



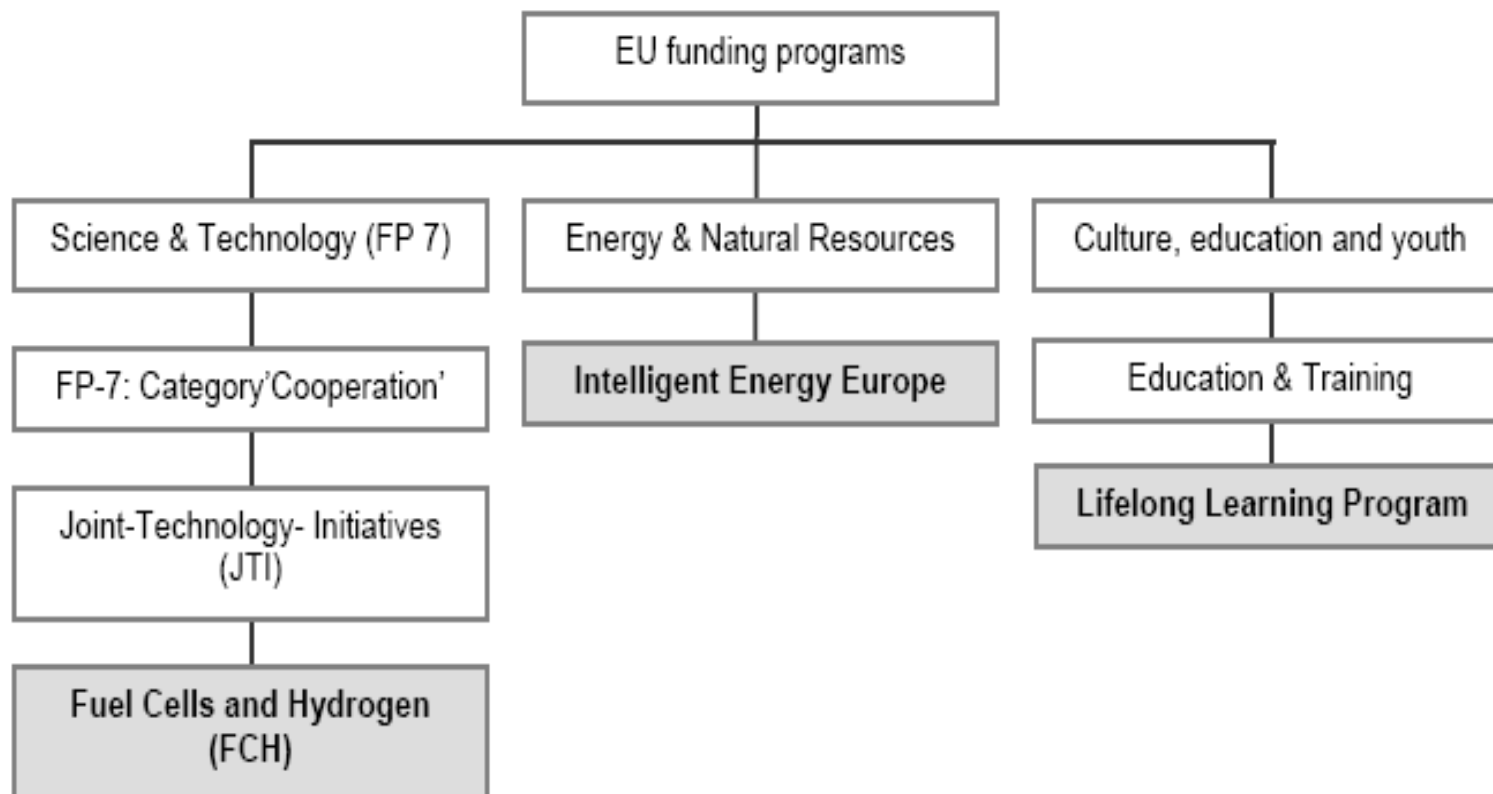
European-wide field trials for residential fuel cell micro-CHP

20th February
WP 3 Seminar (M7)

Alessandro Graizzaro, Envipark



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FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

www.fch-ju.eu



Industry Grouping



Research Grouping



European Commission

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The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) is a unique public private partnership supporting research, technological development and demonstration (RTD) activities in fuel cell and hydrogen energy technologies in Europe. Its aim is to accelerate the market introduction of these technologies, realising their potential as an instrument in achieving a carbon-lean energy system.

