



**OECD**

**TIP/IEA ENERGY INNOVATION CASE STUDY**  
**ON FUEL CELL TECHNOLOGY**

**ITALY**

**O.Tampone**

# ORGANIZATIONAL NETWORK OF ACTORS AND INSTITUTIONS

## Government, Ministries

Issue the Document of Economic and Financial Planning, and National Research Plan

RESEARCH POLICY AND FUNDING

DEVELOPMENT AND ENVIRONMENTAL REGULATIONS

Carry out research activities both with theoretical and experimental studies, also in co-operation with industries and other national and international partners

Public Research Institutes, Universities

KNOWLEDGE

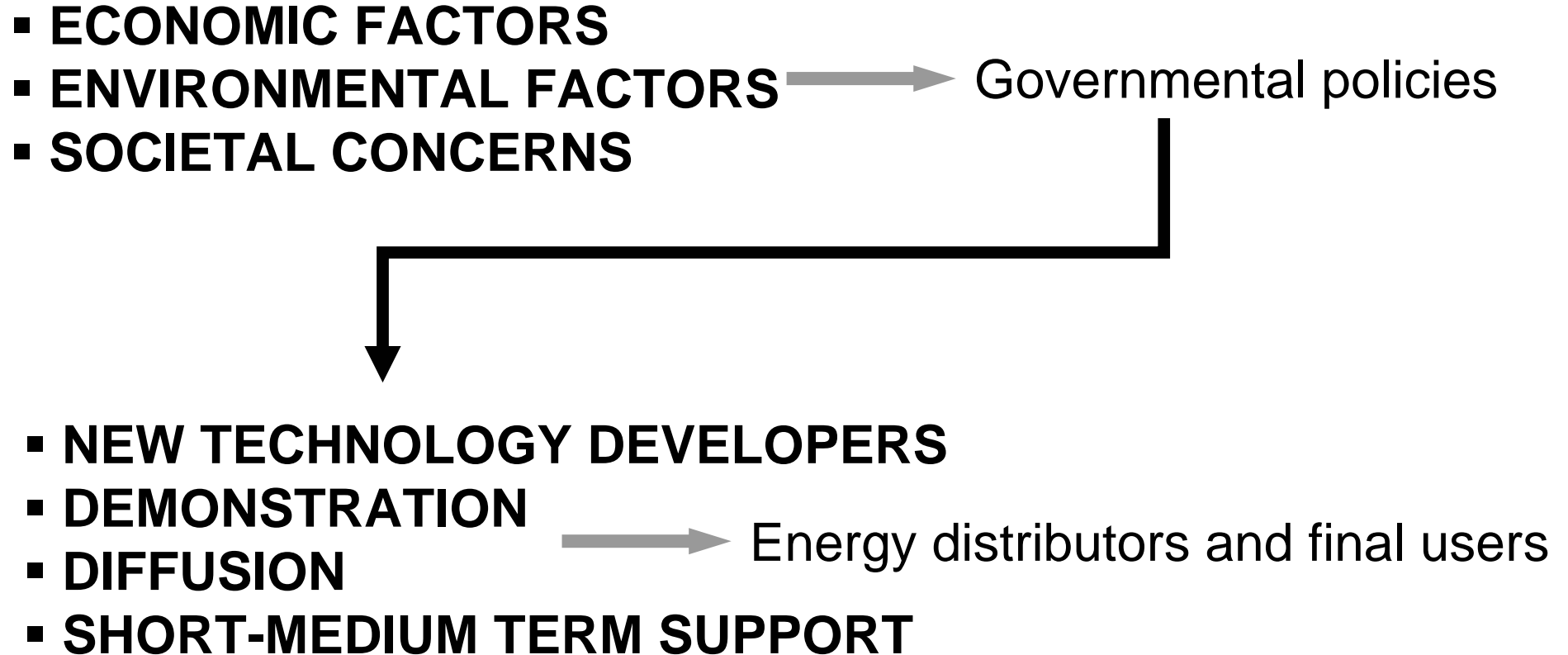
Respecting governmental indications according to economic and environmental factors, participate with variable extent to research activities and knowledge innovations for production aims

