Hydrogen and Fuel Cells Initiatives in Mexico

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- Fuel Cell Network
- Hydrogen Bus in Mexico City
- Hydrogen National Plan
- Hydrogen Network
- Nanotechnology Network
- H&FC at IIE
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Energy Facts (2002) :
Total final use 3,828.9 PJ
Supply

Fossil fuels: 75.9%
Electricity: 15.2%
Biomass: 8.9%

Profile of the Mexican Power Sector

Total Current Generating Capacity: 41,177 MW

- Fossil fuels: 80%
- Large-scale hydro: 12.4 %
- Nuclear: 4.8%
- Geothermal: 2.7%
- Wind & other renewables: <<1%

Government-owned utilities CFE and LFC serve the whole country: 95% grid coverage

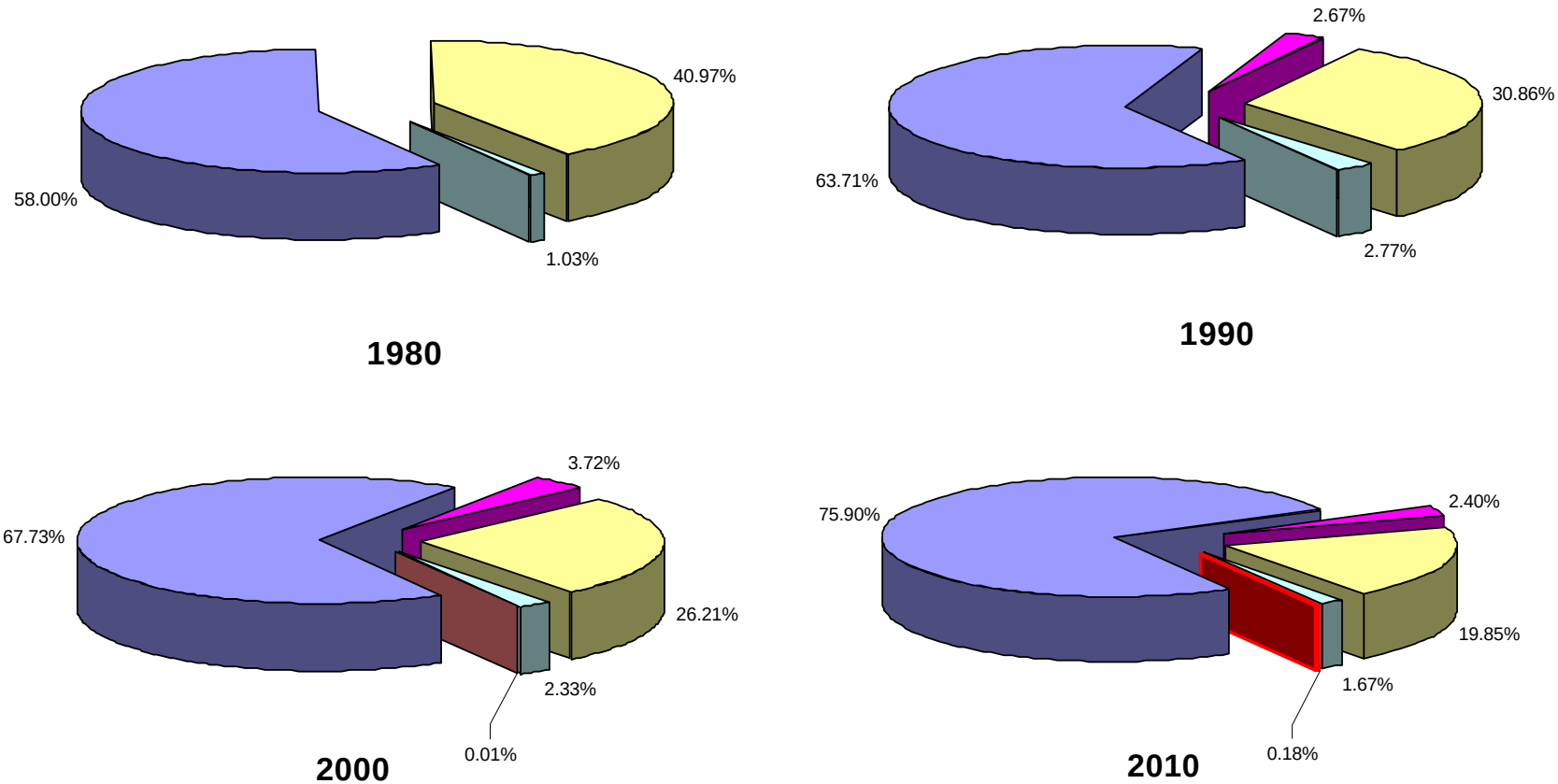
New Power Requirements

2003-2012: 25,757 MW

- **Committed: 12,087 MW**
- **Not Committed: 13,670 MW**

- Natural gas combined cycle: 34.2%
- Other fossil-fuelled: 5.8%
- Large-scale hydro + geothermal: 7%
- Other renewables: not considered

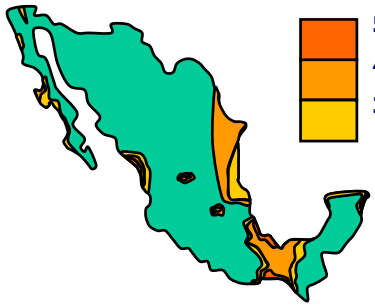
Renewables in the Mexican Power Sector



- **Large potential for green power in Mexico (H_2 included)**
- **Technical and non-technical changes required to tap this potential**
- **Strategies to remove barriers need to be developed and implemented**
- **Capacities to identify and tap niches of opportunity need to be developed**
- **Mechanisms to level the playing field for renewables must be introduced**
- **Effective coordination among stakeholders, necessary**
- **New energy culture must be fostered.**

Renewable Energy Resource Base

Solar Irradiance:
5 kWh/m2-day
evenly distributed



Wind Potential:
5,000 MW
Commercially viable now. Larger overall.

Bioenergy:

Full potential not known.

Forest residues and energy plantations: unknown

Manure and agricultural residues: Unknown

Trash-to-energy: ca 1,000MW

Sugarcane bagasse: ca 250 MW