The objective of the FCH JU is to bring these benefits to Europeans through a concentrated effort from all sectors.

The three [members](#) of the FCH JU are the European Commission, fuel cell and hydrogen industries represented by the NEW Industry Grouping and the research community represented by Research Grouping N.ERGHY.

With about € 730 million of funds available between 2007 and 2013, the Intelligent Energy Europe Programme (IEE) will help deliver on the ambitious climate change and energy targets that the EU has set for itself.

The programme supports concrete projects, initiatives and best practices via annual calls for proposals.

Examples of projects funded under this programme include:

- ✓ Training on new construction techniques that can lead to 50 percent or more energy savings compared with traditional buildings;
- ✓ Improving the effectiveness of support schemes for electricity generation from renewable energy sources across Europe;
- ✓ Helping Europe's cities to develop more energy-efficient and cleaner transport.

http://ec.europa.eu/cip/iee/index_en.htm





With a budget of nearly €7 billion for 2007 to 2013, the programme funds a range of actions including exchanges, study visits and networking activities. Projects are intended not only for individual students and learners, but also for teachers, trainers and all others involved in education and training.

There are four sub-programmes which fund projects at different levels of education and training:

[Comenius](#) for schools

[Erasmus](#) for higher education

[Leonardo da Vinci](#) for vocational education and training

[Grundtvig](#) for adult education

- ✓ Usually there are no direct calls for supporting education and training activities in the field of fuel cells and Hydrogen.
- ✓ In Vocational Education and Training programmes the topic is currently only marginally considered because fuel cell technology is only available in a few niche markets, therefore there is a perception that there is little need for any specific qualification at the moment.

Nevertheless the start of the qualification process for key-personal, such as trainers and multipliers has to start now before mass production begins in the current pre-marketing phase.

3. Pilot Training actions during Hyprofessionals project in different countries (with feedback collected)

Pilot actions which in total were attended (both physically and virtually) by over 350 students.

RESULTS



UNIDO-ICHET carried out a 2 day pilot study on at UNIDO-ICHET facilities Turkey



TARGET: Alternative Fuel and Renewable Energy Departments at Vocational Schools in Turkey.

Total students: 47

SEMINAR ON

- ✓ Hydrogen production, storage, distribution and utilization technologies
- ✓ Laboratory experience with hydrogen and fuel cell technology
- ✓ Equipment, vehicles and



EnviPark carried out 3 pilot actions: training courses based mainly on practical activities in laboratory to create a real physical contact with the FC technology.



students from technical universities,
teachers

Total students: 70

**COURSES IN LABORATORY based on:
Theory**

- ✓ Production of Hydrogen
- ✓ Storage of Hydrogen
- ✓ Fuel Cells Fundamentals
- ✓ Application of Fuel Cells (UPS; microchp...)
- ✓ Safety
- ✓ Fuel cell technologies and system integration

Practical activity:

- ✓ polarization curves on single cell
- ✓ polarization curves on fuel cell stack
- ✓ test of a 10 kWe natural gas

reformer

WBZU carried out pilot studies at WBZU facilities Ulm Germany. The training was structured to ensure that no prior knowledge of electrochemistry or fuel cell technology was required



TARGET: vocational Robert-Bosch school Ulm, Germany

Total students: 56

COURSES based on:

- ✓ Basics and fundamentals of PEFC and Hydrogen technologies
- ✓ Polymer electrolyte Fuel Cell applications
- ✓ Hydrogen system and infrastructure

