

**International Workshop  
“Hydrogen Safety Training for First Responders”  
Aix-en-Provence, 3-4 September 2014**

**World’s first MSc course in  
Hydrogen Safety Engineering**

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**... and partners around the globe**

# Why hydrogen?

- ❖ **Fossil Fuel Reserves at current rates of production by the World Coal Institute on 20.07.14 (<http://www.worldcoal.org/coal/where-is-coal-found/>):**
  - ❖ **Coal: 112 years**
  - ❖ **Gas: 54 years**
  - ❖ **Oil: 46 years**
- ❖ **Geopolitical fears**
- ❖ **Independence of energy supply**
- ❖ **Environment pollution**
- ❖ **Climate change**
- ❖ **EU Regulations 2010 (Horizon 2020, FCH JU-2)**
- ❖ **Global Technical Regulations 2013**

# Education audiences

- ❖ Decision-makers: local and national governments, etc.
- ❖ Regulators and public safety officials: [www.hyfacts.eu](http://www.hyfacts.eu)
- ❖ **First responders:** [www.hyresponse.eu](http://www.hyresponse.eu)
- ❖ Hydrogen industry: production, storage, utilization, etc.
- ❖ Teachers and students: from schools to universities
- ❖ Young professionals in hydrogen and fuel cell technologies: <http://www.hysafe.org/TrainHyProf>
- ❖ Hydrogen professionals: <http://hyprofessionals.eu/>
- ❖ End users: general public

Diversity of audiences requires different approaches to education and training.

# Education in USA and Europe

## **Public education campaign on HFC technologies in USA (DoE):**

- ❖ Introduction to Hydrogen safety for First Responders;
- ❖ Community information program “Increase Your H2IQ”;
- ❖ “H2 Educate!” guides for middle schools;
- ❖ HyTEC (H2 technology and energy curriculum) for high schools;
- ❖ “Hydrogen 101” seminar series;
- ❖ “Hydrogen Energy Institute” training course for state and local government officials;
- ❖ Hydrogen Futures Park at The University of Montana (college curriculum for energy technicians, establishment of national H2S training centre)...

## **European education/training projects:**

- ❖ e-Academy of Hydrogen Safety (NoE HySafe – International Curriculum)
- ❖ Educational/training projects: HyCourse, HySAFEST, HyFire, TrainHy, HyFacts, HyProfessionals, HyResponse, Call by FCH 2 JU (July 2014) includes funding of 1 educational project
- ❖ Summer and technical schools: ESSHS, JSS, TS, short courses PHS at UU
- ❖ Higher education: MSc in Hydrogen Safety Engineering course at UU

# First responders training (USA)

US DoE web-based “Introduction to Hydrogen Safety for First Responders” (can be completed in **an hour**):

- Hydrogen basics (properties/behaviour, comparison other fuels, industry design for safe systems)
- Transport and storage (bulk transport, containers)
- Hydrogen vehicles (tank testing, safety systems)
- Hydrogen dispensing (comparison with other fuels)
- Stationary facilities (bulk storage, FC, refuelling)
- Codes and standards (overview and links)
- Emergency response (detection, initial actions, etc.)
- Summary and quiz (most important “need-to-know”)

**250 unique users per week in 2007!**

# Building the profession

- ❖ There will be no hydrogen economy without public acceptance of hydrogen technologies. Public acceptance can be achieved only through education and training.
- ❖ There will be no hydrogen industry without **hydrogen safety engineering**. There will be no hydrogen safety engineering profession without sustained education and training supported by the international collaboration.
- ❖ “Excellence in teaching through research”!

# European legislation

- ❖ Until 2050 educational efforts in hydrogen technologies and hydrogen safety are needed to build up a skilled workforce and researchers needed to establish a hydrogen economy [1].
- ❖ Legislation requires professionals engaged with hydrogen to have received training in the safety of hydrogen [1, 2].

[1] Wancura H, Mayo B, Reijalt M, et al. Draft implementation report WG5 cross cutting issues (XCI). The European Hydrogen And Fuel Cell Technology Platform, Implementation Panel, 2006.

[2] Directive 1999/92/EC, Official Journal of the European Communities, 21.1.2000.

# e-Academy of hydrogen safety

March 1, 2004: European Network of Excellence HySafe started e-Academy (<http://www.hysafe.net/eAcademy>).