Micro and mini-hydro:
Full potential not known
At least 3,500 MW

Ocean Energy
Unknown potential

Hydrogen Mexican Society - HMS
(Sociedad Mexicana del Hidrógeno – www.smh.org.mx)

Sociedad Mexicana del Hidrógeno A.C.

- Formed in 1999 by academia and Hydrogen producers
- Promotes use of Hydrogen as a Fuel
- Disseminates the Benefits and Opportunities of using Hydrogen
- Organizes a yearly Technical National Congress
- Provides Vocational Information for Students
- It is preparing curricula for graduate studies based on Renewables
- Volume on Hydrogen Technologies for ANES

Hydrogen Mexican Society - HMS

(Sociedad Mexicana del Hidrógeno)

Sociedad Mexicana del Hidrógeno A.C.

- Has been involved in International Meetings representing Mexico (Bilateral USA-Mexico, Trilateral USA-CAN-MEX)
- Has Organized Forums w/Gov's officials to integrate H2 in Mexico's Energy Agenda
- Represents Mexico as an observer within the Partnership for Advancing the Transition to Hydrogen (PATH)

Fuel Cells Network of the HMS

(Sociedad Mexicana del Hidrógeno)

- Foster Collaborative Work among institutions
- Leverage scarce budgets
- Share infrastructure and human resources
- Eventually integrate an Iberoamerican FC Network together w/other similar networks

Hydrogen Bus in Mexico City

- "Fuel Cell Bus Demonstration and Associated Hydrogen Filling System in Mexico City", MEX-01-G31-A-1G-99 (GEF-Mexico Financed Project)
- Executing Agent is SETRAVI (Mexico City Electrical Transport Agency)
- Implementing Organization: UNDP
- Original Proposal considered up to 10 buses in 5 years (unlikely)
- Includes the development of infrastructure for Hydrogen production and Refuelling
- Preparing technical specifications of Bus and Filling Station
- Has faced difficulties (change of coordinator, new technology)
- H2 Technology will be compared with other "clean" technologies