Industry, Utilities, SME





# DRIVERS OF INNOVATION





# Knowledge creation

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**WHO:** Public Research Organizations, Universities, Industry (in co-operation)

**WHAT:** New components, systems, control units and any type of innovated device related to the technology

**HOW:** Theoretical and experimental studies mainly conducted into PRO laboratories. Joint efforts in public/private partnership

**WHERE:** In different locations in the national territory, essentially Public Research Centres and Universities, but also abroad in case of international cooperation

**WHY:** In dependance on economic and environmental factors influencing governmental policies, or on societal concerns about public welfare and environmental protection

**INSTITUTIONAL**

**ENVIRONMENTAL:** Ministries of Environment, Productive Activities, University and Research. DEFP and NRP



# Knowledge diffusion

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**WHO:** Public Research Organizations, Universities, Ministries, Regional and Local Agencies

**WHAT:** Technical reports, prototype and/or demonstration plants and facilities, laboratory scale innovated devices, systems and components, patents

**HOW:** Reports, conferences, workshops, technical meetings, cooperation agreements, joint projects, national and international

**WHERE:** Diffusion of the technology all over the territory, entering the market

**WHY:** From PRO and partners towards large and SMEs. Driven by governmental funding, participation in joint research efforts, small direct industrial funding

## INSTITUTIONAL

**ENVIRONMENTAL:** Depending on international situation on energy demand and supply, oil and gas prices, cost of patenting and licensing



# Knowledge absorption and use

WHO: Industry, Utilities, SMEs

WHAT: New technologies aimed at reducing emissions, increasing energy efficiency and use of the technology for specific applications

HOW: Cooperation in joint research programs, patents and licensing, consulting, reciprocal mobility of researchers

WHERE: In the whole national territory, mainly at Municipalized Energy Boards for stationary applications and Vehicle Manufacturers for mobile ones

WHY: Competition in the market, environmental constraints, increasing of energy efficiency

INSTITUTIONAL

ENVIRONMENTAL: Governmental subsidies and incentives, market perspectives for new technologies, funding to industrial research, acceptance by public opinion



## **Actors engaged in R&D and Demonstration on fuel cells can be divided into the following groups:**

### **Cell manufacturers**

ANSALDO FUEL CELL SPA, mainly developer of MCFC

NUVERA FUEL CELLS EUROPE, mainly developer of polymeric cells

ROEN EST, mainly developer of polymeric cells

### **Cell component manufacturers**

FN NUOVE TECNOLOGIE E SERVIZI AVANZATI, developer of MCFC components

PONTE DI ARCHIMEDE, developer of polymeric electrolyte cells components

### **Users for transport systems**

Centro Ricerche FIAT, developer of Fuel Cell based cars

Consorzio I2T3, developer of FC buses for urban transport

Consorzio IRISBUS, developer of FC buses for urban transport

### **Users/builders of light vehicles (motor-scooters, bicycles)**

APRILIA scooters

FAAM bicycles

### **Users of systems for FC stationary applications**

ZINCAR, developer of hydrogen based systems

SEABO, energy utility

SAPIO, developer of hydrogen based systems

SOL, developer of hydrogen based systems

### **Research, development and technological innovation**

**PRO:** ENEA, CNR-ITAE

**UNIVERSITIES:** Rome University, Genoa University, Milan Technological University

**PRIVATE R.C.:** CESI Institute for electrical applications research



## **Main sectors of R&D and involved organizations**

### **Development of advanced cell components**

ENEA, University of Rome  
Chemistry Department, University of Rome  
Industrial Chemistry Department, University of Milan  
NUVERA Fuel Cells Europe

### **Development and realization of innovative stacks**

CNR - ITAE, Institute for Energy Advanced Technologies  
NUVERA Fuel Cells Europe

### **Realization of a 15 kW complete prototype, natural gas fed, for traction**

ENEA  
CNR, Institute for Energy Advanced Technologies  
FIAT Research Centre  
Environmental Engineering Department, University of Genoa  
Industrial Chemistry Department, University of Milan

