

Towards Hydrogen Safety Education and Training

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- **Need for education in Hydrogen Safety**
- **Current status of education in Hydrogen Safety**
- **International Curriculum on Hydrogen Safety Engineering**
- **e-Academy of Hydrogen Safety**
- **HyCourse: European Summer School on Hydrogen Safety**

- **Improvement of public acceptance of the hydrogen economy**
- **Skill-set sought in the hydrogen economy needs to be matched by education**
- **Professionals need to acquire further expertise in hydrogen safety as the hydrogen economy evolves**
- **New knowledge gained on hydrogen safety matters in a considerable range of applications needs to be disseminated**
- **Legislation requires people to receive training in hydrogen safety matters**

- **Employer pattern:** consulting, process industry, energy industry, government, insurance, manufacture equipment/devices, fire brigades, rescue brigades, ...
- **Employment pattern:** conception, design, construction, transportation, teaching, research operation, commissioning, alteration/modification, decommissioning/demolition, ...

Phenomena, hazards, and risks

Applications and accident scenarios

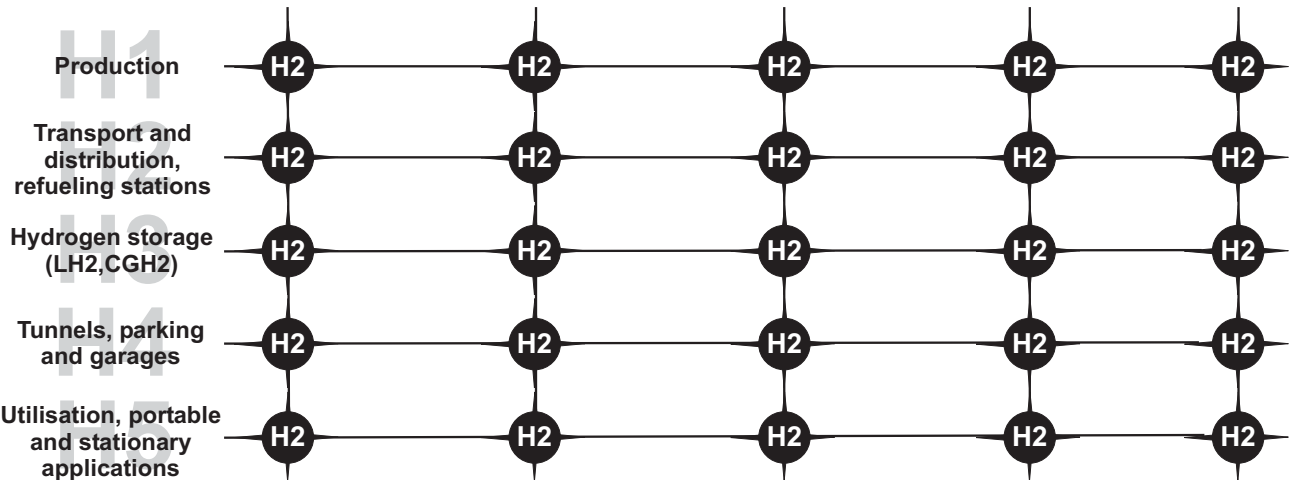
Hydrogen release, mixing and distribution

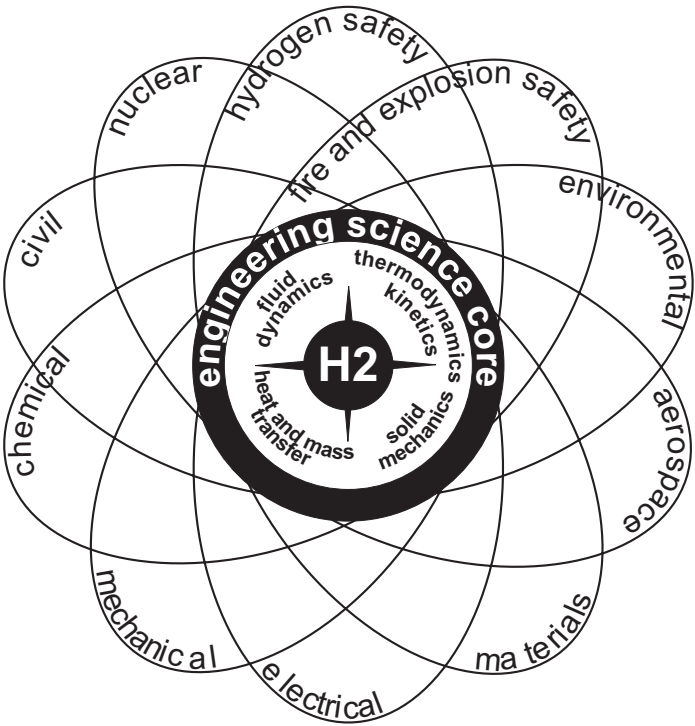
Thermal and pressure and missile effects from fires and explosions

Development and validation of mitigation techniques

Safety assessment and risk analysis

Standards, guidelines, and legal requirements





- Lack of good quality teaching materials on hydrogen safety
- Existing engineering curricula do not support education on hydrogen safety matters
- No coupling of new knowledge on hydrogen safety into existing engineering curricula
- Engineering education needs flexibility to extract new knowledge on hydrogen safety and to adapt itself to the evolving hydrogen economy
- The skill-set sought in the hydrogen economy is not being matched
- **Remedy:** Development of an International Curriculum on Hydrogen Safety Engineering
(FP6 - HySafe, Workpackage 15)

