Country Brief: Colombia

Hydrogen Potential & Opportunities for Shipping

SUMMARY

Colombia stands to benefit from international shipping's shift to scalable zero-emission fuels due to its low potential cost for producing green hydrogen, access to two oceans and ability to leverage renewable energy resources. Although projects focusing on green hydrogen are already emerging in the country, few of these relate to zero-carbon marine fuels, which puts Colombia at risk of missing out on a major growth opportunity.

BACKGROUND

The maritime industry has a strong dependence on fossil fuels, resulting in significant emissions of greenhouse gases (GHG) and air pollutants. The development of sustainable and environmentally friendly scalable zero-emission fuels (SZEF) and the necessary infrastructure for their production are key to reducing the sector's environmental impact. Substantial amounts of renewable energy will be needed for the maritime sector to fully decarbonise and contribute towards meeting global climate objectives.[1]

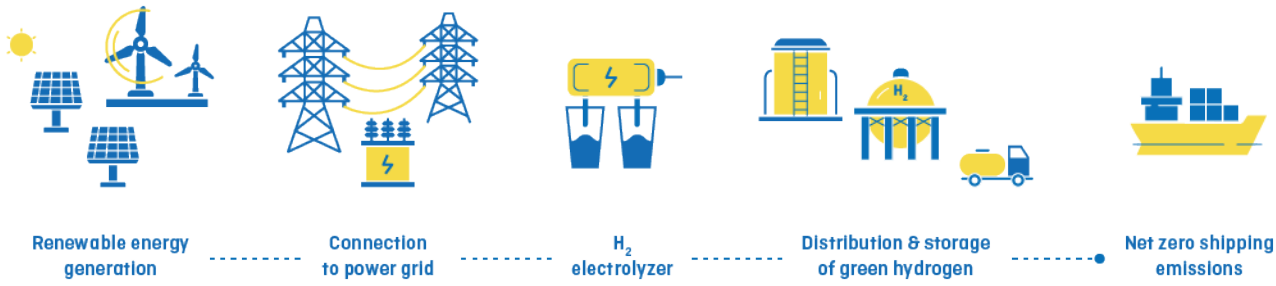


Figure 1: Example of green hydrogen production pathway

1 IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

RENEWABLE ENERGY POTENTIAL

The maritime industry is particularly interested in the production and use of green hydrogen as a means to decarbonise. Created by using renewable electricity to split water into oxygen and hydrogen, green hydrogen offers a clean alternative to fossil fuels and can be processed to make additional maritime fuels. Colombia can capitalise on international shipping's energy transition by leveraging its untapped renewable energy and diversifying its energy mix to include green hydrogen.

As of 2022, Colombia generated 75.5% of its electricity from low-carbon sources and just 24.5% from fossil fuels. Most of this high renewable energy use was from hydropower (73%), while solar and wind combined account for less than one percent.

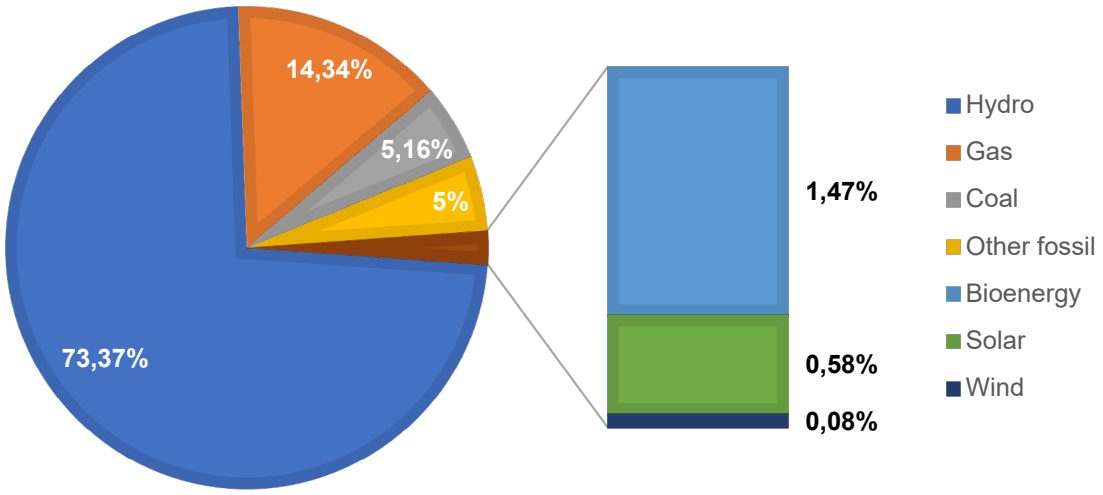


Figure 2: Share of electricity production in Colombia by source[2]

