“Water desalination by freezing out”

-Fresh water and minerals out of mining water-

Water treatment of mining water for further water supply

on May 21st, 2025 by José Gomes,
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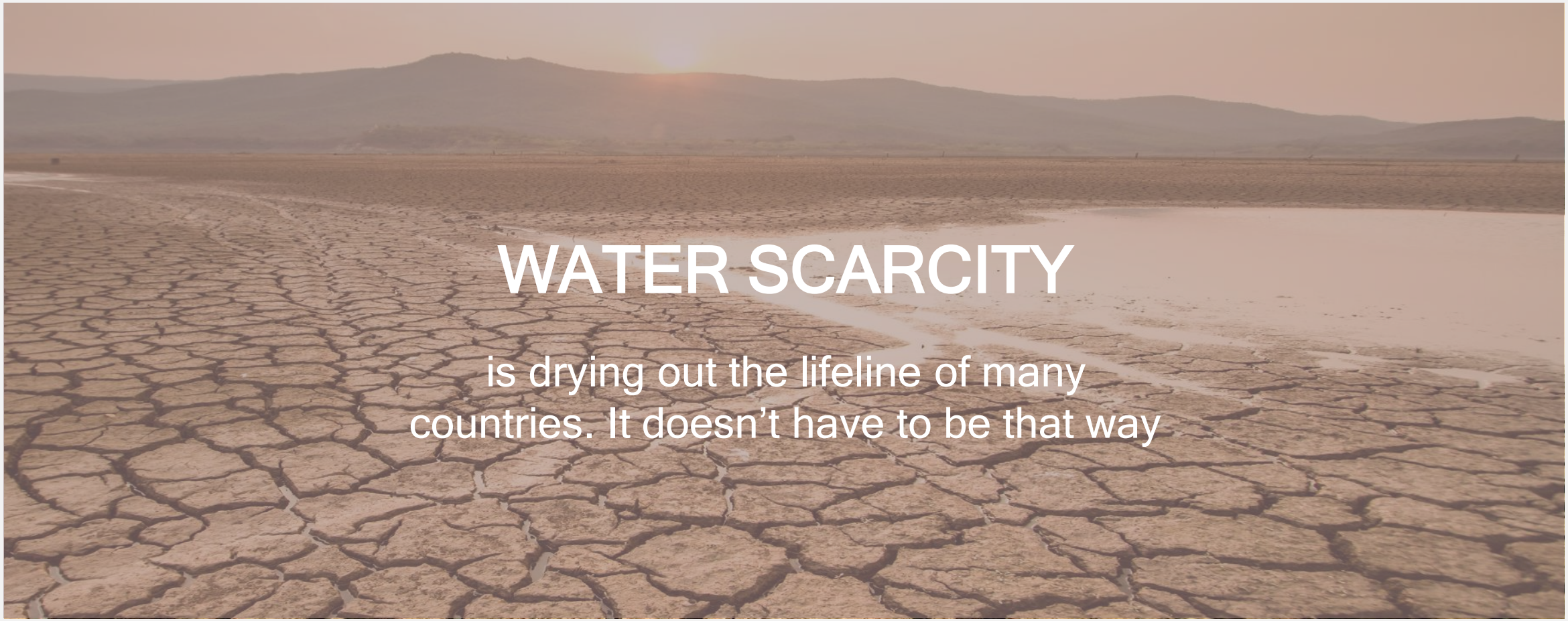
The challenge is today



A holistic solution with a modular approach

1

Affordable energy:
wind and solar sources and a residual gas power production to cover minimum power demands

2

Desalination:
Cheap freshwater and minerals out of seawater or salted ground water