FHa and FSV carried out an E-learning online training course from September to December 2012, including one day (practical) attendance at the Foundation Hydrogen, Aragon

E-learning platform



TARGET: automotive teachers and students, other vocational training, automotive workers

Total students: 198

COURSES based on:

- ✓ General concepts and history
- ✓ Vehicle architecture: components and type
- ✓ Component maintenance (HV-battery, electric motor, inverter, power electronics, etc)
- ✓ HV and hydrogen safety
- ✓ Vehicle examples
- ✓ Practical training (optional)

4. Report on proposed actions for developing training actions in the future

RESULTS



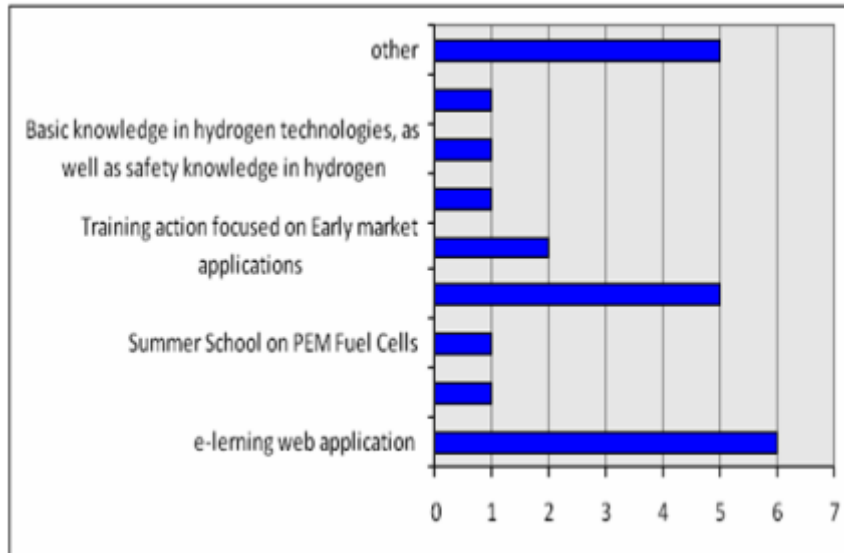
Proposals from the partners were first collected using an on-line questionnaire, shared by the partners. All the partners were asked to describe some specific initiatives and then the collected material was processed and merged in this document.

1. Proposal description
2. Target of the proposal
3. Target of stakeholder
4. Possible funds
5. When the training will start or should start
6. Duration of the training action
7. Place of the training action
8. Training action content description and required materials
9. Language of the training action



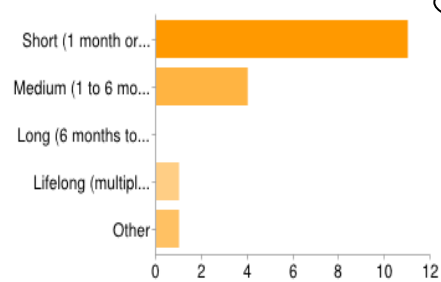
Collected 23 proposals from all partners

Collected proposals: main topics



e-learning web application	6	26%
Developing Hydrogen & Fuel Cell Education Syllabus and Curriculum	1	4%
Summer School on PEM Fuel Cells	1	4%
Training action focused to introduce fuel cell technology applied on cars	5	22%
Training action focused on Early market applications	2	9%
In lab training and demo	1	4%
Basic knowledge in hydrogen technologies, as well as safety knowledge in hydrogen manipulation	1	4%
Train the renewable energy technicians	1	4%
other	5	22%
Total	23	

Duration of the training action



Short (1 month or less)

Medium (1 to 6 months)

Long (6 months to 1 year)

Lifelong (multiple years)

Other

11 73%

4 27%

0 0%

1 7%

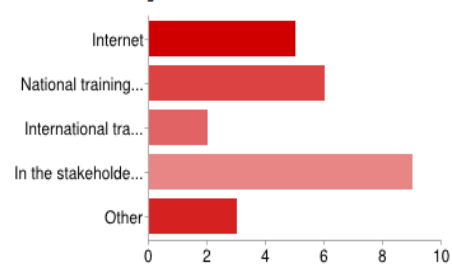
1 7%

People may select more than one checkbox, so percentages may add up to more than 100%.