Hydrogen National Plan

- Proposals based on Projects of Practical Nature
- Hydrocarbons are a strong component
- To establish Energy Policies is not a Problem
- Challenges include getting Commitment from Government to Support some components such as Educational and RD&D programs
- Not concluded yet

Hydrogen Network

- Was formed in 2003 in the National University
- Objetive: Foster Industrial Projects
- Members include the Energy Secretariat, National Labs, others.

Nanotechnology Network

- In the process of being formed
- Basic Research on Nanostructured Material
- S&T Mexican Council Reaserch Centers are main members

Others

- APEC Hydrogen initiative
- IPHE – interest of Mexico's Energy Secretariat

H&FC at IIE

- Renewable Hydrogen Generation
- Objetive: Generate hydrogen from PV solar Energy Surplus

Load

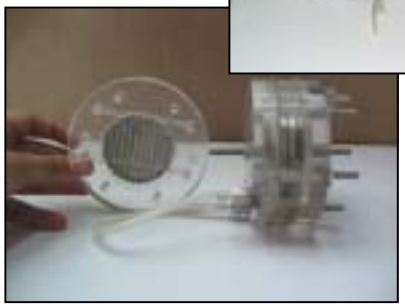
PEM Genera-tor

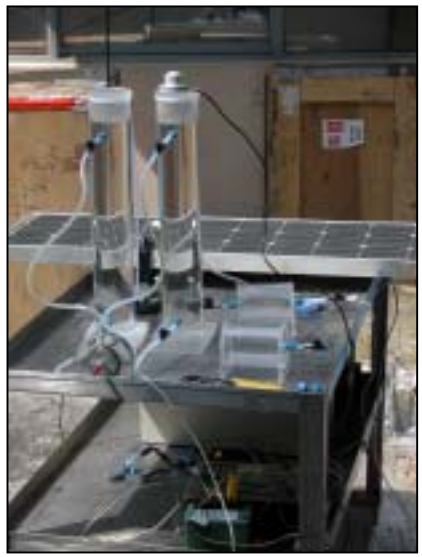
Surplus Solar Energy

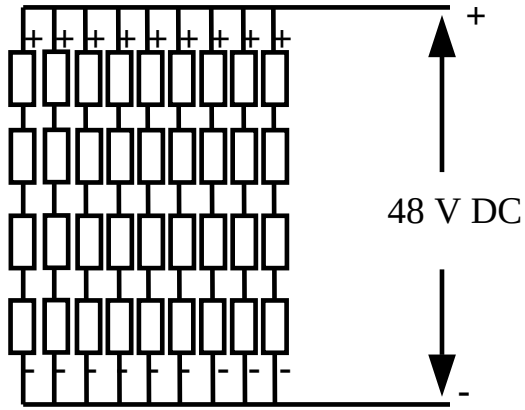
Renewable Hydrogen

hydrides

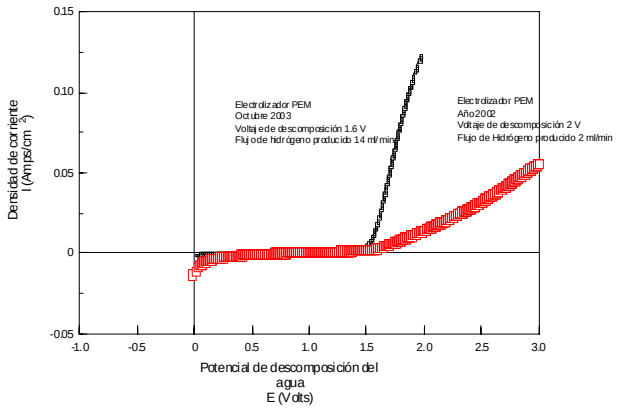
Stored Hydrogen

