

ASME

1st European Fuel Cell Technology
& Applications Conference
Roma, December 14 -16, 2005



ENTE PER LE
NUOVE TECNOLOGIE,
L'ENERGIA E L'AMBIENTE



Development perspectives of fuel cell technology in Italy

Guido Possa

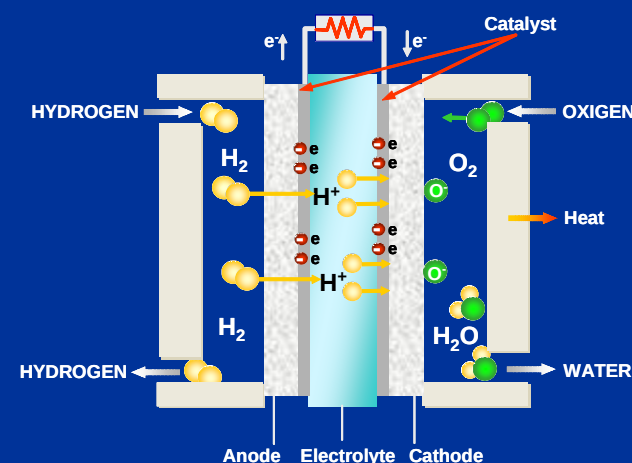
Vice-Minister of the Italian Ministry of Education, University and Research

Raffaele Vellone

ENEA, Hydrogen and Fuel Cells Project

Fuel cells are gaining worldwide attention as power source for a broad range of applications (from small portable electronic devices to large stationary applications and transport) due to their potential advantages (high efficiency, low emissions, modularity, low maintenance, etc)