Colombia plans to diversify its energy mix by increasing the uptake of renewables that will improve the reliability of its energy supply. This includes wind power plants, photovoltaic solar generation, geothermal energy, and the generation of energy from biomass.[3] The potential for energy diversification is significant. Regions such as Guajira have a wind speed of approximately nine metres per second, which is double the world average, and solar radiation that is 60% higher than the world average.[4] Moreover, Colombia's current wind and solar energy capacity are estimated to be at 18.4 megawatts (MW) and 290 MW, respectively, whereas their combined potential is estimated to be between 30 gigawatts (GW) and 32 GW, higher than the current national installed capacity of 18.8 GW across all energy sources.[5]

2 Statista (2023). Share of electricity production in Colombia by source.
3 IEA (2021). Energy Plan 2050 (Plan Energético Nacional Colombia: Ideario Energético 2050)
4 H2LAC (2023). Colombia country profile.
5 Stockholm Environment Institute (2023). Solar and wind power in Colombia: 2022 policy overview.

Grid connectedness

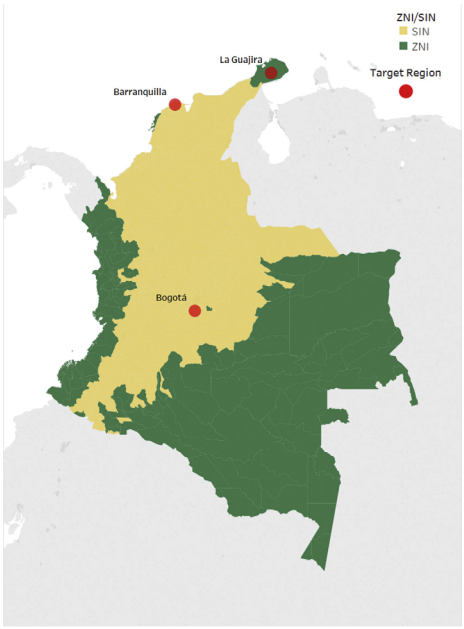
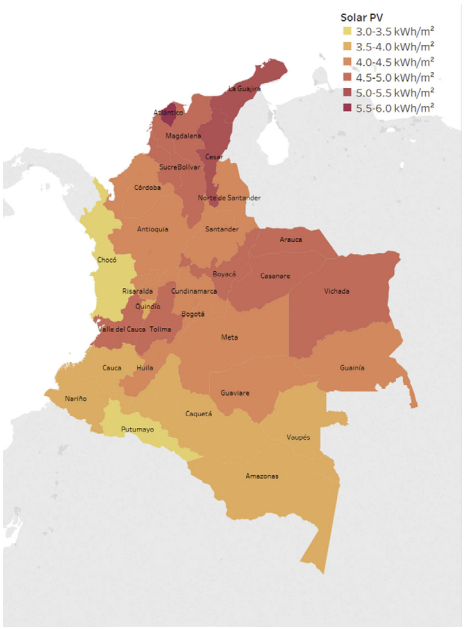


Figure 3: Solar PV generation in Colombia[6]

Average solar potential/department



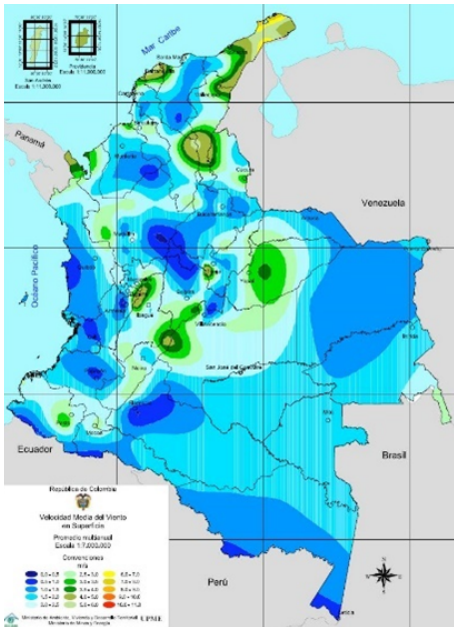


Figure 4: Wind power in Colombia[7]

TRADE IMPACTS

Colombia's export of fossil fuels constitutes a fundamental element in its trade balance, making up 55% of total exports in 2022.[8] However, with the world shifting towards a low-carbon economy, the country faces a gradual decline in both its export of fossil fuels and domestic consumption.

