

Roadmap for the Hydrogen Supply Network in Brazil

Lucca R. S. A. Bastos^{1*}, Leonardo O. S. Santana², Gerhard Ett²

¹SENAI CIMATEC University; Salvador, Bahia, Brazil

Brazil holds significant potential to become a leader in the global energy transition due to its predominantly renewable energy matrix. Hydrogen, particularly when produced from renewable sources, emerges as a crucial energy vector to decarbonize hard-to-electrify sectors, such as heavy transport, petrochemicals and refining, fertilizer production, and the steel industry. However, establishing a hydrogen supply network in Brazil faces substantial challenges. This project aims to create a roadmap for the hydrogen refueling network in Brazil, aligning economic and governmental interests. It is a strategic initiative to ensure that the country not only follows but leads the transition to a hydrogen economy, promoting sustainable economic growth and energy security.

Keywords: Hydrogen. Roadmap. Energy Matrix.

The transportation sector in Brazil accounts for around 20% of global CO₂ emissions, one of the main greenhouse gases, without considering other harmful pollutants [1]. Due to high emissions, the Brazilian market has gradually introduced cleaner fuels, such as hydrogen, produced from renewable sources, playing an important role in reducing atmospheric pollution.

From this perspective, different methods of production were studied, such as natural gas steam reforming and electrolysis supported by solar energy (photovoltaic and photothermal processes), as well as water electrolysis [2]. For storage, the LOCHs technology was analyzed, which consists of storing H₂ in aromatic substances [3]. For distribution, coupling hydrogen with natural gas was considered to increase safety during transportation [4].

The roadmap design relies on this knowledge. A roadmap acts as a guide, a compass leading teams through sequential steps until the final goal. Using software such as ClickUp and Lucidchart [5], the study mapped optimal routes to achieve objectives, considering the integration of new technologies and hydrogen properties. The focus is on heavy

transport, especially trucks, which emit significant amounts of CO₂, contributing to climate change.

Materials and Methods

To design a hydrogen roadmap, beyond the production, storage, and distribution stages, the study reviewed the autonomy of hydrogen, diesel, and electric vehicles, as well as the location and spacing of fueling stations.

A table (Table 1) was created to support a case study in the Northeast region, considering the main highways, refineries, and distribution points, with data provided by Google Maps.

Table 1. Comparison table.

	Gas Station	Distance
Fuel	44054	150 km
Electric Fuel	10622	445 km

Case Study

A field study was conducted between Salvador and Barreiras, analyzing the following variables: price, distance traveled, fuel consumption, and CO₂ emissions. The case compared five trucks powered by hydrogen and diesel.

Due to the high cost of hydrogen, sold by kilogram, a conversion to liters was necessary. Results showed a consumption of 11.2 L/km.

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Address for correspondence: Lucca R. S. A. Bastos. Av. Orlando Gomes, 1845, Piatã, Salvador, Bahia, Brazil. Zipcode: 41650-010. E-mail: lucca.bastos@aln.senaicimatec.edu.br. Original extended abstract presented at SAPCT 2025.

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Diesel trucks, in contrast, consume between 1.5 L/km and 4 L/km, with considerable CO₂ emissions. The study also considered the three sustainability pillars: economic, environmental, and social.

Using these data, the team simulated a fleet transition from diesel to hydrogen along the Salvador–Barreiras corridor. A second table (Table 2) was developed, based on the averages obtained.

The equation used to calculate fuel consumption was:

$$\text{Consumption} = \frac{\text{Distance traveled}}{\text{Fuel consumed}} \quad [6]$$

Additional data sources included InsideEVS (hydrogen pricing), Petrobrás (diesel pricing), and SigaVerde (CO₂ emission calculations).