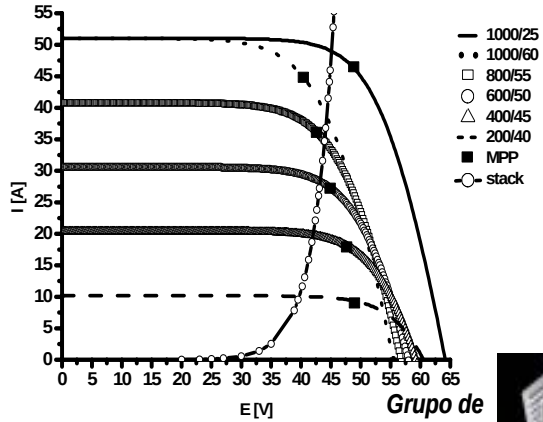






R&D → Prototype → System Design



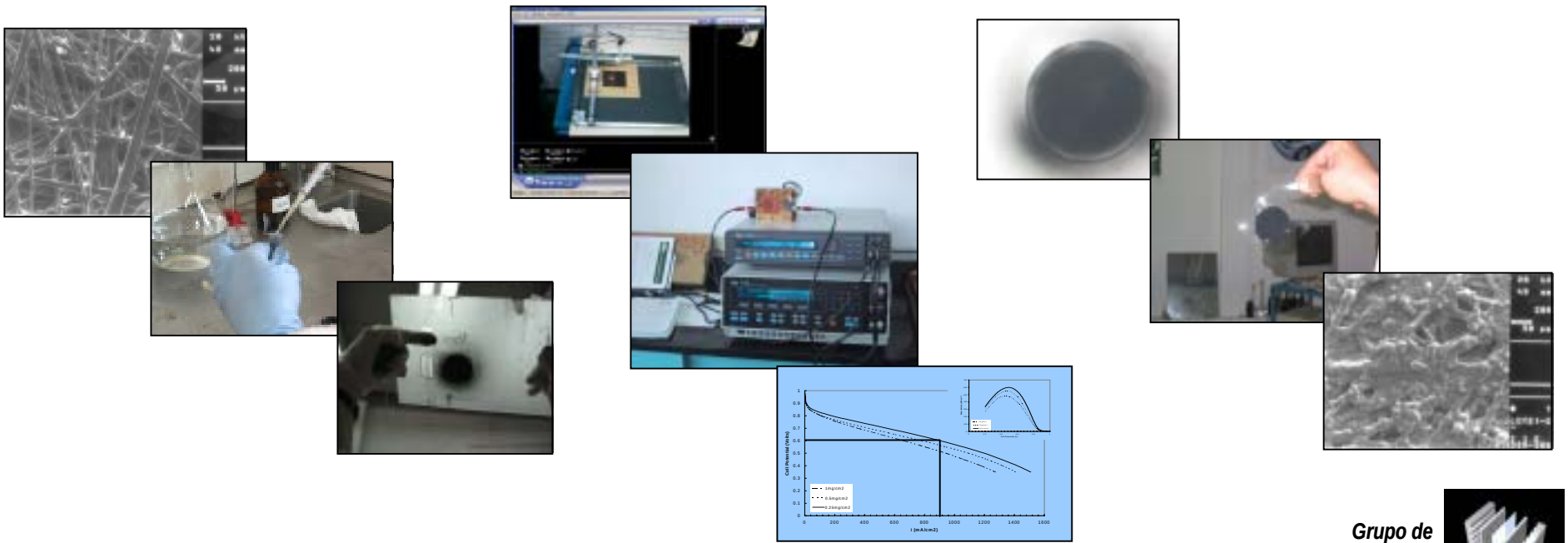


Grupo de Hidrógeno y Celdas de Combustible

H&FC at IIE

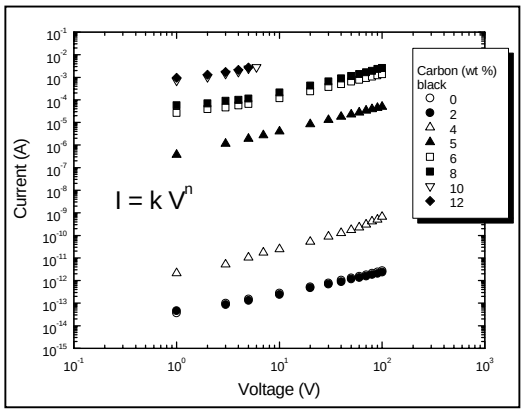
- Low Power PEMFC Generation Systems
- Objetive: Develop PEMFC technology for niche applications

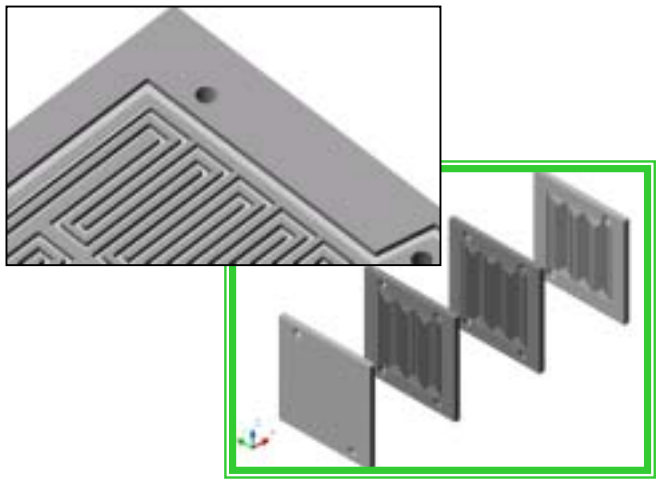
MEA engineering

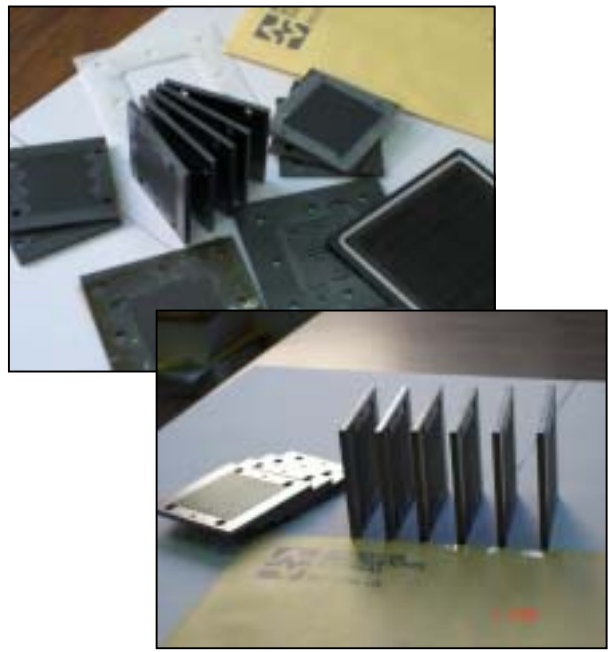


H&FC at IIE

- **Bipolar Plates Development**
  - **IIE's own formulation**
  - **Conduction Mechanisms**
  - **Design and Manufacturing**