To ease this transition, the production and export of green hydrogen could help Colombia progressively replace the role of conventional energy sources within its national economy.[9] From a maritime perspective, Colombia's unique geographic position between the Atlantic and the Pacific Oceans and its proximity to key maritime routes enable abundant access to major trading routes and export markets. This creates ideal conditions both for engaging in hydrogen imports and exports with other geographies, but also the potential for bunkering at Colombian Ports, due to proximity with the Panama Canal.

Lastly, focusing on the development of green hydrogen would also provide Colombia with increased stability economically by maintaining jobs in sectors impacted by decarbonisation. Deploying green hydrogen in mining and oil regions leverages existing infrastructure and expertise furthering employment retention and upskilling labour, which will help to ensure a just transition.

6 López et al. (2020). **Solar PV generation in Colombia: A qualitative and quantitative approach to analyze the potential of solar energy market.** *Renewable Energy*, Volume 148, pg 1266-1279.

7 Flórez (2013). **Wind power in Colombia: La Guajira wind energy potential is 18 GW.**

8 Thema and García (2023). **The Energy Transition in Colombia.**

9 Ministry of Mines and Energy (2021). **Colombia's Hydrogen Roadmap.**

Despite Colombia's riches when it comes to renewable energy resources and untapped capacity, the country has yet to leverage this potential to produce green hydrogen. Through the production of green hydrogen, Colombia could further capitalise on its renewable energy resources to decarbonise other industries in the country and support energy security.

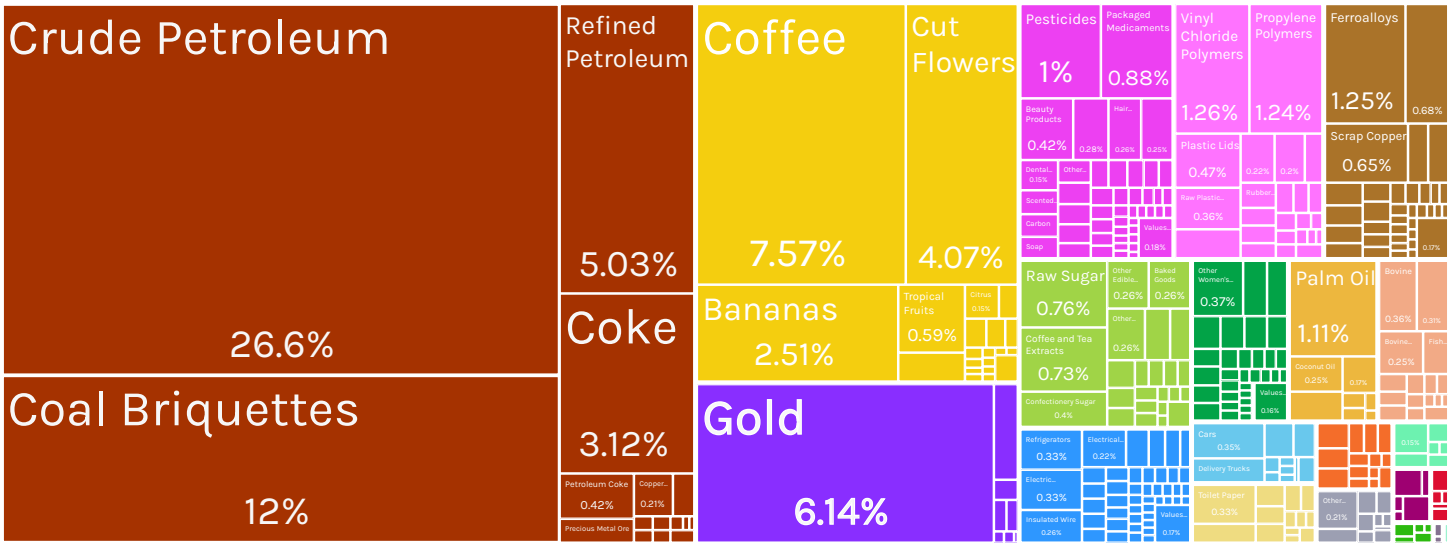


Figure 5: Colombia trade balance: exports[10]

