Energy and Climate Change: from Scientific Research to Policy Implementation

Maria da Graça Carvalho

Member of the European Parliament

Imperial College, 13th June 2011

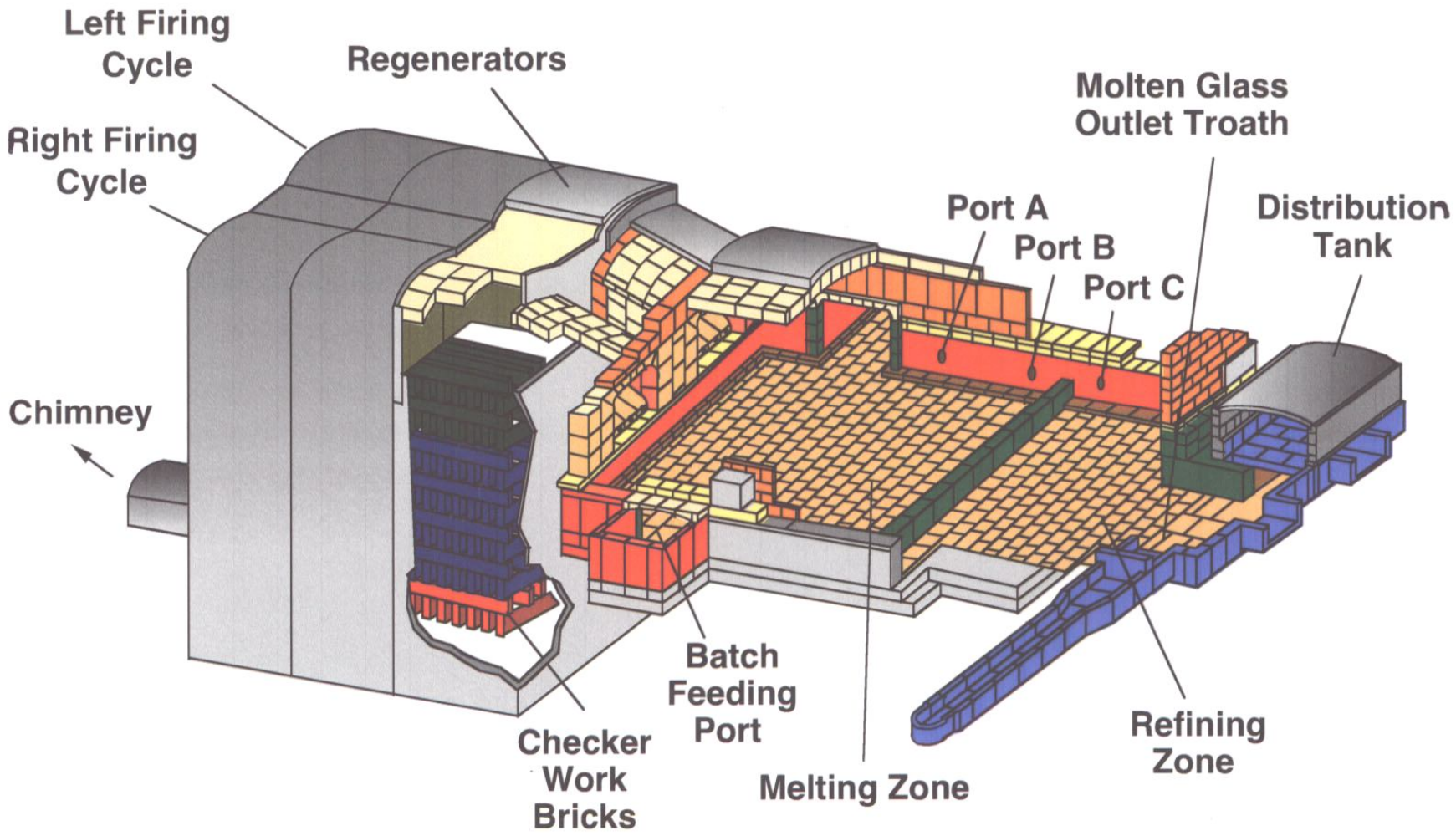
Content of the Presentation

- **30 Years of Research Work**
  - ✓ Fundamental Research and Enabling Technologies
  - ✓ Clean Energy Production
  - ✓ Energy efficiency
  - ✓ Energy Policy and Planning
  - ✓ Energy for Development
  - ✓ Climate Change

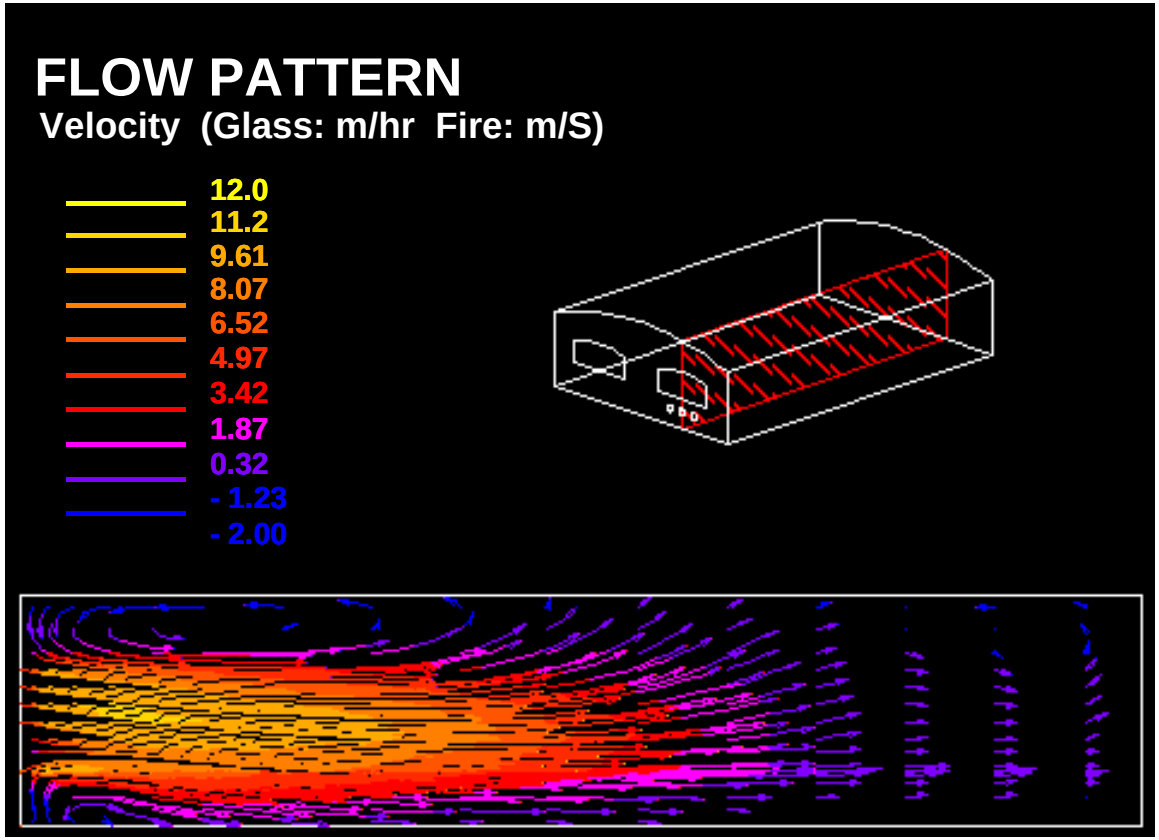
- **15 Years of Public Policy Development**
  - ✓ European Strategy for Energy and Climate Change
  - ✓ International Negotiatios under UNFCCCC

30 Years of Research Work

Mathematical modelling of na industrial glass furnace, **Imperial College 1983**



Mathematical modelling of na industrial glass furnace, **Imperial College 1983**

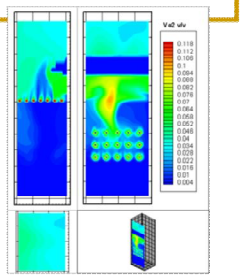


Clean Energy Production

- Clean Combustion
- Renewable Energies
- Hydrogen and Fuel Cells
- CO_2 and Climate Change

Fundamental Research and Enabling Technologies

- Computational Fluid Dynamics
- Modelling of Industrial Combustion Equipment
- Pollutant Emissions Formation in Combustion
- Modelling of Radiative Heat Transfer
- Experiments in Flames and Laboratory-Scale Furnaces

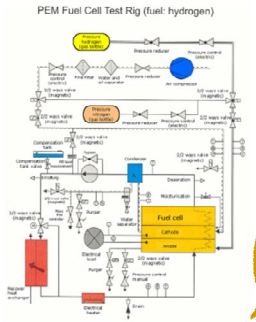


FUNDAMENTAL RESEARCH AND ENABLING TECHNOLOGIES

APPLIED RESEARCH

- **Clean Energy Production**
- **Efficient Use of Energy**
- **Energy Policy, Planning and Sustainable Development**

Transfer of Technology and Dissemination



Energy Policy, Planning and Climate Change

- Energy Policy and Planning
- Energy for Development
- Climate Change

Efficient Use of Energy

- Clean Technologies and Energy Efficiency in Industry
- Energy in Urban Environment
- Clean Urban Transport

FUNDAMENTAL RESEARCH AND ENABLING TECHNOLOGIES

- Modelling of Radiative Heat Transfer
- Soot Radiative Properties
- Modelling and Validation of Industrial Combustion Equipment