### **While prototypes of vehicles are developed by:**

FIAT Group (both for buses and cars)  
Ansaldo Fuel Cells  
ENEA  
Aprilia Motorbike Manufacturers



# Public-private partnerships

➤ Innovation is fostered by:

- Joint participation in governmental, regional, local or European Public programmes
- Agreements on specific aspects of the technology

➤ Roles:

- Government funds
- Public and/or private research organizations carry out the activity

➤ Cost and results sharing:

- Usually activities are balanced and each partner bears its own costs
- Results are shared according to the percentage of activity of each partner in the total program





## Effects of globalization

Research, development and other innovative activities are **greatly globalized**. Italy has cooperation agreements with US, European Countries, China and other Far East Countries. The main point is that cooperation is occurring most among academic organizations and not among industries.

Primary **motivations** leading to research and development globalization are due to being knowledge and know-how spread worldwide. Obviously there is a great easiness of changing cooperation agreements in research activities, that are strongly depending on different national program funding.

Primary **mechanisms** for globalizing Research and Development activities are first of all collaborative research and sometimes merging with foreign companies.



## A synthetic framework on performance of innovation process

|   | <b>Expected benefits &amp; costs</b>   | <b>Options benefits &amp; costs</b>   | <b>Knowledge benefits &amp; costs</b>  |
|---|--|---|--|
| <b>Economic benefits and costs</b>      | <ul style="list-style-type: none"><li>▪ Higher energy efficiency</li><li>▪ High reduction of energy generation costs</li><li>▪ Reduction of system production costs by a factor 3 to 10</li><li>▪ Two phases of market penetration</li></ul> | <ul style="list-style-type: none"><li>▪ Stationary<br/>Target of 250 MW/year at 2020, that is 2.2% of total world foreseen installed power for FC applications</li><li>▪ Transport<br/>FC propulsion systems are the future of vehicles due to low energy consumption and zero emission</li></ul> | <ul style="list-style-type: none"><li>▪ Wide international cooperation allows a better and faster diffusion of the technologies</li><li>▪ Globalization of productive capacity should imply a strong reduction of production costs</li></ul> |
| <b>Environmental benefits and costs</b> | <ul style="list-style-type: none"><li>▪ Strong reduction of emissions</li><li>▪ Significant reduction in associated costs and social concerns</li></ul>  | <ul style="list-style-type: none"><li>▪ First step to achieve a hydrogen based system of energy generation</li><li>▪ Reaching zero emission energy production and utilization</li></ul>   | <ul style="list-style-type: none"><li>▪ Energy generation and environment are strictly connected</li><li>▪ Knowledge of new technologies is a way to improve the standards of living</li></ul>   |
| <b>Security benefits and costs</b>      | <ul style="list-style-type: none"><li>▪ Reduction of the dependence on fossil fuel import</li><li>▪ Increasing of distributed energy production and self generation</li></ul>  | <ul style="list-style-type: none"><li>▪ Crisis in the whole system of energy generation</li><li>▪ Uncertainty of sources and increasing of consumption</li><li>▪ FC will allow distributed generation and cost reduction</li></ul>  |  |

## **Systemic influences on innovation**

- Government regulations on energy and environment
- Diffusion of information on fuel cells and hydrogen, representing a strong element of “cultural change” in energy sector

### **Factors that influence type or magnitude of innovative activities**

1. To create new products
2. To improve the performance or quality of existing products
3. To reduce production costs
4. External sources of information for innovation

## **Importance of sources of technical knowledge**

1. Joint/cooperative ventures
2. Public research institutes and universities
3. Independent suppliers of materials, components or production equipment
4. Technical analysis of concurrent products

## **Importance of outputs of PRO and universities**

1. Specialized or applied knowledge
2. Early versions or prototypes of new product designs
3. New instrumentation and techniques

## **Importance of research undertaken by PRO or Universities**

1. Public research organizations
2. Universities

## **Important sources for learning about research in PRO and universities**

1. Joint research projects between the firms and institutes or universities
2. Contract research where the work is done by the institute or the university
3. Public conferences and meetings