DURATION OF THE TRAINING

The target of stakeholders are people with technical university background (engineering, chemistry, physics...) working for Companies involved in Hydrogen Chain, so the duration of most part of training actions could be 1 month or less.

Place of the training action



Internet

National training centre

International training centre

In the stakeholder facilities

Other

5 29%

6 35%

2 12%

9 53%

3 18%

People may select more than one checkbox, so percentages may add up to more than 100%.

PLACE OF THE TRAINING

In the stakeholder facilities, possibility of →assemble and disassemble the main parts of a electric fuel cell vehicle, CHP and UPS system
→analyze the most crucial issues of hydrogen systems (security, hydrogen manipulation,).

- ✓ need to develop and implement an e-learning platform freely accessible to provide training materials as modules (pdf files, videos...);
- ✓ a close cooperation between Institutes and Industries, in particular in drawing up its proposals, must be improved in order to develop hydrogen trainings.

Proposals descriptions and target stakeholders

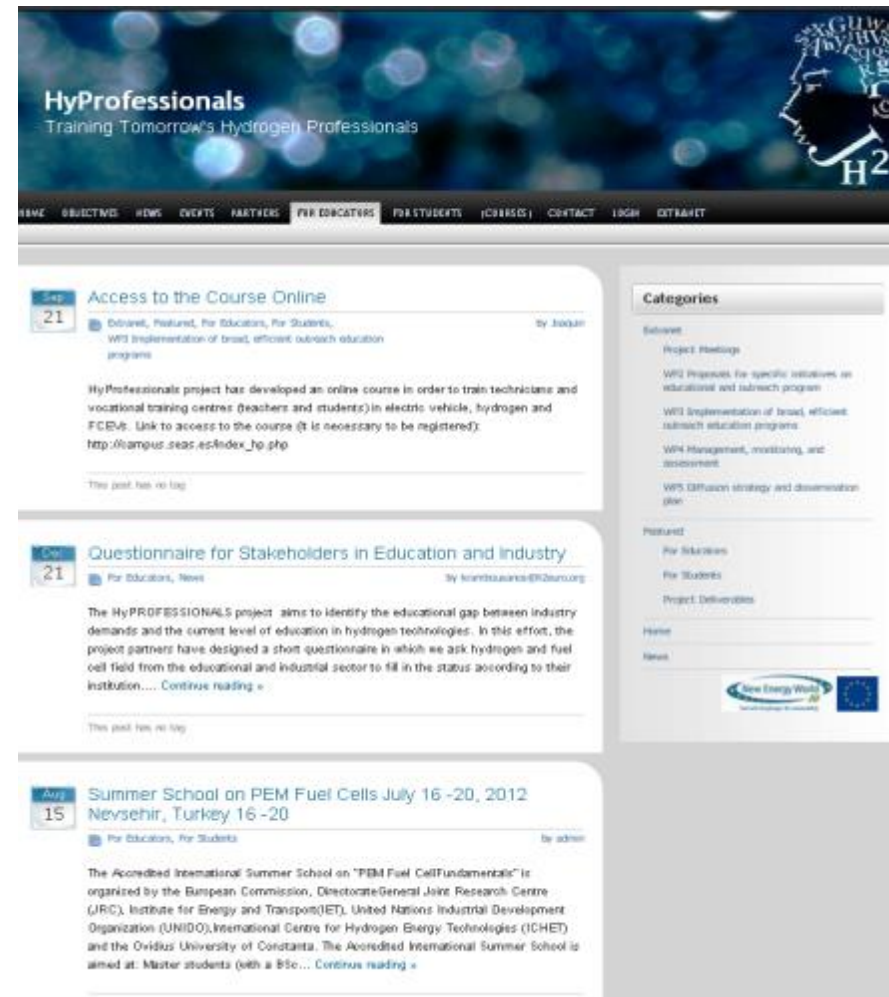
Objective: Define a European strategic working plan to launch initiatives and proposals which help to solve the situation in a right way.