MODELLING OF RADIATIVE HEAT TRANSFER
- Comparison of Methods -

Comparison of modelling of radiative heat transfer methods

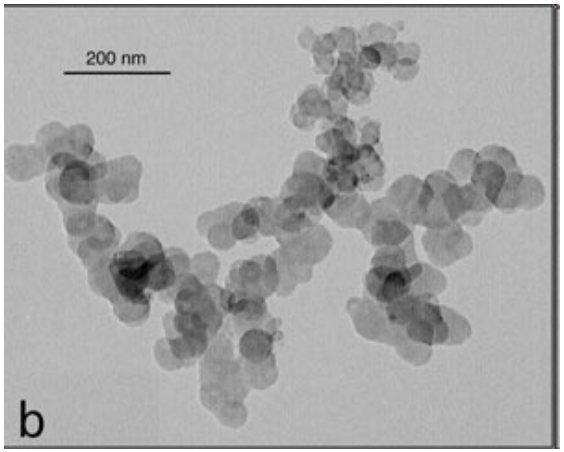
- MultiDimensional Modelling of Radiative Heat Transfer in Scattering Media (Carvalho, Farias, e Fontes, Journal of Heat Transfer, Volume 115, pp. 486-489, 1993)

2D cylindrical enclosure containing an absorbing-emitting medium

SOOT RADIATIVE PROPERTIES

- A Recipe for Image Chracterization of Fractal-Like Aggregates (Brasil, Farias e Carvalho, Journal of Aerosol Science, Vol. 30, 10, 1379-1389, 1999)
- Evaluation of the fractal properties of cluster-cluster aggregates (Brasil, Farias, Carvalho, Aerosol Science and Technology, Vol. 33; pp. 440-454, 2000)
- Numerical Characterization of the morphology of aggregated particles (Brasil, Farias, Carvalho e Koylu, Journal of Aerosol Science, Vol, 32, 489-508, 2001)

Hierachical cluster-cluster model



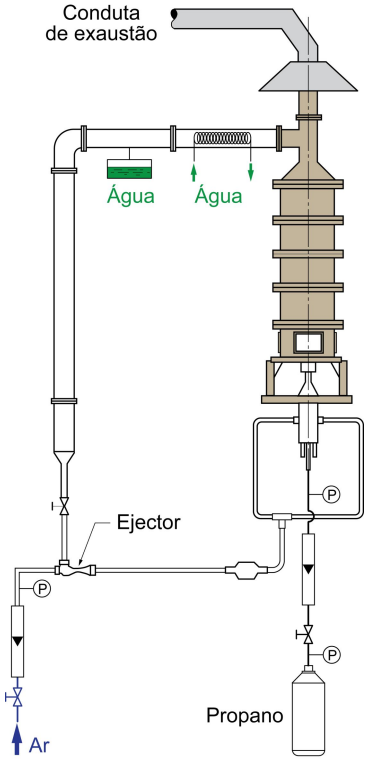
Fonte:http://www.mpbs.wnoz.us.edu.pl/moje_sadze/sadze.html

SOOT RADIATIVE PROPERTIES

- Computational Evaluation of ApproximateRayleigh-Debye-Gans/Fractal Aggregate Theory for the Absorption and Scattering Properties of Soot (Farias, Carvalho, Koylu e Faeth, Journal of Heat Transfer, Vol. 117, pp. 152-159, 1995)
- Effects of Polydispersity of Aggregates and Primary Particles on Radiative Properties of Simulated Soot (Farias, Koylu e Carvalho, Journal of Quantitative Spectroscopy and Radiative Transfer, Vol. 55, N.º 3, pp. 357 - 371, 1996)
- Range of Validity of the Rayleigh-Debye-Gans/Fractal-Aggregate Theory for Computing Optical Properties of Fractal-Like Aggregates (Farias, Carvalho e Koylu, Applied Optics, Vol. 35, N.º 33, pp. 6560 - 6567, 1996)

Flue Gas Recirculation (FGR)

- Flue gas recirculation in a gas-fired laboratory furnace: measurements and modelling (Baltasar, Carvalho, Coelho e Costa, Fuel, Vol. 76, pp. 919-929, 1997)



Combustion Air Staging

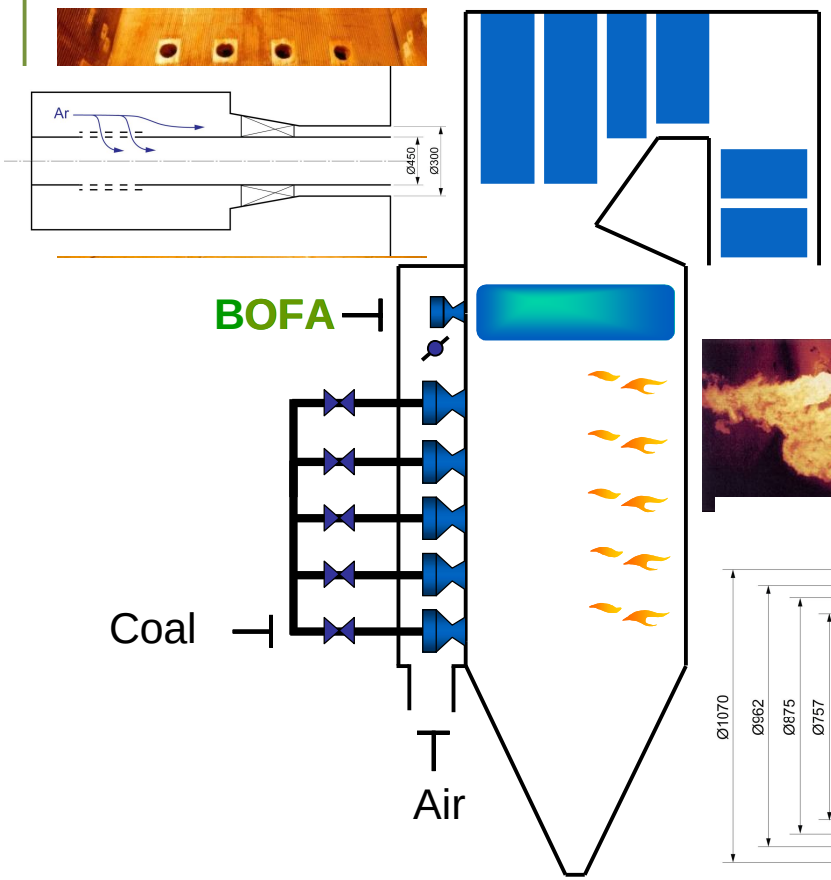
CLEAN ENERGY PRODUCTION

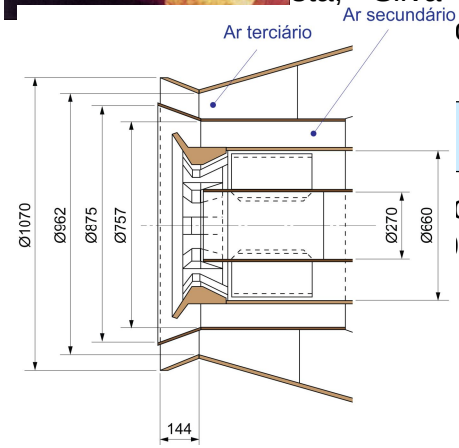
- Clean Combustion – Coal
- Clean Combustion – Fuel-oil
- Hydrogen and Fuel Cells

Boilers at Sines Power Plant – Measurements

CLEAN COMBUSTION – COAL
- Sines Power Plant -

Boilers at Sines Power Plant – Results





	NOx (mg/Nm3@6%O2)	Carbono nas cinzas (%)
Caso base	1405	2,5
QFS	997	3,2

Costa, Azevedo e Carvalho, *Combustion Science and Technology*, Vol. 129, pp. 277-293, 1997