## **Obstacles in limiting absorbing knowledge by PRO and universities**

1. Intellectual property rights
2. Lack of internal expertise

## **Importance of methods to prevent copying by competitors**

1. Secrecy
2. Patent protection

## **Features making difficult innovation copying or imitation**

1. Frequent technical improvements
2. Technical complexity

## **Time required by a competitive firm to market an alternative innovation**

Ranging from 1 to 5 years; average time  
1.5 – 3 years

## **Percentage application of developed innovation in last 3 years**

Ranging from 40 to 100% but too little data collected for a realistic estimate

### **Important reasons for patenting new products**

1. To prevent competitors to copy the inventions
2. To improve the position in negotiation with other firms
3. To be able to access foreign markets where legislation requires new technologies to be licensed by a national firm

## **Reasons for not applying for a patent**

1. Limits to the effectiveness of patents in preventing imitation
2. The amount of information disclosed in a patent application
3. The cost of applying for a patent

## **Factors leading to publish results in open literature**

1. Finding new R&D partners among Public Research Institutes or Universities
2. Giving signals to the Public Research Institutes or Universities

## **Importance of national policies and programmes in supporting innovation**

1. Demonstration programmes
2. Programmes to encourage cooperation in R&D between firms or between firms and research institutes
3. Subsidies (e.g. tax credits)

## **Obstacles limiting to profit from innovation in the markets**

1. Copying of innovation by local competitors
2. Incompatibility with local technical standards
3. Environmental regulations
4. Public procurement rules that favour local firms

# CONCLUSIONS

- ❑ **Innovation is driven by economic and environmental factors, societal concerns. Influence is given by governmental policy, by means of Document of Economic and Financial Planning and National Research Program.**
- ❑ **PRO and universities are sources of knowledge, often there is a strict cooperation with industry and utilities in carrying out research activities.**
- ❑ **Funding is mainly public (Central or Local Administration). Great importance of funding by joint EU programs.**
- ❑ **Innovation is diffused by technology developers, mainly PRO, in agreement and cooperation with ministries, regional and local boards.**
- ❑ **It is necessary to increase the participation of industry and in general private sector to research activities, promoting consortia, joint ventures, joint participation to national and international programs.**
- ❑ **Greater attention must be given to environmental and efficiency factors in energy production and utilization.**

|   | <b>Expected benefits and costs</b>  | <b>Options benefits and costs</b>   | <b>Knowledge benefits and costs</b>  |
|---|---|---|--|
| <b>Economic benefits and costs</b>      | Energy efficiency higher than the one of conventional systems, also of the most advanced ones. High reduction of energy generation costs. Production costs of the systems are at now very high; it is necessary to reduce them by a factor 3 to 10. First phase of market penetration will have costs of about 1000-1500 Euro/kW to reach a regime value of 600-750 Euro/kW | For stationary applications a market penetration is foreseen of 250 MW/year at 2020, that is 2.2% of total world foreseen installed power for FC applications.<br>For transport applications in the last ten years there has been a 25% increase of CO2 emissions. Fuel Cell based propulsion systems represent the future of vehicles due to their low energy consumption and zero emission. | To increase the knowledge by means of a wide international cooperation allows a better and faster diffusion of the technologies. This will foster a globalization of productive capacity that should imply a strong reduction of production costs. |
| <b>Environmental benefits and costs</b> | Strong reduction of emissions that will be less than 10% of those related to an equivalent conventional power plant. This allows to have a significant reduction in associated costs and social concerns  | Fuel Cells represent the first step to achieve a hydrogen based system of energy generation both for stationary and mobile applications, as to reach zero emission energy production and utilization.   | Energy generation and environment cannot be seen as separate topics. Increasing knowledge about new technologies represents a way to get an improvement of the standards of living.  |
| <b>Security benefits and costs</b>      | Possibility to reduce the dependence on fossil fuel import. Increasing of distributed energy production and self generation in a sufficiently wide range of power generation capacity   | The whole system of energy generation and distribution is experiencing crisis due to uncertainty of sources and increasing of consumption. Fuel Cells will allow distributed generation and cost reduction.   |  |