CEGA
CENTRO DE EXCELENCIA EN GEOTERMIA DE LOS ANDES

Fraunhofer CHILE

KIT
Karlsruher Institut für Technologie

Fraunhofer ISE

GTN LA
INGENIERÍA & GEOLOGÍA

GTN

SolarSpring membrane solutions

BrineMine
Project Overview

Bundesministerium für Bildung und Forschung

Consortium

Bundesministerium für Bildung und Forschung

German Consortium

1. KIT Institute of Applied Geosciences – Department of Geothermal Research
2. Frauhofer Institute for Solar Energy Systems
3. SolarSpring GmbH, Freiburg/Germany
4. GTN Geothermie Neubrandenburg GmbH

Chilean Consortium

1. CEGA – CENTRO DE EXCELENCIA EN GEOTERMIA DE LOS ANDES
2. Fraunhofer CSET - Center for Solar Energy Technologies - Fraunhofer Chile Research
3. GTN LA – GTN Latin America
4. TRANSMARK

Fraunhofer ISE

Project Funding

Bilateral Project funding scheme

“BMBF CLENT II”

- German partners are financed by BMBF

- Chilean partners are usually financed by CORFO or CONICYT

BrineMine is actually not funded in Chile but financed by in-house efforts of the partners

Motivation and Background

Geothermal brines often contain a high amount of valuable minerals (e.g. lithium, fluoride, wolfram, potassium, borate, gold, silver,…)

- A short literature study shows sources with e.g. magnesium content > 0,5 g/l, potassium content > 1,7 g/l, borate content > 0,1 g/l or lithium concentration > 0,6 g/l….
- Present water analysis are incomplete and many other potential valuable metals have not been analyzed in the geothermal brines up to now
- Increasing difficulties for the implementation of conventional mining projects require new innovative approaches

Motivation and Background

Water shortage is an pressing issue in different parts of Chile

- Fresh water is required for domestic use and irrigation
- Mining and the processing of mining products needs huge amounts of water
- Desalination is used to produce fresh water but needs huge amounts of energy ~3.5 to 5 (kWh/m³) plus pumping
- The utilization of geothermal heat for fresh water production is sustainable and autonomously possible on site