STRATEGIC ACTION

In order to recognise the opportunities and trade impacts of hydrogen production within Colombia, strategic action should build on existing work like the 'National Hydrogen Strategy and Road Map'. This comprehensive plan outlines the introduction of hydrogen across the country[11] and sets a target of achieving one gigawatt electrolysis capacity by 2030, with 40% of low-carbon hydrogen designated for industrial applications. The plan also outlines an expansion of hydrogen infrastructure within the transportation sector, with an emphasis on enhancing the hydrogen network for long-haul heavy-duty transport.[12]

Colombia currently has a number of projects and foreign collaborations with a hydrogen focus. However, very few relate to zero-carbon marine fuels, highlighting the potential in developing projects within this area.

10 OEC (2021). **Colombia country profile.**
11 H2LAC (2023). **Colombia country profile.**
12 International PtX Hub (2023). **Leveraging existing infrastructure and hydrogen demand to kickstart the transition to net zero.**

Name	Description
Green Hydrogen Pilot	Ecopetrol and the Colombian Petroleum Institute announced a green hydrogen pilot project with an electrolyser capacity of 50 kW at the Cartagena refinery in 2022.[13]
Promigas, Surtigas - Heroica	Pilot project set to 1.6 t H2/year (15 t H2/year in next pilot phase).[14]
MOU between Colombia and Germany	Analysing and promoting green hydrogen production and derivatives in Colombia with intent to export to Germany.[15]
MOU between the Ministry of Mines and Energy and the Ministry of Transport of Colombia with Port of Rotterdam	Establishing dialogues around the creation of an export and import corridor for green hydrogen and its derivatives between Colombia and the Netherlands.[16]

THE OPPORTUNITY

By leveraging the vast untapped energy potential in solar and wind, Colombia has the opportunity to develop new products including green hydrogen and its derivatives. This opportunity brings with it several benefits to local industries and the national economy.

Three key opportunities include:

1. The domestic use of renewable energy and hydrogen

Green hydrogen has the potential to help Colombia's hard-to-abate sectors decarbonise. In addition to shipping, Colombia's hard-to-abate sectors include cement, mining, and steel, all of which stand to benefit from increased domestic production of green hydrogen to meet their energy needs.[17]

2. Hydrogen as a marine bunker fuel for international shipping

Colombia will need to prepare to supply SZEF to ships that bunker at its ports. This will require infrastructure solutions for SZEF storage as well as upskilling and training the ports' employees to handle such fuels.

Ports such as Cartagena benefit from their proximity to the Panama Canal and location near vast renewable energy resources. This can be leveraged for the bunkering of ships waiting to enter

13 Ecopetrol (2022). **The Ecopetrol Group initiated green hydrogen production in Colombia.**
14 Surtigas (2022). **Promigas and Surtigas launch a pilot for the production of green hydrogen and injection into natural gas networks in Colombia.** (ESP)
15 H2LAC (2023). **Colombia and Germany sign agreement to promote the green hydrogen industry.** (ESP)
16 H2LAC (2022). **Colombia and Port of Rotterdam sign memorandum for a green hydrogen corridor.** (ESP)
17 International PtX Hub (2023). **Colombia country profile. Leveraging existing infrastructure and hydrogen demand to kickstart the transition to net zero.**

the canal or as fuel provided directly to Panama, highlighting Colombia's potential to become a hydrogen logistics hub, supplying nearby countries by both sea and land.[18]

3. The country's export of hydrogen and/or SZEF as a commodity.

Colombia is among the top countries when it comes to the projected levelised cost of hydrogen in 2050.[19] Levelised cost of hydrogen is a financial metric that is used to assess the cost of producing hydrogen over its entire lifecycle. As countries around the world seek to reduce their domestic GHG emissions, there is an opportunity to export green hydrogen to regions unable to produce a sufficient amount of green hydrogen themselves, such as Europe and Asia (among others). Colombia could engage in discussions with key trading partners to explore demand for the trade of green hydrogen.

18 Ministry of Mines and Energy (2021). Colombia's Hydrogen Roadmap.

19 IRENA (2022). IRENA Global Hydrogen Trade Costs 2022.