H I D R O G E N O A N D I N O

HIDROGENO ANDINO

Hidrógeno Andino is a strategic macro-project structured in stages to deeply transform Colombia's agricultural and industrial sectors through renewable energies and green hydrogen. Currently, the country imports around 2 million tons of fertilizers annually, creating significant economic dependency. Thus, the project initially aims to gradually replace these imports by producing locally sourced green ammonia using small-scale hydropower plants (SHPP), enabling the manufacture of low-carbon fertilizers that strengthen sustainable agriculture. In advanced stages, Hidrógeno Andino will establish a robust industrial platform focused on exporting green ammonia, low-carbon fertilizers, hydrogen, and other sustainable derivatives to Latin America and international markets. This initiative will position Colombia as a regional leader in energy transition and green industrialization, significantly contributing to sustainable development, climate change mitigation, and the country's economic prosperity.

Current Stage – Phase 1: Pilot Plant "Protium" (2023–2025)

SHPP
2.7 MW

NH_3

1.8 kton/yr

Commercial-scale pilot plant. Green ammonia commercial production of 1,800 tons/year for local market (10-year PPA, and 10APA).

Stage 2 – Deuterium Commercial Plant (2026–2028)

SHPP
20 MW

NH4HO3

60 kton/yr

Commercial production of 60ktpa aprox ammonium nitrate fertilizer for regional consumption, targeting crops oriented towards export markets.

Stage 3 – Tritium Regional Export (2029–2033)

SHPP
100 MW

NH4HO3

300 kton/yr

Commercial production of 300 ktpa aprox ammonium nitrate fertilizer for regional consumption, targeting crops oriented towards export markets.

Stage 4 – Hidrógeno Andino Global Export (2033–2036)

SHPP
400 MW

NH4HO3

1200 kton/yr

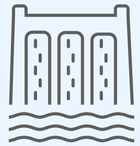
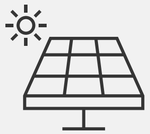
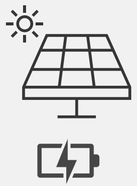
Global-scale export-oriented hydrogen and derivatives production, supplying markets across continents.

APPENDIX

DISRUPTIVE BUSINESS MODEL

Hevolucion's business model is based on hydroelectric energy, which is more efficient for hydrogen/ammonia production compared to solar energy and even eolic energy. Below is an estimate of the investments required to produce 5 tons of zero-emission ammonia (equivalent to one ton of hydrogen) using different sources of renewable energy.

Hevolucion's business model

Types of renewable energy	Required CapEx (USD mm)			Total CapEx (USD mm)	Description
 Hydropower	 SHPP* 5,0 MW USD 8 mm	 Alkaline electrolyzer 2 MW USD 1 mm	 Ammonia liquefaction 5 Ton/día USD 3 mm	USD 12 millions	• Business model based on a non-conventional renewable energy source, where a fraction of the CapEx can achieve the same production level. • Main competitive advantage of this business model is the continuous 24/7 production of electrical energy (from the SHPP) and hydrogen (from the electrolyzer), enabling low-cost ammonia production and ensuring the financial viability of the project.
 Solar	 Solar farm 6 MW USD 13 mm	 PEM electrolyzer 6 MW USD 6 mm	 Hydrogen compression 1 Ton/día USD 7 mm	USD 26 millions	• An alternative electricity generation option that requires triple the production capacity, as solar energy is available for an average of 8 hours per day, which is only 1/3 of the time compared to hydroelectric power. • Since solar energy does not provide a constant production, larger investments are necessary, and hydrogen cannot be directly converted into ammonia. Instead, a process of compression and storage of hydrogen must be undertaken, which is significantly more expensive than ammonia liquefaction.
 Solar & batteries	 Solar farm & batteries 13MW & 32MW USD 45 mm	 Alkaline electrolyzer 2 MW USD 1 mm	 Ammonia liquefaction 5 Ton/día USD 3 mm	USD 49 millions	• An alternative production method involves the use of a solar farm (13 MW) and a large-scale battery bank (32 MW) to store the necessary energy to operate the electrolyzer. • The above method allows for the liquefaction of hydrogen into ammonia. However, this alternative is four times more expensive than hydroelectric generation, which poses a challenge to the financial feasibility of the project.

*It is assumed that to guarantee the 2 MW consumed by the electrolyzer, a small hydropower plant (SHPP) with double the capacity is required. This is due to the high variability of river flows and the different seasons of rainfall and drought in the country.

PROTIUM

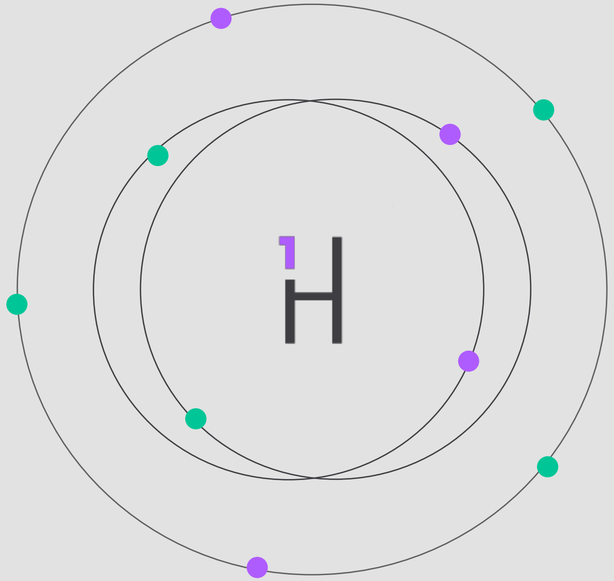
DEMOSTRATIVE PLANT

Innovation leader in the world

Protium is a Colombian project leaded by Hevolution S.A.S and OPEX S.A.S that has been leading the development of the hydrogen value chain and its byproducts for over 5 years.