+ OFA	620	4,1

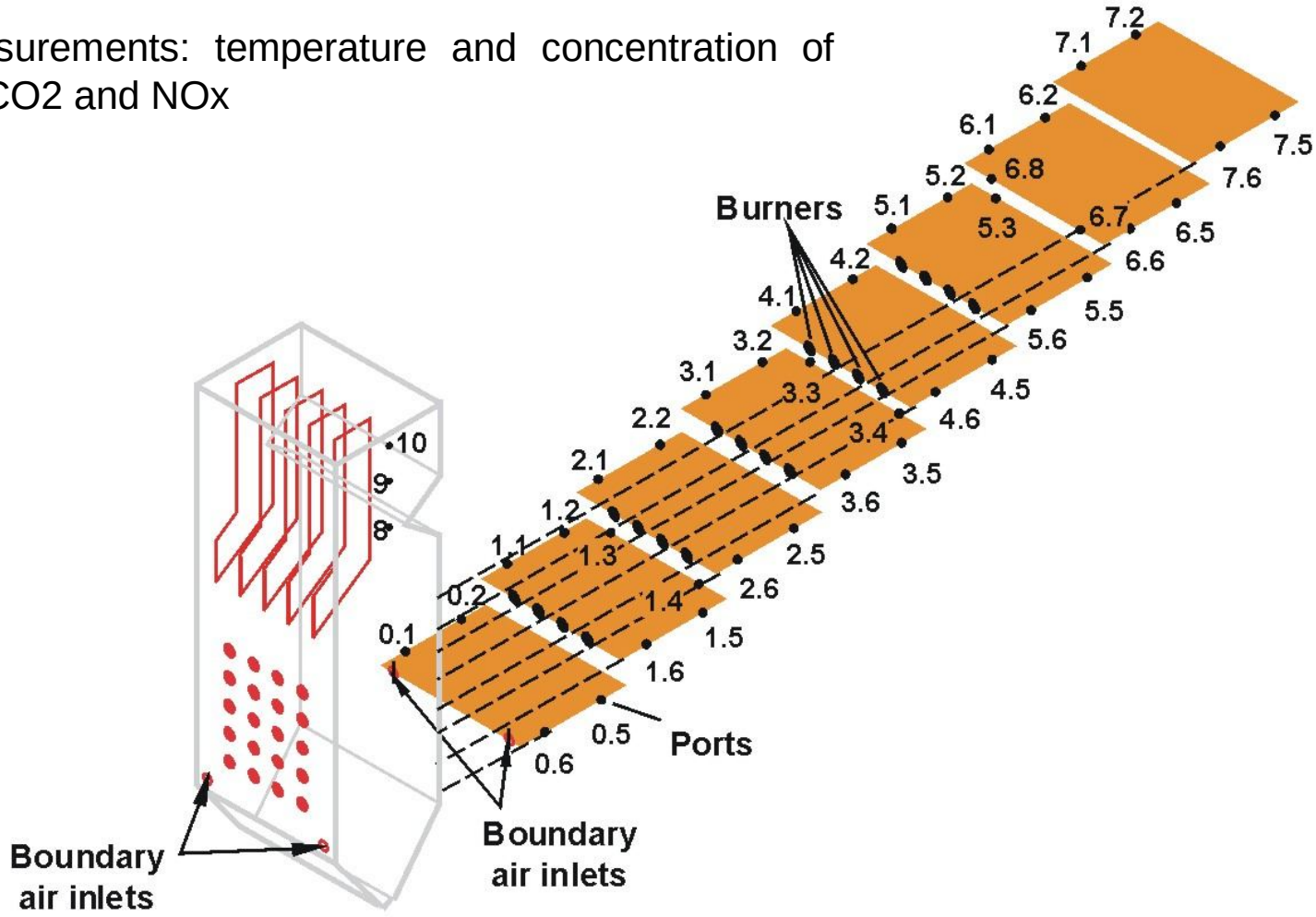
sta, Silva e Azevedo, *Combustion Science and* ol. 175, pp. 271-289, 2003

469	5,8

do, *Combustion Science and Technology*, 23-1935, 2007

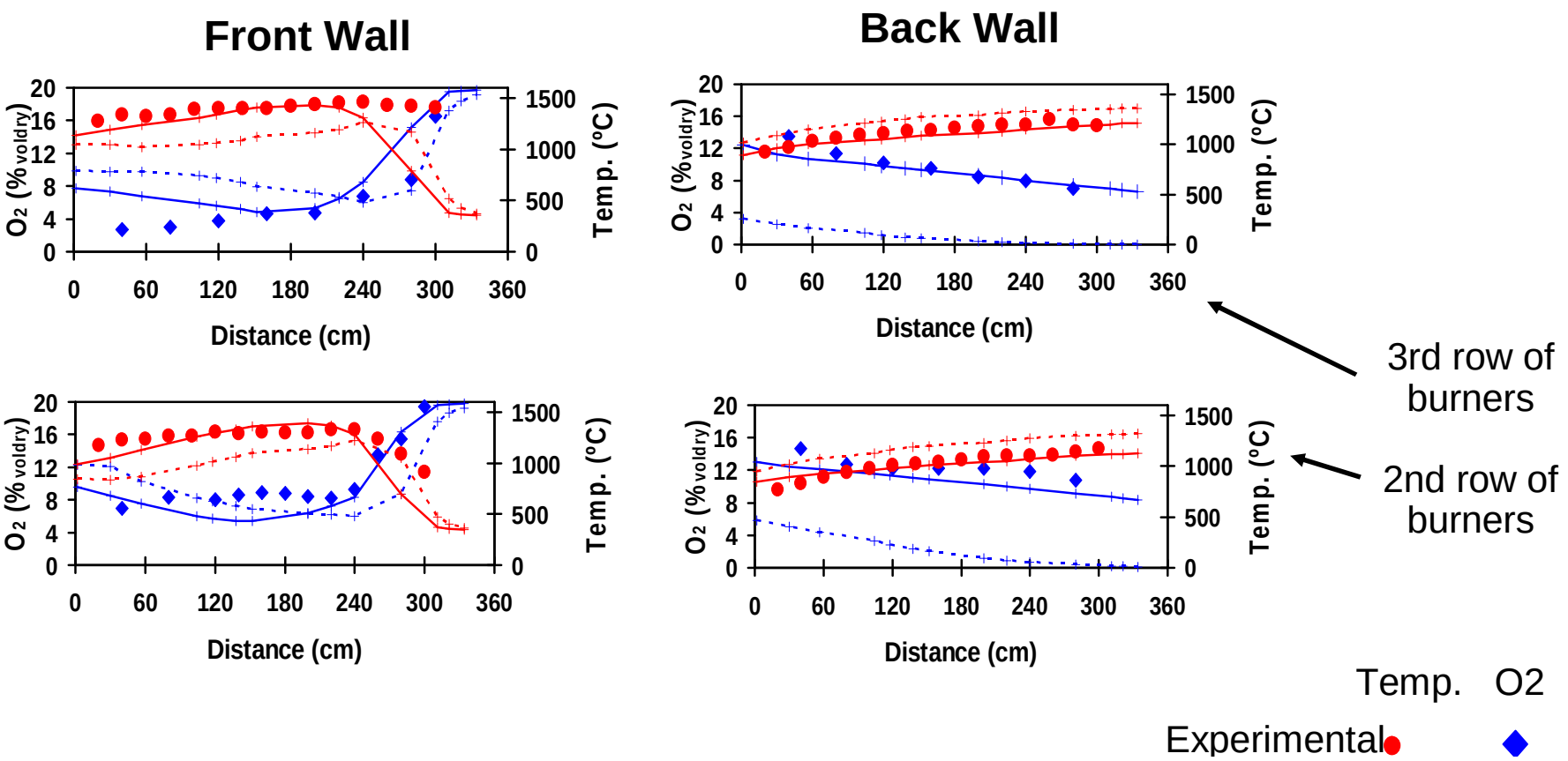
ACORDE Model

- Measurements: temperature and concentration of O2, CO2 and NOx



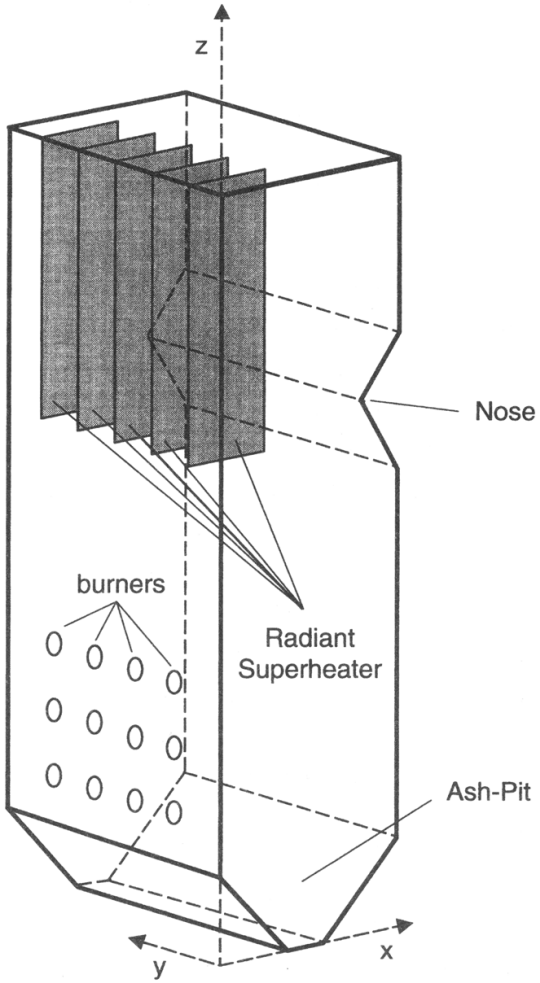
CLEAN COMBUSTION – COAL
- Sines Power Plant -