A website dedicated to provide open access lectures, e-learning, animations and training materials useful to guide interested stakeholders on the subject of fuel cells & hydrogen technologies.

Target of the stakeholders

The e-learning courses are addressed to:

- Young professionals & technical students (technician & bachelor levels);
- Scientists and engineers working in or entering the fuel cell industry;
- Employees of industries that have recently invested or plan to invest in fuel cell technology;
- System developers & integrators;
- End users and system operators.



The screenshot shows the HyProfessionals website interface. The header features the title "HyProfessionals" and the tagline "Training Tomorrow's Hydrogen Professionals" against a blue bokeh background with a silhouette of a head filled with letters and a hydrogen molecule symbol (H₂). A navigation menu includes links for HOME, OBJECTIVE, NEWS, EVENTS, PARTNERS, FOR EDUCATORS, FOR STUDENTS, COURSES, CONTACT, LOGIN, and CONTACT. The main content area displays three news items:

- Access to the Course Online** (Sep 21): A notice about online course access for educators and students, including a link to the course registration page.
- Questionnaire for Stakeholders in Education and Industry** (Oct 21): A notice about a questionnaire designed to identify educational gaps between industry demands and current education levels.
- Summer School on PEM Fuel Cells July 16 -20, 2012 Nevsehir, Turkey 16 -20** (Aug 15): A notice about an accredited international summer school on PEM fuel cell fundamentals, organized by the European Commission and other international organizations.

The right sidebar contains a "Categories" section with links to follow project meetings, WPI projects, WPI implementation, WPI management, and WPI diffusion strategy. It also includes a "Featured" section for educators and students, and project deliverables. At the bottom of the sidebar are logos for "New Energy World" and the European Union.

- **Analysis of educational gaps and needs**

- **Objective:**

- Define a European strategic working plan to launch initiatives and proposals which help to solve the situation in a right way.

- **Results:**

- Several market studies: early markets (forklifts), automotive, stationary and back up solutions, hydrogen production and refueling stations

- **Conclusions:**

- By **2015**, only some specialization courses will be enough to satisfy the demand.
- By **2020**, vocational training may update and adapt their current curriculas to H2&FC
- By **2030**, all vocational centers need to train FC technologies

The close link that exists between Research Institutes, Universities, Polytechnic and car-Companies has resulted to focus training events for technical people involved in car workshops.

Target of the stakeholders

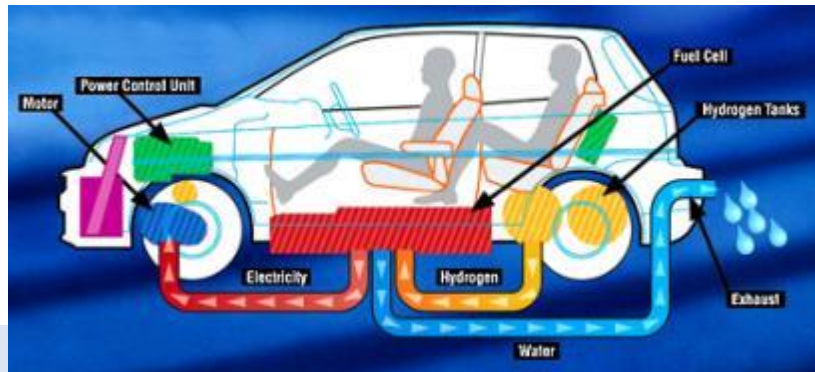
- Owners of cars workshops
- Car dealer and manufacturer companies
- Local association of car workshops
- Taxi drivers

The main topics:

1. Introduction, general knowledge
2. Components of the vehicle
3. Actuations of workshops about repairing the electric and fuel cell vehicle. The focus is in the possibility of assemble and disassemble the main parts of a electric fuel cell vehicle
4. Prospective about electric and fuel cell vehicle
5. Advantages and calculations of costs related to maintenance of the vehicle.