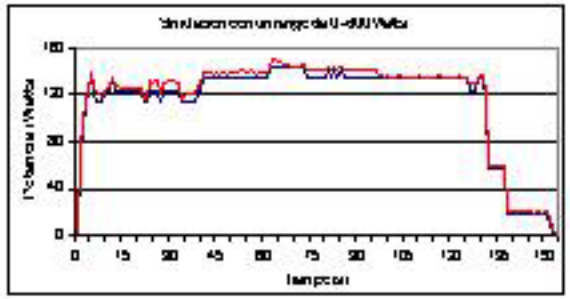




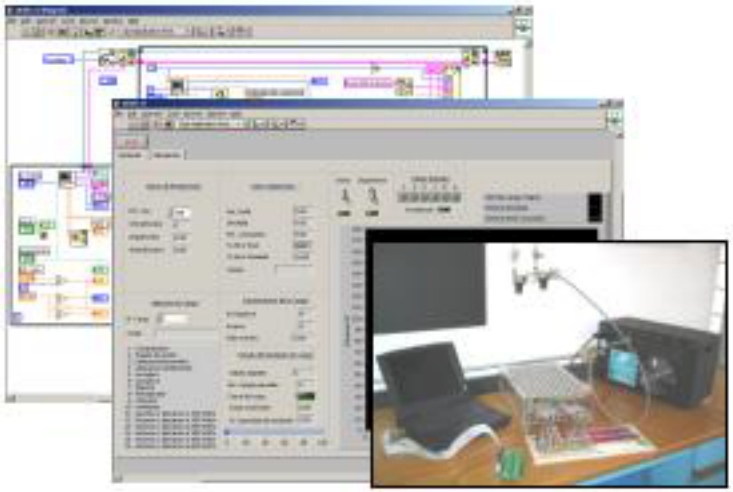
Systems

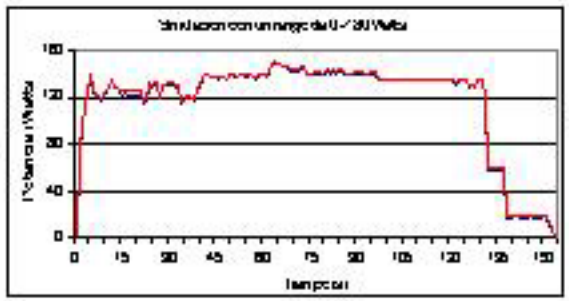
Commercial FC Technology Evaluation

INSTITUTO DE INVESTIGACIONES

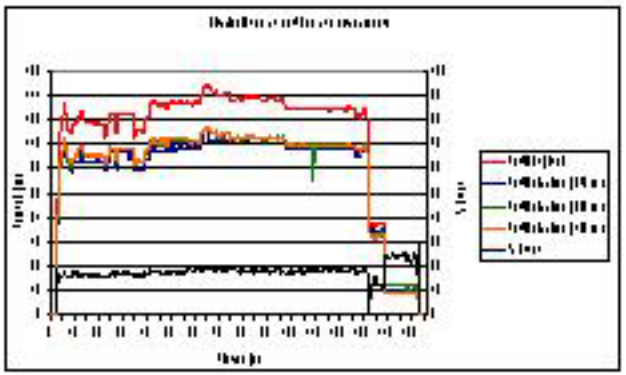


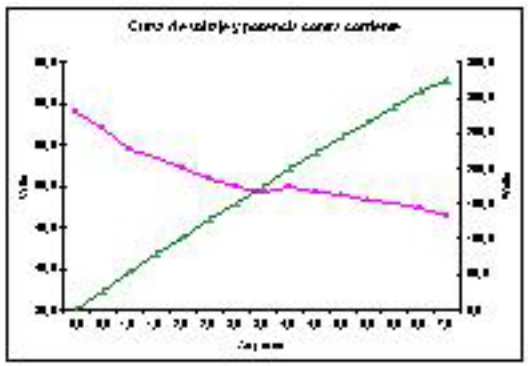