Sines Power Plant – Comparison of measurements and model predictions



CLEAN COMBUSTION – FUEL-OIL
- Setúbal Power Plant -

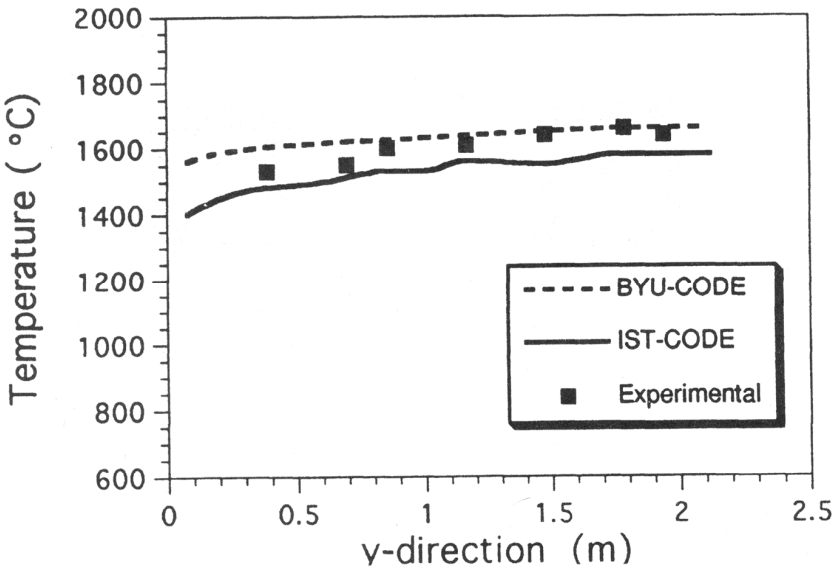
Boiler at Setúbal power plant

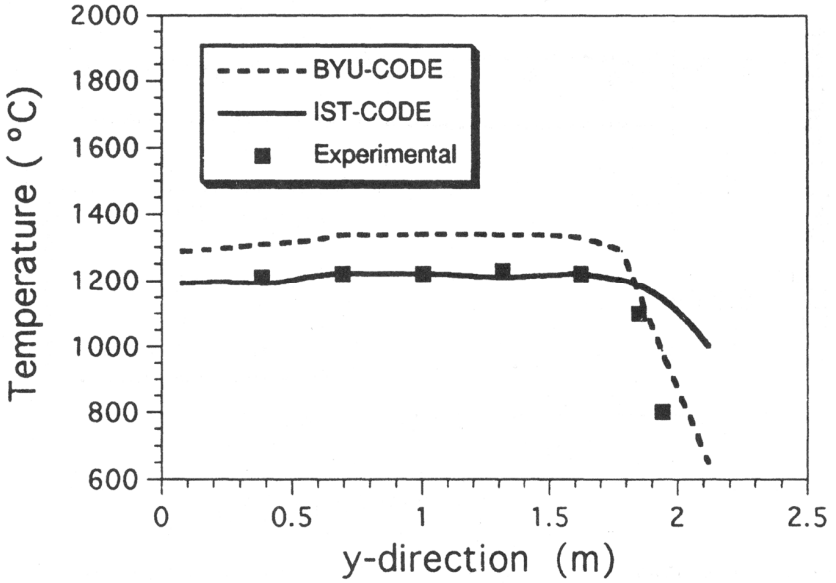


CLEAN COMBUSTION – FUEL-OIL
- Setúbal Power Plant -

Comparison of measurements and BYU model predictions of BYU

- The Comparison of Two Comprehensive Combustion Codes to Simulate Large-Scale Oil-Fired Boilers (Coimbra, Coelho, McQuay e Carvalho, Combustion Science and Technology, Vol. 120, Nº 1-6, pp. 55-81, 1996)



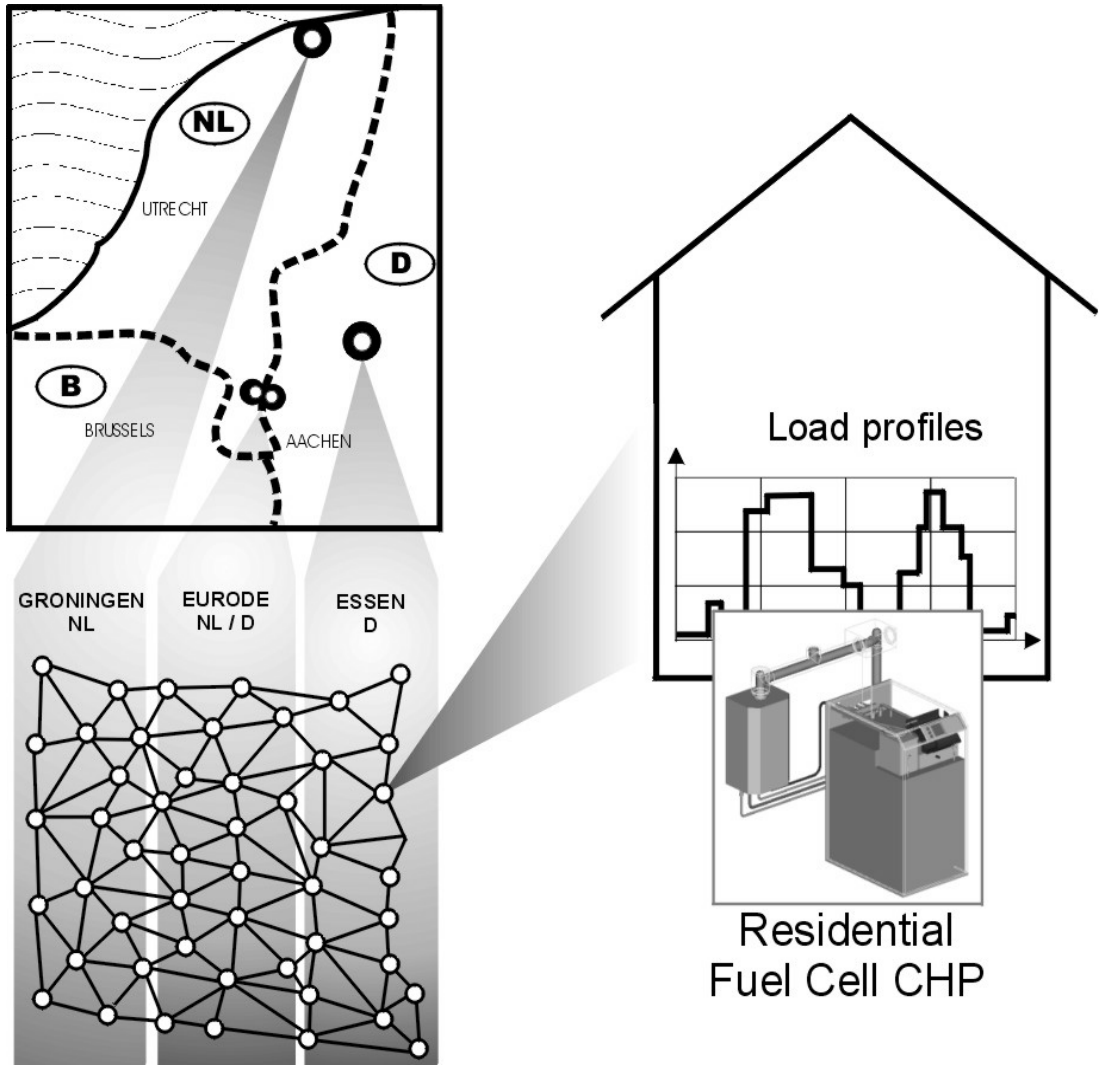


Virtual Fuel Cell Power Plant Project

"System Development, Build, Field Installation and European Demonstration of a Virtual Fuel Cell Power Plant, Consisting of Residential Micro-chips"

(project co-financied by DGTREN , European Commission)

Virtual Fuel Cell Power Plant



ENERGY EFFICIENCY

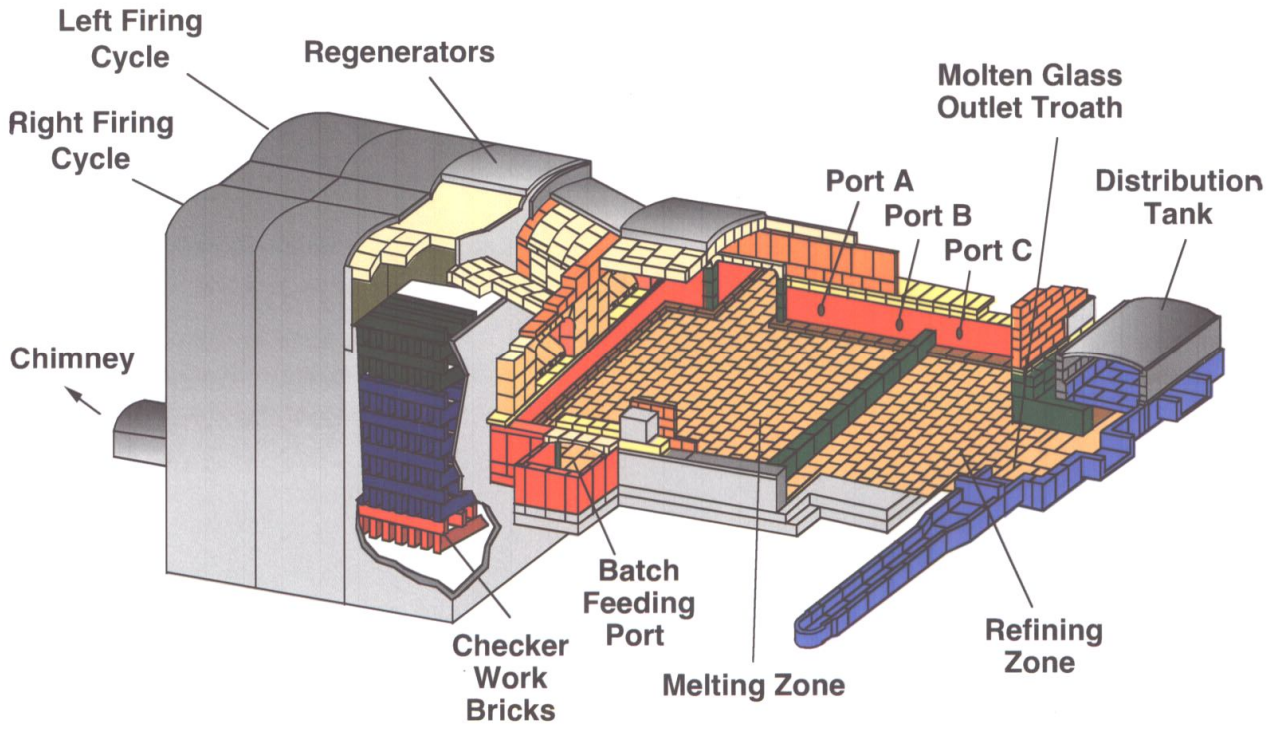
- Energy efficiency - Industry
- Energy efficiency - Transports
- Energy efficiency - Buildings
- Renewable and energy efficiency integration