In Italy fuel cells will be a key technology in hydrogen-based energy systems

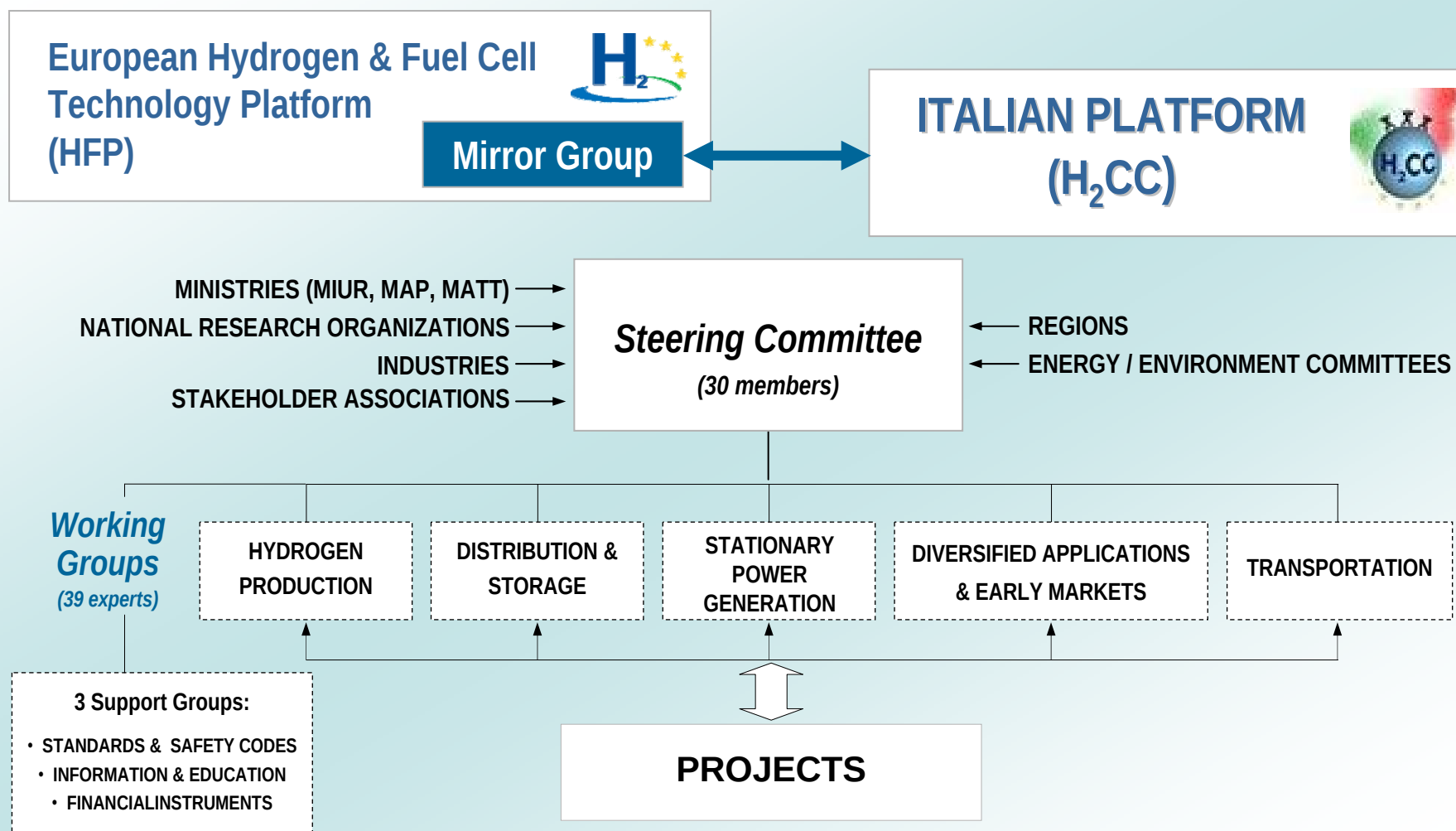


- ◆ Reduction of the greenhouse gas emissions and of the local pollution
- ◆ Security of energy supply
- ◆ Enhancement of industrial competitiveness

For initiative of the Ministry of Education, University and Research, a group of experts from different organizations is engaged in the definition of an Italian Platform for Hydrogen and Fuel Cells, with the following objectives :

- to define an Italian research and deployment strategy for hydrogen and fuel cell technologies and promote initiatives capable of increasing the national industry's competitiveness
- to establish a strong and co-ordinate relationship with the European Platform and to favour a major participation of the national organizations
- to avoid duplication of efforts between different projects so that resources can be used in the most effective way

H₂CC Platform Structure



H₂CC Platform

Working group participants



Co-ordination : FIAT Research Center

HYDROGEN PRODUCTION	STATIONARY POWER GENERATION	TRANSPORTATION
WG Leader - ENEA • CESI • ENEL • MATT • Enitecnologie • Assoelettrica • Ansaldo • Assogastecnici • CNR-ITAE • Edison • Coord. Interr. Energia-Ambiente	WG Leader - ENEL • CESI • Assoelettrica • Federenergia/AEM MI • ENEA • CNR-ITAE • Ansaldo • Nuvera Fuel Cells • Arcotronics Fuel Cells • Edison • Enitecnologie • GTT • Coord. Interr. Energia-Ambiente • Lombardia Region • SGS • Genoa University	WG Leader - CRF • CRF • IVECO • Ansaldo • Fincantieri • Consorzio Train • Salerno University • Ansaldo Breda • CNR-ITAE • ENEA • Nuvera Fuel Cells • Arcotronics Fuel Cells • Coord. Interr. Energia-Ambiente • Lombardy Region • Alenia
DISTRIBUTION & STORAGE	DIVERSIFIED APPLICATIONS & EARLY MARKETS	
WG Leader - CESI • ENEL • Assogastecnici • Federenergia/AEM MI • ENEA • CNR-ITAE • Enitecnologie • Coord. Interr. Energia-Ambiente	WG Leader - CNR-ITAE • Nuvera Fuel Cells • Arcotronics Fuel Cells • Assogastecnici • Coordinamenti Interregionale Energia-Ambiente • ST Microelectronics	

Support Groups

STANDARDS & SAFETY CODES

Com. Termotecn. Ital.