The way to make the training action will based on classes with a teacher who explain the possibilities of fuel cell applications on cars.

Training materials utilized: Documentation in paper and CD



Training action focused to introduce fuel cell technology applied on Early Market installations: UPS (Uninterruptible Power Supply) and relative devices, Forklift and CHP



Actually vocational training is mainly required for Installers and After sale operations.

Manufacturers are actually training their installers internally because the product line is still evolving quite rapidly, as well as certification requirements for the installations, different from country to country.

Target of the stakeholders

- Companies which integrate systems related to data bases and company data
- Technicians involved in Early market installations

The way to make the training action will be based on classes with a teacher who explains the possibilities of fuel cell applications on cars.

Training materials utilized: Documentation in paper and CD



E-learning platform seems to be the best way to disseminate the contents for this kind of purpose, at least in a first stage. Practical courses are also recommended for specific topics in the early market maintenance for instance.



Target of the stakeholders

- Young professionals & technical students (technician & bachelor levels) desiring an understanding of FC Technology;
- Scientists and engineers working in or entering the fuel cell industry;
- Employees of industries that have recently invested or plan to invest in fuel cell technology;
- System developers & integrators;
- End users and system operators.

5. Report on training courses contents developed in past projects within Leonardo Agency Framework

RESULTS



Part of the European Commission's [Lifelong Learning Programme](#), this programme funds many different types of activities of varying scales. These include 'mobility' initiatives enabling people to train in another country, co-operation projects to transfer or develop innovative practices, and networks focusing on topical themes in the sector.

Leonardo da Vinci enables organisations in the vocational education sector to work with partners from across Europe, exchange best practices, and increase their staff's expertise. It should make vocational education more attractive to young people and, by helping people to gain new skills, knowledge and qualifications, the programme also boosts the overall competitiveness of the European labour market.

Innovation projects are key to the programme. They aim to improve the quality of training systems by developing and transferring innovative policies, courses, teaching methods, materials and procedures.



The Leonardo da Vinci Programme funds practical projects in the field of vocational education and training. Initiatives range from those giving individuals work-related training abroad to large-scale co-operation efforts.

www.h2training.eu

10 partners from Five European Countries: plural participation of public and private entities

Spain: San Valero Foundation (Promoter), San Jorge University and Foundation for the Development of New Hydrogen Technologies in Aragón.

Austria: Graz Energy Agency and Eco4ward.

Germany: Kolping-Bildungswerk and Weiter Bildungszentrum

England: Wales University.

Italy: Environment Park and Italian Hydrogen Association.



UNIVERSIDAD
SAN JORGE



UNWIC
Cardiff's **metropolitan** university
prifysgol **metropolitan** Caerdydd



ENVIRONMENT
PARK



- ✓ Definition of a European curricular design and prepare educational contents in a new emerging professional profile (renewable energies and hydrogen technologies)
- ✓ Development of a didactic material of international reference for training of trainers in the renewable energy ambit and fuel cells
- ✓ Development of two pilot "training of trainers" pilot actions ; a face-to-face training action with international teachers and a European e-learning action;
- ✓ Promotion of professional training to the innovation process in order to improve competitiveness and create new employment possibilities;
- ✓ Validation of the methodology, products and results through diverse pilot actions with an international scope;
- ✓ Introduction of a transversal approach to support gender equality;
- ✓ **Dissemination of the project and its valorization on a national and international scale.**

- Ch 1: Hydrogen Economy Background
- Ch 2: Alternative Vehicle Concepts
- Ch 3: Alternative Fuels
- Ch 4: Hydrogen-Technology
- Ch 5: Fuel Cell Technology
- Ch 6: Auxiliary Equipment
- Ch 7: Gas Technology
- Ch 8: Hazard of electricity
- Ch 9: CHP plants
- Ch 10: Regulations, codes and standars
- Ch 11: Gender Mainstreaming
- Ch 12: Practical training