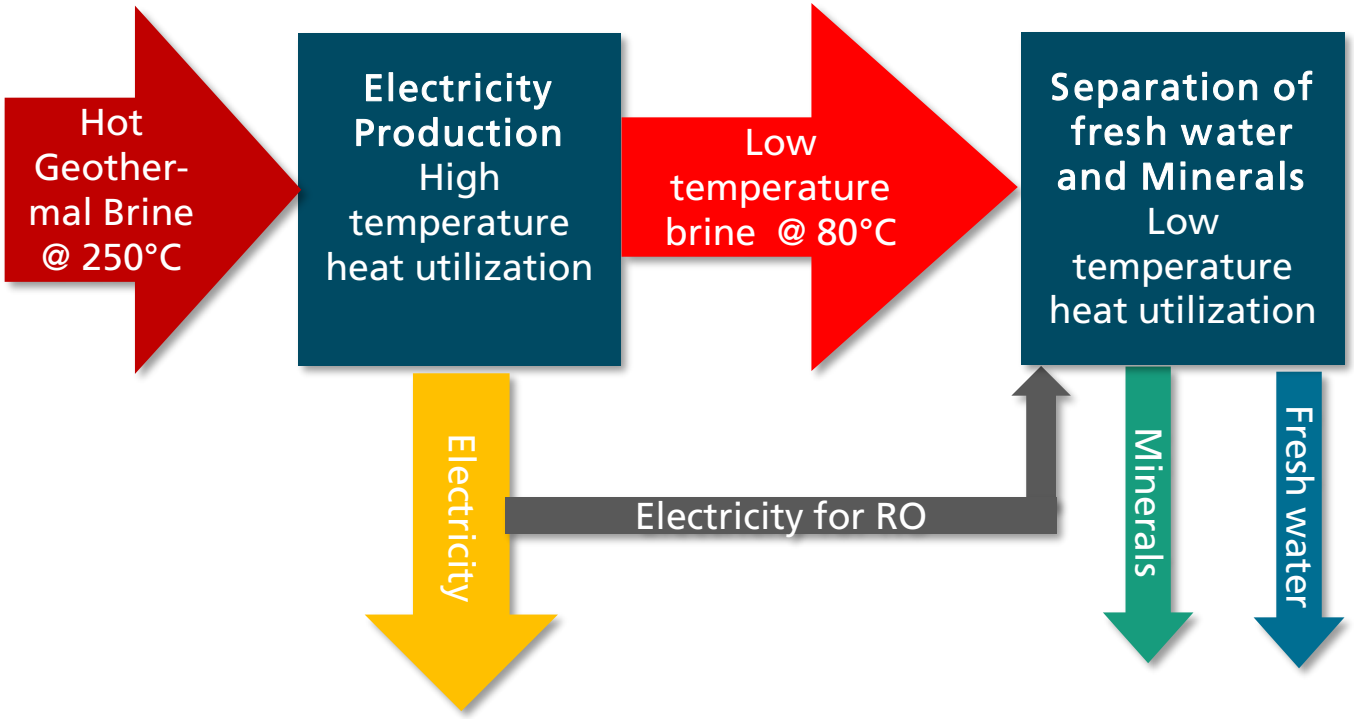
Main Objectives of the Project

The main objectives of the BrineMine project are:

- To conduct an accurate survey including mapping of minerals and geothermal resources in Chile and assess business models for exploitation
- To develop, construct and test a process consisting of different separation technologies including membrane process, which will be able to recover minerals and metals as well as fresh water from geothermal brines.
- To encourage and foster a reliable interdisciplinary and transnational research cooperation between Chile and Germany

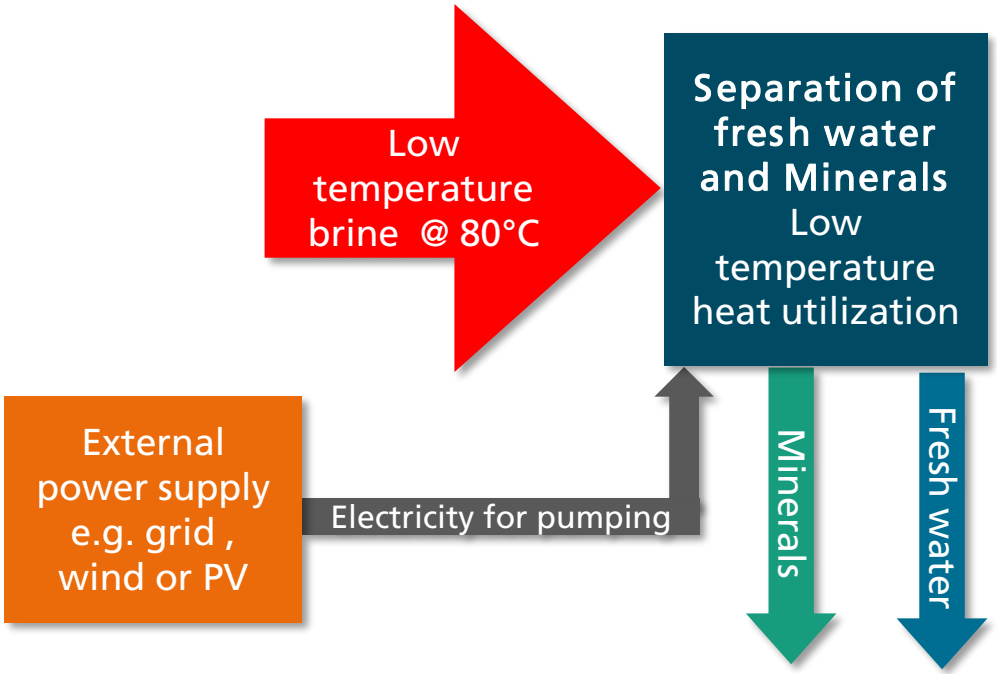
Technical Approach

Principal idea for the deployment of the BrineMine system in conjunction with **a geothermal power plant**



