

CEBRI

BRAZILIAN CENTER FOR INTERNATIONAL RELATIONS



Australian Embassy

Brazil

GREEN HYDROGEN'S CONTRIBUTIONS TO THE ENERGY TRANSITION: PERSPECTIVES AND PREREQUISITES

ENERGY PROGRAM

November, 2022





BRAZILIAN CENTER FOR INTERNATIONAL RELATIONS

www.cebri.org

#2 Think Tank in South and Central America

*University of Pennsylvania's Think Tanks
and Civil Societies Program 2020 Global Go
To Think Tank Index Report*

THINKING
DIALOGUING
DISSEMINATING
INFLUENCING

The Brazilian Center for International Relations (CEBRI) is an independent think tank that contributes to building an international agenda for Brazil. For over twenty years, the institution has engaged in promoting a pluralistic and proposal-oriented debate on the international landscape and Brazilian foreign policy.

In its activities, CEBRI prioritizes themes with the greatest potential to leverage the country's international insertion into the global economy, proposing pragmatic solutions for the formulation of public policies.

It is a non-profit institution, headquartered in Rio de Janeiro and internationally recognized. Today, its circa 100 associates represent diverse interests and economic sectors and mobilize a worldwide network of professionals and organizations. Moreover, CEBRI has an active Board of Trustees composed of prominent members from Brazilian society.

CEBRI's activities are organized around 14 Thematic Programs, coordinated by members of the CEBRI Board and by Senior Fellows. The Energy Program is one of the most dynamic and its activities are conducted by CEBRI Vice-Chairman Jorge Camargo and by Senior Fellow Rafaela Guedes.

ENERGY PROGRAM

The Program focuses on the future of energy and global energy trends and seeks out solutions to create a competitive and attractive investment environment for Brazil.

All Rights Reserved.

BRAZILIAN CENTER FOR INTERNATIONAL RELATIONS
Rua Marquês de São Vicente, 336 - Gávea
Rio de Janeiro / RJ - 22451-044
Tel + 55 21 2206-4400 - cebri@cebri.org.br
www.cebri.org



TRUSTEE

Jorge Camargo

Vice-Chairman of the Board of Trustees of CEBRI and coordinator of the Energy Program. He is a member of the Boards of Directors of the Ultrapar and Prumo Global Logistics Groups. He was Chair of the Brazilian Institute of Petroleum, Gas and Biofuels (IBP) and is today an emeritus member of its Board of Directors. He has held executive positions at Petrobras, including as a member of the Executive Board, responsible for the International Area, and at Equinor, initially as Senior Vice President, at the company's headquarters in Norway, then as Chair of Equinor in Brazil.



SENIOR FELLOW

Rafaela Guedes

Rafaela Guedes is Petrobras' Chief Corporate Social Responsibility Officer. In this role, she is responsible for working with communities to co create solutions transforming positively the regions where the company operates, anticipating and managing social and environmental impacts of current and future activities. In addition, she seeks to ensure respect for human rights and to promote of diversity. She is currently member of the Oil and Gas Climate Initiative Executive Committee.



SENIOR RESEARCHER

Gregório Araújo

Sector Manager of Reforestation and Environmental Projects at Petrobras. He has served in the position of Senior Economist at Petrobras since 2008, with management roles in the Strategy and Planning department. Araújo served as Member of the "Future Energy Leaders Program" and of the "Scenarios Committee" of the World Energy Council, as well as Seconded at the International Energy Agency, contributing to the elaboration of the Brazil chapter at the World Economic Outlook's 2013 edition.



GREEN HYDROGEN'S CONTRIBUTIONS TO THE ENERGY TRANSITION: PERSPECTIVES AND PREREQUISITES

ENERGY PROGRAM

November, 2022

TABLE OF CONTENTS

6	Presentation
7	Prospects for hydrogen in Brazil and synergies with Australia
10	Challenges and requirements to expand the production and use of green hydrogen
14	Recommendations
15	Event participants

Presentation

The mitigation of the social and environmental impacts of climate change and of the global environmental crisis requires urgent and effective solutions. Green hydrogen can potentially offer a decisive contribution to achieve the carbon neutrality required to implement a low carbon economy, which is one of the goals of the Paris Agreement and of other environmental efforts.

