increased sustainability of brine lithium extraction projects
- Growing profitability through production and sale of mineral products whilst reducing the need for landfilling
- Taking advantage of leveraged cost of operation against fluctuations in lithium prices
- Increased lithium productivity
- Permanent solution for safe land disposal of intractable waste
- Technology-based solutions that are compatible with local, state, and national regulatory guidelines
- Generated site-specific IP and optimised TAE will be owned by the client
- Readiness in addressing future project risks such as carbon border adjustment mechanisms for lithium exporters

About Pact Renewables

- A privately owned cleantech company, established in 2011, and led by Dr Aharon Arakel with a business focus on providing industry with best fit technology-based saline waste minimisation and nature-tech solutions
- Deep knowledge of scientific, technical, and environmental aspects related to saline water and wastewater processing
- Industrial and environment solutions that are driven by technology platforms developed by Dr Aharon Arakel and his team
- Granted its first Salpro patent entitled “Saline water and wastewater processing” (Arakel, 1993)
- Arakel was co-founder and chief technologist of an Australian salt lake SOP (sulphate of potash) exploration and development company which was vended to an ASX listed company in mid 2010s
- Was selected as a “Top Innovator” at 2023 World Economic Forum, and became a member of World Economic Forum’s Toplink Platform
- Follows a fundamental approach based on waste footprint reduction through recovery of values which may also include generation of carbon credits
- Holds unique expertise and project delivery capabilities ,with teams comprised of technologists, scientists, engineers, specialist consultants, equipment suppliers, EPCM providers, and product offtakers
- Collaborates with universities and experts in water and processing engineering
- Uses in-house specialised testing facilities and has access to a NATA registered testing laboratory.

Some of the organisations assisted by Dr. Arakel and his team



Our approach to developing and optimising technology applicability envelopes (TAE)

- Lithium extraction technologies need to be tailored to each brine resource and based on our experience from providing industry with fit-for-purpose technology-based brine management solutions, we propose undertaking an integrated techno-economic and lifecycle assessment (LCA) in the form of feasibility assessments. This may commence with a scoping study, as the first step towards developing and optimising a technology applicability envelope (TAE).
- The scoping study (which may include limited laboratory test work, if necessary) will provide a high-level evaluation of the technically possible processing options, potential product streams, and a high-level definition of TAE input parameters.
- Subject to satisfactory outcomes, the follow up evaluations will include development of TAE, detailed feasibility assessments of selected treatment scenarios, product markets, and sensitivity and risk analyses.
- Following presentation/discussion of the results, the generated information will be applied to optimisation of TAE prior to preparation and submission of a final report, incorporating the outcomes from detailed integrated techno-economic and life cycle cost assessments, for commercial decision making.

Value proposition to brine lithium project proponents and their technology providers

- Deep knowledge of geoscientific and technical aspects of treatment technologies for extraction of lithium from continental, geothermal, and oilfield brine resources, and the current and proposed methods for disposal of spent brine and solid/liquid waste.
- A focus on technological solutions and the fundamentals of reducing footprint of present and future brine lithium mining projects via product recovery, for offsetting costs associated with waste disposal and brine polishing, and for reducing process and operational risks associated with brine lithium extraction and refining projects.
- Worldwide experience, past performance, technology reputation, knowledge of product markets and dynamics.
- Availability of robust flowsheets for Salpro and Synpotash processes and products, and modular plant design packages, for reducing risks associated with technology ramp up, reducing costs, and fast-tracking project approvals for commercial rollout.

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