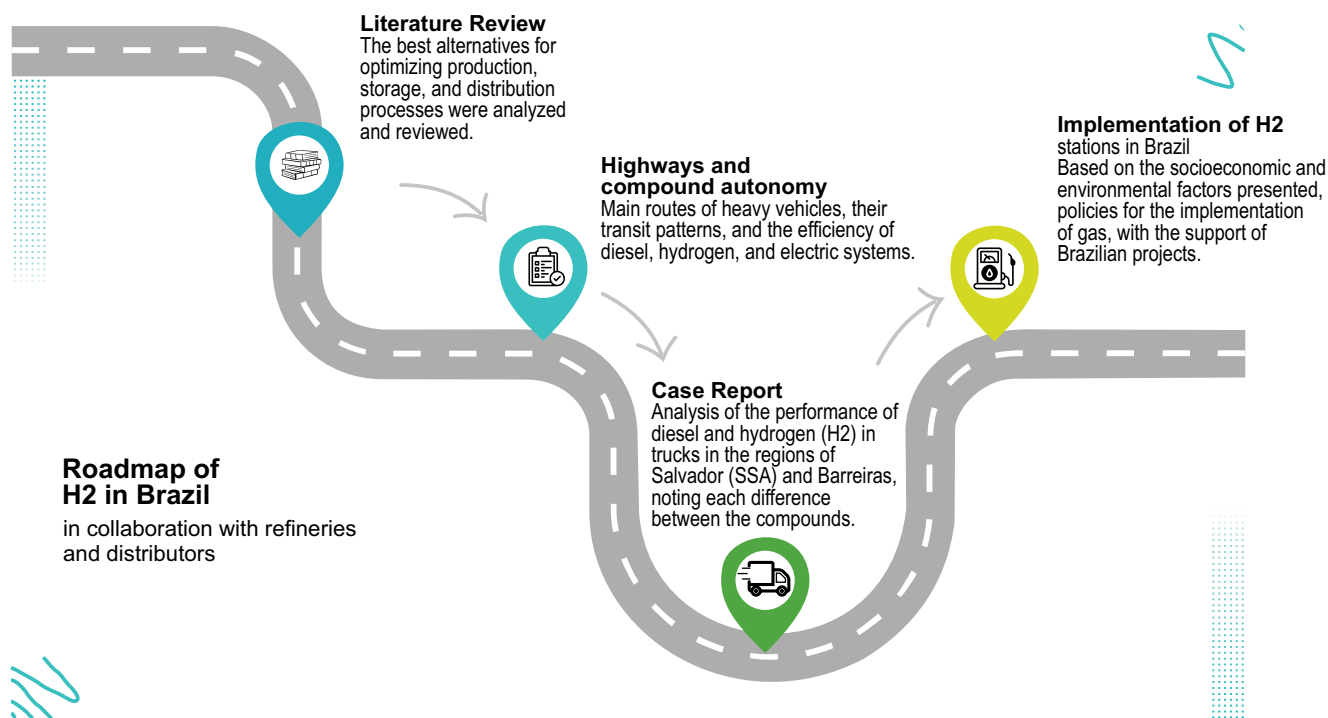
Results and Discussion

The final roadmap was built considering economic challenges (e.g., the high commercial value of hydrogen, making it scarce among heavy vehicles), environmental advantages (zero greenhouse gas emissions), and infrastructure (station placement between Salvador and Barreiras).

Table 2. Case study table.

Gas Station	Price (R\$)	Distance	Consume	CO ₂ Emission (kg/L)
Fuel	6.44	862	215.5 km/L	3.2
Hydrogen	186.49	862	77.5 km/L	Non

Figure 3. Roadmap for hydrogen in Brazil.



The study proposed a roadmap highlighting the main production, storage, and distribution methods for hydrogen and identifying priority areas for hydrogen fueling stations (Figure 3). The calculations assumed an autonomy of 500–700 km per tank.

Conclusion

The study concludes that Brazil faces major challenges for hydrogen adoption, including limited infrastructure and the urgent need for strategic planning to build a robust national supply network. However, investments in renewable energy, particularly in the Northeast, are advancing. Bahia is already focusing on hydrogen through the Corredor Verde project, funded by SENAI CIMATEC and Petrobrás, which aims at decarbonization and energy development.

Tools such as the Atlas platform, which maps hydrogen production areas and related value chains, strengthen the Brazilian industry and facilitate integration of the national hydrogen network with

international markets. This study thus contributes to Brazil's path toward a low-carbon economy.

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