- ❖ Draft for Development of the International Curriculum on Hydrogen Safety Engineering (63 experts from 14 countries): <http://www.hysafe.net/Curriculum>:
  - 5 basic modules (thermodynamics; chemical kinetics; fluid dynamics; heat and mass transfer; solid mechanics),
  - 6 fundamental modules (introduction to hydrogen as an energy carrier; fundamentals of hydrogen safety; release, mixing and distribution; hydrogen ignition; hydrogen fires; deflagrations and detonations),
  - 4 applied modules (fire and explosion effects on people, structures and the environment; accident prevention and mitigation; computational hydrogen safety engineering; risk assessment)
- ❖ Teaching materials: European Summer School on Hydrogen Safety, €620k, 2006-2010, up to 87 attendees (28 countries)
- ❖ PGC in Hydrogen Safety Engineering in 2007: train-the-trainer

# MSc Hydrogen Safety Engineering

- ❖ **Distance learning** course in (full-time) and part-time modes.
- ❖ **January 2007:** PG Certificate in Hydrogen Safety Engineering (60 CATS points, total student effort 600 hours, 1 year PT): 30 students in September 2007: Germany, Iceland, Ireland, Israel, Italy, Netherlands, Poland, Russia, Spain, UK, USA.
- ❖ **January 2009:** expanded to PG Diploma in Hydrogen Safety Engineering (120 CATS points, 2 years PT).
- ❖ **January 2010:** expanded to full MSc in Hydrogen Safety Engineering programme (180 CATS points, 3 years PT).
- ❖ During last years **3 bursaries** are available annually from the International Association for Hydrogen Safety ([www.hysafe.info](http://www.hysafe.info)). Contact speaker at: [v.molkov@ulster.ac.uk](mailto:v.molkov@ulster.ac.uk)
- ❖ **Registration for the course at:**  
<http://www.ulster.ac.uk/elearning/programmes/view/course/10139>

# MSc Hydrogen Safety Engineering

## Part-time distance learning:

- ❖ Year 1 modules (semesters 1 and 2):
  - Principles of hydrogen safety (30 points)
  - Hydrogen safety technologies (30 points)
- ❖ Year 2 modules (semesters 1 and 2):
  - Regulations, codes and standards (compulsory, 30 points)
  - *Hydrogen powered transport and infrastructure safety (optional, 30 points)*
  - *Progress in hydrogen and fuel cell technologies (optional, 30 points). Short course attendance (next is TS2015)*
- ❖ Year 3 module (semesters 1 and 2):
  - Dissertation (60 points)

**Assignment is coursework (no exam).**

**Note: Industry should have expert with higher education**

# Where we are?

- ❖ 2007: “Current knowledge and awareness levels of hydrogen and FC are low” (C. Cooper, A. Chew)
- ❖ There are number of “energy” and “FC” courses in which safety module is embedded. Useful not enough.
- ❖ January 2007: the DoE Hydrogen Program launched a web-based stand-alone tutorial “Introduction to Hydrogen Safety for First Responders”, other training
- ❖ January 2007: UU launched first higher education DL course in hydrogen safety (PGC) emerged from the activities of European e-Academy of Hydrogen Safety.
- ❖ These are examples of complimentary activities in Europe and USA. Clear benefits and need for further coordination in H<sub>2</sub>S education/training.

# Further opportunities

- ❖ Funding of educational activities within FCH 2 JU.
- ❖ Collaboration with research organisations to close knowledge gaps and technological bottlenecks, and prepare high quality professional textbooks.
- ❖ New instructional and research/engineering facilities, e.g. developed during HyResponse at ENSOSP, transnational access to infrastructure ([www.h2fc.eu](http://www.h2fc.eu)).
- ❖ Development of e-Infrastructure, e.g. Cyber-Laboratory for hydrogen safety ([www.h2fc.eu](http://www.h2fc.eu)).
- ❖ Establishment of the educational committee at the International Association for Hydrogen Safety to coordinate strategic research-led national and international educational/training activities.

# Concluding remarks

- ❖ Hydrogen economy depends on public acceptance. To promote public awareness and trust in hydrogen technologies we need well educated and trained staff.
- ❖ PGCert/PGDip/MSc in Hydrogen Safety Engineering is World's first higher education course in hydrogen safety. This is research-led course which is under constant development. Graduates are uniquely prepared and qualified for employment in industry, engineering and safety consultancies, insurance companies, governmental bodies, research organisations, academia, etc.
- ❖ To develop an excellent safety culture the investment to education/training at all levels is needed: training at short courses (60% of demand!) and higher education.



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([www.hyresponse.eu](http://www.hyresponse.eu))

**MSc in Hydrogen Safety Engineering (distance learning course):**  
<http://www.ulster.ac.uk/elearning/programmes/view/course/10139>

**Fundamentals of Hydrogen Safety Engineering (free eBook,**  
<http://bookboon.com>, search “hydrogen”, available since October 2012)