Green hydrogen's significance as a source of clean energy, especially for industries that face the greatest technological challenges to reduce their emissions, and its energy storage capacity make it a strategic resource for different global stakeholders. Despite the significant technical and market hurdles to the materialisation of that potential and to the large-scale production of green hydrogen, the hydrogen market now is poised to grow thanks to a push in research and development initiatives, to the interest of businesses and governments in green hydrogen projects and to the creation of specific regulatory frameworks and public policies.

The event "*Green Hydrogen's Contributions to the Energy Transition: Perspectives and Prerequisites*" organised by CEBRI in partnership with the Australian Embassy, aimed at exploring the perspectives and conditions for hydrogen to serve as a strategic energy vector to achieve carbon neutrality targets, focusing specifically on using that technology to store energy cleanly, to produce derivatives such as ammonia and methanol, and as an energy source in the absence of more efficient electrification alternatives: long-distance transportation, industrial processes and aviation. The participants in the event were Agnes da Costa, Chief Special Advisor on Regulatory Affairs at Brazil's Ministry of Mines and Energy, Cameron Mathie, Manager of Future Carbon Markets at the Australian Clean Energy Regulator, Fiona Simon, CEO of the Australian Hydrogen Council, and Luis Viga, CEO of Fortescue Metals Group in Brazil. Grant Morrison, Chargé d'Affaires of the Australian Embassy in Brazil, Jorge Camargo, Vice Chairman of the CEBRI Board of Trustees, and André Bello, Energy Technology & Decarbonisation Manager at the Petrobras Research Centre opened and moderated the event. This report will summarise the main inputs gleaned from the debate and the resulting recommendations.¹

In May 2022, CEBRI produced a Whitepaper on hydrogen opportunities for energy transition. The report, which can be accessed [here](#), gives a first overview of potential uses of hydrogen and of the progress of implementation of that technology in Brazil. This report will complement and update that initial diagnosis.

1. Click [here](#) to watch the event, [here](#) to view the presentation shown by Agnes da Costa (MME) and [here](#) to view presentation of Cameron Mathie (CER).

Prospects for hydrogen in Brazil and synergies with Australia

Australia and Brazil see hydrogen as an enabler for the energy transition and as an opportunity for economic, social and industrial development. Both countries are very well positioned to generate renewable energy for the production of green hydrogen. On the other hand, that mutual interest opens the door to valuable cooperation opportunities to develop markets, establish regulatory frameworks, promote innovation and attract investments.



Brazil sees hydrogen as a key element in its decarbonisation efforts over the next ten years. The Ten-Year Energy Expansion Plan jointly developed by the Energy Research Company (EPE) and by the Ministry of Mines and Energy (MME) projects for Brazil an annual Remaining Technical Potential of some 1.8 Gt H₂, of which about 96% will come from renewable energy sources and will be considered green hydrogen.

Interest in hydrogen has increased in recent years but Brazil has long been investing in research and development initiatives. As early as in 2002 Brazil's strategic energy planning process included reports on the potential of hydrogen and of fuel cells in particular, prepared by the Ministry of Science, Technology and Innovation (MCTI) and by the Ministry of Mines and Energy (MME). More recently, in 2021, the National Energy Policy Council (CNPE) passed Resolution no. 2/2021 establishing guidelines for energy research, development and innovation and allocating government funds to priority areas, hydrogen included. CNPE's latest resolution (no. 6/2022), passed in August 2022, created the National Hydrogen Program (PNH₂) and established its governance structure.

The National Hydrogen Program (PNH₂) was created to galvanise government and non-government players, as well as academia and international partners, to develop a broad and competitive hydrogen market in Brazil. A significant part of the plan involves cooperation efforts within bilateral, multilateral and regional strategic partnerships to discuss and share insights on energy transition, with special focus on hydrogen's role in this process.²

In addition to government-sponsored funding from the National Social and Economic Development Bank (BNDES) and from the Federal Study and Project Funding Agency (FINEP), businesses, the capital market and foreign investors offer a wide array of green investment opportunities. Businesses show great interest in numerous hydrogen-related initiatives ranging from bioethanol-powered fuel cells to infrastructure to export hydrogen to Europe, for example.