4

Synfuel production:
Biomass waste to produce „green“ fuel gases

3

Creating arable land:
Fresh Water is the key to overcome water scarcity

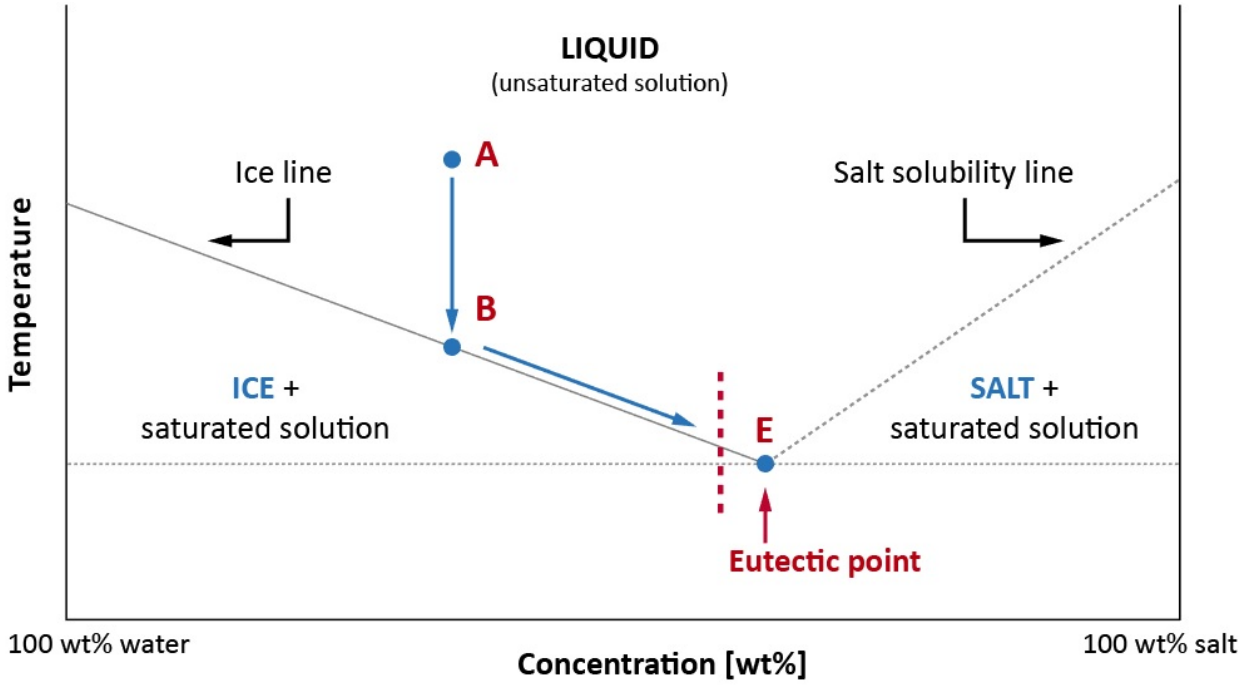
Desalination: „Reverse Osmosis“ or „Freezing out“?

- Reverse Osmosis (RO) is a well known and proven technology to produce freshwater and a concentrated brine.
- The energy needs for RO are only in the range of 3-4 kWh/m^3 of very pure potable water, but the system is quite expensive and at least 40 % of the feed (mostly sea water) ends as hypersaline brine.
- However there is a cheaper system than RO, but with higher energy consumption of appr . 6 kWh/m^3.
- Further on, this approach can also be used to crystallize the minerals in a sorted way, one by one at its eutectic temperature.

„Freezing out“ of fresh water – cheap and simple

„Freezing“ – requires only less than 15 % of the energy needed for evaporation

1. After a simple but customized cleaning, filtering and neutralisation of the feed water, the freezing starts at appr. -2°C by crystallizing fresh water out of salt water.
2. Now, along the „ice line“, pure water crystallizes to ice which will float and can be removed continously. The remaining brine becomes more concentrated in the process.
3. At their individual eutectic temperatures salts will precipitate at the same time. It starts with carbonates and sodium sulfate at appr. -2°C, then potassium chloride will follow at appr. -13°C and finally sodium chloride at -22°C.
4. The salts can be collected at their related temperatures from the bottom of the relaited vessel.



Freeze Concentration with **E**utectic **F**reeze **C**rystallization (EFC)

What are the technical obstacles?

- Freezing salted water is not a rocket science!
- But we need floating ice slurry that can be removed, pressed and eventually washed and dried up.
- Salt slurry has also to be removed from the bottom of the containing vessel and then washed with the related saturated salt solution.
- Overall electrical energy consumption:
  - Appr. 6 – 20 kWh/m^3 of fresh water, depending on the freezing temperature.
  - Appr. 20 kWh per m^3 of feed at the Eutectic Point of sodium chloride.
- Our unique selling point: Our cooling is done via vacuum cooling and injection of liquid propane as coolant. We don't require the cooling of the container walls, but pressurized vessels of up to 500 kPa (5 bar).