- Hydrogen Forum
- Assogastecnici
- CRF
- MI Firefighter Department
- ENEA

INFORMATION & EDUCATION

Hydrogen Forum

- Hydrogen Forum
- H2IT
- ENEA
- CNR-ITAE
- Roma H2
- MI Firefighter Department

FINANCIAL INSTRUMENTS

Sviluppo Italia Piemonte

- RASFIN
- Sanpaolo IMI

Involvement in European and international co-operation

- **International Partnership for Hydrogen Economy**
promoted by US Department of Energy



- **European Hydrogen and Fuel Cells Technology Platform**
of the European Commission



- **Implementing Agreements IEA** on Advanced Fuel Cells and
Electric and Hybrid Vehicles



- **Participation in EU projects**





Fuel cell activities, started in the early 1980s, are focused on the development and demonstration of:

- ◆ **polymer electrolyte fuel cells** for stationary and transport application
- ◆ **molten carbonate fuel cells** for on-site and distributed generation

Research activities on **solid oxide** and **direct methanol fuel cells** are also carried out

- ◆ AUSIMONT
- ◆ ENEA
- ◆ ENEL Ricerca - CESI
- ◆ ENITECNOLOGIE
- ◆ FN, Nuove Tecnologie e Servizi Avanzati
- ◆ FIAT Research Center
- ◆ PIRELLI Labs
- ◆ Venezia Tecnologie
- ◆ CNR Institute (ITAE, ISTIC, IM. IC, etc)
- ◆ Universities (Turin, Milan, Genoa, Pisa, Perugia, Rome, Salerno, Messina, Palermo, etc)
- ◆ ANSALDO FUEL CELLS Co
- ◆ ARCOTRONICS FUEL CELLS
- ◆ NUVERA FUEL CELLS / DNTE
- ◆ APRILIA
- ◆ IVECO/IRISBUS
- ◆ FAAM
- ◆ MICRO-VETT

Fuel Cells

Barriers and targets

Many fuel cell systems have been used with success in stationary applications and transportation, but technical barriers to their commercial use still remain. Fuel cell **cost** and **durability** are today the major hurdles to commercialization



Targets

DISTRIBUTED ENERGY (PEFC)

- less than 1,000 €/kW
- 40,000 hours durability

DISTRIBUTED ENERGY (MCFC, SOFC)

- 1,000-1,500 €/kW
- 40,000 hours durability

TRANSPORTATION

- 50-100 €/kW
- 5,000 hours durability

PEFC

- ◆ 1-5 kW systems for residential power generation
- ◆ Development of 75 kW systems for transportation
- ◆ Prototypes of FCEV (car, bus, scooter)

MCFC

- ◆ Development of 125 kW and 500 kW systems for stationary applications

SOFC

- ◆ Basic research on novel materials and components
- ◆ Demonstration of a 100 kW CHP unit (GTT, Turin)

DMFC

- ◆ Basic research on materials and components
- ◆ Development of stacks for portable applications

Polymer Electrolyte Fuel Cells

Arcotronics Fuel Cells



ELECTRUM H2

1kW PEFC portable power module



PENTA H2

5 kW CHP PEFC system

Development of **PEFC** stacks and integrated systems (500 W - 50 kW) for stationary applications and transportation.

ARCOTRONICS NISSEI GROUP



ARCOTRONICS FUEL CELLS srl

Arcotronics Fuel Cells, in the frame of a collaboration with ENEA, developed a patent technology (**MEGA - Membrane Electrode Gasket Assembly**) capable to ensure minimized costs, easy maintenance and high reliability





- ◆ Hydrogen power modules for industrial vehicles and equipment
- ◆ Systems for cogeneration
- ◆ Gasoline fuel processor and fuel cell stacks for automotive



PowerFlow™

STATIONARY APPLICATIONS

- ▶ **PowerFlow™** - 2.5-5 kW PEFC module for a variety of industrial applications
- ▶ **AVANTI™** - 4 kW CHP system
- ▶ **FORZA™** - modular systems (up to 120 kW) for multi-MW power plants and heavy-duty applications



