International Partnership for Hydrogen and Fuel Cells in the Economy

Hydrogen and Fuel Cells in Brazil

Country Report

19th IPHE Steering Committee Meeting

London, UK – May 23-24, 2013

Ministry of Mines and Energy

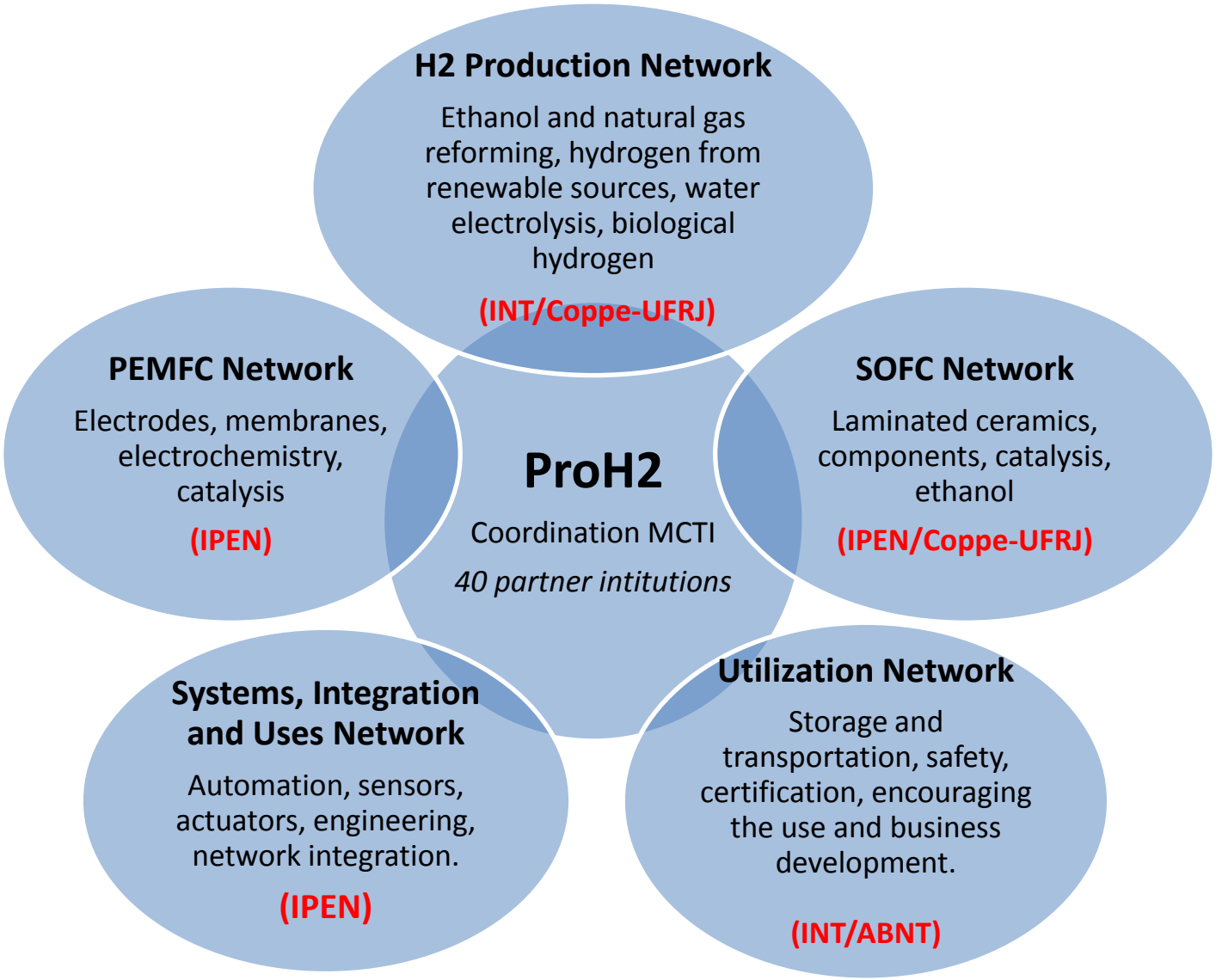
Ministry of Science, Technology and Innovation

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

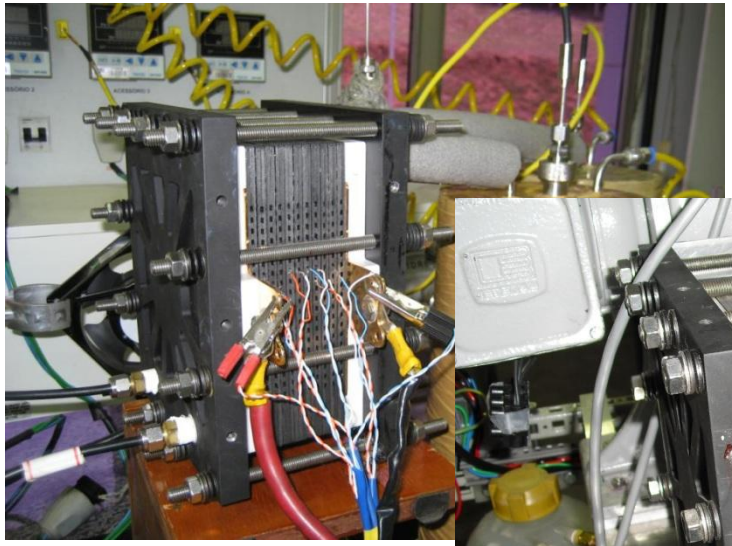
Brazilian R&D Program for Hydrogen and Fuel Cells – ProH2

- ProH2 Program celebrated its 10th anniversary in 2012, with total investments of ca. USD 56 million (from all partners);
- Coordination and mobilization of 40 laboratories in 20 research institutions distributed throughout the country;
- Objective: developing technologies for hydrogen production and fuel cell systems with focus on (i) production of hydrogen, preferably using ethanol, water electrolysis, other renewable sources and natural gas, and (ii) fuel cells for stationary use, (up to 50 kW), using hydrogen or ethanol directly;
- Results:
  - Development of national technology for hydrogen production and fuel cells, and about 20 patents on products developed by the networks (catalysts, membranes, etc.);
  - Development of norms and standards (ABNT) for hydrogen and fuel cells (usability and safety);
  - More than 200 PhD and master's degree theses.

Brazilian R&D Program for Hydrogen and Fuel Cells – ProH2

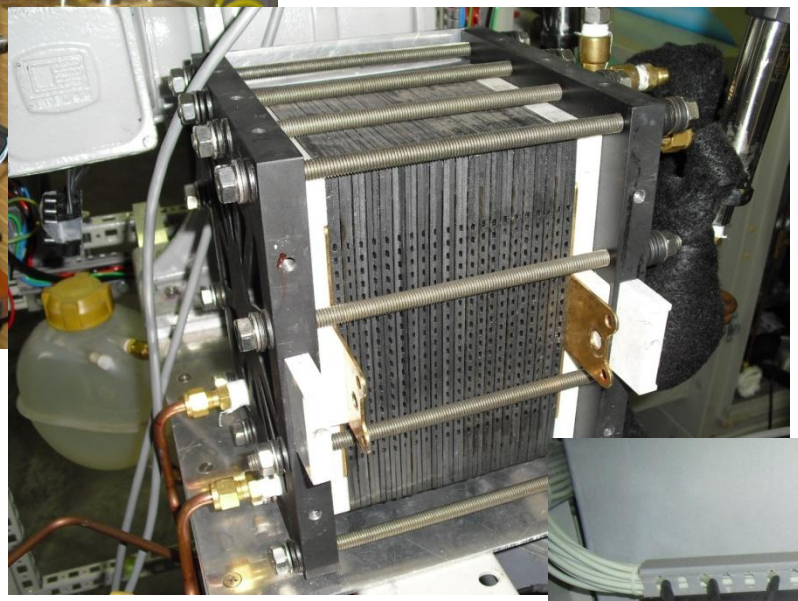


100% national technology fuel cell modules



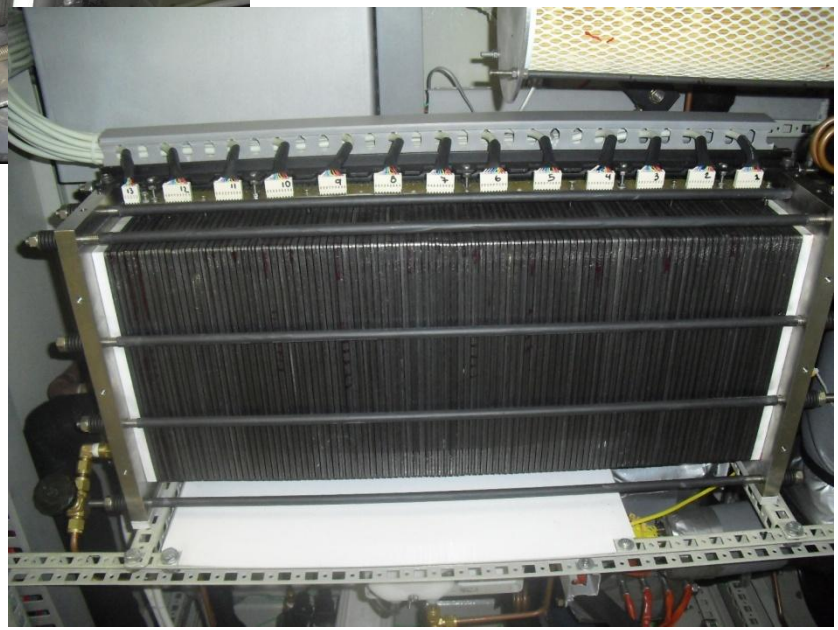
0.5 kW

- 2009 -



1.0 kW

- 2010 -



5.0 kW

- 2011 -

Technological Evolution 2009 to 2011

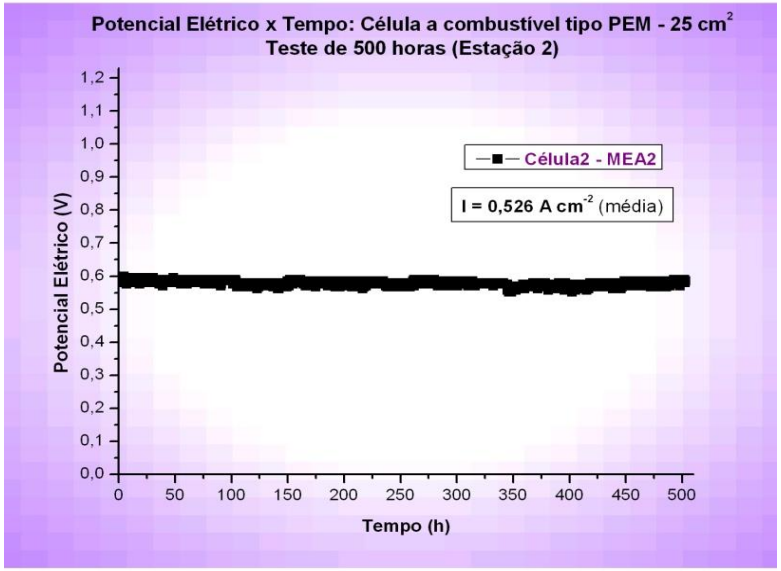
Source: IPEN, 2012.

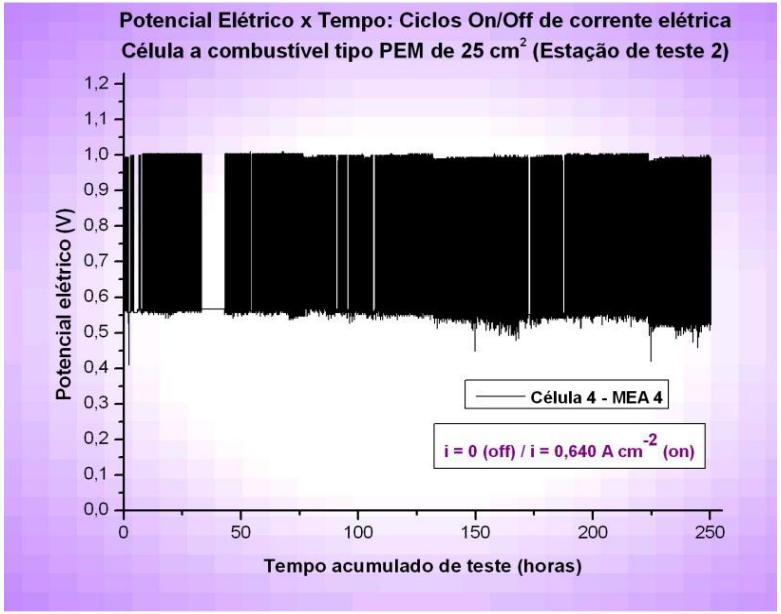
5 kW Module

200 MEAs (ELAT-Type) of 250 cm2 by Sieve Printing

Source: IPEN, 2012.

Reliability Studies in IPEN





Source: IPEN, 2012.

Recent activities (1)

- Brazil hosted last year the IEA-HIA Task 21 Annual Meeting – Bio-inspired and Biological Hydrogen, in Campinas/SP, April, 2012;
- 35 participants from 12 different countries, including researchers, and representatives from national and foreign companies;
- A technical visit to a company that has a 1000L-biological hydrogen pilot plant (partnership between Petrobras and Sapporo Brewery);
- Also took place a visit to the National Institute of Technology (INT), one of the national laboratories working on biological hydrogen production.

Recent activities (2)

- Six editions of the International Workshop on Hydrogen and Fuel Cells – WICaC, since 2002 – last edition occurred October, 2012, in Campinas/SP, with participation of top scientists and high officials from universities and companies;
- International Cooperation: support for three research groups from Brazil to visit Argentinian research groups working on hydrogen and fuel cells – three joint projects are already in elaboration;
- *Inova Energia*: new joint support plan for innovation in the energy sector has opened opportunities for R&D projects in hydrogen for transportation, for example, pilot projects of hydrogen fuel stations for hybrid/electric vehicles, batteries, fuel cells and other storage systems for hybrid/electric vehicles – 373 companies expressed interest (ca. USD 1.5 billion) – the result of the first phase (selected projects) is expected for May 23rd, 2013.

INOVA ENERGIA

Recent activities (3)

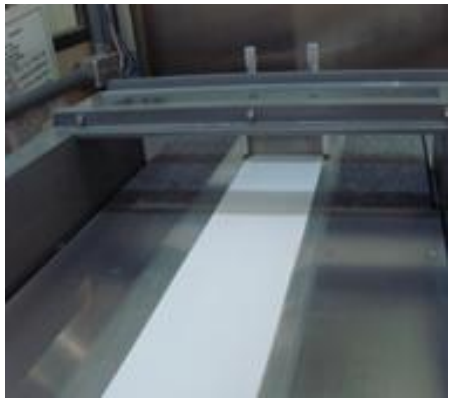
- During Rio+20 Conference, launch of the new prototype of the hydrogen hybrid-bus of Federal University of Rio de Janeiro - COPPE/UFRJ, that includes upgrades in the traction system and improvements in performance in comparison with the first one, demonstrated in 2010.

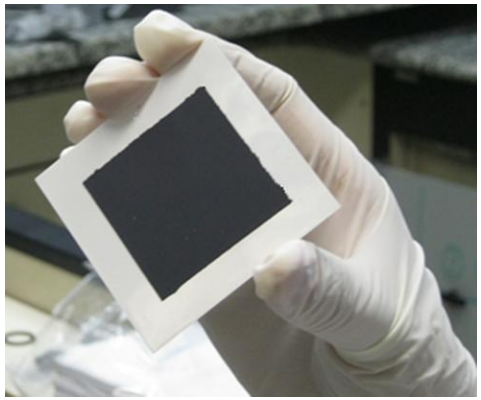
Some projects in development (1)

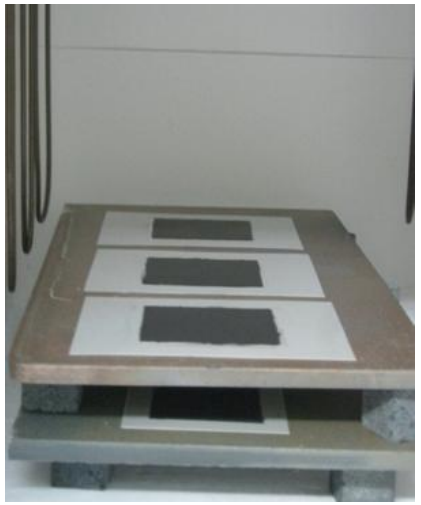
- **Brazilian Hydrogen Fuel Cell Buses for Urban Transport Project in São Paulo**: three new buses with hydrogen fuel cell are being manufactured with improvements on the previous prototype design. Delivery of the first bus is scheduled for the end of this year, while the delivery of the other two buses is scheduled for the first half of 2014. Hydrogen production (based on water electrolysis) and supply infrastructure is under commissioning process;

Some projects in development (2)

- ***PaCOS Project***: 4-year-project (2011-2015) of the Hydrogen Laboratory at COPPE/UFRJ, in partnership with companies Oxiteno S.A. and EnergiaH Ltd., for the development of SOFC with multifunctional anodes for distributed power generation with ethanol and for electrochemical conversion of methane into C2-hydrocarbons, with investments of R$ 15 million (USD 7.5 million);







OXITENO

ENERGIAH

Laboratório de Hidrogênio
COPPE/UFRJ
PEMM

COPPETEC FUNDAÇÃO

BNDES

COPPE UFRJ

Some projects in development (3)

- ***Furnas Bus Project:*** 2-year-project (2013-2015) of the Hydrogen Laboratory at COPPE/UFRJ, in partnership with the company Tracel Ltd., for the development of a bus with 100% electric traction system, and performance tests of urban buses with three different traction technologies – hybrid-hydrogen; hybrid-ethanol and 100% electric, with investments of R$ 10.5 million (USD 5.25 million);

- **Furnas Boat Project**: 4-year-project (2013-2017) of the Hydrogen Laboratory at COPPE/UFRJ, in partnership with the company Tracel Ltd., for the development and performance characterization of six boats with three different electric propulsion technologies – hybrid-hydrogen; hybrid-ethanol and 100% electric, with investments of R$ 51 million (USD 25.5 million).

  Two new hydrogen refueling infrastructures will be installed.

Eletrobras Furnas

Laboratório de Hidrogênio COPPE/UFRJ PEMM

COPPE UFRJ

TRACEL Veículos Elétricos

COPPETEC FUNDAÇÃO

Some projects in development (4)

- ***Project NG reformer, HT-PEMFC***: three-year project (2012-2015) of Hytron company, in partnership with BG Brazil and Instituto Inova, that aims at developing and operating a natural gas reformer, capable of supplying hydrogen to a high temperature PEM fuel cell of 15 kW (electric) and at evaluating the system in technical, economic, environmental and energy efficiency aspects – budget of US$ 1.53 million;

- ***BAESA Project for H2 from spilled turbinable water:*** two-year project (2012-2014) of Hytron company, in partnership with BAESA hydropower company, which objective is to study technical, economic and environmental aspects of turbinable energy of Barra Grande Hydro Power Plant to produce hydrogen, and reconverting it into electricity. The project also aims at designing and building an alkaline water electrolysis pilot plant and at installing and adjusting a hydrogen generator set to operate efficiently – budget of US$ 1.28 million;

Some projects in development (5)

- ***AES Tietê Project for H2 from ethanol reforming***: three-year project (2010-2013) from Hytron company, in partnership with AES Tietê company, with the objective of developing a prototype of electric generator: an auxiliary power unit that comprises an ethanol reformer, a high temperature proton exchange fuel cell and an inverter for grid connection. The project also aims at designing and building a non-catalytic reactor for ethanol reforming to produce hydrogen. The reactor design is innovative, unique in the Brazilian context, and it can be used for processing other fuels, such as glycerol and natural gas – budget of US$ 1.61 million.

AES a força de ser global

Hytron TECNOLOGIA EM HIDROGÊNIO

Some projects in development (6)

- ***1 kW PaCOS Project:*** 3-year project (2011-2014) of the LAMPAC/UFMG laboratory for the development of a 1 kW solid oxide fuel cell prototype with investments of R$ 6 million (US$ 3 million).

LaMPaC
LABORATÓRIO DE MATERIAIS E PILHAS A COMBUSTÍVEL
UFMG - CEMIG

CEMIG
A Melhor Energia do Brasil.

Departamento de Química
UFMG

Some projects in development (7)

- ***R&D projects developed under the Power Sector R&D Program, regulated by Aneel (power sector regulatory agency):*** at the moment, there are 18 projects in development, an investment of R$ 40 million (USD 20 million);
- MCTI and Aneel, under their joint committee, intend to foster closer links between the research groups that participate in the ProH2 Program and the power companies that have developed projects through its mandatory R&D program – a workshop is planned to be held next September.

Other activities

- Approval of the Brazilian application to host the 22nd WHEC – World Hydrogen Energy Congress, in 2018, in Rio de Janeiro/RJ;
- Support for the construction of two pilot plants for hydrogen production (ethanol and natural gas reforming) – USD 700,000.00;
- New national public call for R&D projects in hydrogen and FC in universities and research institutions – USD 3 million;

New opportunities...

- Opportunities for H2 and FC R&D projects in other public calls that may also be held in 2013 (e. g. combustion, biotechnology);
- ***Recent regulation for small scale decentralized generation*** (until 1 MW) allows consumers to become small power generators and exchange energy with the local power utility. At the moment, the rule applies just for subsidized energy sources (solar, hydro, wind, biomass and cogeneration) – fuel cells can benefit from this rule in the near future;
- ***Science without Borders Program***: to promote ST&I in Brazil by international exchange and mobility. The program aims at increasing the presence of students, scientists and industry personnel from Brazil in international institutions of excellence and inducing the internationalization of universities and research centers in Brazil – hydrogen and fuel cells are eligible (link: http://www.cienciasemfronteiras.gov.br/web/csf);

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