Technical Approach

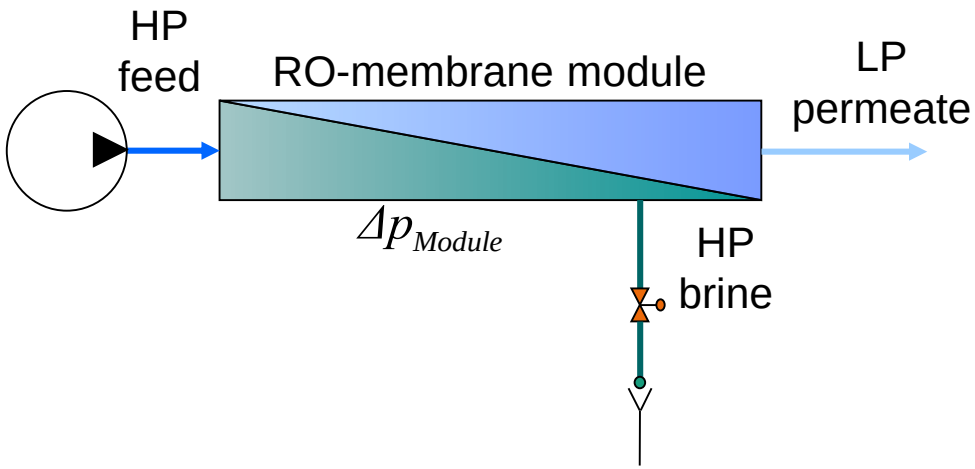
Principal idea for the deployment of the BrineMine system in conjunction with **low grade geothermal sources**



Reverse Osmosis:
A Pressure Driven Separation Process

Principal of RO

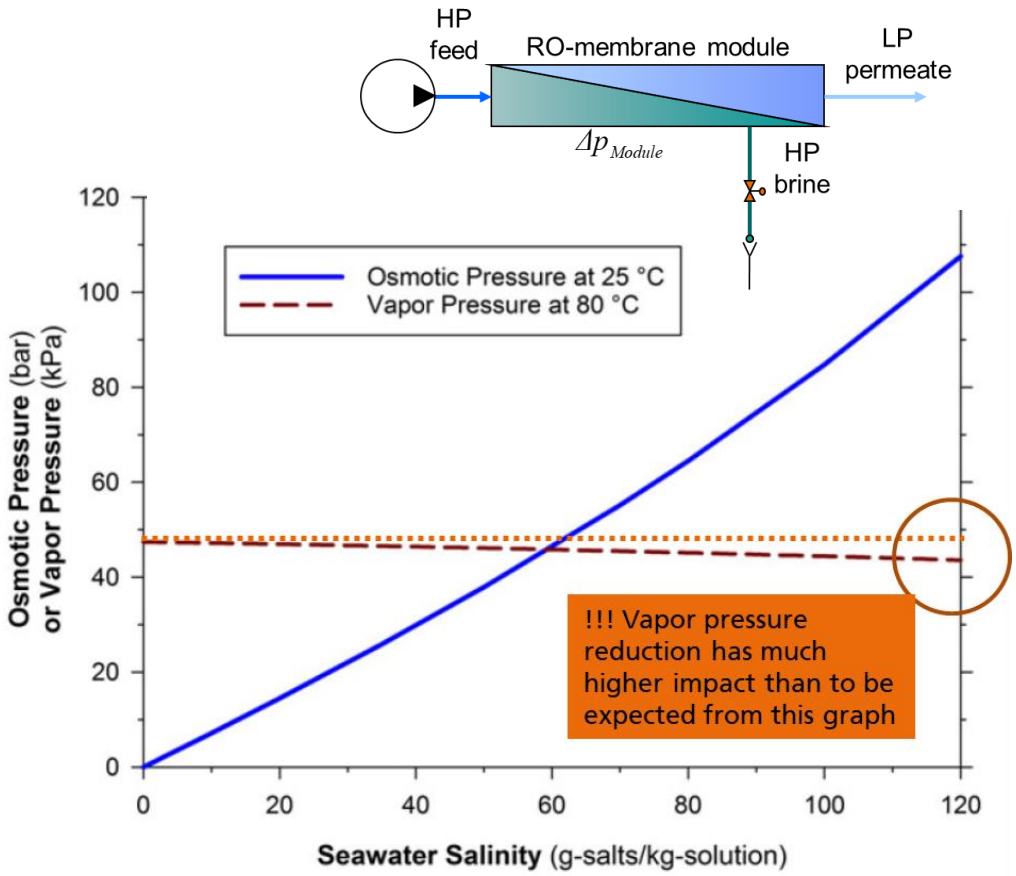
Reverse **O**smosis is a pressure driven membrane separation process.



Reverse Osmosis:
A Pressure Driven Separation Process

Principal of RO

Reverse **O**smosis is a pressure driven mebrane separation process.
The required operation pressure and associated energy demand is almost proportional to the osmotic pressure and salt content respectively.



Brine treatment needs extremely high pressure!
Therefore usually thermal distillation is applied

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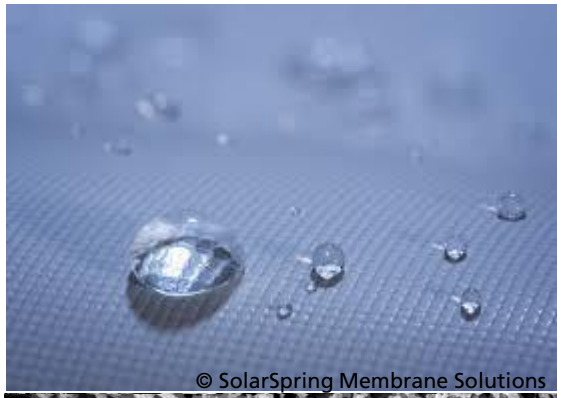
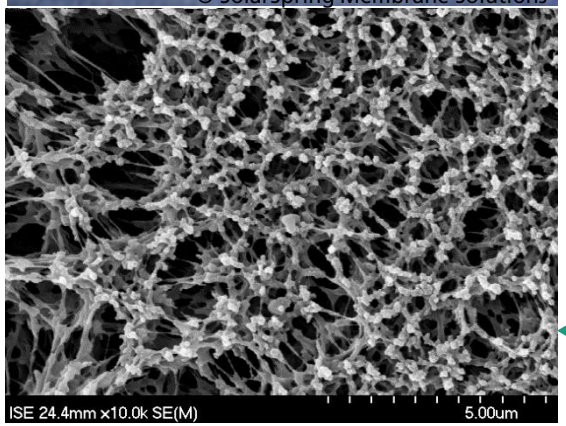
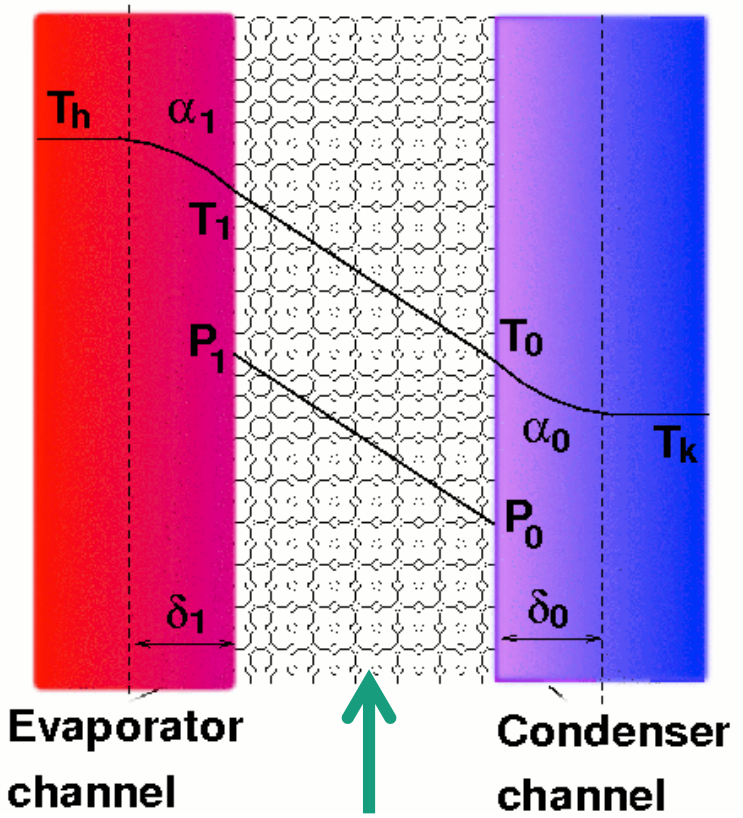
Membrane Distillation:
A Thermal Evaporation Process







Hydrophobic, micro-porous membrane, pore diameter 0.1-0.4µm (PVDF, PTFE, …)