Technology investors show enthusiasm for projects now in development in three Brazilian states (Pernambuco, Rio de Janeiro and Ceará) and in projects planned for another three (Bahia, Rio Grande do Norte and Espírito Santo). Companies now active in Brazil, such as Fortescue Metals Group, are committed to producing 50 million tonnes of green hydrogen globally by 2030 and show interest in producing hydrogen in Brazil both for domestic use (aiming at reducing the market share of imported fertilizers from 85 to 45% by 2050) and for export.

Brazil is poised to become a significant player in the production of hydrogen thanks to important natural features, the government's commitment to develop green hydrogen, a lively energy business environment and wise regulation. Ongoing investment in human capital and in technological and logistics capabilities puts Brazil in a privileged position to tap strategic international markets.

But Brazil needs policies that can at the same time help its comparative advantages come to fruition and spark new opportunities that will assist in the maintenance of its

2. For more information on PNH₂ and on the Brazilian hydrogen outlook, see the chapter "Uma Economia de Hidrogênio no Brasil" in the Whitepaper published in May 2022: https://www.cebri.org/media/documentos/arquivos/Noruega_Hidrogenio_Mai22.pdf, pg.14-17

leading position. Aspects such as technological neutrality, commitment to broad and varied international partnerships and the organisation of a competitive market are key for hydrogen's future in Brazil.

In Australia, as in Brazil, prospects for the development of green hydrogen are closely associated with the country's competitive advantages. Australia too offers excellent natural conditions for the production of hydrogen given its ability to generate energy from renewable sources, which are the most important input for the production of green hydrogen. The country is also building significant international partnerships and is actively working with partners such as Japan, South Korea and the European Union, Germany in particular.

On the other hand, the Australian Hydrogen Council believes those advantages alone are not enough to guarantee Australian leadership in future hydrogen projects and deems it essential to design effective public policies and to build a competitive and at the same time well-regulated market. Australia's National Hydrogen Strategy created the vision for a clean, innovative, safe and competitive hydrogen industry that can position Australia as a major global player by 2030. The plan rests on three main pillars:

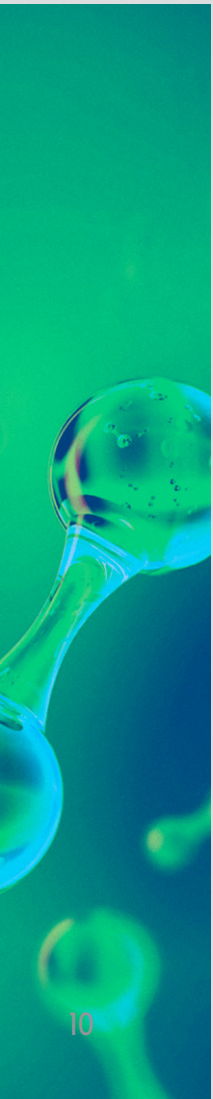
-
- 1. Expansion of renewable energies**
 - 2. Hydrogen certification in Australia**
 - 3. Demand-side support for hydrogen use**
-

The more than \$1.5 billion funding announced for hydrogen development is a powerful signal of political support. In addition, Australian governments are backing the 57 nationally coordinated government actions set out in the Strategy. It is estimated that businesses can contribute 3 to 4 times that amount, investing 6 billion dollars in the Australian hydrogen industry. That said, the cost of transition is high and the Australian Hydrogen Council expects more funding will be needed. A [Deloitte report \(2019\)](#) on the National Hydrogen Strategy estimated the development of the Australian hydrogen market will potentially raise GDP by 26 billion dollars per year and generate about 16,900 new jobs in the country by 2050.

An important aspect of the Australian Hydrogen Strategy is the close involvement of regulatory agencies in building traceability and standardisation processes for the renewable energy sector. Entities such as the Clean Energy Regulator (CER) have managed renewable energy certificates for the past 20 years and the ensuing transparency and guarantee of origin has contributed to accelerate investments in renewable energy in Australia. The certification approach has provided a safe environment for renewable energy producers to invest in and to extract value from their low-emission products.

Challenges and requirements to expand the production and use of green hydrogen

Major challenges to boost hydrogen use include the need for a larger scale market (industry and specialised infrastructure, increased consumption) and the technological and economic feasibility of larger projects, which presupposes significant investments and the choice of technological competitive routes.



Hydrogen's versatility is both an advantage and a challenge because it makes the creation of a comprehensive regulatory framework and its harmonisation worldwide more difficult. The guarantee of origin and energy source certification systems used in hydrogen production are very useful tools to help identify viable and traceable standards. Another significant issue concerns the balance in carbon incentive strategies. Governments must find a midpoint between promoting lower carbon footprint options and discouraging polluting technologies without disproportionately penalizing some industries.

The peculiarities of each hydrogen application must be carefully reviewed within a complex process to establish rules and standards for a new and dynamic market. The Australian and other governments are working to map statutes that may apply to hydrogen and to understand what new regulations may be necessary to foster the development of hydrogen production and demand. Regulatory agencies such as the Clean Energy Regulator (CER) focus on two key issues: facilitating the hydrogen market with emphasis on certification instruments and supporting growth in hydrogen demand.

Market facilitation through certification tools

Implementing hydrogen certification is a key action mentioned during the event, alongside incentives for infrastructure, research and qualifications. Some certification initiatives stand out as powerful tools to promote value generation on top of sustainable practices. The Australian Large-Scale Generation Certificate (LGC) is a clear and transparent mechanism to certify the purchase of renewable electricity that helps create a stable environment conducive to value generation. The underlying impact of the LGC is to provide a price signal for investors. The same logic can be applied to hydrogen so as to give the market the ability to extract value from its green customers.

Moving in that direction, Australian authorities are working on a hydrogen Guarantee of Origin system to build up global confidence in Australia's low emission products. The centrepiece of the system is a certificate that will provide information on the origin of the relevant product, whether hydrogen or a derivative such as ammonia, and on its carbon footprint. The Australian government expects the GO (Guarantee of Origin) scheme to be up and running by late 2023 with international reach and covering hydrogen production and hydrogen energy carriers. The policy design process includes several stages until the relevant legislation is enacted:

-
- 1. Development of a methodology aligned with IPHE
(International Partnership for Hydrogen and Fuel Cells in the Economy)**

 - 2. International consumer outreach trials**

 - 3. Co-design of scheme architecture in consultation with key stakeholders**

 - 4. Renewable energy accounting and certification**

 - 5. Legislation development**
-

The efforts now in progress focus on enabling emissions traceability at any point along the supply chain so as to provide clear and transparent provenance and origin data at each stage in the process. In December 2021 the authorities ran Guarantee of Origin trials to benchmark and validate the IPHE carbon accounting framework and to calculate emissions for real-world projects. More than 20 companies participate in hydrogen projects involving methane steam reforming, electrolysis and coal gasification. Phase 1 tested the early-stage carbon accounting framework and various hydrogen activities in Australia and the second phase will measure emissions from hydrogen, ammonia and liquid hydrogen transportation and storage processes.

Initiatives in support of the expansion of demand

On the other hand, the creation of regulations and incentives to reduce emissions and the continuous promotion of access to international markets can contribute to boost demand. The drive to substitute clean for conventional energy sources across the Australian economy is expected to cut emissions by some 100 megatonnes.

Initiatives such as the Safeguard Mechanism, which sets a basic cap on the amount of carbon an industrial facility is allowed to emit in a single year, can create additional demand for hydrogen. Authorised carbon emissions will be reduced as those baselines go down, encouraging more activities to turn to hydrogen as an alternative to fossil fuels and thereby increasing demand for hydrogen.

In furtherance of the transition process and to boost green hydrogen use, Australia will in 2023 implement the ACCU (Australian Carbon Credits) system. The purpose of that tool is to give credits (one ACCU unit for each tonne of CO₂eq.) when some high-emission fuel is replaced by clean hydrogen produced on site or injected from the distribution network.

Recommendations

1. **Move forward with the implementation of the Brazilian strategy for hydrogen**, with the objective of developing the domestic market while becoming a leading global producer.
2. **Foster investments** in hydrogen plants, port and specialized infrastructure, and clean energy production, based on the country's competitive advantages - ethanol, hydroelectricity, wind, solar, natural gas, biogas, nuclear, and other biomass - in the production and export of low-carbon hydrogen. Promote technological neutrality and diversity rather than locking-in technologies to boost competitiveness.
3. **Develop market regulation for clean hydrogen** in Brazil, in order to boost investor confidence and increase product value. Reinforce traceability and standardisation through processes such as certification of origin, to provide guarantees of low-emissions, with the involvement of certification agencies. To this end, Brazil could build on Australia's CER's experience in issuing renewable energy certificates, and monitor progress and lessons learned from the implementation of the GO (Guarantee of Origin) scheme. Currently there are already initiatives in Brazil to certify the renewable energy content, such as that of the Chamber of Commercialization of Electrical Energy CCEE.³
4. **Create incentives to expand the scale of the hydrogen market** through increased consumption, especially in the industrial sector. In particular, develop carbon market mechanisms to promote the use of low-emission fuels, drawing on examples such as Australia's Safeguard Mechanism or Carbon Credits system.
5. **Enhance and diversify Brazil's international partnerships** to spark market and investment opportunities, develop best practices and common standards, and promote benchmarking and collaboration on legislation and incentive mechanisms.

3. CEE will act as a certifier for the energy used to produce green hydrogen in Brazil", december 2021. Article available in portuguese [here](#).

Event participants



Agnes da Costa

Head of the Regulatory Advisory Office at the Brazilian Ministry of Mines and Energy



Cameron Mathie

Manager of Future Carbon Markets at Australia's Clean Energy Regulator



Dr Fiona Simon

CEO of the Australian Hydrogen Council



Luis Viga

Brazil Country Manager at Fortescue Future Industries



André Bello

Low Carbon Innovation Coordinator at Petrobras
MODERATION



Jorge Camargo

Vice-Chairman of CEBRI's Board of Trustees
OPENING



Board of Trustees

Chairman

José Pio Borges

Emeriti Chairman

Fernando Henrique Cardoso

Vice Chairmen

Jorge Marques de Toledo Camargo

José Alfredo Graça Lima

Founders

Carlos Mariani Bittencourt

Celso Lafer

Daniel Klabin

Gelson Fonseca Jr.

João Clemente Baena Soares

Marcus Vinicius Pratini de Moraes

Maria do Carmo (Kati) Nabuco de Almeida Braga

Roberto Teixeira da Costa

Eliezer Batista da Silva *(in memoriam)*

Luciano Martins de Almeida *(in memoriam)*

Luiz Felipe Palmeira Lampreia *(in memoriam)*

Luiz Olavo Baptista *(in memoriam)*

Sebastião do Rego Barros Netto *(in memoriam)*

Walter Moreira Salles *(in memoriam)*

Vice Chairmen Emeriti

Daniel Klabin

José Botafogo Gonçalves

Luiz Augusto de Castro Neves

Rafael Benke

Trustees Emeriti

Izabella Teixeira

Luiz Felipe de Seixas Corrêa

Luiz Fernando Furlan

Marcos Azambuja

Pedro Malan

Rubens Ricupero

Winston Fritsch

CEO

Julia Dias Leite

Board of Trustees

Ana Toni

André Lara Resende

André Clark

Armando Mariante

Armínio Fraga

Clarissa Lins

Demétrio Magnoli

Edmar Bacha

Francisco Müssnich

Henrique Rzezinski

Ilona Szabó

Joaquim Falcão

José Aldo Rebelo

José Luiz Alquéres

Luiz Ildefonso Simões Lopes

Marcos Galvão

Paulo Hartung

Pedro Henrique Mariani

Renato Galvão Flôres Jr.