GLASS INDUSTRY

EX-LIBRIS Project – Expert system for energy efficiency and pollution abatement in industry

(project co-financied by DGXII , European Commission)

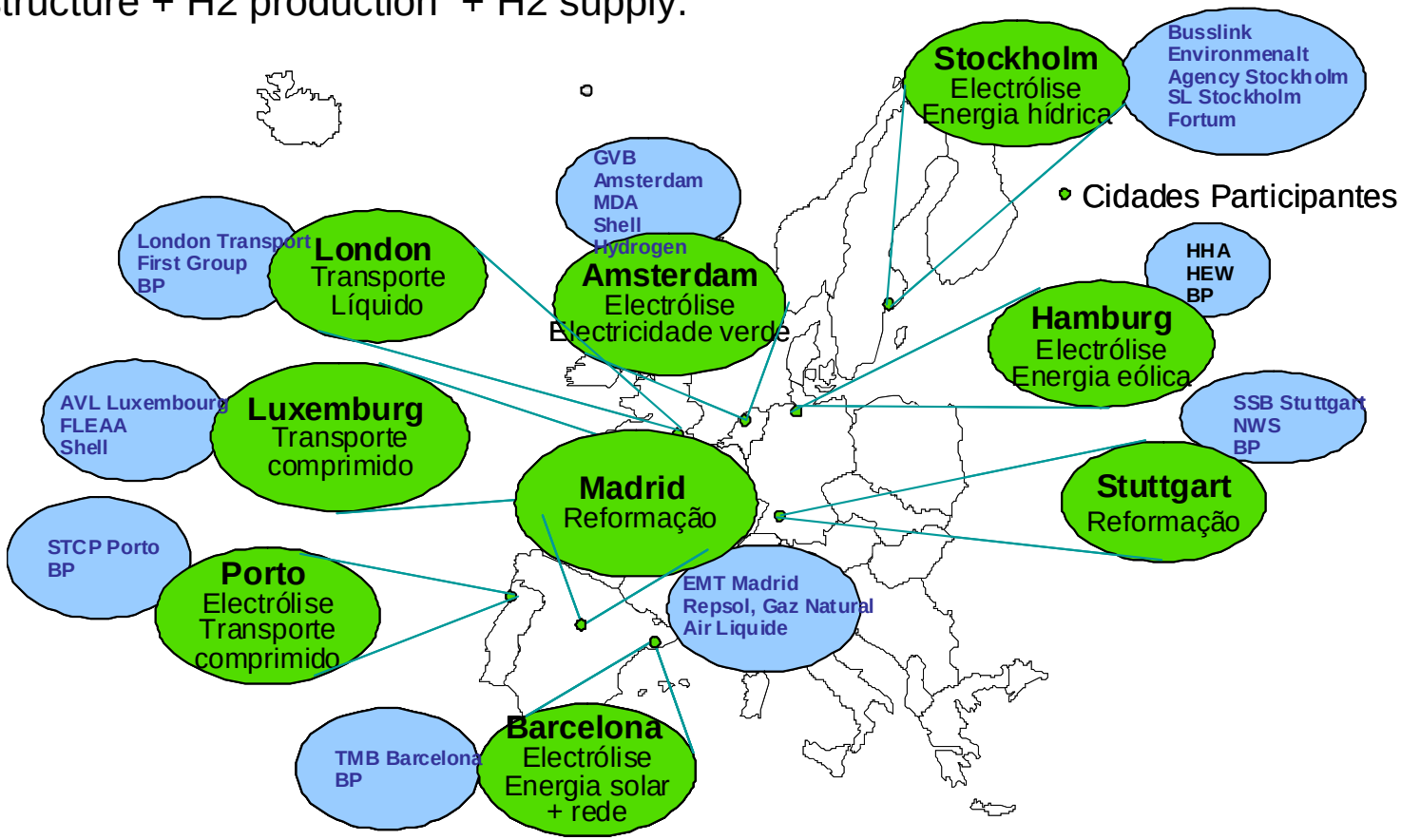
Typical Glass Furnace



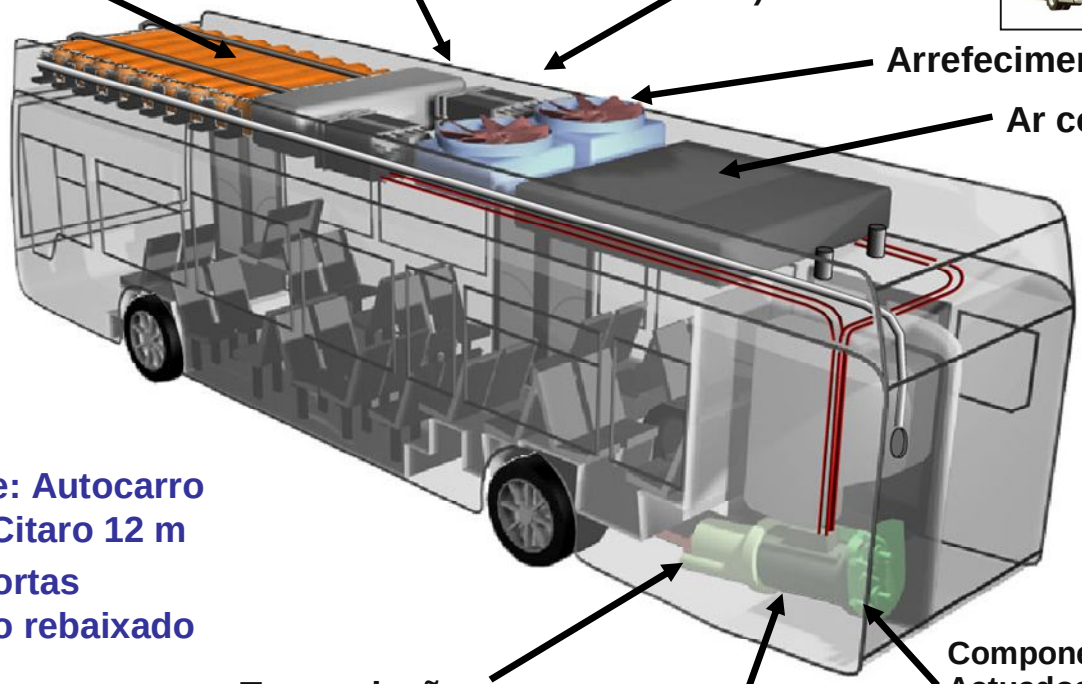
CUTE Project – Clean Urban Transports for Europe

(project co-financied by DGTREN, European Commission)

Construction and implementation of a fuel cell urban bus fleet + infrastructure + H2 production + H2 supply.



CUTE – Mercedes-Benz Citaro (Components)



