Project “Brine-to-Value” in Chile

Valorization of Reject Brine to Enhance Ecological and Economic Process Sustainability

The challenge

Hydrogen (H_2) can be generated from water through electrolysis, a process that breaks down water molecules into hydrogen and oxygen. The hydrogen produced can be stored or used as a raw material or energy vector. When the energy for electrolysis comes from renewable sources such as wind or solar power, the hydrogen is termed *green hydrogen* due to the significant reduction in carbon emissions for its production.

Although electrolysis requires pure water, various water sources can be utilised if they undergo appropriate treatment. Desalination of seawater is an attractive technology in this context, as it addresses water demand in regions with water scarcity. This is particularly relevant in areas with high potential for economically producing green hydrogen due to abundant solar radiation yet facing water challenges.

It is estimated that about 85% of the green hydrogen capacity in the global pipeline will need to source its water from seawater or brackish water using desalination processes as these projects are planned in water-stressed countries such as Chile, Australia, Spain or Saudi Arabia.

Thus, the production of green hydrogen through desalinated water faces two main challenges:

1. The desalination process generates brine as waste product, which contains potentially environmentally harmful concentration of salts and chemicals and could impact the marine ecosystem if its discharge is not appropriately managed.
2. The increase of costs related to the energy requirements for desalination (roughly 1kWh per cubic meter of purified water), which would make this process a less attractive alternative than other water sources for green hydrogen production

Fig. 1: K-UTEC’s technical centre, with more than 1,500 sqm for process technology equipment and systems that can be flexibly combined to replicate complete production processes. The industrial scale demonstration plant allows to process several tons of raw materials into desired end products.

The solution

The public-private partnership (PPP) between K-UTEC and GIZ seeks to address the need for a sustainable solution for the management of reject brine from desalination plants used by the green hydrogen industry and other associated sector that can benefit from, such as the mining sector in Chile.

The handling of reject brine from future desalination plants is a matter of concern for local authorities, project developers, environmental institutions, and civil society, as it may incur in negative impacts on the water sources, marine ecosystem, and local activities such as fishing and tourism.

The further processing of the desalination reject brine to valuable products, such as sodium, potassium and magnesium salts, as well as other by-products, is proposed. Thus, the discharge of the reject brine to the marine ecosystem can be minimised or even avoided.

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

K-UTEC SALT TECHNOLOGIES

Using renewable energy, fractional salt crystallisation, mechanical or solar evaporation, and membrane technologies, brine can be concentrated, and salts extracted.

Several potential by-products, such as potassium and magnesium salts, can be produced in significant quantities, and their commercialisation may reduce the overall operating costs of the desalination process. Moreover, this approach would ideally result in zero liquid discharge and provide additional pure water for industrial applications. Thus, this proposal enables a sustainable and economic development of green hydrogen projects.

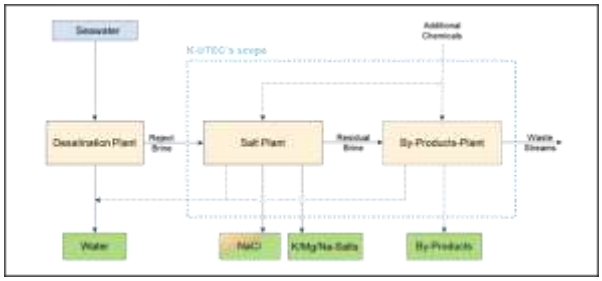

Fig. 2: General flow chart of the project (K-UTEC). N.b. although the project's scope is focused on salt recovery and by-products, the necessary analysis and linkages with the green hydrogen industry and desalinisation plants will be established, such as heat integration analysis and benefits for green hydrogen production costs.

How it will be done

To implement the proposed solution, a technical and economic pre-feasibility study for the production of valuable salts will be developed, defining the project requirements and location criteria for the successful implementation, comparing different methods for brine concentration and salt extraction, energy sources, among other variables.

Once the preferred process option for the brine is chosen, the technology will be developed to be flexible for different desalination projects. The plant will be designed in a modular form so that it can be easily scaled up or down.

Given Chile's water scarcity, it is anticipated that the green hydrogen industry, as well as the mining, industrial, and agricultural sector, and the general public and will depend on water supply from desalination plants in the future. These sectors, along with the emerging green hydrogen industry, will benefit from sustainable solutions for the reuse of brine from desalination plants. Therefore, this PPP will create the required know-how to unlock these benefits for Chile, Latin America, and the rest of the world.

Expected outcomes

K-UTEC AG will produce a conceptual design study for the processing of the reject brine after seawater desalination to valuable products, through which a preferred brine process option will be chosen to be further developed through a pre-feasibility assessment to a level close to the desktop study required for dimensioning the key equipment for cost estimates.

Additionally, the Conceptual Design Study and Pre-feasibility Study will be presented through workshops with green H_2/PtX project developers, desalination plant operators, representatives from the mining industry and local authorities and policy makers to receive their feedback and conclude a sustainable solution for desalination brine disposal and reutilisation as a possible business case for the implementation in Chile.

The project at a glance	
Duration	December 2024 – May 2026
Country	Chile
Objective	Assess the viability of utilising reject brine from desalinated seawater by converting this waste material into valuable products.
Partners	GIZ, K-UTEC AG Salt Technologies
Expected Results	• Conceptual Design Study for the processing of reject brine into valuable products. • Technical and Economic Pre-feasibility Assessment for the preferred process option for brine treatment. • Outreach activities and stakeholder engagement

The International Hydrogen Ramp-up Programme (H2Uppp) of the German Federal Ministry for Economic Affairs and Climate Action (BMWK) promotes projects and market development for green hydrogen in selected developing and emerging countries as part of the National Hydrogen Strategy.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

T +49 61 96 79-0
F +49 61 96 79-11 15
E info@giz.de
I www.giz.de

Chile, March 2025

Editors:
Isabella Boese
Oswald Eppers

Design:
Peppermint Werbung Berlin GmbH, Berlin

Photo credits:
K-UTEC AG Salt Technologies

URL links:
Responsibility for the content of external websites linked in this publication always lies with their respective publishers. GIZ expressly dissociates itself from such content.

GIZ is responsible for the content of this publication.

Contact:
GIZ Chile
N Javier Ortiz de Zúñiga
E francisco.ortiz@giz.de
I https://www.giz.de

K-UTEC
N Oswald Eppers
E oswald.eppers@k-utec.es
I https://www.k-utec.de/