Residential load profile data logging





Digitally simulated load profiles coupled to a fuel cell

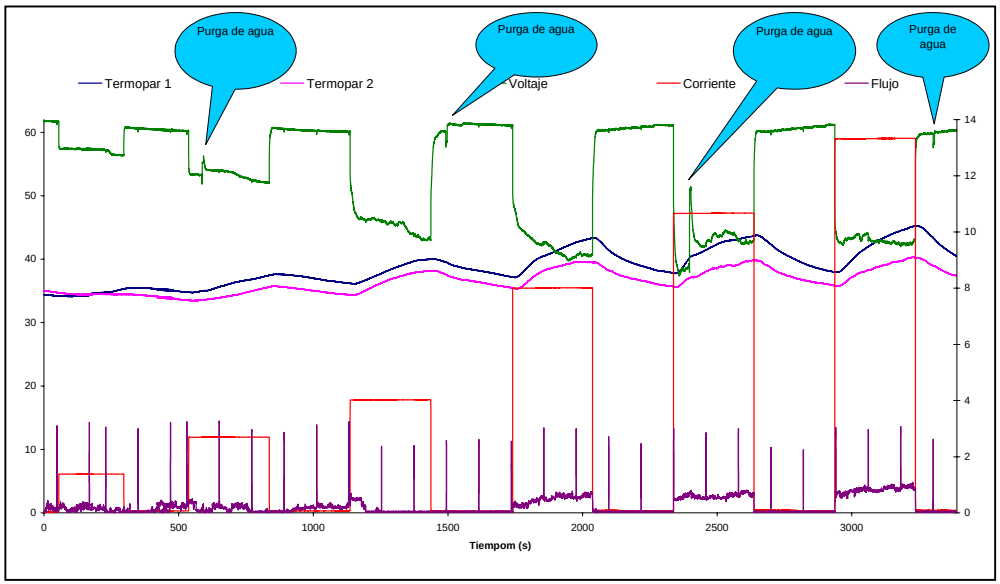


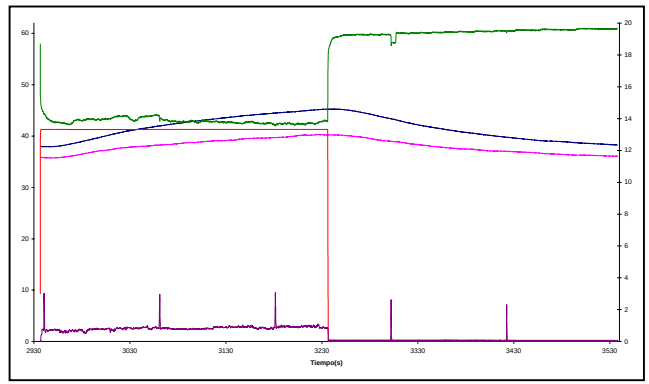


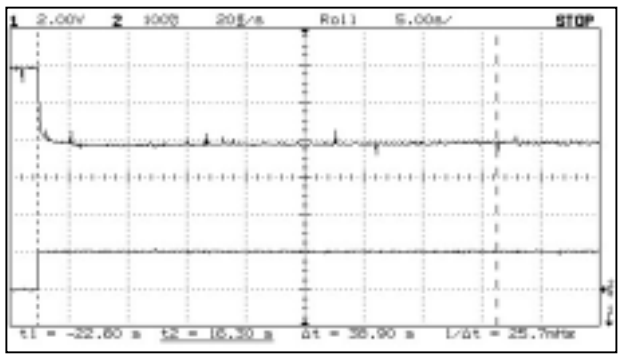
FC response evaluation due to changes in load profile + analysis