Base: Autocarro MB Citaro 12 m

- **3 portas**
- **piso rebaixado**

(*) potência bruta

CUTE – Oporto city

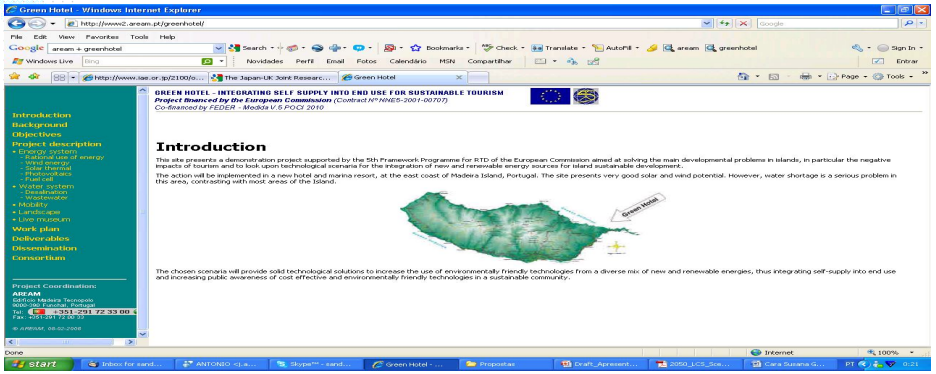
Fotografia de: Armindo Cerqueira

Fotografia de: Armindo Cerqueira

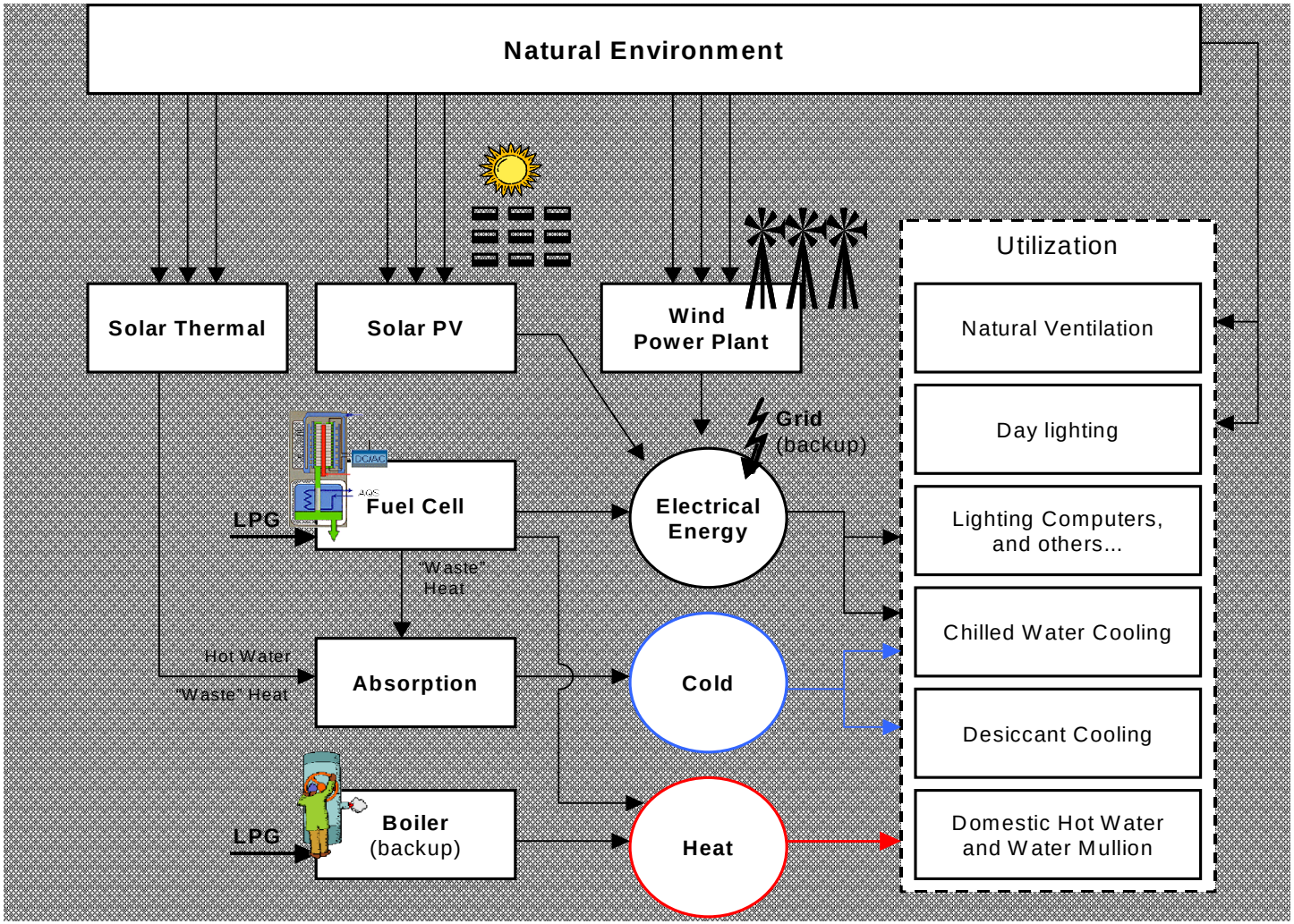
ENERGY EFFICIENCY – BUILDINGS

Green Hotel – "Integrating Self-Supply into End Use for Sustainable Tourism"

(project co-financied by 5ºFP, European Commission)



ENERGY EFFICIENCY – BUILDINGS



ENERGY EFFICIENCY – BUILDINGS

Green Hotel

Electrolyser and Fuel Cell

RENEWABLE AND ENERGY EFFICIENCY INTEGRATION

Porto Santo Demonstration Plant, Madeira

- Energy Policy and Planning

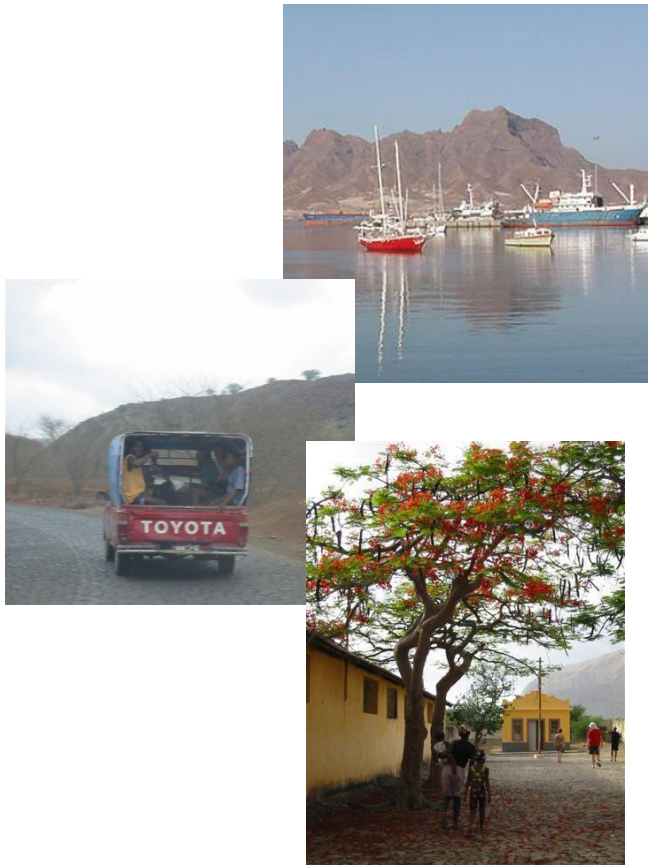
- **PEN CV -** Energy Plan for Cabo Verde Islands

Aim:

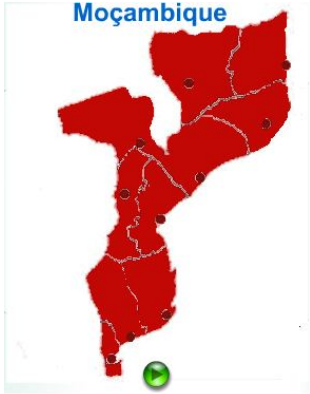
To provide Capeverdean Energy Authorities with guidelines, suggestions and tools to define long term energy policy and an action plan.

Objectives

- Socio-economic characterization of Cabo Verde;
- Description of current energetic situation and analysis of past trends;
- Elaboration of middle and long term Scenario for economy, demography and energy consumption.
- Proposal of a number of supply configurations for each consumption scenario and analysis of associated socio-economic and environmental impacts and barriers.



- **SYNERGY Mozambique** – Assistance to Energy Policy Implementation in Mozambique



Objectives:

Creating the basis for the development of the energy sector in Mozambique, which will become an important tool for the development of the country

Goals

- Provide institutional support to political authorities and main energy consumers in order to restructure the energy sector
- International cooperation and technical programmes implemented by the European Commission to assist in strengthening the energy sector
- Build continuous energy policy dialogue
- Allow further progress in global efficiency of the sector

ENERGY FOR DEVELOPMENT

- Promotion of sustainable energy technologies
- Energy for poverty alleviation in developing countries

ENERGY FOR DEVELOPMENT
- Energy for Poverty Alleviation in Developing Countries-

- **IE4Sahel** – Energy for Poverty Alleviation

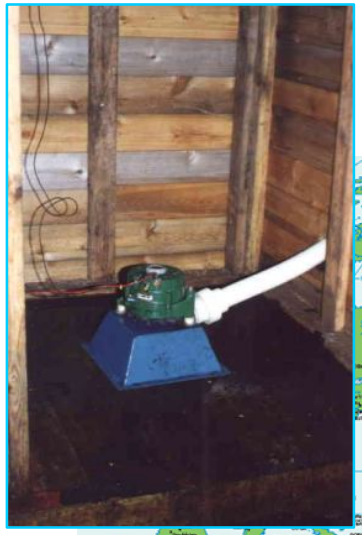
Research:

- Assessment of the energy policies in the Region
- Study of the Renewable Energy potential
- Elaboration of policy recommendations for sustainable energy policies targeted at poverty reduction

Cooperation:

- Capacity Building for the Centre AGHRYMET
- Organisation of two Regional Conferences
- Development of a Professionals' Network Organisation d'ateliers régionaux

ENERGY FOR DEVELOPMENT
- Energy for Poverty Alleviation in Developing Countries-

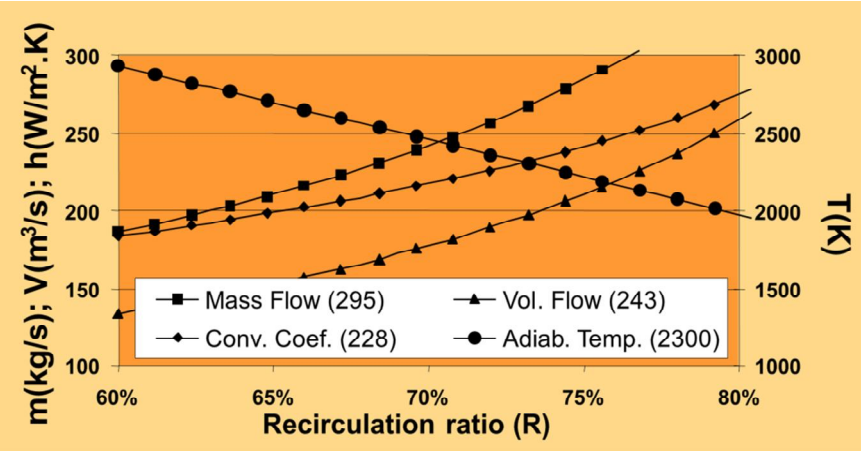


CLIMATE CHANGE

- Mitigation of Climate Change
- Clean Development Mechanism
- Capacity Building
- Technology Transfer Clearinghouse