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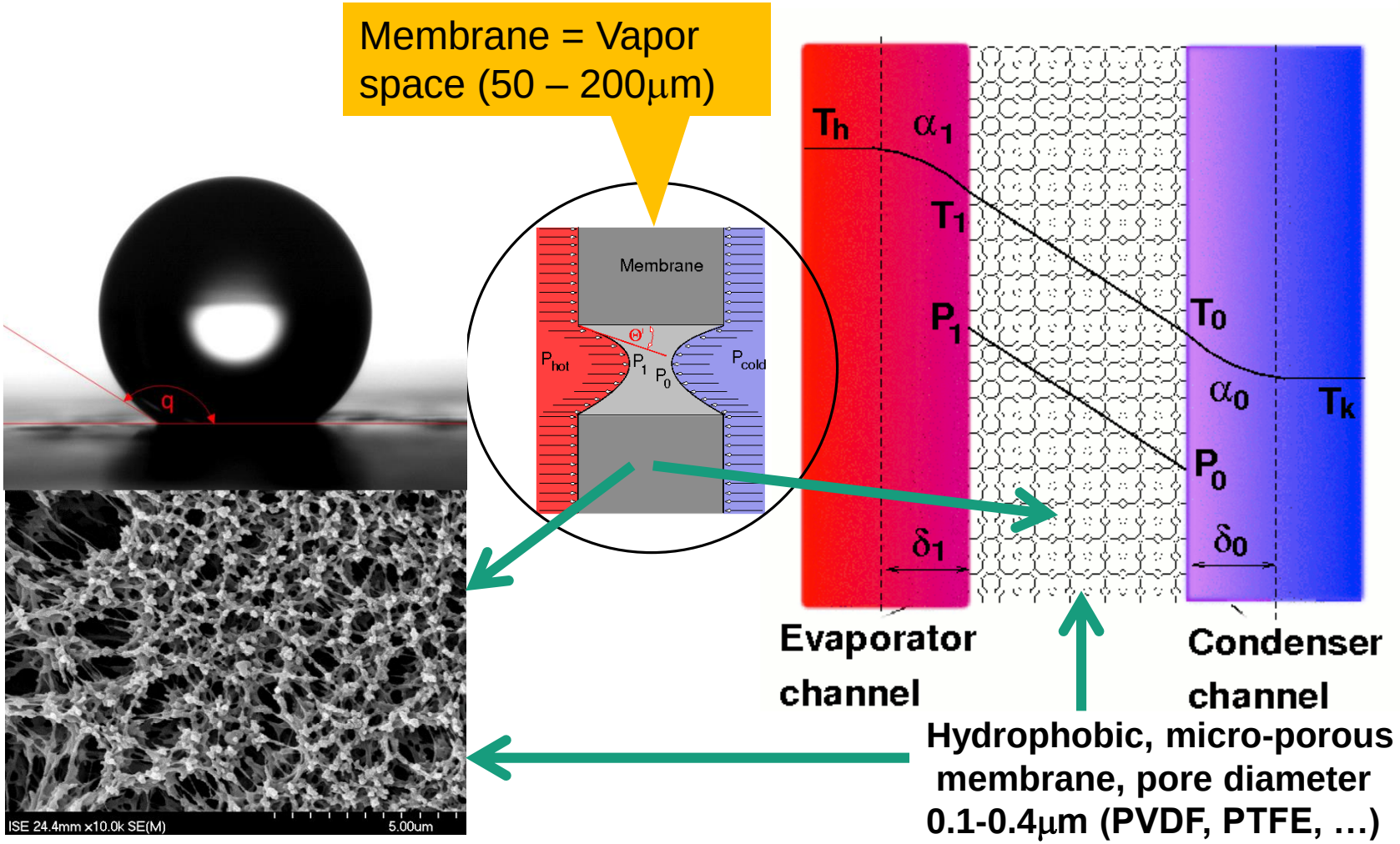
Membrane Distillation: A Thermal Evaporation Process



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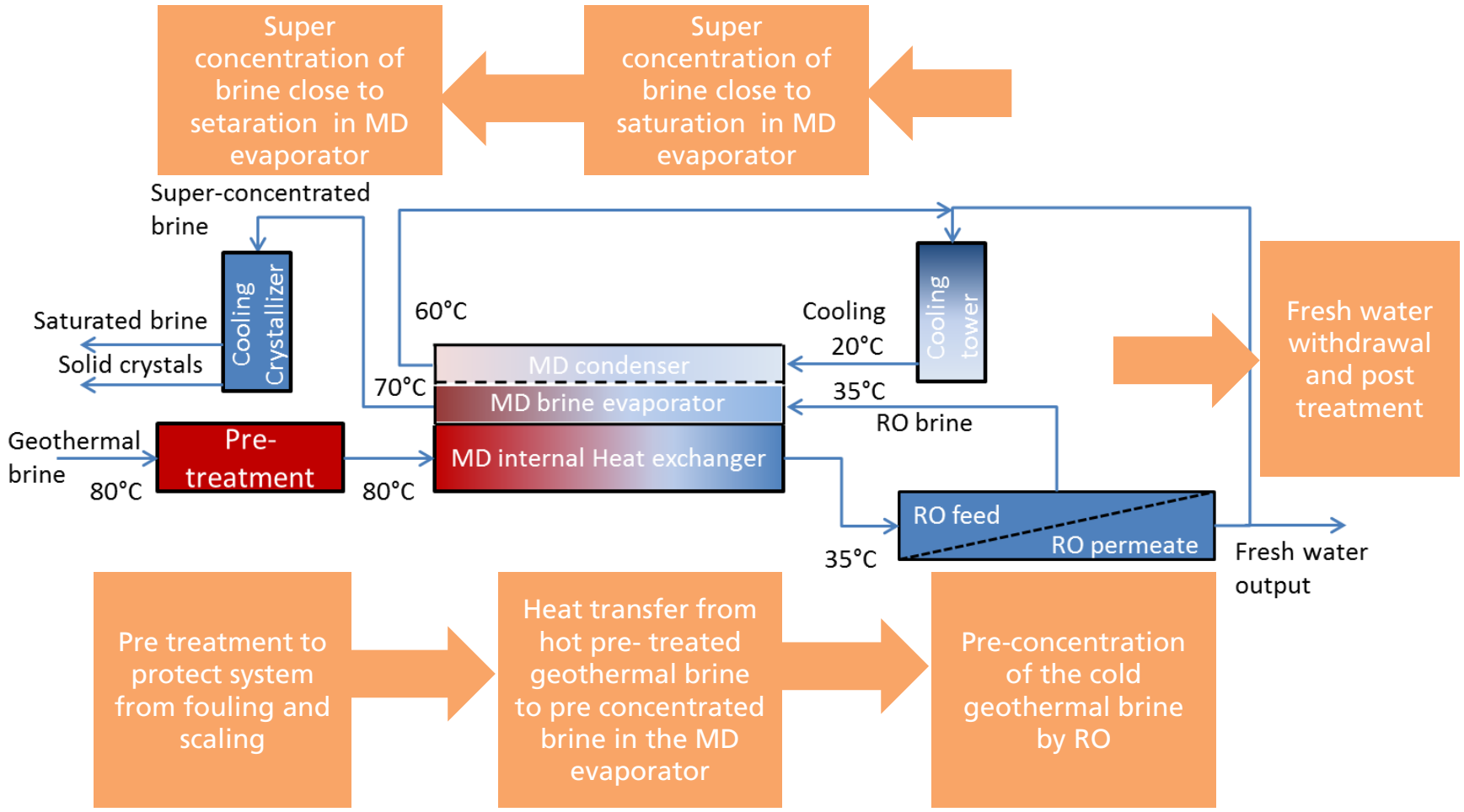
Anticipated Process Layout

The combined process investigated in the BrineMine project



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Scope of the Project

The research focus

- Pre-treatment must be developed with respect to particular geothermal brine condition (Temperature reduction and concentration may lead to crystallization in membrane modules…)
- Set up and operation methods for the RO System and MD evaporator will be developed and investigated
- A method and device for selective crystallization of relevant metals an minerals will be developed and investigated

Scope of the Project

Challenges

- Scaling problem is not trivial to be solved (Silica scaling in particular…)
- Long term reliability of membranes must be confirmed
- Selective crystallization of components with similar solubility will be challenging
- Economic validity of the concept will depend very much on the minerals that can be selected and on process costs

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Thank you for your attention!

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