Roberto Abdenur

Roberto Jaguaribe

Ronaldo Veirano

Sergio Amaral

Tomas Zinner

Vitor Hallack

International Board

Albert Fishlow
Alfredo Valladão
André Corrêa do Lago
Antonio Patriota
Felix Peña
Flávio Damico
Hussein Kalout
Ivan Sandra
Jackson Schneider
Joaquim Levy
Leslie Bethell
Marcos Caramuru
Marcos Jank
Monica de Bolle
Paolo Bruni
Sebastião Salgado

Senior Fellows

Adriano Proença
Ana Célia Castro
Ana Paula Tostes
André Soares
Benoni Belli
Carlos Milani
Carlos Pereira
Daniela Lerda
Denise Nogueira Gregory
Diego Bonomo
Evangelina Seiler
Fabrizio Sardelli Panzini
Francisco Gaetani
Igor Rocha
José Mario Antunes
Larissa Wachholz
Leandro Rothmuller
Leonardo Burlamaqui
Lia Valls Pereira
Lourival Sant'anna
Mário Ripper
Matias Spektor
Miguel Correa do Lago
Monica Herz
Patrícia Campos Mello
Paulo Sergio Melo de Carvalho
Pedro da Motta Veiga
Philip Yang
Rafaela Guedes
Ricardo Ramos
Ricardo Sennes
Rogerio Studart
Ronaldo Carmona
Sandra Rios
Tatiana Rosito
Vera Thorstensen
Victor do Prado

Members

Aegea
Air Products
Altera
Arara.io
BAMIN
Banco Bocom BBM
BASF
BAT Brasil
Bayer
BMA Advogados
BRF
Bristow
Brookfield Brasil
CCCC/Concremat
Consulado Geral dos Países Baixos no Rio de Janeiro
Consulado Geral da Irlanda em São Paulo
Consulado Geral do México no Rio de Janeiro
Consulado Geral da Noruega no Rio de Janeiro
Desenvolve SP
Dynamo
EDF Norte Fluminense
EDP
Eletrobras
Embaixada da Austrália
Embaixada da China no Brasil
Embaixada da Suíça
Embraer
ENEVA
ENGIE Brasil
Equinor
ExxonMobil
Furnas
Galp
Grupo Lorentzen
Grupo Ultra
Haitong
Huawei
IBÁ
IBRAM
Icatu Seguros
Instituto Clima e Sociedade
Itaú Unibanco
Klabin
Light
Machado Meyer
Mattos Filho Advogados
Museu do Amanhã
Microsoft
Neoenergia
PATRI
Petrobras
Pinheiro Neto Advogados
Promon Engenharia
Prumo Logística
Repsol Sinopec
Sanofi
Santander
Shell
Siemens
Siemens Energy
SPIC Brasil
State Grid
Suzano
Total E&P do Brasil
Unilever
Vale
Veirano Advogados
Vinci Partners

CEBRI Team

Executive Board

CEO

Julia Dias Leite

Director of External Affairs

Carla Duarte

Director of Projects

Luciana Gama Muniz

Academic Director

Feliciano Guimarães

Administrative Financial Director

Ana Paula Marotte

Projects

Deputy Director of Projects

Marianna Albuquerque

Projects Coordinators

Barbara Brant

Léa Reichert

Paulo Robilloti

Thais Jesinski Batista

Projects Analyst

Eduardo Neiva Souza

Projects Assistant

Larissa Vejarano

Intern

Daniel Fontes

External Affairs

Deputy Director of External Affairs

Fernanda Araripe

Director of Fundraising

Maria Eduarda Marques

Institutional Relations Coordinator

Fernando Mattos

Special Projects Coordinator

Caio Vidal

Special Projects Analyst

Lucas Bilheiro

Partnership Assistant

Beatriz Pfeifer

Communications and Events

Events Manager

Nana Villa Verde

Events Analyst

Adriano Andrade

IT Analyst

Eduardo Pich

Events Assistant

Isabella Ávila

Communications Assistant

Daniele Thomaselli

Administrative and Financial

Administrative-Financial Manager

Fernanda Sancier

Financial Analyst

Eliana Mello



Rua Marquês de São Vicente, 336
Gávea, Rio de Janeiro - RJ - Brasil
22451-044

Tel: +55 (21) 2206-4400
cebri@cebri.org.br

[@cebrionline](#)

cebri.org