Basic modules

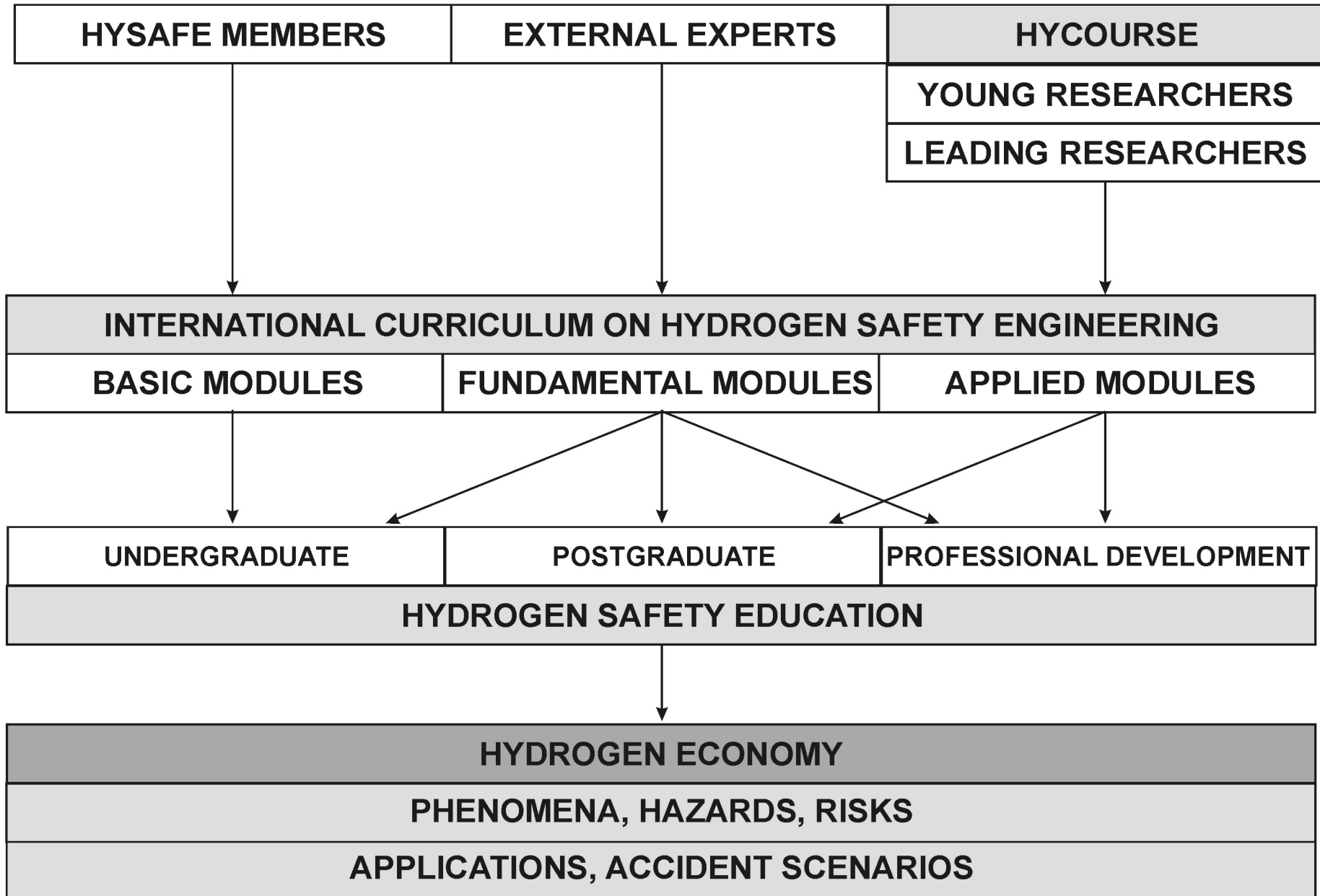
- **Module thermodynamics**
- **Module chemical kinetics**
- **Module fluid dynamics**
- **Module heat and mass transfer**
- **Module solid mechanics**

Fundamental modules

- **Module introduction to hydrogen as an energy carrier**
- **Module fundamentals of hydrogen safety**
- **Module release, mixing and distribution**
- **Module hydrogen ignition**
- **Module hydrogen fires**
- **Module explosions: deflagrations and detonations**

Applied modules

- **Module fire and explosion effects on people, structures, and the environment**
- **Module accident prevention and mitigation**
- **Module computational hydrogen safety engineering**
- **Module risk assessment**



- **Combine resources and expertise of HySafe Universities (IST,UC, UNIPI,UPM,UU,WUT) and HySafe Research Institutions (FZK,FZJ,GexCon) to develop (2005-) and deliver (2007-) teaching on Hydrogen Safety**
- **Provide on-line teaching (distance learning) on Hydrogen Safety at postgraduate level (PGC, PGD, MSc) and Continuing Professional Development (Short Courses)**
- **Develop and improve International Curriculum on Hydrogen Safety Engineering to match skill-set sought in the hydrogen economy**

- **A series of four summer schools:** 2006, 2007, 2008, 2009
- **Possible locations:** Athens, Belfast, Bergen, Cambridge, Delft, Karlsruhe, Lisbon, Madrid, Paris, Pisa, Warsaw
- **Topics:** hydrogen release, mixing, distribution; accidental combustion involving hydrogen; thermal, pressure, and missile effects from hydrogen fires and explosions; hydrogen safety assessment and risk analysis
- **Application areas:** production; transport and distribution; hydrogen storage; tunnels, parking and garages; utilisation; portable and stationary applications
- **Format:** Keynote lectures by leading researchers to an audience of young researchers; Work in progress sessions with presentations by young researchers

- **Keynote speakers:** travel, subsistence, course note development funded
- **Eligible researchers:** travel, subsistence funded
- **Course notes:**
 - Improvement materials for fundamental and applied modules of curriculum (2006-2010)
 - Improvement of curriculum (2006-2010)
 - Development of two pilot modules for on-line delivery of teaching (2008-2010)