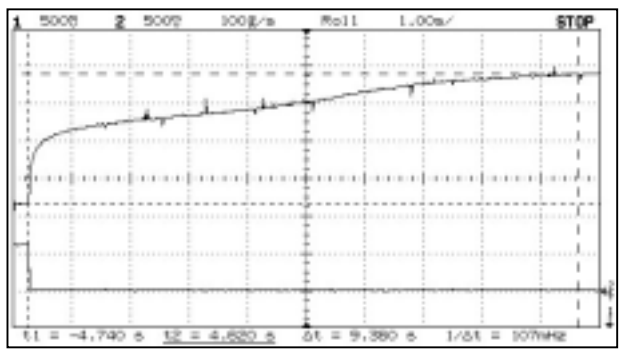
Systems Evaluation

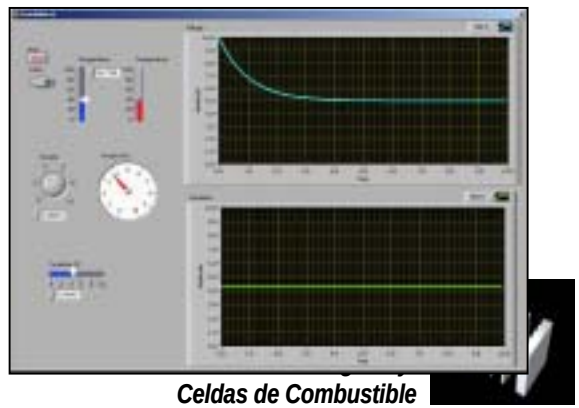
FC System Dynamics (transient response): modelling – emulator development for Power Electronics and Control Estrategies







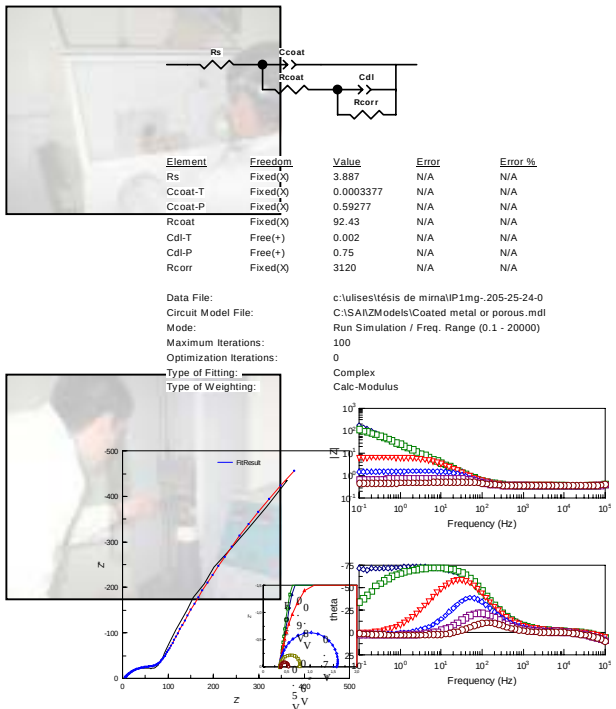


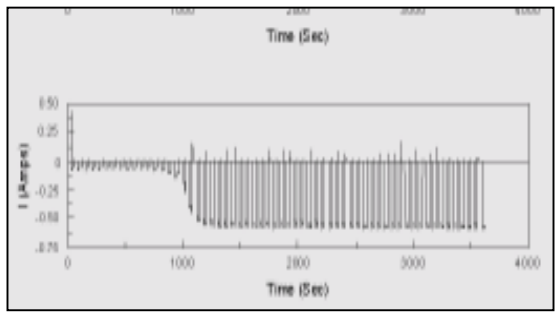


Celdas de Combustible

H&FC at IIE

- H&PEMFC Technology R&D
- Objetive: Develop the necessary elements for the integration of Hydrogen and PEMFC systems technology, including development of tools or own methods (diagnosis, testing, manufacturing techniques, QC)





H&FC at IIE

- IEA Advanced Fuel Cell Agreement (Portable Fuel Cells Annex)
- MOU with UBC-IFCI in Vancouver, Canada (IIE's researcher doing Ph.D.)
- IIE's researcher doing Ph.D. in Fraunhofer Institut (ISE) in Germany
- Received students from Germany and Switzerland (Paul Scherrer Institute)
- Fuelcell Propulsion Institute (IIE's participation 2000-2002)
- FC2000 and USFCC – FC info in Spanish

Conclusions

- There is interest on Hydrogen in Mexico
- Ongoing R&D in Universities and Research Centers
- Hydrogen Producers interested too
- Government Committment is not clear
- PEMEX divided opinions
- R&D needs to be coordinated among institutions
- plan should be completed to consider necessary elements (infrastructure, human resources, public education, etc.)
- steps are being taken

Muito Obrigado pelo Convite...!