- **VITIATED AIR** - Coal combustion in advanced burners for minimal emissions and CO2 reduction technologies

CO2 Recirculation with O2 Injection



Wall / R (%)	Air	67.9%	69.3%	73.5%
Front	30.1	25.8	24.2	19.3
Back	41.0	45.5	43.5	36.0
Side	55.4	53.7	51.5	43.1
Nose and Ash Pit	4.7	6.6	6.3	5.3
Total	131.2	131.6	125.5	103.7

Heat fluxes in boiler as function of recirculation rate

- **CDM MEDA** – Business Opportunities for CDM Development in the Mediterranean

Objectives

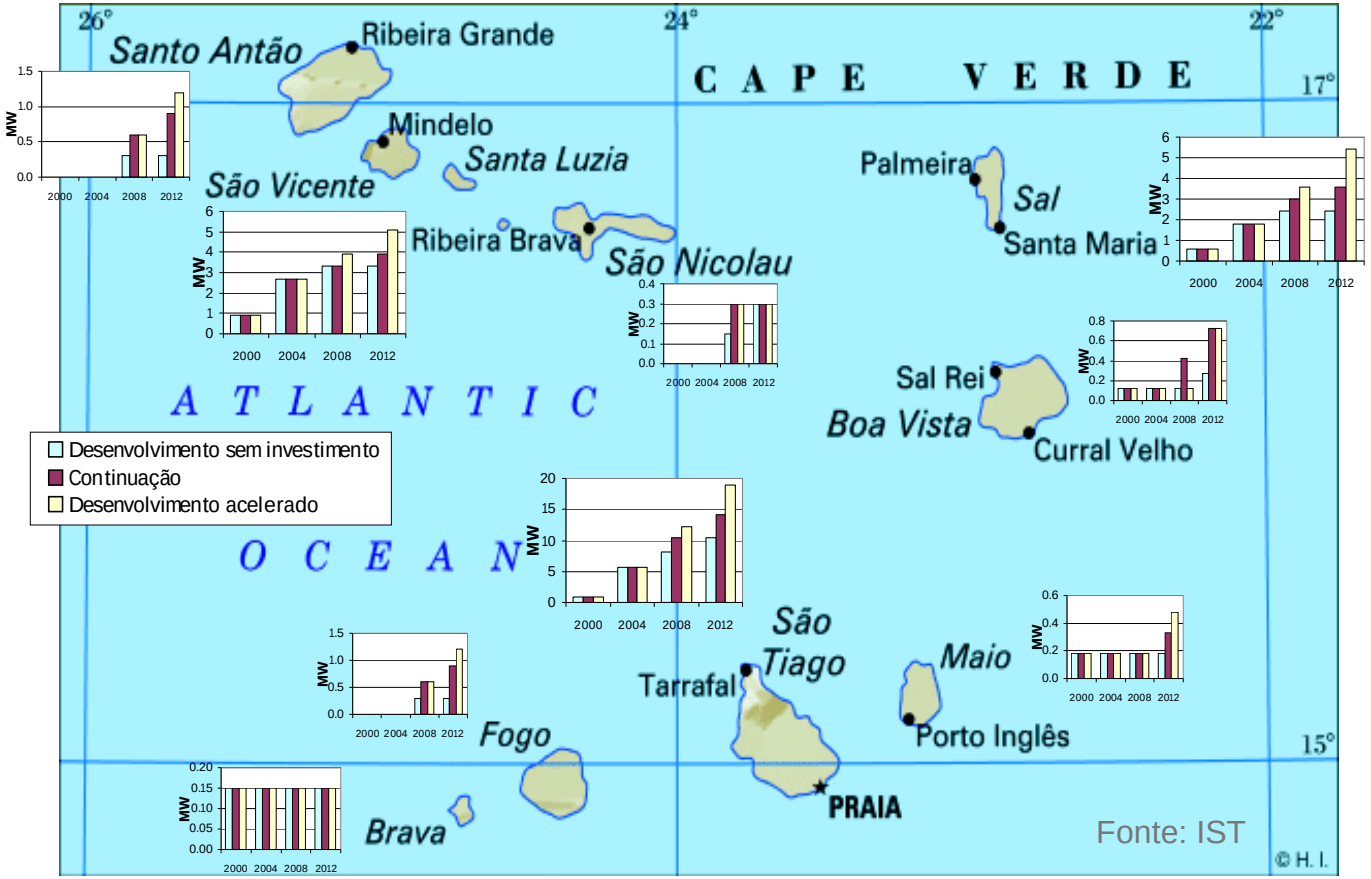
Build the private sector's capacity in CDM project activities and related carbon trading concepts. This will facilitate active and major participation on the part of the private sector in flexible mechanisms. This was proposed by the Kyoto Protocol and aims to alleviate global greenhouse gas emissions.

Goals

- Produce promotional and analytical tools
- Conduct capacity building events specifically designed for the private sector. These will describe the implications as well as the achievement of high environmental standards (especially for urban areas) and new economic opportunities linked to CDM projects.
- Target private enterprise and industry

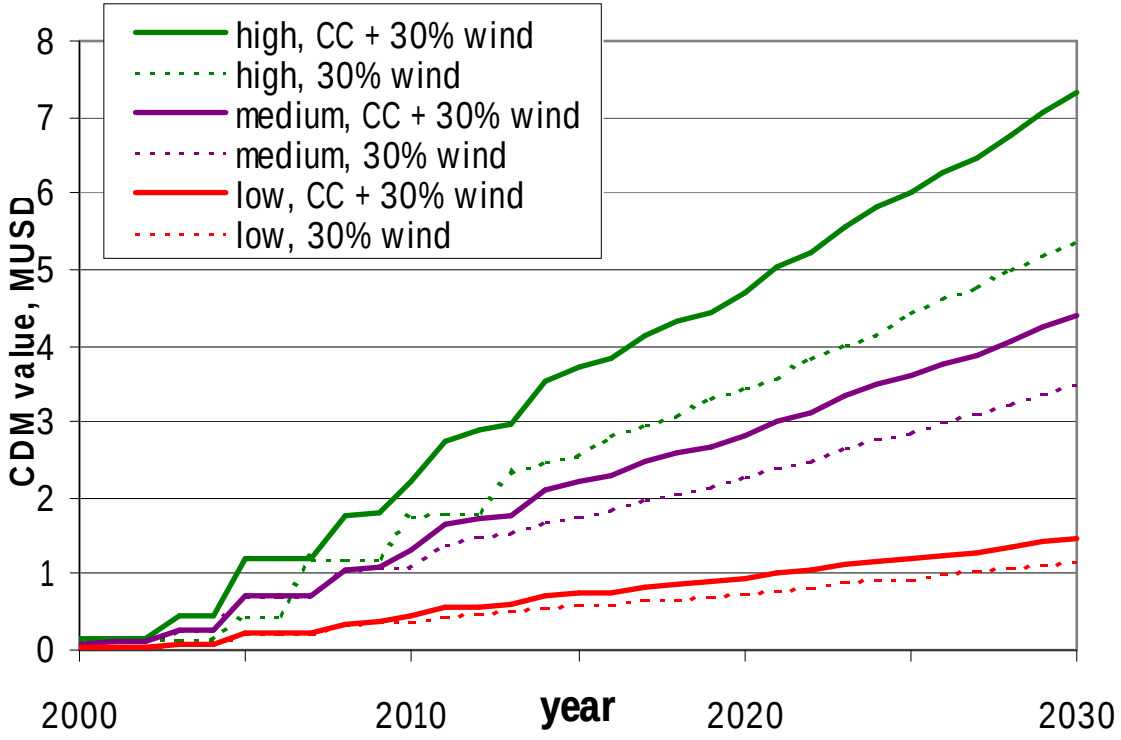
CDMSIDS – Facilitating the Kyoto Protocol Objectives by Clean Development Mechanism in Small Islands Developing States

Wind turbines scenario



CLIMATE CHANGE
- Clean Development Mechanism -

Clean Development Mechanism Scenario (CDM)



CDM potencial MDL for 2 electricity production scenaria and 3 certificates prices:

- High – 25$/tCO2
- Medium – 15$/tCO2
- LoW – 5$/tCO2

Economic Scenario BAU

CLIMATE CHANGE
- Capacity Building -

- **CDM for Sustainable Africa** – Capacity Building for CDM in Sub-Saharan African Countries

Goals

- **Evaluate Sub-Saharan African countries' potential to contribute to the Kyoto objectives**
- **Identify an appropriate framework enabling CDM-linked investment flows to the Sub-Saharan African countries**
- **Create a methodology to assess social and economic impacts of CDM-linked projects**

- **Estimate the potential contribution of CDM in Sub-Saharan African countries to European commitments and to provide a cost-benefit analysis for CDM in those countries**
- **Contribute to a mapping of best geographical areas for EU CDM investments in Sub-Saharan Africa**
- **Identify CDM-linked project development opportunities for environmental, social and economic feasibility studies in one Sahel country (Niger)**

- **CDMChina** – Capacity building on business opportunities for CDM projects in China

Objectives:

Build the private sector's capacity in CDM project activities and related carbon trading concepts. This will facilitate active and major participation on the part of the private sector in flexible mechanisms. This was proposed by the Kyoto Protocol and aims to alleviate global greenhouse gas emissions.