Unique business model

Production of zero-emission hydrogen from non-conventional renewable energy sources, obtained from Colombia´s immense hydroelectric power potential



Opportunity

First independent green hydrogen producer in Colombia, with exclusive access to low-cost, stranded hydropower near Medellín and a strategic position to serve unique high-value markets.

Highly replicable business model

Potential to integrate small electrolyzers with Small Hydropower Plants (SHPs), strategically distributed across Colombia, to enable zero-emission hydrogen production

6 MMUSD
CAPEX allocated for the development of the demonstration plant..

8.6 ¢/kWh
10-years hydro power PPA signed with the local utility.

360 tons/year
Zero-emission **hydrogen** production installed capacity

1.800 tons/year
of **ammonia** produced from hydrogen for industrial applications

500 USD/ton
Super competitive green ammonia production cost in a small-scale plant.

2000 USD/ton
Off-takeLong-term (10-year) ammonia supply agreement with a local industrial partner.

PROTIUM

WHAT WE HAVE ACHIEVED

First industrial production plant for ammonia and hydrogen using renewable energy from small hydroelectric plants in LATAM.
Video : https://youtu.be/pMqoozsxFrk

DEUTERIUM

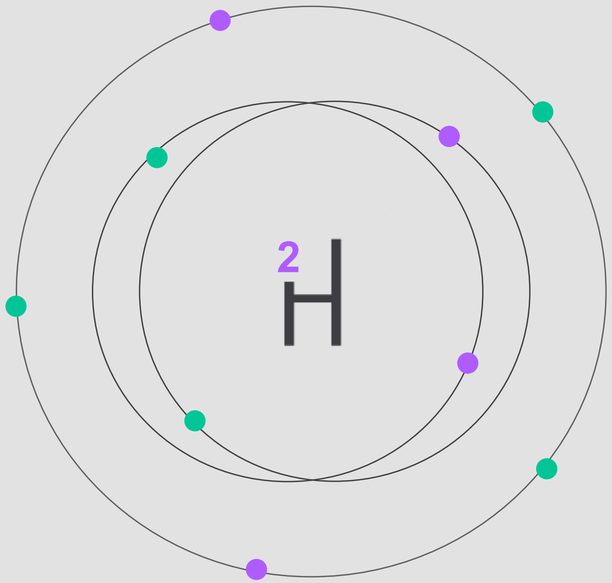
First commercial installation

A Scalable Solution for Colombia's Industry and Agriculture

Deuterium is Protium's scale-up project, aiming to produce 3,600 tons of green hydrogen and 18,000 tons of green ammonia annually—targeting the fertilizer market in a country with 39.2 million hectares of arable land, only 13.5% of which is used.

Strategic Location

Based in Colombia's Coffee Axis—720,000 tons of coffee/year and 72,000 ha of plantain and banana—Deuterium benefits from nearby off-takers and 56 GW of hydro potential. By integrating 20–50 MW SHPs with electrolyzers, it cuts 21,896 tons of CO_2 annually and boosts LATAM market access.



Solving Colombia's Transmission Gap

With 56 GW of hydro potential—6x its current capacity—Colombia faces limitations due to weak transmission infrastructure, especially in the Coffee Axis. Deuterium overcomes this by using decentralized 20–50 MW SHPs, producing 3,600 tons of green hydrogen and 18,000 tons of green ammonia annually. This avoids 21,896 tons of CO_2 emissions, reduces reliance on the grid, and cuts energy costs by up to 50% vs. PPAs—boosting competitiveness and sustainability..

Proof of Model Replicability

In the project's area of influence, 2 GW of SHP projects exist—1.5 GW licensed, 1 GW without grid access—ranging from 20 to 50 MW. Deuterium's second phase will integrate these into green hydrogen hubs.

150 MMUSD
CAPEX for scaling up by a factor of 10, incorporating the energy source as a core asset of the production project.

2.5 ¢/kWh
(LCOE) considering the generation asset as an integrated part of the project.

18000 tons/year
Primarily intended for the production of ammonium nitrates, with a small portion allocated to the development of mobility applications.

411 USD/ton
(LCOAN)Super competitive green **ammonium nitrate** production cost in a medium-scale plant.

17% IRR
Backed by a replicable model and proven technology, this return reflects a low-risk profile for early movers in the green ammonia market.

DEUTERIUM

>20 MW SHPP

Río Aures

Gravity flow pipe

Tubería de flujo libre

Casa de Máquinas

Tubería de presión

Tanque de carga

km 1 2 3 km


EL ÚLTIMO COMIENZO