Solar NH_3-Pool Chile

Concepts for the development of a sustainable green hydrogen/ammonia plant pool in the Antofagasta region (Chile)

PPP background

Chile has natural and political conditions that favor the production of renewable energies and fuels, presenting an opportunity for the production, use, and export of green hydrogen (GH_2) and its derivatives. The Antofagasta region has significant potential for solar and wind energy, complemented by the presence of enabling infrastructure. This advantageous landscape has catalyzed the announcement of 12 projects with a planned electrolysis capacity of 8,650 MW by 2030.

Given the structure of the GH_2 value chain, the projects share similar technical and infrastructure requirements, leading to substantial investment and operating costs. However, they stand to benefit from synergies and the utilization of shared facilities housing more efficient technologies. Such collaborative approaches not only minimize the use of land and coastline, but also mitigate environmental and social impact while reducing project development expenses. To avoid redundant infrastructure and foster a sustainable industry, appropiate territorial conditions and a high level of public-private coordination are imperative.

One proposed solution involves collaboration through the establishment of a green hydrogen and ammonia industrial park in Antofagasta. This initiative requires strategic planning for technical development, including the positioning of various activities within a shared, favorable property, along with the provision of supply and logistics services.

Project description

The public-private collaboration between the German Cooperation Agency (GIZ) and the consortium of companies led by Soventix Chile SpA aimed to contribute to the development of an industrial park for green hydrogen and derivatives in the region of Antofagasta, commune of Mejillones. To accomplish this, the conceptualization, pre-design, and technical-economic analysis of a model plant for the production of green hydrogen and ammonia were carried out. This facility could be potentially located within the industrial park to optimize different components of its value chain. Finally, public relations and collaboration with different stakeholders were promoted to contribute to the transfer of knowledge and the formation of human capital.

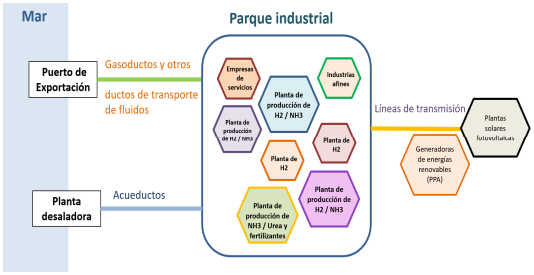

Figure 1: Conceptualization of the H2-Mejillones Industrial Park.

Main findings and results

1. Conceptualization of a GH_2 industrial park: The industrial park encompasses a cluster of several production facilities varying in product types and scales, designed for phased development. Primarily, it focuses on the production of green hydrogen and ammonia, alongside other derivatives or products utilizing these chemicals as inputs. A toll-based business model is envisioned, wherein electrical, water, and port services are integrated through contractual agreements. For the production of ammonia, several smaller-scale green hydrogen production plants are proposed, which sell their product through long-term "take or pay" contracts, ensuring a stable revenue stream.

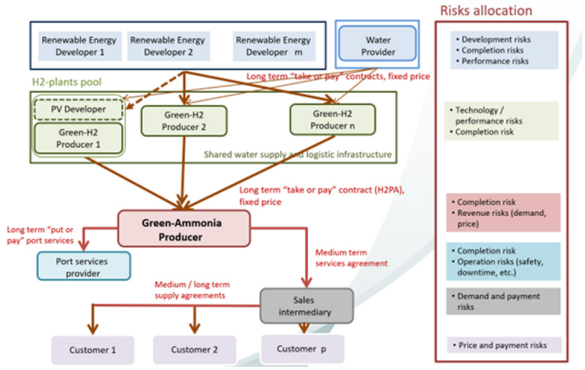

Figure 2: Business model based on supply contracts with multiple suppliers along the value chain.

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2. Enabling infrastructure in Antofagasta and Mejillones: The development of the mining sector has favored the consolidation of regional infrastructure. This encompasses various components such as the National Electric System's grid lines, road networks, railways, gas pipelines, aqueducts, desalination plants, and ports. The presence of thermoelectric power stations in Mejillones further enhances the potential for leveraging electricity and water infrastructure in the future under decarbonization scenarios. In addition, Mejillones Bay hosts 11 port terminals, including those designated for public use within the Mejillones Port Complex (CPM). CPM developed a comprehensive Master Plan for its long-term development, structured on a concession model facilitating private investment and terminal operation. One such terminal has the capacity to handle up to 7 million tons of ammonia annually, complemented by storage capacities of 100,000 m^3.

3. Master Plan for the development of a GH_2 industrial park: Under an optimistic scenario, the industrial park in Mejillones was preliminarily designed to satisfy both local consumption and export demands within the region, estimated at 2.65 Mtpa of hydrogen equivalent. This requires an electrolysis capacity of 28.3 GW and a land area of 900 ha, which aligns with the dimensions of industrial parks of comparable nature worldwide. Following a territorial and infrastructure analysis, suitable geographical zones for the hydrogen industrial park were identified. It is emphasized that ensuring legal certainty is key for the decision regarding project siting and investment in the hydrogen sector.

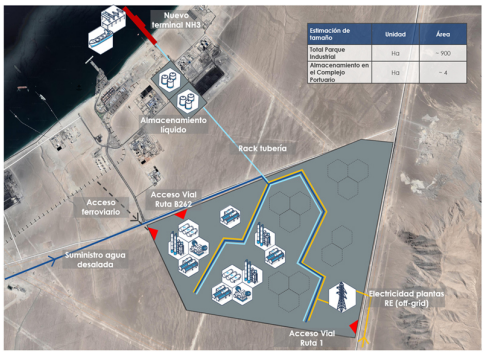

Figure 3: Master plan for the green hydrogen industrial park in Mejillones.

4. Conceptual design for a green ammonia model plant: The optimized design of a green ammonia production plant was carried out, whose development can be implemented in two phases, with the results shown in Table 1.

Table 1: Two-phase model plant design.

Results	First phase 2028	Second phase 2035
PV plant capacity [MW]	1,130	2,259
Electrolysis plant capacity [MW]	803	1,609
Annual ammonia production [ktpa]	320	640
Levelized cost of electricity (LCOE) [USD/MWh]	35.0	32.6
Levelized cost of hydrogen (LCOH) [USD/kg H_2]	4.1	3.6
Levelized cost of ammonia (LCOA) [USD/t NH_3]	928	836
Total CAPEX [MUSD]	2,081	3,765

It is concluded that locating a project within a hydrogen industrial park offers numerous economic benefits. These include reduced investment and operational costs, achieved by circumventing the need for constructing dedicated port and storage facilities or the shared utilization of water supply and electricity transmission infrastructure. Other advantages stem from mitigated development risks. Moreover, the outcomes indicate favorable LCOA, showcasing competitiveness relative to international market prices of grey ammonia. LCOA values ranging from 600 to 800 USD/ton of ammonia are attainable, with LCOH within the range of 3.5 to 4.0 USD/kg.

5. Collaboration with stakeholders: Since its inception, the project's development has considered presenting progress to different actors from the public, private, and academic sectors. The engagement of Soventix Chile SpA in the public consultation of the Green Hydrogen Action Plan led by the Ministry of Energy is highlighted, as well as the support of CORFO in applying for funding for the second phase of the development of a green hydrogen industrial park. In addition, the relationship with the Municipality of Mejillones is identified as crucial to evaluate site alternatives, ensure compatibility with territorial planning instruments, and foster social acceptance of the proposal.

Further information

- 5° Green Hydrogen Summit Chile LAC 2023
- Seminar "Conditions for the competitiveness and sustainability of the GH2 and derivatives industry in Antofagasta"

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