AVANTI™



FORZA™

TRANSPORTATION

- ▶ **ANDROMEDA™** - 75 kW PEFC stack
- ▶ **STAR™** - gasoline fuel processors



Andromeda™



STAR™

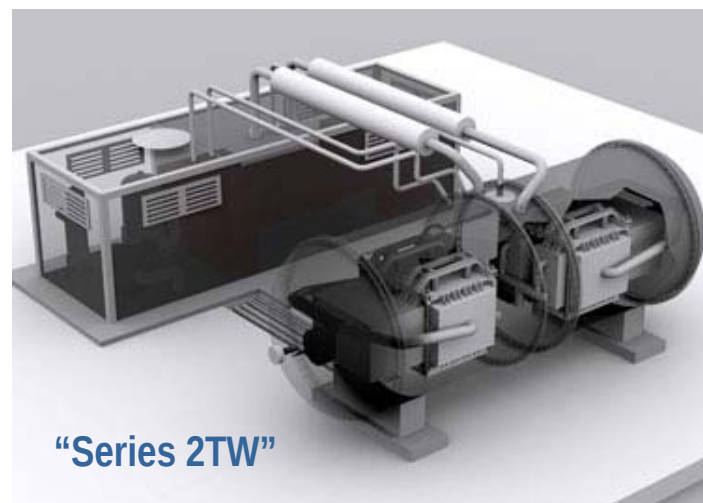
ANSALDO FUEL CELLS

- ◆ Development of stacks and balance of plant components
- ◆ Development of multi-megawatt demo units

“Series 2TW” plants



Production and commercialization of 0,1 – 10 MW MCFC plant



Two electrochemical modules, each formed by two stacks, integrated with their relevant ancillaries

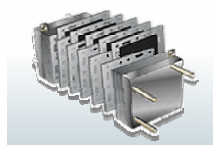
In Italy the resources employed in fuel cell field are increasing in the frame of national and European programs

Several projects are starting at research institutes and industries in the framework of a **National R&D Programme** on “Hydrogen and Fuel Cells” supported by the **Ministry of Education, University and Research** and **Ministry of Environment** through the Special Integrative Fund for Research (FISR)

FISR PROJECTS – 2005-2008

-  **ENEA** – Development of fuel cell technologies and systems for their applications
-  **CNR-ITAE** - PEFC and SOFC development. New materials and applications
-  **University of Genoa** - Development of a pressurized MCFC system and 500kW demonstrative plant
-  **University of Perugia** - New MCFC systems for distributed generation
-  **University of Rome "La Sapienza"** - Development of protonic membranes for PEFC applications
-  **ISTM** - Hybrid and inorganic nano-systems for the development of fuel cells

Total cost 54 M€ (FISR funding 70%)



TECSA Project

Duration: 36 months

Total cost: 10.8 M€



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DE NORA TECNOLOGIE ELETTROCHIMICHE
GRUPPO DE NORA



ANSALDO FUEL CELLS

DEVELOPMENT OF FUEL CELL TECHNOLOGIES AND SYSTEMS FOR THEIR APPLICATIONS

Polymer Electrolyte Fuel Cells

Molten Carbonate Fuel Cells

Objectives

- Improvement of performance and cost reduction, through the development of new materials, components and cell design
- Development of fuel cell systems, through the construction and testing of prototype plants with different characteristics (type of fuel cell, size, fuel).

Polymer electrolyte fuel cells

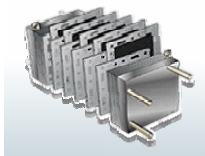


R&D of innovative materials and components

MEA materials, metal components and fabrication techniques



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Development of stack and new cell configurations

Realization and characterization in single-cell and short-stack (5 cells, 750 W)

Development of “multiple” cells (several cells on the same plane) (up to 1 kW)

Development of a microcell for portable generation fuelled with sodium NaBH_4



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Realization and testing of 1-5 kW stacks and systems, using different fuels

Comparative tests on 1 kW and 5,5 kW stack fuelled with hydrogen

Comparative tests on 4 kW stack fuelled with natural gas

1 kW portable system operating on LPG/methanol for specific applications



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Molten carbonate fuel cells



R&D of innovative materials and components

Materials, cell components and related fabrication processes



Development of hybrid systems (MCFC – GT)

Development, realization and demonstration of a 500 kW MCFC hybrid system simulator at Research Centre of ENEA Casaccia



Experimental operation of 125 kW MCFC stack

Up grading of the existing facility realised at Trisaia ENEA research centre

Experimental operation with different fuels

Feasibility studies and cost analysis



Environmental impact and life cycle analyses

Development and validation of calculation code and its application



ANSALDO FUEL CELLS



In July 2005, as part of the National Research Plan, the [Ministry of Education, University and Research](#) launched a call for proposal for new projects on fuel cell technology aimed mainly at FC system demonstration in order to overcome the technical and economic barriers to their deployment and commercialization