Chapter: Fuel Cell Technology

Chapter: Regulations, Codes and Standars

Chapter: Practical Training

Overview of the Manual
And
Practical Advice for Training

<http://www.h2employment.eu/>

The International Observatory of the European project "H2 EMPLOYMENT" approved by the EU under the Leonardo da Vinci is a European dimension platform open to institutions, training centers, organizations and companies interested in valorizing the results of this international pilot project and analyze the evolution of technology and market in the field of renewable energy and hydrogen technologies for the design of a permanent expert skills adapted to the development of new emerging profiles internationally.



- ✓ Manual of training in hydrogen technologies as basis of the transfer to elaborate a didactic material (ES, EN, IT and DE) of great interest for engineerings and professional associations and for the continuous training and occupational of workers and unemployers of intermediate technical degree for which the consortium is excellent.
- ✓ Didactic material adapted through the development of two pilot actions from the international cooperation of training (distance and presential) aimed at professional associations, workers and unemployers. The labour insertion of the new professional profile will be analysed (200 beneficiaries).
- ✓ Valorisation of results through the very same regional public authority competent in the matter of employment and occupational training and the active participation of the technical engineers professional association integrated in the partnership themselves.
- ✓ Permanent dissemination at great scale differentiated by target levels and with an impact higher than 5.000 recipients for the benefit of a subsequent effective transfer.

- 01 Environment, Energy and Hydrogen*
- 02 Production of Hydrogen*
- 03 Storage of Hydrogen*
- 04 Handling of Hydrogen*
- 05 Fuel Cells Fundamentals*
- 06 Application of Fuel Cells*
- 07 Battery Fundamentals*
- 08 Hydrogen Internal Combustion Engines*
- 09 Regulations and Codes*
- 10 Exam*



01 Environment, Energy and Hydrogen

01 Environment, Energy and Hydrogen

Slide 1

- Fossil Fuels
- Combustion Emissions
- Global Warming
- Energy Demand
- Hydrogen Economy
- History
- Properties



Training Manual

- 01 Environment, Energy and Hydrogen (M)
- 02 Production of Hydrogen (A)
- 03 Storage of Hydrogen (M)
- 04 Handling of Hydrogen (Th)
- 05 Fuel Cells Fundamentals (A)
- 06 Application of Fuel Cells (Th, A)
- 07 Battery Fundamentals (Th)
- 08 Hydrogen Internal Combustion Engines (M)
- 09 Regulations and Codes (xx)
- 10 Exam

A...Alessandro Graizzaro, Environment Park

M...Manfred Klell, HyCentA

Th...Thomas Aigle, WBZU

xx...xxx



6. Ene.Field manufacturers collected experience on technicians training

RESULTS



The objective of this report is to collect information about technicians training: primary aim of this action is the identification of training needs for the people involved in the installation of the CHPs.

Informations from the manufacturers were first collected using an on-line questionnaire, shared by the partners.

ENE.FIELD WP3 Questionnaire

This questionnaire is related to WP3 of ENE.FIELD project. Main target is the development of a proper training path for technicians involved in mCHP on-field installations.

* Required

Technicians Training

*Which kind of technicians are involved during the installation phase? **

- Only from an external authorized company
- People from the company plus external installers
- Only people from the company
- Other:

*How many Technicians are involved during the start-up phase? **

- Only one from the company
- One trained person from an external company
- Other:

*Which kind of technicians are involved during the installation and start-up phase? **

- Plumbers
- Electricians
- Internal trained people
- Other:

*How do you handle residential maintenance?
Which kind of needs you foresee for the future in term of technicians training?*

How do you train the technicians involved in the different phases?

- Internal Training
- External vocational training centers
- Other:

Please specify which kind of skills shortages characterize the technicians involved in the different installation phases:

