HYPROFESSIONALS

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Best educational practices report

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(PU – Public, PP – Restricted to other programme participants, RE – Restricted to a group specified by the consortium, CO – Confidential)

New Energy World JU
fuel cells & hydrogen for sustainability

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0 Executive Summary

The focus of this report is to carry out a compilation of the most important educational projects in the area we are concerned with training in fuel cells and hydrogen technologies.

Data collection focuses on countries of the European community. Through the project participants involved in the task Hyprofessionals 1.1. We review the various educational resources that are currently available to all students who want to begin or deepen knowledge about this set of technologies used.

We selected those who understand the best educational proposals taking especially the criterion of length of training, the curriculum and the opportunity to study individually and only training, not as a subject or part of a larger formation. The study focuses in 6 European countries, which are the countries through institutions involved in the task 1.1.

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1 Objective(s) of the report

The deliverable D3 refers to task 1.1 in WP1. The objective of the task is to collect the best or excellent educational initiatives which can be replicated to other European regions.

The focus of the report is to expose the educational initiatives on fuel cell and hydrogen technologies in the origin countries of the partners involved in the task. Partners from 6 European countries were involved, these are:

Fig.1: Countries considered in the educational programs

2 Best Educational Practices in Different European Countries

2.1 Germany

1. Academic Level (Universities)

In Germany on an academic level fuel cells are considered usually in lectures for electrochemistry. Autonomous bachelor and master degrees do not exist at the moment. One exception is the University of Dresden which offer a Master in “Hydrogen technology”. It is a 2 year program with 9 modules and a thesis. Further information:
http://www.dresden-international-university.com/index.php?id=45

Some Universities in Germany offer lectures for fuel cells and Hydrogen technology (selection):

- RWTH Aachen University
- Technical University Munich
- University Karlsruhe
- University Münster
- University Ulm

2. Further training (seminars)

In the field of further training some educational institutions offer seminars dealing with fuel technologies. Most of the offers are in German and have an average duration from 1 to 3 day.
These are (selection):

- Technische Akademie Esslingen (TAE):
  Seminar: e.g. „Wasserstoff in mobilen Anwendungen“
  Weblink: http://www.tae.de

To be developed in same way that WBZU studies

- Haus der Technik (HdT) in Essen
  Seminar: e.g. „Batterien und Brennstoffzellen - Schlüsseltechnologien für die Mobilität der Zukunft“
  Weblink: http://www.hdt-essen.de
  To be developed in same way that WBZU studies

- OTTI - Ostbayerisches Technologie-Transfer-Institut e.V., Regensburg
  Seminar: No specific seminars at the moment
  Weblink: http://www.otti.de/otti.html
- To be developed in same way that WBZU studies. In this case, as finished programs.TÜV-Süd Akademie, München
  Seminars: „Grundlagen der Hybrid- und Brennstoffzellentechnik“, „Wasserstofftechnologie“,
  Weblink: http://www.tuev-sued.de/akademie_de
- To be developed in same way that WBZU studiesWeiterbildungszentrum Brennstoffzellen Ulm e.V. (WBZU)
  Seminars: PEFC course, Hydrogen seminar (see tables below)
  Weblink: www.wbzu.de

Ok, developed.

Most of the mentioned training institutions also offer trainings for handling high voltage (HV) in electric vehicles. These seminars mostly address staff that have to do service and maintenance of hybrid and electric vehicles. For the reason that hybrids and first battery powered EV are already on the market the high voltage topic is of importance. Fuel cells also have a voltage of more than 400V. For this reason the “HV qualification” also will become more important for fuel cell vehicles as soon as the market introduction is foreseeable. Car manufacturer like Daimler talk about the year 2015 introducing fuel cell to market.

In general it can be mentioned that in Germany battery and hybrid vehicles play currently a more important role in education and training than fuel cells do. It would be desirable for the moment that both technologies, fuel cells and batteries, are considered under the term “electro mobility”.

3. Studies

CONTACTED INSTITUTION / CENTRE	
Institution's name:	WBZU
Centre:	Fuel Cell Education and Training Centre Ulm
Address:	see above
Web site:	www.wbzu.de
Contact person:	Thomas Aigle
Telephone:	see above
E-mail address:	see above
GENERAL INFORMATION:	
Type of Institution:	Further training
Type of studies taught:	Seminares, workshops, conferences
Year of fundation:	2002
Number of employees:	5
Geographical ambit of action/influence:	mostly national, some courses are international
Relation with companies:	WBZU is a non for profit society with 60 members from trade, industry, universities and R&D centres. Most ot them are involved an fuel cell an H2 topics.

Studies_1

Identification of studies programmes.

Name of the studies programme:

Course: Polymer Electrolyte Fuel Cells (PEFC).

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

No, it isn't an accredited one.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

The seminar addresses staff form industry and R&D (engineers, scientists) who want to have a detailed understanding of function, processes, components and materials in a PEFC.

Duration of the training action:

5 days (40 hours): 3 day theory, 2 day practical training

Teaching modality: in classroom, distance, blended

Classroom with practical trainings. Between 10 - 20 participants.

Ambit of action:

International

Formats or type of studies:

Course for further training.

Age in teaching these studies programs:

Level of work experience:

The course will be valuable to people who wish to achieve a quick working knowledge of fuel cells and utilize this information at their work. The course is structured to ensure that no prior knowledge of electrochemistry or fuel cell technology is required for participation. A B.S. degree in a science or engineering discipline is desirable but not required.

Objectives:

The PEFC-Course gives a detailed introduction in PEFC-Technology, shows the state of the art of the development and gives hints to present bottlenecks and suggested research / development directions

Outlook / planed study programmes:

A transfer of the concept to SOFC-technology is planned.

Facilities required (specific materials and equipment):

Registration

Herewith I register to the below marked course **„Polymer Electrolyte Fuel Cells"**. I agree to the payment fees and the participation conditions (see below).

☐ K-PEFC-1: 21.-25.03.2011

Title, Name

Institution

Street

ZIP, City

Phone

Fax

E-Mail

Payment:

☐ Bank transfer
☐ Credit card ☐ EURO/MASTER ☐ VISA
Card-No.:
Validity date:
Card owner:
☐ Cash payment by beginning of the course

Date Sign

Please send the registration form:
by Fax: +49 (0)731 / 1 75 89-10
online: www.wbzu.de

Conditions of participation:
Registrations are binding and will be considered by the order of its incoming. The number of participants is limited. Please, transfer the participation fee after receiving the invoice.
If you cancel your participation less than 14 days before the course we will charge a service fee amounting to 50% of the participation fee. If you cannot participate (and do not log out before) we will charge the full amount. It is possible to nominate an alternative participant. The organizer can do changes in the program because of urgent cases.

Organisation

Organizer:
Weiterbildungszentrum Brennstoffzelle Ulm e.V. (WBZU)
(Fuel Cell Education and Training Center Ulm)

Venue:
Weiterbildungszentrum Brennstoffzelle Ulm e.V.
Helmholtzstraße 6, D-89081 Ulm (Germany)

Registration Fee – please mark with a cross:
☐ 1.590,00 EUR*
☐ 990,00 EUR* (Non-Profit-Organisations)
☐ 690,00 EUR* (Students)

* By registration latest 4 weeks before beginning of the course you will get a rebate of 10% of the registration fee.

Note: As a member of WBZU e.V. you can honor your educational coupon for this course.

Transportation:
Most visitors to the area fly to Stuttgart International Airport, approximately 60 miles from Ulm. Train and taxi services are available at the airport. Also convenient is Frankfurt International Airport, approximately 150 miles from Ulm. In Frankfurt you have a direct "High-Speed-Connection" with the ICE-Trains to Ulm (approx. 2 hours).

Contact person:
Ms. Manuela Egger

If you have any questions please do not hesitate to contact me:

Phone: +49 (0)731 / 1 75 89-21
Fax: +49 (0)731 / 1 75 89-10
manuela.egger@wbzu.de

WBZU

Course 2011
Polymer Electrolyte Fuel Cells (PEFC)

Ulm, Germany

K-PEFC-1: 21.-25.03.11

General information

Background: Polymer Electrolyte Fuel Cells

The PEFC Fuel Cell uses a polymer membrane as an electrolyte. It is used in all applications with dynamic loads, especially in mobile applications but also as combined heat and power units in households. The development of the ion-conductivity of the membranes has much increased over the last 30 years.

Today nafionbased membranes achieve a power density up to 1 W/cm² active area. In the last 10 years the successful adoption of the PEFC in different prototypes could be demonstrated. For a market introduction a few "teething problem" like life-time and costs have to be solved. In this context scientists have high expectations in the development of high-temperature membranes. Cells with these temperatures can be operated over 100°C.

The PEFC-Course gives a detailed introduction in PEFC-Technology, shows the state of the art of the development and gives hints to present bottlenecks and suggested research / development directions.

Who should attend?

The course will be valuable to people who wish to achieve a quick working knowledge of fuel cells and utilize this information at their work. The course is structured to ensure that no prior knowledge of electrochemistry or fuel cell technology is required for participation. A B.S. degree in a science or engineering discipline is desirable but not required.

This course is suitable for:

- 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
- science and engineering graduate students desiring an understanding of FC technology
- science and engineering faculty whose expertise lie in other fields and are looking to enter

Program – theoretical lectures

All days: Monday to Friday 9 a.m. to 12 p.m.

Lecture topics include:

- Electrochemical fundamentals of fuel cells
- Overview of fuel cell applications
- Fundamentals of electrocatalysis
- Properties of ion-conducting materials
- Polymer electrolytes
- Sealing and gasketing
- Porous media
- Membrane electrode assemblies
- Coating technologies
- PEFC at elevated temperatures
- Lifetime aspects of PEFC
- High temperature fuel cells
- Gas processing
- Testing of fuel cells

The course will be splitted in theoretical lectures and practical training units. Training days will provide two blocks of lecture times in the morning. The afternoon will be devoted to practical training.

The instructors are trainers from WBZU and scientists from the "Centre for Solar Energy and Hydrogen Research (ZSW)" which is located next to WBZU. ZSW is a research centre on fuel cells and batteries and world-wide known for its work on PEFC-fundamentals, stack-developing and -testing and system engineering. The instructors also give lectures on fuel cell technology at different universities in Southern Germany.

Program – practical training units

All days: Monday to Friday 13 p.m. to 17 p.m.

Laboratory topics include:

- Electrochemical fundamentals of fuel cells
- Basic experiments with fuel cell kits
- Operation of a PEFC stack by pressure and gas composition
- Theoretical introduction by variation in humidification and temperature
- Manufacturing of a membrane electrode assembly by spray coating
- Manufacturing of a PEFC stack
- Operation of a fuel cell CHP
- Operation of a PEFC stack in hybrid systems
- Operation of a PEFC based uninterrupted power supply unit

Laboratory sessions will be conducted to reinforce important concepts covered during the presentations. The instructors will select a number of laboratory modules for the course from among the above-named topics. At WBZU laboratories special test-benches and demonstration-units are installed to guarantee a practical training.

Sightseeing and common dinner

A walk through Ulm opens different views. The 161 meters high spire of the "Ulmer Münster" (Ulm cathedral) is the highest in the world. But there are also historical quarters, which give an impression of daily life in former ages.

Studies_2

Identification of studies programs.

Name of the studies programme:

Seminar: Safety aspects and Handling of Hydrogen. 3 days

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

No, it isn't and accredited one.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

The seminar mainly addresses technicians and engineers from trade and industry as well as operators who use Hydrogen technologies in their daily work.

Duration of the training action:

3 days (24 hours): 2 day theory, 1 day practical training

Teaching modality: in classroom, distance, blended

Classroom with practical trainings. Between 10 - 20 participants.

Ambit of action:

At the moment: national. On demand: international

Formats or type of studies:

Seminar for further training. http://www.wbzu.de/seminare/cal/52.html

Level of work experience:

The course addresses people who have to deal with Hydrogen in their daily work. This can be staff involved in the development of fuel cell applications or operators who have to do service and maintenance. A bachelor or master degree in a science or engineering discipline is desirable but not required.

Objectives:

1. Fuels for vehicle applications
2. Hydrogen: properties and dangers
3. Hydrogen: production, storage, and distribution
4. Hydrogen: How to behave in case of an accident
5. Materials, hardware, sealing
6. Use of hydrogen inside buildings
7. Safety and location of hydrogen filling stations
8. Transport of hydrogen filled vehicles
9. Electrical measurements in explosion prone environment
10. Handling hydrogen

Outlook / planed study programmes:

With the progress of market introduction of fuel cells the contents of seminars will be more and more adopted for operators, e.g. technicians for service, bus drivers, staff at filling stations, public authorities etc….

Facilities required (specific materials and equipment):

Appendix:

Anmeldung

Hiermit melde ich mich verbindlich zum folgenden Termin der Praxisseminare „**Sicherheitsaspekte im Umgang mit Wasserstoff**" an. Die Teilnahmebedingungen (siehe unten) habe ich gelesen.

☐ PS-H2-1: 12.-14.04.2011
☐ PS-H2-2: 11.-13.10.2011

Titel, Name

Institution

Straße

PLZ, Ort

Telefon

Telefax

E-Mail

Datum Unterschrift / Stempel

Senden Sie uns Ihre Anmeldung:
per Fax: +49 (0)731 / 1 75 89-10
per Post: WBZU e.V., Helmholtzstr. 6, 89081 Ulm
online: www.wbzu.de

Teilnahmebedingungen
Anmeldungen sind verbindlich und werden nach der Reihenfolge des Eingangs berücksichtigt. Die Teilnehmerzahl ist begrenzt. Bitte überweisen Sie die Teilnahmegebühr nach Erhalt der Rechnung.
Stornierungen bis 14 Tage vor der Veranstaltung sind kostenfrei. Bei späteren Stornierungen berechnen wir 50% der Teilnahmegebühr. Bei Nichtteilnahme ohne vorheriger Stornierung berechnen wir den vollen Betrag.
Ein Ersatzteilnehmer kann zu jedem Zeitpunkt gestellt werden. Etwaige Programmänderungen aus dringendem Anlass behält sich der Veranstalter vor.

Organisation

Veranstalter:
Weiterbildungszentrum Brennstoffzelle Ulm e.V. (WBZU)

Ort:
Weiterbildungszentrum Brennstoffzelle Ulm e.V.
Helmholtzstraße 6, 89081 Ulm

Teilnahmegebühr – bitte ankreuzen:
☐ 990,00 EUR*
☐ 790,00 EUR* (Non-Profit-Organisationen)
☐ 390,00 EUR* (Studenten)

* Bei einer Anmeldung bis spätestens 21 Tage vor Veranstaltungsbeginn erhalten Sie einen Preisnachlass in Höhe von 10% des Teilnahmebeitrages.

Hinweis: Als Mitglied des WBZU e.V. können Sie Ihren Bildungsgutschein für dieses Seminar einlösen.

Bezahlung:
Nach Erhalt der Rechnung
siehe Teilnahmebedingungen

Anreise:
Näheres unter www.wbzu.de

Ansprechpartnerin:
Frau Manuela Egger

Bei Fragen können Sie sich gerne an mich wenden:

Tel.: +49 (0)731 / 1 75 89-21
Fax: +49 (0)731 / 1 75 89-10
manuela.egger@wbzu.de

WBZU

Praxis-Seminare 2011
Sicherheitsaspekte im Umgang mit Wasserstoff

PS-H2-1: 12.-14.04.11
PS-H2-2: 11.-13.10.11

Zielsetzung

Sicherheitsaspekte in Entwicklung und Anwendung

Ein fundiertes Wissen über einen sachgemäßen und sicheren Umgang mit Wasserstoff spielt nicht nur im Entwicklungsprozess von Brennstoffzellensystemen eine wichtige Rolle, sondern mit zunehmender Marktreife auch in der alltäglichen Anwendung der Technologie. Brennstoffzellenfahrzeuge und auch -BHKW werden zur Zeit in groß angelegten Feldversuchen erprobt und getestet. In bestimmten Nischen, z. B. als Unterbrechungsfreie Stromversorgung (USV), sind Brennstoffzellen bereits auf dem Markt.

Praxisseminare am WBZU

Die frühzeitige und praxisnahe Weiterbildung der von der Brennstoffzellentechnik potentiell betroffenen Branchen und Berufsgruppen ist eine Kernaufgabe des Weiterbildungszentrums Brennstoffzelle Ulm. Hierfür betreibt das WBZU ein Brennstoffzellen-Technikum mit verschiedenen Versuchsaufbauten und Geräten zur praktischen Demonstration. Das Praxis-Seminar vermittelt anschaulich wichtiges Know-how zum sicheren Umgang mit wasserstoffbetriebenen Brennstoffzellensystemen. Die ersten beiden Tage der dreitägigen Schulung vermitteln die Grundlagen in Theorie und Praxis. Der dritte Tag behandelt gezielt Fragestellungen zum Umgang mit Wasserstoff in Fahrzeugen.

Zielgruppen

Das Seminar ist konzipiert für Personen, die mit Wasserstoff im Berufsalltag umgehen. Sicherheitsaspekte sind dabei in allen Stufen der Produktentstehung von großer Bedeutung. Aber auch bei den Anwendern spielt Sicherheit eine große Rolle. Daher müssen diese genau über die Spezifika von Wasserstoff informiert sein:

- Techniker, Konstrukteure, Ingenieure
- Forscher und Entwickler
- Verfahrenstechniker
- Sicherheitsfachkräfte
- Anwender, z.B. Handwerker, Servicepersonal

Programm

Tag 1: 10:00 – 17:00 Uhr

Grundlagen Wasserstoff und Brennstoffzellen
Dipl. Ing. Christian Machens, efficientics

- H_2-Einsatz: Historie – Gegenwart – Zukunft
- Grundlagen zur Brennstoffzellen-Technologie
- Übersicht über Brennstoffe für mobile Anwendungen
- Wasserstoff: Eigenschaften und Gefahren
- Wasserstoff: Herstellung, Speicherung und Verteilung

Tag 2: 9:00 – 17:00 Uhr

Umgang mit Wasserstoff in der Praxis
Dr. Ludwig Jörissen, Zentrum für Sonnenenergie und Wasserstoff-Forschung Baden-Württemberg

- Wasserstoff: Verhalten im Störfall
- Umgang mit H_2 in Arbeitsräumen
- Transport von H_2-gefüllten Fahrzeugen
- Arbeiten und messen in der Nähe potentieller Wasserstoffaustrittsstellen
- Wichtige Empfehlungen im Umgang mit H_2 in der Praxis
- Wie dicht ist dicht?

Praktikum
Dipl.-Ing. Peter Pioch, Technischer Leiter WBZU e.V.

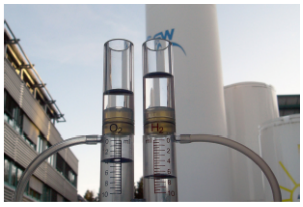
- Klemmring-Verschraubungen
- O-Ring-Verschraubungen
- Leckagetest
- Verschiedene Aufbaubeispiele anhand von Teststänaden

Programm

Tag 3: 9:00 – 17:00 Uhr

Sicherheit in Wasserstoff-Fahrzeugen
Dipl. Ing. Bernhard Brieger, TÜV Süd Automotive

- Wasserstoff zum Antrieb von Fahrzeugen
- Gesetzliche Grundlagen in Deutschland
- Entwurf einer ECE-Richtlinie
- European Integrated Hydrogen Project
- Prinzipieller Aufbau einer Gasanlage in einem Fahrzeug
- Verantwortliche Person und Fachkraft
- Prüfungen an Wasserstoffanlagen in Fahrzeugen
- Arbeitssicherheit



Add for each study: Idiom The program course (at least) must be translated to English.

Conclusions

1. Academic Level (University)

In Germany exist in summa 105 Universities and 211 Universities of Applied Science [DSTATIS 2011]. Fuel cells are usually considered in form of lectures within study programs for chemistry, physics, electrochemistry mechanical or electrical engineering. Autonomous bachelor and master degrees do not exist at the moment. One exception is the University of Dresden which offers a Master in “Hydrogen technology”. It is a 2 year program with 9 modules and a thesis. Further information: http://www.dresden-international-university.com/index.php?id=45

Some Universities in Germany offer whole lectures for fuel cells and Hydrogen technology. Amongst the most well-known are

- RWTH Aachen University
- Technical University Munich
- University Karlsruhe
- University Münster
- University Ulm

2. Vocational training

Fuel cells are applied in vehicles, in CHP-Units and as portable power sources. For service and maintenance qualified staff from the trade sector will be in future necessary. Discussions when and how to implement fuel cells and Hydrogen systematically in vocational curricula are running. This process of designing curricula is done by vocational associations and chambers in Germany.

The handling of high voltage (HV) in electric vehicles will be one of the key qualifications necessary for service and maintenance of battery and fuel cell cars. For the reason that hybrids and first battery powered EV are already on the market the high voltage topic is of importance. Fuel cells also have a voltage of more than 400V. For this reason the “HV qualification” also will become more important for fuel cell vehicles as soon as the market introduction is foreseeable. Car manufacturer like Daimler talk about the year 2015 introducing fuel cell to market.

In general it can be mentioned that in Germany battery and hybrid vehicles play currently a more important role in education and training than fuel cells do. It would be desirable for the moment that both technologies, fuel cells and batteries, are considered under the term “electro mobility”.

For example the TAK (Technische Fahrzeugakademie) offers vocational training for hybrid vehicles. In 43 automotive training centres technicians are trained for Hybrid cars [TAK 2011]. These centres are very suitable for offering trainings for fuel cell and hydrogen in future. In summa for vocational training and further qualification in Germany exist 391 schools run by a vocational association (“Bildungsstätten des Handwerks”) [HPI 2005, 18].

A short-term measure and very important in the current phase of market preparation for fuel cells is the training of the trainer. Through further training and qualification of the trainers the knowledge can be transferred to the young workers of tomorrow. For the implementation of new technologies (e.g. like fuel cells) and qualification of trainer the HPI-Institute plays an important role in Germany. Tasks of the HPI are

- Further qualification of trainers at vocational training institutions (“Weiterbildung der Ausbilder in überbetrieblichen Bildungseinrichtungen des Handwerks – WÜA-seminars”)

- Organisation of further training courses for new technologies (Weiterbildungslehrgänge für neue Technologien – NT – courses")

The offers and activities of HPI can be found under http://hpi-hannover.de.

A first step for an implementation of the fuel cell topic in the WÜA-offers was done by the Chamber of Trade in Ulm (HWK Ulm) in cooperation with WBZU. A three-day seminar dealing with batteries and fuel cell will be offered in November 2011. For details please check: http://wuea.bistech.de.

Also in the "NT-courses" the fuel cell topic is considered in the section "NT 6 Energy technologies" of the course program. All the offers are in German and available under:
http://hpi-hannover.de/uploads/NT-Seminar_pdfs/hpi_nt_lehrgaenge_gesamtuebersicht.pdf. In detail two NT-courses are acknowledged by HPI and for that can be funded. These are:

- NT 6.11: Entwicklungsstand der Brennstoffzellentechnologie in der Hausenergieversorgung
- NT 6.21: Brennstoffzellen- und Wasserstofftechnologie – Grundlagen, Einsatzfelder und Marktchancen

3 Further Training / post gradual training (seminars)

In the field of further training some private and public educational institutions offer seminars dealing with fuel technologies. Most of these offers are in German and have an average duration from 1 to 3 day. Some examples are presented below.

- Technische Akademie Esslingen (TAE):
  Seminar: e.g. „Wasserstoff in mobilen Anwendungen"
  Weblink: http://www.tae.de

- Haus der Technik (HdT) in Essen
  Seminar: e.g. „Batterien und Brennstoffzellen - Schlüsseltechnologien für die Mobilität der Zukunft“
  Weblink: http://www.hdt-essen.de

- OTTI - Ostbayerisches Technologie-Transfer-Institut e.V., Regensburg
  Seminar: No specific seminars at the moment
  Weblink: http://www.otti.de/otti.html

- TÜV-Süd Akademie, München
  Seminars: „Grundlagen der Hybrid- und Brennstoffzellentechnik“, „Wasserstofftechnologie“,
  Weblink: http://www.tuev-sued.de/akademie_de

- Weiterbildungszentrum Brennstoffzellen Ulm e.V. (WBZU)
  Seminars: PEFC course, Hydrogen seminar (see tables below)
  Weblink: www.wbzu.de

2.3 Spain

The educational landscape in the fuel cell and hydrogen technologies in Spain is mainly distributed through universities and technological institutes. We can also find training courses for these technologies in training, although this level of training where there is less scope of supply in terms of number of centers that offer this possibility.

The format which offers training in Hydrogen Technologies in Spain is varied. From specific courses in the applications of hydrogen energy use through fuel cells to seminars, lectures, summer.... Passing through the most common format, which is part of the training offered in vocational training related to renewable energy and chemical engineering.

Although we can find training opportunities in hydrogen technology in more than 60 offers of training in Spain, a small percentage focuses exclusively on the study of hydrogen and fuel cells.

At least, we have to comment a little bit about these 60 offers, a table with centre, name, content …

When expressed in this report, the training offer available in Spain, we will highlight best practices as those focusing on technology noted, indicating in detail his most notable references. In turn, indicate less detail those educational offerings, which belong to the same institution treated in some way the technology of hydrogen and fuel cells:

CONTACTED INSTITUTION-CENTRE

Institution:

Universidad Internacional Menéndez Pelayo***.*** UIMP

Centre:
Sede Madrid

Address:

C/ Joaquín Costa, 22 28006 Madrid, Spain.

Website:

http://www.uimp.es/

E-mail-address:

GENERAL INFORMATION

Type of Institution:

University

Type of studies taught:

Degrees, Master

Geographical ambit of action/influence:

International

Relation with companies:

Different kind of sponsorship.

Studies_1

Identification of studies programs.

Name of the studies programme:

Máster Universitario/Doctorado en Energías Renovables, Pilas de Combustible e Hidrógeno. Master/doctor in renewable energy, Fuel Cells and Hydrogen

Level/Origin of studies:

Accredited

Studies Addresses: Educational level and professional groups to whom the training is addressed.

The master mainly addresses graduates and engineers from trade and industry as well as operators who use Hydrogen technologies in their daily work.

Duration of the training action:

Nine months, from October to July. 20 hours a week. 600 hours.

Teaching modality: in classroom, distance, blended

Classroom 25 participants. Seminars, company visits. Laboratory training.

Ambit of action:

International

Formats or type of studies:

Doctor´s degree

Level of work experience:

The course addresses people who have to initiate in applied research

Objectives:

Know the economic environment / social and environmental determinants that underlie the legal rules and specific policies affecting the development, implementation and management of renewable energy.

Understand the fundamentals and the tools needed for applied research to the generation of renewable energy: photovoltaic, solar, biomass, wind and geothermal.

Understand the fundamentals underlying operating principles of different types of fuel cells, and have a perspective on problems facing their research, technological development and implementation.

Know the production technologies and hydrogen storage.
Being able to access the third cycle of university studies, and integrated into a line of research to develop his thesis.

Outlook / planed study programmes:

RENEWABLE ENERGY MODULE I (37 ECTS)
1. Present and future of energy
2. Ocean wave energy and hydro
3. Photovoltaic
4. Solar thermal
5. Thermo-electric solar energy
6. Biomass energy, agro-energy
7. Biomass energy use
8. Wind Energy
9. Other energy: geothermal and waste recovery
1. Regulatory and environmental policies

FUEL CELL MODULE II (13 ECTS)
1. Polymer Fuel Cells
2. Fuel Cells Solid oxide
3. Other fuel cells
4. Auxiliary devices for fuel cells:

supercapacitors and advanced batteries
5. Engineering, technology and systems integration in cell fuel

Comments:

Brochure: http://www.uimp.es/attachments/1241423662Master%20Energia.pdf

CONTACTED INSTITUTION-CENTRE

Institution:

Fundación CIRCE. CIRCE (Centro de Investigación de Recursos y Consumos Energéticos). Center for Research Resources and Energy Consumption

Centre:

Edificio CIRCE

Address:

Campus Río Ebro / Mariano Esquillor Gómez, 15 / 50018 ZARAGOZA, Spain

Website:

http://circe.cps.unizar.es/

E-mail-address:

circe@unizar.es

GENERAL INFORMATION

Type of Institution:

Center for Research

Type of studies taught:

Degrees, Master

Geographical ambit of action/influence:

National

Relation with companies:

Development of industrial research for companies and training programmes.

Studies_1

Identification of studies programmes.

Name of the studies programme:

Diploma of Specialization
Hydrogen Technologies and Fuel Cells

Level/Origin of studies:

Grade from University of Zaragoza

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Addressed mainly towards responsible, professional and technical energy or automotive sector, organizations or governments, as well as to new graduates and researchers who wish to focus their career in this sector.

Duration of the training action:

Four months, from February to May. 12 hours a week.

Teaching modality: in classroom, distance, blended

Classroom and companies visit.

Ambit of action:

National

Formats or type of studies:

Diploma

Level of work experience:

Visit companies related with studies

Objectives:

Developing projects and feasibility studies for facilities for the generation and storage of hydrogen from renewable energy sources.

Knowing the potential offered by new technologies and applications of hydrogen, analyzing the development potential of these technologies globally and locally.

Define the best strategies to follow to build energy infrastructure based on hydrogen vector compatible with the principles of sustainable development.

Understand the legal framework in the field of hydrogen and know how to apply the rules and regulations relating to industrial uses and various applications of hydrogen.

Understand the operation and maintenance of power plants and fuel cells get the energy and material balance, making comparative analysis with other forms of energy generation.

Assessing options for the use of hydrogen in the automotive sector as a driving force for fuel cell vehicles and / or internal combustion engine as auxiliary power unit (APU).

Outlook / planed study programmes:

Subject 1: Technologies for hydrogen generation.
Subject 2: Technologies for hydrogen storage and supply.
Subject 3: Fuel Cells.
Subject 4: Energy of Hydrogen lines of action and future prospects.
Course 5: Final Draft.

Comments:

Brochure: http://circe.cps.unizar.es/spanish/hidro/prog.html

CIRCE also includes fuel cells and hydrogen formation in other formation possibilities. But these studies are only a chapter in them.

These are the courses:

- Máster Europeo de Energías Renovables. European Master of Renewable Energy.

http://circe.cps.unizar.es/spanish/master/presen.html

- Posgrado de energías renovables. Graduate Renewable Energy

http://circe.cps.unizar.es/spanish/core/presen.html

- Ecoeficiencia y Mercados Energéticos. Eco-efficiency and Energy Markets.

http://circe.cps.unizar.es/ecom/index.html

CONTACTED INSTITUTION-CENTRE

Institution:

Asociación española del Hidrógeno. AEH2. Spanish Hydrogen association.

Centre:
Sede Madrid

Address:

Sector Embarcaciones, 24 - Local 5 Tres Cantos, 28760 Madrid. Spain.

Website:

http://www.aeh2.org/en/index.htm

E-mail-address:

info@aeh2.org

GENERAL INFORMATION

Type of Institution:

Technology centre

Type of studies taught:

Formation curses, no accredited ones.

Geographical ambit of action/influence:

National.

Relation with companies:

Promotion and support of the technological development of the hydrogen energy and its use in industrial and commercial applications.

Studies_1

Identification of studies programmes.

Name of the studies programme:
Curso de Hidrógeno y pilas de combustible. Hydrogen and Fuel cells curse.

Level/Origin of studies:

No accredited curse.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

People with a general technical training, which for some reason wish to deepen the proposed agenda. It is especially suitable for people who are working on some aspect of the hydrogen technology, and want to have a greater and clearer overview, as well as those planning to launch a career in these subjects. The course also presents an opportunity to acquire specialized training in preparation for additional entry into the labor market.

Duration of the training action:
From May 30 to June 2

Teaching modality: in classroom, distance, blended

Mixture seminars and on-line. Also visit companies.

Ambit of action:

National

Formats or type of studies:

Seminars, own courses.

Level of work experience:

Training in classroom.

Objectives:

The course takes a tour of all the standard technologies of production, storage and use of hydrogen as well as real-life applications of hydrogen and fuel cells.

Outlook / planed study programmes:

1. Hydrogen energy system
2. Polymer electrolytic H2 production
3. H2 production by electrolysis alkaline and integration with RES
4. H2 production from coal
5. H2 production from natural gas
6. H2 production from methanol, ethanol and biomass
7. H2 production by thermochemical processes
8. Storage and distribution of H2
9. Fuel Cells: Fundamentals and typology
10. MCFC fuel cells
11. PEMFC fuel cells
12. Fuel Cell Testing
13. H2 combustion motors and turbines
14. Industrial use of H2
15. Compressors and gas stations
16. Vehicle Applications
17. stationary applications
18. Safety and legal
19. National situation, international and expectations

Comments:

Brochure: http://www.cursoh2.com/

CONTACTED INSTITUTION-CENTRE

Institution:

SEAS. Estudios Superiores Abiertos

Centre:
SEAS Zaragoza

Address:

Violeta Parra, 9 50015 Zaragoza, Spain.

Website:

http://www.seas.es/

E-mail-address:

GENERAL INFORMATION

Type of Institution:

University and training centre

Type of studies taught:

Degrees, Master, own courses.

Geographical ambit of action/influence:

International

Relation with companies:

Laboral training in companies

Studies_1

Identification of studies programs.

Name of the studies programme:

Curso de hidrógeno y pilas de combustible. Fuel cells and hydrogen course.

Level/Origin of studies:

Own course.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

The course addresses to people with technical training in related materials who wants to get knowledge in this emerging technology. To be able to adapt this technology in his job or get a new job.

Duration of the training action:

80 hours

Teaching modality: in classroom, distance, blended

On-line

Ambit of action:

International

Formats or type of studies:

Technical course

Level of work experience:

Training actions with specific software accurate for evaluation of fuel cell based installations. Training seminars.

Objectives:

* The search needs of an energy system based on energy sources that respect the environment.

* The various hydrogen production processes, especially through renewable energy sources.

* The physical-chemical principles governing the chain of hydrogen.

* The various forms of hydrogen storage and use in specific cases.

* The basic operating principles, characteristics and components of a fuel cell.

* The applications of hydrogen technologies, which are highlighted in detail the fuel cells.

* Basic safety behaviors, laws and regulations associated with handling hydrogen.

Outlook / planed study programmes:

1. GENERAL CONCEPTS
Hydrogen: physical and chemical properties. The hydrogen economy. Introduction scenarios. Hydrogen technologies.

2. PRODUCTION OF HYDROGEN
Electrolysis: fundamentals, types of electrolyzers, components and features, current market. Fossil fuels: reformed from natural gas, gasification. Solar Energy: thermochemical cycles, photolysis, solar thermal cracking. Production from biomass: gasification, pyrolysis, biological methods.

3. STORAGE AND DISTRIBUTION
Characteristics associated with the storage of hydrogen. Storage as a solid: absorption (nanotubes) adsorption (metal hydrides). Compressed gas storage. Cryogenic liquid storage. Hydrogen distribution systems. Logistics hydrogen.

4. APPLICATIONS
Fuel cells: fundamentals, types of batteries, features and components, applications, cogeneration, backup, automotive, portable. Hydrogen combustion engines. Integration with renewable energies. Software tool integration HOGA hybrid systems.

5. SAFETY
Basic behavior of security: prevention, risk and recommendations. Standards and regulations. Security. Future developments. CE marking and approval.

6. PROJECT MANAGEMENT
R & D programs in hydrogen. Who's Who. International and National Projects. Project financing and finding aids.

Comments:

Brochure: http://www.seas.es/cursos/curso-de-hidrogeno-y-pilas-de-combustible

SEAS also includes fuel cells and hydrogen formation in other formation possibilities. But these studies are only a chapter in them.

These are the courses:

Postgrado en Gestión y Desarrollo de Energías Renovables. A distancia.
Graduate Certificate in Management and Development of Renewable Energies. Distance.
http://www.seas.es/postgrados/postgrado-en-gestion-y-desarrollo-de-energias-renovables?piloto=S02&gclid=CL_3yfnG2psCFVkA4wodsF9Z_Q

Conclusions

- Total of activities in Spain:
  66

- Number of university and non university activities:
  70% universitary/30% N0 universitary

- Number of entities that offer training activities:
  38

- In which courses specific training is required, in which there is no required:
  The information about the training actions doesn´t indicate what material is needed

- Difference between short and long courses:

  18 >500 hours,
  25 <500 hours,
  20 no specify

- In institutions, difference between higher education and not.
  90% Higher education

  - Language of the courses: Spanish

2.3 Italy

Studies programs in Italy:

The interest towards hydrogen and fuel cells technologies is decreasing in Italy, due in general to reduction of public investments for research and to lack of ad hoc hydrogen programs. As far as FAST knows, vocational training courses have never been organised in Italy order to train hydrogen technicians. The more recent experience is Fast participation in HyTraining project, co-financed by Leonardo program and coordinated by San Valero Foundation. Only big firms sometimes plan training courses for their employees.

Institutions in Italy:

HYSCHOOL	English
ITIS Alfabetizzazione	Italian
ForteChance	Italian
Master EFER	English
Master MEA	English

The infrastructure required and the material available

* HYSCHOOL Presentations PPT, Video Lessons, Picture on the website http://www.flamesofc.org/public/hyschool-bardonecchia

* ITIS Alfabetizzazione Presentations PPT. Not shared on the net

* ForteChance Presentations PPT. Not shared on the net

* Master EFER Not Available

* Master MEA Nota Available

The contact data of those related directly to the course

* HYSCHOOL Politecnico di Torino (Guido Saracco, Debora Fino)

* ITIS Alfabetizzazione Hysylab (Alessandro Graizzaro)

* ForteChance ForteChance (Tamburini), Hysylab (Alessandro Graizzaro)

* Masters EFER, EFEA CIRPS, Università la Sapienza Roma (Paola Artuso)

Conclusions:

- Total of activities in Italy :
- 5 (VOCATIONAL ONLY)
-
- Number of university and non university activities:
- 3 not UNIV, 2 UNIV (vocational ONLY)
-
- Number of entities that offer training activities: data not found
-
- Difference between short and long courses: data not found
-
- In institutions, difference between higher education and not:
- all the reported are higher education cases.

2.4 United Kingdom

CONTACTED INSTITUTION / CENTRE	
Institution's name:	Newcastle University
Centre:	Faculty of Science, Agriculture and Engineering
Address:	Newcastle upon Tyne, Tyne & Wear, NE1 7RU, UK
Web site:	www.ncl.ac.uk/sage/postgrad/taught/reflex/
Contact person:	Sandra Haney
Telephone:	
E-mail address:	reem-reflex@ncl.ac.uk
GENERAL INFORMATION:	
Type of Institution:	*University*
Type of studies taught:	Research projects (UK and European), Doctoral studies and Postgraduate taught training
Year of fundation:	University - 1963, faculty - 2005
Number of employees:	university 200+
Geographical ambit of action/influence:	*UK, European, International*
Relation with companies:	*As projects dictate*

Studies_1

Identification of studies programmes.

Name of the studies programme:

Renewable Energy Flexible Training Program (REFLEX)

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

REFLEX is an innovative postgraduate programme in renewable energy. Accredited to 5 UK professional institutions

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Graduate level, students

Duration of the training action:

REFLEX is designed to be flexible therefore candidates can take up to 5 years to complete modules for either postgraduate certificate, postgraduate diploma or MSc.

Teaching modality: in classroom, distance, blended

Distance learning and intensive school attendance

Age in teaching these studies programs

Up to five years

Level of work experience:

REFLEX is designed to be highly flexible allowing students to study renewable energy either fill-time or part-time while continuing to work.

Objectives:

REFLEX provides a fully integrated training programme covering mechanical, electrical, chemical (hydrogen and fuel cells), marine engineering, geothermal energy, PV,policy, ethic.

Outlook / planed study programmes:

Each module of the course is delivered by a combination of distance learning material and a one week intensive school. All modules are valued at 10 credits. Modules consist of: mechanical power transmission, wind & hydro energy technology, Hydrogen and Fuel cell technology, biomass & waste technology, policy, politics & ethics, marine & offshore devices, marine & offshore structures, energy management.

CONTACTED INSTITUTION / CENTRE	
Institution's name:	University of Ulster
Centre:	School of the Built Environment - HySAFER Group
Address:	Shore Road, Newtownabbey, Co Antrim, BT37 0QB
Web site:	http://hysafer.ulster.ac.uk/index.php
Contact person:	Professor Vladimir Molkov
Telephone:	
E-mail address:	v.molkov@ulster.ac.uk
GENERAL INFORMATION:	
Type of Institution:	*University*
Type of studies taug	The centre is carrying out research and related activities in the area of safety of hydrogen as an
Year of fundation:	2004
Number of employe	unknown
Geographical ambit of action/influence:	*The HySAFER vision is to be an internationally outstanding centre in hydrogen safety research and*
Relation with companies:	*HySAFER has relationships with a variety of national research organisations and private organisations*

Studies_1

Identification of studies programs.

Name of the studies programme:
Hydrogen safety (international short courses), specific title varies

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

The International Short Course and advanced research workshop is ideally suited to those who wish to meet the growing demand for specialists in Hydrogen Safety Engineering i.e. industries and services such as aerospace, process industry, energy industry, civil works, transport and distribution, fire and rescue services, regulatory authorities, teaching and research institutes, various industrialist co operations, consultancies etc.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

The course is aimed at researchers, professionals, industrialists and those who have an interest in working with hydrogen in this new and rapid advancing field.

Duration of the training action:

Usually 4-5 day courses (however opportunities to attend specific days if necessary)

Teaching modality: in classroom, distance, blended

Typical lecture based training

Ambit of action:

National

Formats or type of studies:

Lectures, seminars

Level of work experience:

Those working or aiming to work in areas associated with Hydrogen safety. These could include the fuel cell sector or aerospace, process industry, energy etc

Objectives:

Provide information on Hydrogen safety in general

Outlook / planed study programmes:

Short courses also for part of the Universities post graduate certificate/diploma or MSc in Hydrogen Safety Engineering

CONTACTED INSTITUTION / CENTRE	
Institution's name:	Pure Energy Centre
Centre:	Pure Energy Centre
Address:	Hagdale Ind Estate, Unst, Shetland, Scotland UK, ZE
Web site:	www.pure.shetland.co.uk/html/index.html
Contact person:	Dr Daniel Aklil
Telephone:	
E-mail address:	daniel.pure@btconnect.com
GENERAL INFORMATION:	
Type of Institution:	*(University, Vocational Training, Postgraduates…)*
Type of studies taug	Courses on H2 safety, H2 electrolyser principles, H2 storage mechanisms, uses of stored H2, Intro to
Year of fundation:	2006
Number of employe	Unknown
Geographical ambit of action/influence:	*(local, regional, national, on-line…)*
Relation with companies:	*Expose if the institution has any colaboration with companies which work about H2 and/or fuel cells techologies*

Studies_1

Identification of studies programs.

Name of the studies programme:

Short training courses on areas such as: H2 safety, H2 electrolyser principles, H2 storage mechanisms, uses of stored H2, introduction to fuel cells, H2 R&D opportunities

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

No accreditation, locally developed and delivered short training courses.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

A wide variety of educational and professional groups.

Duration of the training action:

By there very nature these a short training courses of approximately 1,2, 3 days in duration

Teaching modality: in classroom, distance, blended

Classroom based

Ambit of action:

Local, regional and national

Formats or type of studies:

(Degrees, postgraduates, seminars…)

Level of work experience:

A variety of work experience, such as those with an interest in H2 and Fuel Cell to technician and graduates.

Objectives:

Specific information on the relevant training programs

Outlook / planed study programmes:

Hydrogen Safety

Be familiar with the safety properties of hydrogen.

Identify and evaluate hazards in a hydrogen system.

Understand the methods for addressing hazards.

Achieve an understanding of safe practices in design, materials selection and operation of a hydrogen system.

Recognise the physical principles and empirical observations on which these safe practices are based.

Respond to emergency situations involving hydrogen.

Identify parameters important to hydrogen safety.

Hydrogen Production Principles

Identify the methods of hydrogen production and display a basic knowledge of hydrogen production technologies.

Display a basic knowledge of the general and renewable hydrogen market.

Display an understanding of hydrogen production in the PURE system and understanding what the “HyPod” does. Hydrogen Electrolyser Principles

Understand what an electrolyser is.

Understand the basic reactions within the electrolyser.

Identify the electrolyser operational considerations and operating parameters.

Identify the relationship between the operating parameters and the electrolyser subsystems.

Hydrogen Storage Mechanisms

Become acquainted with the available methods of hydrogen storage.

Understand the advantages and disadvantages associated with each method.

Uses of Stored Hydrogen

Understand the range of applications for renewable hydrogen consumption.

Learn about issues specific to each application.

Identify issues relevant to all hydrogen applications.

Devise original hydrogen applications.

Introduction to Fuel Cells

Understand the operation of a Proton Exchange Membrane (PEM) Fuel Cell.

Understand the basic chemistry of the fuel cell and the basic electricity producing regions of the fuel cell.

Identify the PEM operating conditions.

Identify the relationship between the operating conditions and the fuel cell subsystems. Hydrogen Research & Development Opportunities

Production – alternate methods of producing hydrogen.

Delivery – methods of producing hydrogen to meet demand.

Storage – various storage facilities

Conversion – conversion of hydrogen to energy.

Applications – methods for hydrogen consumption.

Codes and safety – hydrogen technologies standards.

CONTACTED INSTITUTION / CENTRE	
Institution's name:	Imperial College London
Centre:	Electrical Engineering Building - Energy Futures Lab
Address:	South Kensington, London, SW7 2AZ, UK
Web site:	www.imperial.ac.uk/energyfutureslab
Contact person:	Victoria Harding
Telephone:	
E-mail address:	energymscinfo@imperial.ac.uk
GENERAL INFORMATION:	
Type of Institution:	*University*
Type of studies taug	Post graduate MSc, Research & Development, Proje
Year of fundation:	
Number of employe	Unknown
Geographical ambit of action/influence:	*(local, regional, national, on-line…)*
Relation with companies:	*Expose if the institution has any colaboration with companies which work about H2 and/or fuel cells techologies*

Studies_1

Identification of studies programs.

Name of the studies programme:

MSc in Sustainable Energy Futures

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Post graduate

Studies Addresses: Educational level and professional groups to whom the training is addressed.

PhD

Duration of the training action:

1 Year (full-time)

Teaching modality: in classroom, distance, blended

Mixture of seminars, tutorials, meetings, lectures

Ambit of action:

Local, regional, national and international

Formats or type of studies:

Post graduate

Level of work experience:

PhD graduates will have a systematic knowledge and understanding of Hydrogen, Fuel Cells and their Applications, including developments and problems at the forefront of the discipline. They will be able to evaluate current research critically, and be original in the application of their knowledge, proposing new hypotheses as appropriate.

Objectives:

The MSc in Sustainable Energy Futures aims to develop the next generation of leaders in the energy sector. This postgraduate course provides grounding in the major features of global energy issues, sustainable energy technologies and their interactions with economics, the environment and policy.

Outlook / planed study programmes:

Modules: Semester One

Core Foundation modules are taught during semester one (Autumn Term) to provide a solid grounding for students from diverse academic backgrounds. Below is an outline of the content covered in each module:

Energy Systems Technology

Fundamentals of energy and power in technical, economic and environmental impact terms. Estimation of energy resources and demands. Main sources of data and analyses. Global and regional energy systems. Overview of main energy technologies; current and emerging, for energy supply, storage and transmission and

demand management. Co-generation and efficiency, distributed vs centralised energy systems. Typical applications and case studies.

Methods for the Analysis of Energy Systems

Technical performance and environmental impact metrics and analysis. Modelling, simulation and optimisation of energy systems (components, networks and supply chains). Multiscale modelling, Sensitivity, uncertainty and risk analysis. Multi-objective optimisation and trade-off analysis. Life cycle and scenario analysis. Typical applications for each method and case studies.

Energy Economics and Policy

Energy demand, supply markets and competition. Energy policy principles and local, national and regional examples. National and international regulatory and legal environments. Energy-economics-environmental models of global impact. Cost/Benefit analysis. Private investment decision making. Evaluating future technologies. Policy instruments and market mechanisms for carbon mitigation.

MSc in Sustainable Energy Futures debating club and seminar series

This module gives students the opportunity to explore current energy issues. Previous debating topics include: the role of industrialised nations in leading the march on climate change; the construction of new nuclear power stations and their role in the UK energy landscape; and whether an individual can influence the use of one technology through their investment in it. In addition to the debating club, guests from the leading edge of academia, industry and government are invited to give bespoke lectures exclusively to the MSc in Sustainable Energy Futures students. Modules: Semester Two

The modules in Semester Two (Spring Term) are a series of intensive courses lasting two weeks. Each module is taught by experts in that field, from academia, industry and government. Below is the outline of the content covered in each module:

Urban Energy Systems

Urbanisation and growth in energy demand; cities as dynamic systems. Characterising city infrastructures; complex systems and networks. Energy supply, conversion and demands in cities; resource flows and city sustainability. Modelling, analysis and optimisation of cities from an energy systems perspective. Transport modelling; land use interactions and energy demands. Case studies.

Clean Fossil Fuels

Role of fossil fuels and key issues, analysis, potential solutions. Scale of carbon emissions and climate change driven targets. Conversion technologies for stationary power generation. Carbon capture and storage; technologies, economics. Transportation and long-term storage options for CO2. Coal based processes. Gas based processes. Cogeneration processes. Fuel cells using fossil-based hydrogen and hydrocarbon feedstocks, combined processes. Oil and gas production. Non-conventional hydrocarbon production. Options for cleaner production. The CO2 lifecycle.

Low Carbon Technologies: Bioenergy (half module)

Introduction to sustainable bioenergy: issues, formulations, analysis, potential solutions. Thermal and bio-conversion processes; biomass supply, demand, technology and sustainability issues; engineering of biomass composition, biorefineries, biofuels; molecular microbiology and metabolic engineering; prospects for improving engineering photosynthetic efficiency. Economics and policy aspects of each technology.

Low Carbon Technologies: Nuclear (half module)

Nuclear fission and its position in the energy mix. Fundamentals of power production by fission. Reactors fundamentals. The fuel cycle. Options for dealing with spent fuels. Nuclear waste management. Safety aspects. Decommissioning. Advanced reactor designs and future prospects. The economics of nuclear energy.

Energy Transmission and Storage

Electrical networks; natural gas networks and future hydrogen networks including the technical opportunities, constraints and economics; Energy demand and supply variation in electrical networks. Electrical energy transmission in a variable environment and congestion management. Power flow control. Balancing supply and demand. Natural gas networks. Technologies and prospects for hydrogen transmission. Energy storage for electrical networks and other forms of energy (gas, electrochemical). Managing energy networks in the face of uncertainty and in distributed generation.

Sustainable Transport

Role of transport in the overall energy picture. Aviation and road transport technologies. Rail related (mass transit) issues (linking with Urban Energy Systems). Aero and vehicle propulsion (including aero engine propulsion models, IC engines, hybrid vehicles, fuel cells for transport applications), infrastructure implications, current and emerging technologies. Role and impact of transport policy.

CONTACTED INSTITUTION / CENTRE	
Institution's name:	University of Bath
Centre:	Centre for sustainable Chemical Technologies
Address:	Bath, BA2 7AY, UK
Web site:	www.bath.ac.uk/csct/
Contact person:	Professor Matthew Davidson
Telephone:	
E-mail address:	m.g.davidson@bath.ac.uk
GENERAL INFORMATION:	
Type of Institution:	*(University, Vocational Training, Postgraduates…)*
Type of studies taug	PhD Studentship
Year of fundation:	2008
Number of employe	approx 40
Geographical ambit of action/influence:	*(local, regional, national, on-line…)*
Relation with companies:	*Expose if the institution has any colaboration with companies which work about H2 and/or fuel cells techologies*

Studies_1

Identification of studies programmes.

Name of the studies programme:

PhD from Centre for Sustainable Chemical Technologies - Clean Energy

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Post graduate

Studies Addresses: Educational level and professional groups to whom the training is addressed.

PhD

Duration of the training action:

4 Years

Teaching modality: in classroom, distance, blended

Mixture of seminars, tutorials, meetings, lectures

Ambit of action:

Local, regional, national and international

Formats or type of studies:

Post graduate

Level of work experience:

Hydrogen storage, fuel cells, lithium batteries, solar energy conversion

Objectives:

Hydrogen storage, fuel cells, lithium batteries, solar energy conversion

Conclusions:

The language of the courses:

All are in English

Infrastructure required & material available:

The infrastructure for these courses are all a combination of lectures, laboratory work, conferences etc and material consists of lecture notes, laboratory experiments notes, notes for conferences etc.

Total of activities (courses) in United Kingdom:

This is difficult to quantify, as there are a large number of Universities, colleges etc in the UK. We have highlighted the major 6 institutions which offer 'pure' Hydrogen and Fuel Cell courses. There are a number of others.

Number of universities and non universities activities:

All but one are universities.

Number of entities that offer training activities:

There are very few institutions in the UK offering training activities specific to hydrogen and Fuel Cell, other than Universities .The only specific H2 and Fuel Cell organisation that delivers H2 and Fuel Cell training is the Pure Energy Centre based in the Shetland, Scotland. These tend to be short courses of 1-5 days in duration.

In which courses specific training is required, in which there is not required:

All UK universities require related higher education certificates such as A (Advanced)- level in appropriate subjects. Therefore for H2 and Fuel Cell related

courses, Mathematics, Chemistry, Physics etc. The non university courses i.e. the short courses delivered by Pure Energy Centre for example, these would probably ask for at least some experience/knowledge in the field of the course.

Difference between short and long courses:

If we assume that long courses are of a duration of 3 to 4 years and short course of between 1-5 days, then I would say that in the UK there is approximately 90-95% long courses.

In institutions, difference between higher education and not:

All the university courses are under-graduate, post-graduate (including MSc and PhD).

a. Turkey

Most of the educational activities are sponsored by the Ministry of Education (MEB) as proposals submitted to them. Separately, MEB has Technical Education Directorate to manage subject specific activities for technologist and technician education. For each subject areas, training modules are developed and implemented by traineers based on industry specific needs.

Hydrogen and fuel cell research in Turkey is mainly funded by Turkish Scientific and Technical Research Council (TUBITAK) on national and international level. Various funding were provided under different programs to universities, industry and others. Since the year 2000, more than 10 million Euro funding was provided for hydrogen and fuel cell research in Turkey. There is no specific funding scheme for education but one can submit proposals to cover hydrogen and fuel cell education as well.

ICHET (International Centre for Hydrogen Energy Technologies) supports educational activities through various mechanisms.

- More than 70 university students part-time employed to work on hydrogen and fuel cell technologies.
- Quarterly short courses organized with total participation of 200+ people. Summer schools on PEM fuel cells have been organized with 120+ participation in the last 3 years.
- High school fuel cell vehicle competion organized along with 20+ high school visits and seminars.
- Several nationwide hydrogen and fuel cell education workshops were organized with total attendance of more than 800 physics, biology and chemistry teachers.

All the above activities have been mentioned to give an idea for better and continuing implementation.

CONTACTED INSTITUTION / CENTRE	
Institution's name:	ICHET
Centre:	
Address:	Sabri Ulker Sk,38/4, Cevizlibag-Zeytinburnu-Istanbul, Turkey
Web site:	www.unido-ichet.org
Contact person:	Osman Atanur
Telephone:	
E-mail address:	oatanur@unido-ichet.org
GENERAL INFORMATION:	
Type of Institution:	*International*
Type of studies taught:	Hydrogen & Fuel cell
Year of fundation:	7
Number of employees:	30
Geographical ambit of action/influence:	*International*
Relation with companies:	*Funding Hydrogen & fuel cell projects*

Studies_1

Identification of studies programmes.

Name of the studies programme:

Short courses

Introduction to Hydrogen and Fuel Cells

Hydrogen and Fuel Cell System Integration

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Basic level of hydrogen and fuel cell education, Basic level system integration training.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Open to everybody. Participants include engineers and scientists from public and private organizations, teachers and lecturers.

Duration of the training action:

2 days, 4 times per year

Teaching modality: in classroom, distance, blended

Classroom and Laboratory

Ambit of action:

National. (Turkish Language)

Formats or type of studies:

Theoretical and laboratory

Level of work experience:

Basic engineering knowledge of fuel cell systems

Objectives:

Educating public and private organizations on importance and basics of hydrogen & fuel cell systems. Showing system integration aspect of hydrogen and fuel cell systems to experienced engineers.

Since 2007, this action has trained more than 200 engineers and scientists in Turkey.

Studies_2

Identification of studies programmes.

Name of the studies programme:

International Summer School on PEM Fuel Cells

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Not Accredited EU Programmes

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Acceptance to the course is based on a selection process from engineers and scientists working towards their MS or Ph.D degrees on fuel cell topics

Duration of the training action:

1 week

Teaching modality: in classroom, distance, blended

Classroom and some instances laboratory work.

Ambit of action:

International activity (English)

Formats or type of studies:

Lecturers from European institutions present their subject topics and homeworks assigned to students to encourage active participation.

Level of work experience:

M.S. and Ph.D. level involvement on fuel cell systems

Objectives:

Provide training for advance level of PEM fuel cell knowledge.

Since 2008, this initiative resulted training of more than 120 engineers and scientists throughout the world.

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International Summer School on:

PEM FUEL CELLS
APPLICATIONS and INTEGRATION

July 11-15, 2011
Izmir, Turkey

Summer School Objective
The Summer School is organised by the European Commission Joint Research Centre (JRC), Institute for Energy (IE), in cooperation with the UNIDO International Centre for Hydrogen Energy Technologies (ICHET)

The Summer School, as part of the JRC Enlargement and Integration Action, has strategic objectives of:

- Helping the Candidate Countries and Potential Candidate Countries in dealing faster with the "EU acquis" in areas of JRC competence
- Contributing to the development of the European Research Area (ERA)

The technical objective is to provide researchers and engineers with the required knowledge of theoretical and application aspects related to Proton Exchange Membrane Fuel Cell (PEMFC).

Topics
The summer school will address science and fundamentals of material science and electrochemistry applied to PEM fuel cells. Particular attention will be given to applications and system integration.

Target audience
This is a lecture series addressing researchers, PhD students and research fellows working in the fuel cell research and applications.

Lectures
A selection of international experts from Academia, Industry and Research Centres will provide the audience with technical lectures.

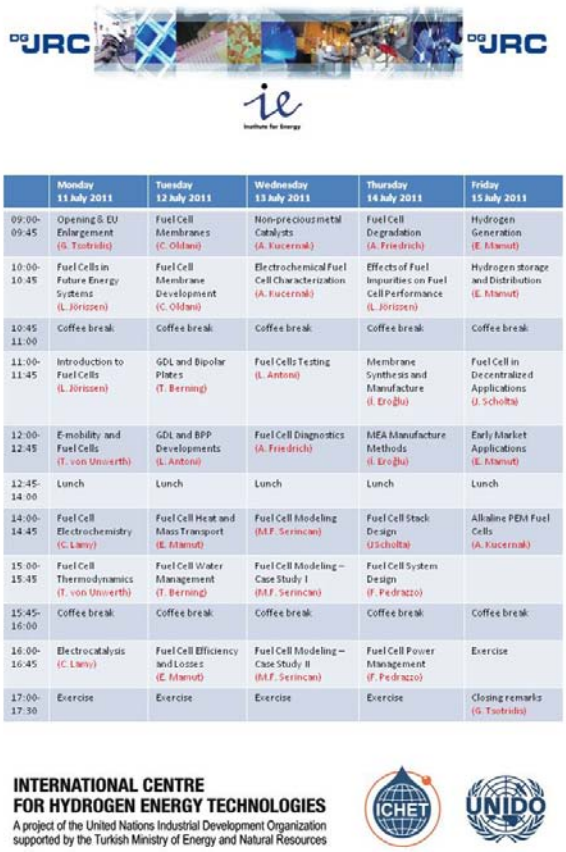
Venue
Izmir Institute of Technology (IYTE), Izmir Turkey

The official language will be English

Contacts
Dr. Mustafa Fazil Serincan (fserincan@unido-ichet.org)
Dr. Georgios Tsotridis (georgios.tsotridis@jrc.nl)

INTERNATIONAL CENTRE
FOR HYDROGEN ENERGY TECHNOLOGIES
A project of the United Nations Industrial Development Organization supported by the Turkish Ministry of Energy and Natural Resources

ICHET UNIDO



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	Monday 11 July 2011	Tuesday 12 July 2011	Wednesday 13 July 2011	Thursday 14 July 2011	Friday 15 July 2011
09:00-09:45	Opening & EU Enlargement (G. Tsotridis)	Fuel Cell Membranes (C. Oldani)	Non-precious metal Catalysts (A. Kucernak)	Fuel Cell Degradation (A. Friedrich)	Hydrogen Generation (E. Manut)
10:00-10:45	Fuel Cells in Future Energy Systems (L. Jörissen)	Fuel Cell Membrane Development (C. Oldani)	Electrochemical Fuel Cell Characterization (A. Kucernak)	Effects of Fuel Impurities on Fuel Cell Performance (L. Jörissen)	Hydrogen storage and Distribution (E. Manut)
10:45 11:00	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
11:00-11:45	Introduction to Fuel Cells (L. Jörissen)	GDL and Bipolar Plates (T. Berning)	Fuel Cells Testing (L. Antoni)	Membrane Synthesis and Manufacture (I. Eroğlu)	Fuel Cell in Decentralized Applications (J. Scholta)
12:00-12:45	E-mobility and Fuel Cells (T. von Unwerth)	GDL and BPP Developments (L. Antoni)	Fuel Cell Diagnostics (A. Friedrich)	MEA Manufacture Methods (I. Eroğlu)	Early Market Applications (E. Manut)
12:45-14:00	Lunch	Lunch	Lunch	Lunch	Lunch
14:00-14:45	Fuel Cell Electrochemistry (C. Lamy)	Fuel Cell Heat and Mass Transport (E. Manut)	Fuel Cell Modeling (M.F. Serincan)	Fuel Cell Stack Design (J.Scholta)	Alkaline PEM Fuel Cells (A. Kucernak)
15:00-15:45	Fuel Cell Thermodynamics (T. von Unwerth)	Fuel Cell Water Management (T. Berning)	Fuel Cell Modeling – Case Study I (M.F. Serincan)	Fuel Cell System Design (F. Pedrazzo)	
15:45-16:00	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
16:00-16:45	Electrocatalysis (C. Lamy)	Fuel Cell Efficiency and Losses (E. Manut)	Fuel Cell Modeling – Case Study II (M.F. Serincan)	Fuel Cell Power Management (F. Pedrazzo)	Exercise
17:00-17:30	Exercise	Exercise	Exercise	Exercise	Closing remarks (G. Tsotridis)

INTERNATIONAL CENTRE
FOR HYDROGEN ENERGY TECHNOLOGIES
A project of the United Nations Industrial Development Organization supported by the Turkish Ministry of Energy and Natural Resources

ICHET UNIDO

CONTACTED INSTITUTION / CENTRE	
Institution's name:	TURKISH UNIVERSITIES
Centre:	
Address:	
Web site:	
Contact person:	
Telephone:	
E-mail address:	
GENERAL INFORMATION:	
Type of Institution:	*UNIVERSITIES*
Type of studies taught:	
Year of fundation:	
Number of employees:	
Geographical ambit of action/influence:	*National-Turkey*
Relation with companies:	*Joint Hydrogen & fuel cell projects*

Studies_1

Identification of studies programmes.

Name of the studies programme:

University Lectures

Middle East Technical University

Gebze Institute of Technology

Nigde University

Istanbul Technical University

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Accredited university courses

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Undergraduate & Graduate

Duration of the training action:

Semester & Quarter

Teaching modality: in classroom, distance, blended

Classroom lectures and some laboratory work and field trip

Ambit of action:

National

Formats or type of studies:

Degree & postgraduate

Level of work experience:

Engineering

Objectives:

Several universities in Turkey offer courses towards completion of engineering degrees. There are also several engineering departments established as Energy Engineering focusing on energy technologies including hydrogen and fuel cells. Purpose of these activities is due to research interest of the lecturers or academic purpose.

Conclusions:

- Total of activities identified in Turkey:

18 private and university (Government and private)

- Number of university and non university activities:

University activities: 15 / non university activities: 3

- Number of entities that offer training activities:
15

- In which courses specific training is required, in which there is no required:

There is usually no prerequisite for taking tranining and lectures, but basic engineering knowledge is required. In specific research oriented tranining, CV is requested for targeted training.

- Difference between short and long courses:

- Short courses (1-5 days): some are only theoretical and others both theoretical and laboratory sessions are combined on hydrogen and fuel cell technologies.

- Long courses: These courses very much implement as part of a degree requirement in engineering departments, renewable energy programs or recently forming energy engineering departments. There are both theoretical and practical laboratory sessions implemented in parallel. In some cases, there area site trips to see hydrogen and fuel cell installations.

2.6 France

CONTACTED INSTITUTION / CENTRE

Institution's name: ineris

Centre: paris

Address:

Web site: http://www.ineris.fr/

Contact person: Stéphanie Jameaux

Telephone: 03 44 55 65 01

E-mail address: stephanie.jameaux@ineris.fr

GENERAL TRAINING INFORMATION:

Type of Institution: National institute

Type of studies taught: security aspects

Age: adults

Geographical ambit of action/influence:
national (two sessions per year : one in Paris and the other one in Lyon)

Studies_1

Identification of studies programmes.

Name of the studies programme:

The risk of hydrogen in laboratories

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

No accredited.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Anyone working with hydrogen in laboratories

Duration of the training action:

1 day

Teaching modality: in classroom, distance, blended

In classroom (this formation can also be done in a company)

Ambit of action:

National

Formats or type of studies:

Conference with a documentary diaporama

Level of work experience:

People have a good knowledge on the security and the risks

Objectives:

To characterize the risks linked to hydrogen

To identify the protection measures according to the reglamentation and the specificity of the laboratory

Studies programme:

• Definitions: combustion, explosion, flammability domain.

• Combustion and explosion phenomena

•Risks characterization

• Risks characterization

• Hydrogen security.

• ATEX regulation.

• Laboratory specificity.

CONTACTED INSTITUTION / CENTRE

Institution's name: Nancy Universités formation continue

Centre: Institut National Polytechnique de Lorraine

Address: EPCS de Nancy-Université / Formation Continue 32 rue de Saurupt □BP 60289□54005 NANCY CEDE>

Web site: http://www.fc.nancy-universite.fr/

Contact person: Mme Mouginot

Telephone: 0033 (0)3 83 68 28 23

E-mail address:

GENERAL TRAINING INFORMATION:

Type of Institution: in-service training organism

Type of studies taught: generalities and technical aspect of fuel cells

Age: 3 years

Studies_1

Identification of studies programmes.

Name of the studies programme:

Fuel cells

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Program proposed by the national polytechnic institute of Lorraine

Studies Addresses: Educational level and professional groups to whom the training is addressed.

For the people with at least a L1 level. The prerequisites are: notion in electricity.

Duration of the training action:

35 hours

Teaching modality: in classroom, distance, blended

E-learning, with a tutor available to answer to the questions

Ambit of action:

National, on-line

Level of work experience:

Good knowledge of the fuel cells

Objectives:

To have a general knowledge of the fuel cells technologies.

CONTACTED INSTITUTION / CENTRE

Institution's name: SUPELEC

Centre: gif sur yvette

Address: Plateau du Moulon - 3 rue Joliot-Curie - 91192 GIF-SUR-YVETTE CEDEX

Web site: http://www.supelec.fr

Contact person: Amir ARZANDE

Telephone:

E-mail address: amir.arzande@supelec.fr

GENERAL TRAINING INFORMATION:

Type of Institution: engineering school

Type of studies taught: 5 days formation

Age: adults

Geographical ambit of action/influence: (local, regional, national, on-line...)

Studies_1

Identification of studies programmes.

Name of the studies programme:

Renewable energy and energy storage

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

No accredited.

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Engineers or high qualified technicians

Duration of the training action:

5 days (35hours)

Teaching modality: in classroom, distance, blended

In classroom in the school Supelec in Gif sur Yvette

Ambit of action:

National

Formats or type of studies:

Formation with technical lectures

Objectives:

To acquire basic knowledge on the production of electrical energy from renewable energy.
To comprehend the economical aspects of the insertion of the renewable intermittent energy in the competitive electricity market

CONTACTED INSTITUTION / CENTRE

Institution's name: université de Corse

Centre: Ajaccio

Address: Avenue Jean Nicoli, BP 52, 20250 Corte

Web site: http://www.univ-corse.fr/

Contact person: Philippe POGGI

Telephone:

E-mail address: poggi@univ-corse.fr

GENERAL TRAINING INFORMATION:

Type of Institution: university

Type of studies taught: Master 2

Studies_1

Identification of studies programmes.

Name of the studies programme:

Energy systems and renewable energy

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Master 2

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Students holders of a licence level

Duration of the training action:

2 years (1080 hours)

Teaching modality: in classroom, distance, blended

In classroom in the university of course

Ambit of action:

National.

Formats or type of studies:

Technical lectures and practical sessions

Level of work experience:

Engineering, research, consulting

Objectives:

To prepare students to the reality of an "enterprise" by backing and developing with them their professional insertion project of activity development in an already existing structure, or of enterprise creation by teaching technical and professional aspects.

Relation with companies:

Students have contacts with enterprises, in particular with:

Météo-France, Société Énergie et Territoire, Institut National de l'Énergie Solaire (INES), Enertrag BE Eolien, Énergie 21 SAS, AREVA HELION, SUNWATT France, Groupe RAFFALLI, Énergies 21, Solaria Systems, ESE Solar, Petra Cumpacq, CCI Corse du Sud, l'ONF, Bureau d'étude fluide CAP ENERGIES, CEA, ACD2, CSTB, EDF.

CONTACTED INSTITUTION / CENTRE

Institution's name: université de Nantes

Centre: Nantes

Address: 1, quai de Tourville - BP 1026 44035 NANTES CEDEX 01

Web site: http://www.sciences-techniques.univ-nantes.fr/

Contact person: Linda CATTIN

Telephone:

E-mail address: Linda.Cattin-Guenadez@univ-nantes.fr

GENERAL TRAINING INFORMATION:

Type of Institution: university

Type of studies taught: Master 2

Age: students

Geographical ambit of action/influence: national

Studies_1

Identification of studies programmes.

Name of the studies programme:

New and renewable Energy

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Master 2

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Students holders of a Master 1 level

Duration of the training action:

1 Year

Teaching modality: in classroom, distance, blended

In classroom in the university of Nantes

Ambit of action:

National

Formats or type of studies:

Technical lectures and practical sessions

Level of work experience:

Engineering, research

Objectives:

To develop the skills necessary to professional sectors faced to the requirement of the energy control and to the activity sectors, growing, producing, implementing and using energy conversion and storage system

CONTACTED INSTITUTION / CENTRE

Institution's name: INPT national polytechnical institute of toulouse

Centre:

Address: 6 allée Emile Monso BP 34038 - 31029 Toulouse cedex 4

Web site: http://www.inp-toulouse.fr/

Contact person: Christophe TURPIN

Telephone: 0033 (0) 5.62.24.21.00

E-mail address: turpin@laplace.univ-tlse.fr

GENERAL TRAINING INFORMATION:

Type of Institution: group c (University, Vocational Training, Postgraduates...)

Type of studies taught: engineer and masters diploma

Age:

Geographical ambit of action/influence: national

Studies_1

Identification of studies programmes.

Name of the studies programme:

Master eco-energy

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Master 2

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Students holders of a Master 1 level

Duration of the training action:

1 Year

Teaching modality: in classroom, distance, blended

6 months in classroom and 6 month of training period

Ambit of action:

National

Formats or type of studies:

Technical lectures and practical sessions

Level of work experience:

Engineering, research

Objectives:

Good knowledge of the current and future energy market, source and vectors, systems and components, applications

Good and accurate knowledge of the process of energy conversion of energy production, applications fields and distribution and storage

Conception of adapted and optimized solutions based on interdisciplinary methods.

Relation with companies:

Privileged partnership with the CEA, Gaz de France, IFP

CONTACTED INSTITUTION / CENTRE

Institution's name: plate form e technologique énergies propres

Centre: IUT de Marseillle

Address: 142, Trav. Charles SUSINI □13388 Marseille Cedex 13

Web site: http://www.inp-toulouse.fr/

Contact person: Hervé FERRATO

Telephone: 0033 (0)4 91 28 93 06

E-mail address: <herve.ferrato@univ-cezanne.fr>

GENERAL TRAINING INFORMATION:

Type of Institution: technological platform

Type of studies taught: technological universitary diplom a but there is also curses on fuel cells for engineer and masters diploma, and on dem and for particulars or entreprises

Age:

Geographical ambit of action/influence: national

Studies_1

Identification of studies programmes.

Name of the studies programme:

Professional Licence energy harnessing and renewable energy

Level/Origin of studies: Indicate if it is accredited, belongs to EU-Programmes…

Professional licence

Studies Addresses: Educational level and professional groups to whom the training is addressed.

Students holders of a BAC +2

Duration of the training action:

1 Year

Teaching modality: in classroom, distance, blended

6 months in classroom and 12 weeks of training period

Ambit of action:

National

Formats or type of studies:

Module hydrogen: 10 hours of lectures + 10 sessions of 4h of practical work

Level of work experience:

After the licence, student can work as:

Project manager in engineering offices

Works foreman for installer

Sales engineer for manufacturers

Agent of development in collectivities

Objectives:

To form executives able to

- to propose and argue at a technical and economical plan rational solutions concerning renewable energy
- to make diagnostics and energy audits
- to determinate appropriate process and methods
- to fix realization conditions regarding to the laws.

Conclusions:

- Total of activities identified in France:
23

- Number of university and non university activities:
University activities: 15 / non university activities: 8

- Number of entities that offer training activities:
20

- In which courses specific training is required, in which there is no required:

There are usually not specific training required, but a minimum knowledge on electricity are required.

- Difference between short and long courses:

- short term formations (few days): these are theorical courses on hydrogen technology

- long term formations: the courses on hydrogen and fuel cells are always included into a program on the renewable energy. There are practical work and theorical courses. These can be a professional formation (called licence professionnelle) or a master formation (higher education).

- In institutions, difference between higher education and not:

The institutions of the higher education are managed by public administration. The professional formation (licence professionelle) are delivered in institutions called IUT: institut universitaire de technologie. They depend on the universities. The engineering schools are also considered as higher education.

Conclusions about the report

Several conclusions can be drawn from the information presented in this report.

On the one hand, if we focus on the fuel cell technology: there are very few educational offerings focused exclusively on the technology of fuel cells and hydrogen. It is common to find references to studies related to hydrogen in chemical technology and some minor references in relation to fuel cells.

Other areas of knowledge where knowledge on fuel cells and hydrogen is incorporated are in studies related to renewable energy. In this approach we find a closer treatment to the technology sought in this report. We can find that it appears as an energy carrier and as an alternative to other energy sources. Any approach to this technology represents a small chapter in the whole syllabus of the course.

The other point of view which is interesting to note is the level of education that this type of knowledge offers. Most courses are university level, as free subjects, postgraduate, masters or as part of a given subject. In general, the academic level of courses is aimed at graduates, engineers or equivalent levels.

Clearly, this level of training is essential for the proper implementation and development of a technology. But it is necessary to bring this training to the operational level of implementation to allow the formation of those staff members who will be able to solve and apply all products and installations resulting from the implementation of fuel cell technology.

The size of the training offered at the technical level is small and we understand that it should grow. This report presents some examples that go in line with this that approach and we understand they are a reference to take into account.