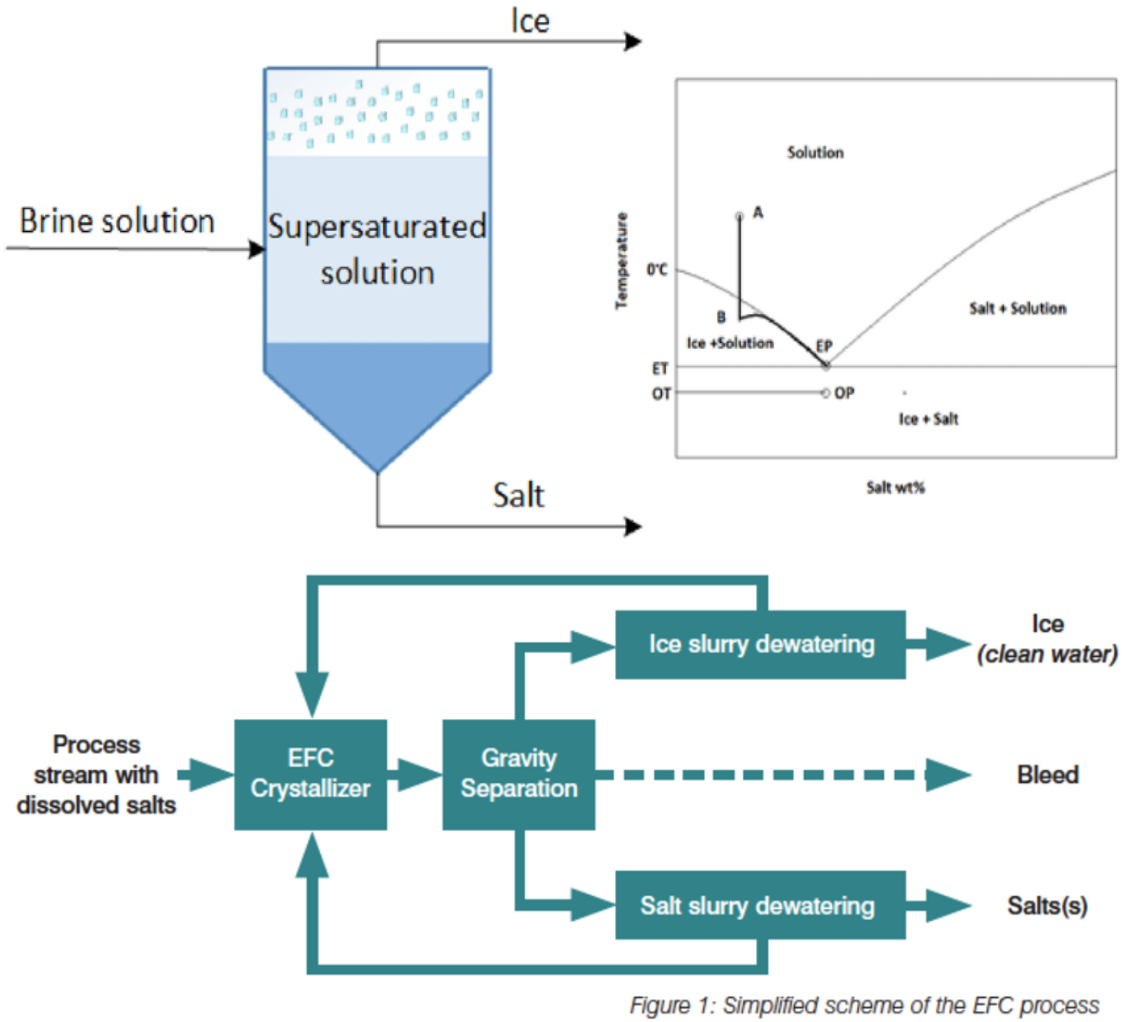


Figure 1: Simplified scheme of the EFC process

Our references

mobile R/O desalination plants

Identifying well fields for emergency ground water supply and installing mobile R/O desalination plants

Doha, Qatar – 2013 – 2018

MARE NOSTRUM: our references

utility-scale solar energy market

Market study on the solar energy market in Tunisia, developing business models for utility-scale solar projects.

Tunisia – 2018 -2019

MARE NOSTRUM: Our references

strategic water storage & recovery

Underground strategic freshwater storage after desalination

Abu Dhabi, UAE – since 2008

Potable water aquifer storage & recovery scheme (ASR)

Basic & Detail engineering for the ASR scheme incl. Injection/ recovery wells, transmission and distribution pipelines, water reservoirs & operations.

Dubai, UAE – 2017 -2022

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