CLIMATE CHANGE
- Technology Transfer Clearinghouse -

Motivation: Taking the advantage of the emerging markets created by EU-ETS and CDM to enhance the penetration of European sustainable energy solutions and know-how in these markets

- **OPET OLA -** Promotion of modern, clean energy and transport technologies and policies in Latin America and Caribbean

- **SETatWORK** - Sustainable Energy Technologies at Work: Thematic Promotion of Energy Efficiency and Energy Saving Technologies in the Carbon Markets

Public Policy Development

European Strategy for Energy and Climate 20-20-20 by 2020

- **By 2020 – The three 20s:**
  - to reduce greenhouse gas emissions by 20%, rising to 30% if a global agreement is reached;
  - to increase the share of renewable energy to 20%, and
  - to make a 20% improvement in energy efficiency.

- **By 2050 – descarbonisation path with a target for the EU and other industrialised countries of 60 to 80 % cuts in GHG emissions**

KYOTO NEGOTIATIONS
- 2000’ EU Portuguese Presidency -

- Advisor for the "Climate Change“ Programme of the Ministry of Environment for the negotiations of the Kyoto Protocol during the Portuguese Presidency of the Union European Union (January to June 2000).

- Coordinator, at European level, for the thematic groups CB (Capacity Building) and TT (Technology Transfer) under the "Climate Change“ Programme.

International Negotiations

COP 13

Bali 2007

Bali Action Plan:

- Launches the negotiations on a post 2012;
- agrees on the main agenda items for these negotiations (reduction of greenhouse gas emissions, adaptation, technology and finance)
- Sets a time line to finish these negotiations.

"The final step of the two-year negotiating process will be to define targets and the type of legal instrument that is needed to make the new international deal work"

(UNFCCC Executive Secretary, Yvo de Boer)

International Negotiations

COP 14

Poznan 2008

Main outcomes from Poznan

- Management of a UN Adaptation Fund to help developing countries agreed
- Funds can be disbursed using a 2% levy on carbon trading under CDM
- Progress on how environment-friendly technology can be transferred to developing countries
- Agreement that deforestation needs to be reduced

International Negotiations

COP 15

Copenhagen 2009

Main outcomes from Copenhagen

- The Copenhagen Accord **:**
- not legally binding
- does not set reduction targets
- reduction commitments not enough to address the 2° objective
- positive signs - 2° Celsius objective
- targets for emission reduction for developed countries and mitigation actions by developing countries
- reporting and verification
- basis for financing
- basis for reducing emissions from deforestation
- addresses action on adaptation

International Negotiations

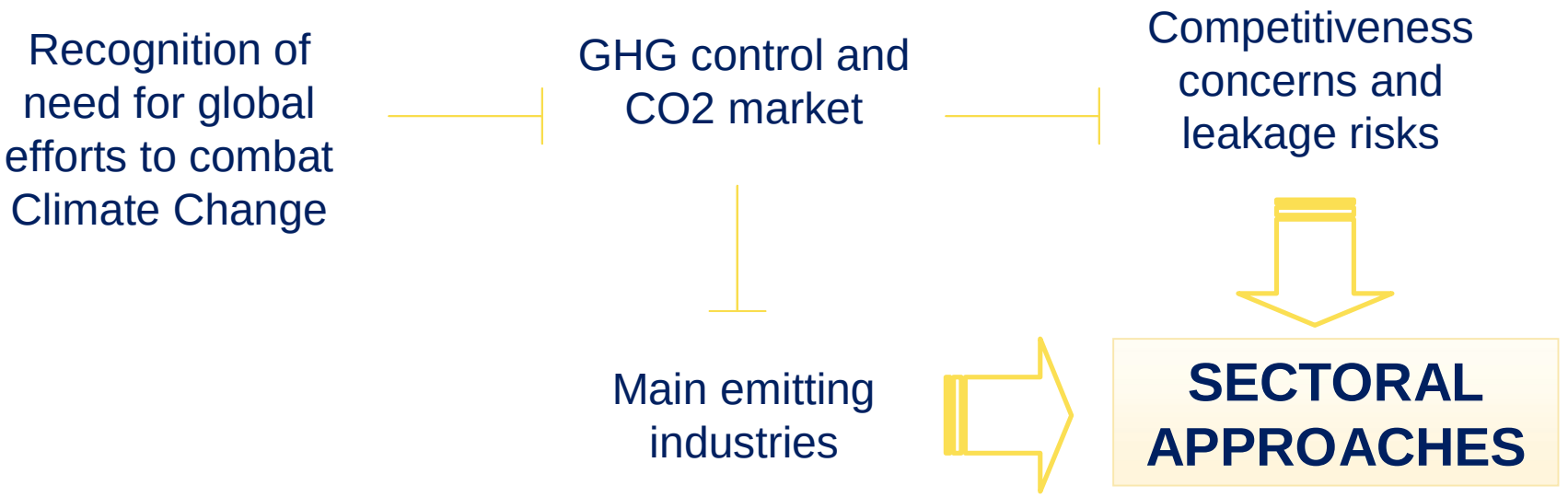
COP 16

Cancun 2010

Main outcomes from Cancun

- "Cancun Agreements" - important step forward
- trust in the process has been restored
- most elements of the Copenhagen Accord
- developed countries agreed on more ambitious goals to reduce greenhouse gas emissions
- Financial support to developing countries
- Developing countries mitigation actions at national level
- did not yet resolve key outstanding issues:
- the question on a second commitment period of the Kyoto Protocol
- nor whether a new protocol is to be adopted under the Convention
- did not result in the requested more ambitious pledges by developed and developing countries

MOTIVATIONS FOR A SECTORAL APPROACH



UNFCCC

Bali Action Plan: “co-operative sectoral approaches and sector-specificactions”

EPP Group

INTERNATIONAL AGREEMENT

SA IMPLEMENTATION UNDER THE UNFCCC

Commitment and pledges under different tracks, adopted as a package

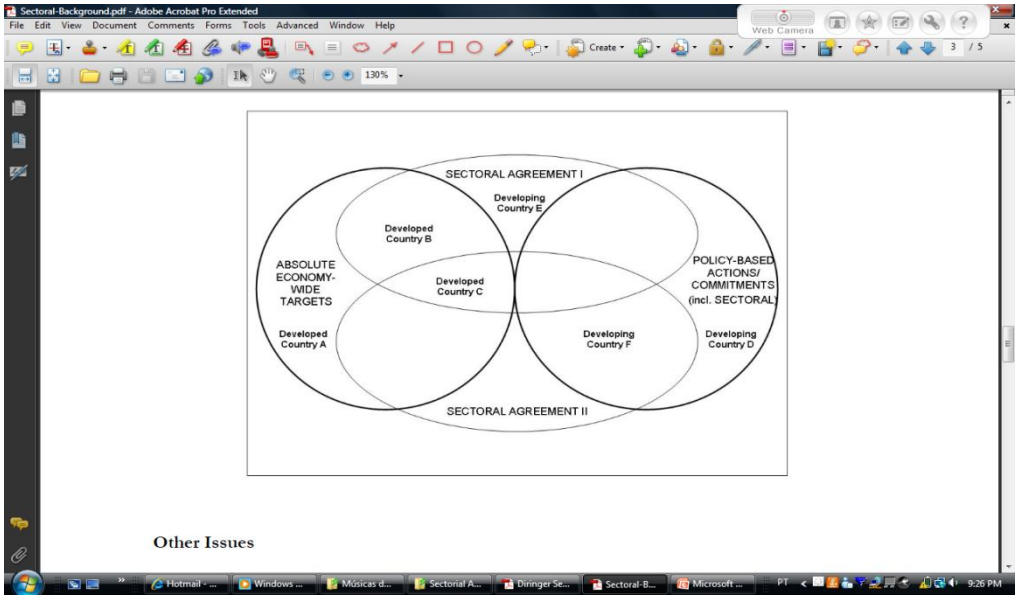
"A flexible **multi-track post-2012 Framework**, including:

- Absolute **economy-wide targets**;

- **Policy-based actions/ commitments** (sectoral or economy-wide)

- **Sectoral agreements**".

Pew Center on Global Climate Change



Source: Pew Center on Global Climate Change

www.gracacarvalho.eu

EPP Group

EUROPEAN POLICY FOR CLIMATE AND ENERGY – FUTURE DEVELOPMENT

Background

- European Strategy 2020
- Treaty of Lisbon

… and after 2020?

- EU Energy Efficiency Plan 2011
- Energy infrastructure priorities for 2020 and beyond
- Roadmap for building a competitive low-carbon Europe by 2050
- European Union budget beyond 2013

CONCLUSION

Having worked for thirty years in scientific research and education, the political aspect to my career really began in 2002.

I feel that a scientific background has been invaluable in the development of public policies. In many fields, the challenges and problems are extremely complicated and often have a technological and scientific aspect to them. This is obviously the case with climate change.

Without a scientific background and a scientific approach, these difficulties can appear wholly intractable.