Training, re- and up-skilling for the hydrogen economy

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The Need

2012									
	Est. annual production		Market value	CAGR	Number of companies involved		Employment		
Application area	Unit		(M€)		SMEs	Large companies	Workers	Technicians	Engineers
Fuel cell electric vehicles	#	100	5	---	10	8	250	750	1500
Hydrogen refuelling stations	#	20	20	---	10	5	133	133	133
Hydrogen Production	ton	895	9	---	15	5	447	447	447
Stationary fuel cells	#	50	2	---	18	5	83	83	83
Early markets - forklifts	#	300	4	---	18	6	25	25	25
Early markets - power generation	#	500	1,2	---	18	5	25	25	25
TOTAL			**41**				**964**	**1464**	**2214**

2020									
	Est. annual production		Market value	CAGR	Number of companies involved		Employment		
Application area	Unit		(M€)	2012-2020	SMEs	Large companies	Workers	Technicians	Engineers
Fuel cell electric vehicles	#	100 000	3 000	45%	5	12	12 500	6 250	6 250
Hydrogen refuelling infrastructure	#	150	135	12%	3	7	750	750	750
Hydrogen Production	ton	145 447	1 164	32%	10	10	4 848	4 800	4 800
Stationary fuel cells	#	50 000	625	45%	10	7	5 000	5 000	5 000
Early markets - forklifts	#	10 000	100	21%	10	8	417	417	417
Early markets - power generation	#	20 000	28	22%	10	7	208	208	208
TOTAL			**5 052**	**30%**			**23 723**	**17 425**	**17 425**

2030									
	Est. annual production		Market value	CAGR	Number of companies involved		Employment		
Application area	Unit		(M€)	2020-2030		Large			
Fuel cell electric vehicles	#	500 000	12 500	7%					
Hydrogen refuelling infrastructure	#	300	420	3%					
Hydrogen Production	ton	425 635	3 405	5%					
Stationary fuel cells	#	150 000	1 500	5%					
Early markets - forklifts	#	30 000	240	5%					
Early markets - power generation	#	30 000	42	2%					
TOTAL			**18 107**	**7%**					

Employment

Workers	Technicians	Engineers
88 850	50 737	50 737

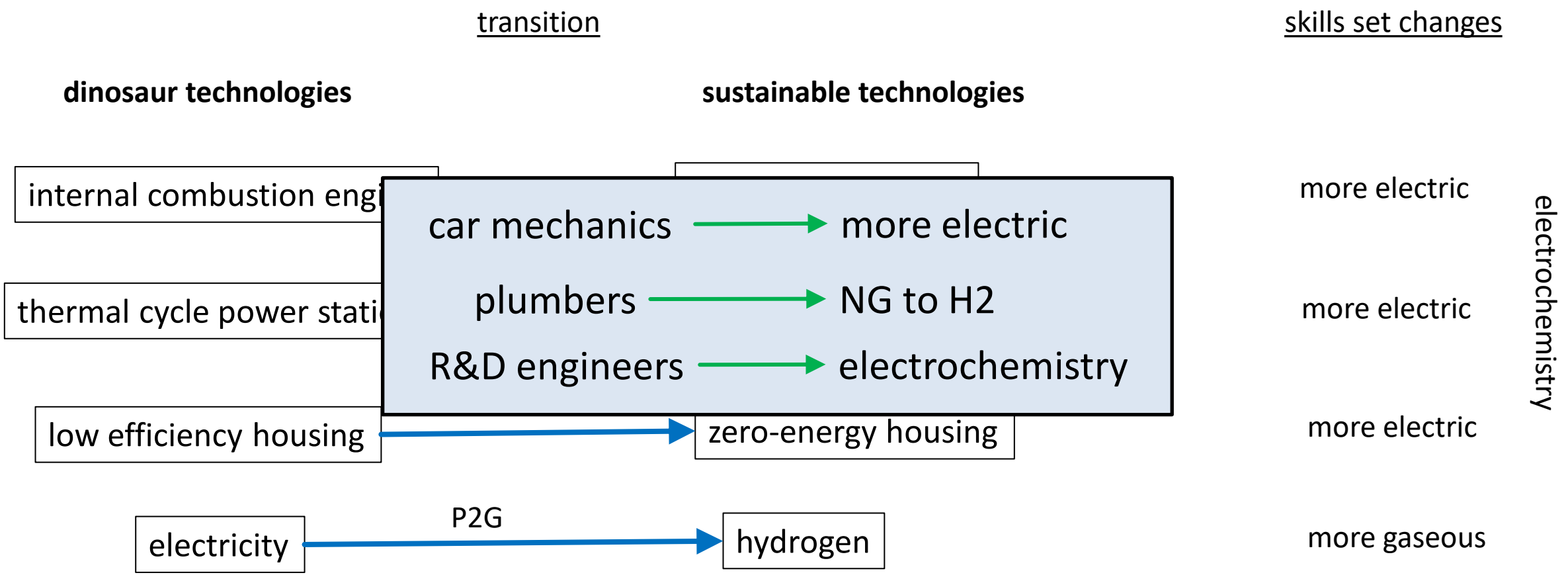
3 elements:
- university type programme (MEng/MSc)
- CPD re-training
- technician (re-) training (Level 3 to 6)

from: Assessment Report SET-Plan on Education and Training - Working Group: Fuel Cells and Hydrogen. Brussels, 14. Nov. 2012.

How to approach this ‘Skills Gap’?

1. does it exist at all?
2. what is needed?
3. what are the quality standards?
4. what are the best measures?
5. who pays?

Does the ‘Skills Gap’ even exist at all?



What is needed to close the ‘Skills Gap’? (across Europe)

Degrees: assuming 60% converts, 40% newly trained:

- 20,000 university trained students required by 2030
- -> 10 cohorts @2,000 students / year
- -> 20 students per programme = 100 universities

Technicians: assuming 40% up-skilled, 30% trained-on-the-job, 30% new:

- 80,000 training measures required by 2030
- -> 8,000 trainings per year
- -> 20 students per training = 400 events per year

How to secure the quality of training?

- there is a need for recognised qualifications
- system of ‘recognised’ qualification points across professional development (CPD) and vocational training (VET)
- transferrable and accumulable points that can lead to further qualification and ‘degrees’
- this has nothing to do with ‘certification’ of courses
- question: who will be the guarantor?

Who pays to fill the ‘Skills Gap’?

- companies reluctant to pay adequately for qualified training
- companies complain about lack of suitable candidates and their salary demands
- fees can be seen as individual investment into ‘career path’
- societal stake in developing future technologies
- government subsidies, incentives and loan schemes to help individuals manage their personal career risks

Training Technicians

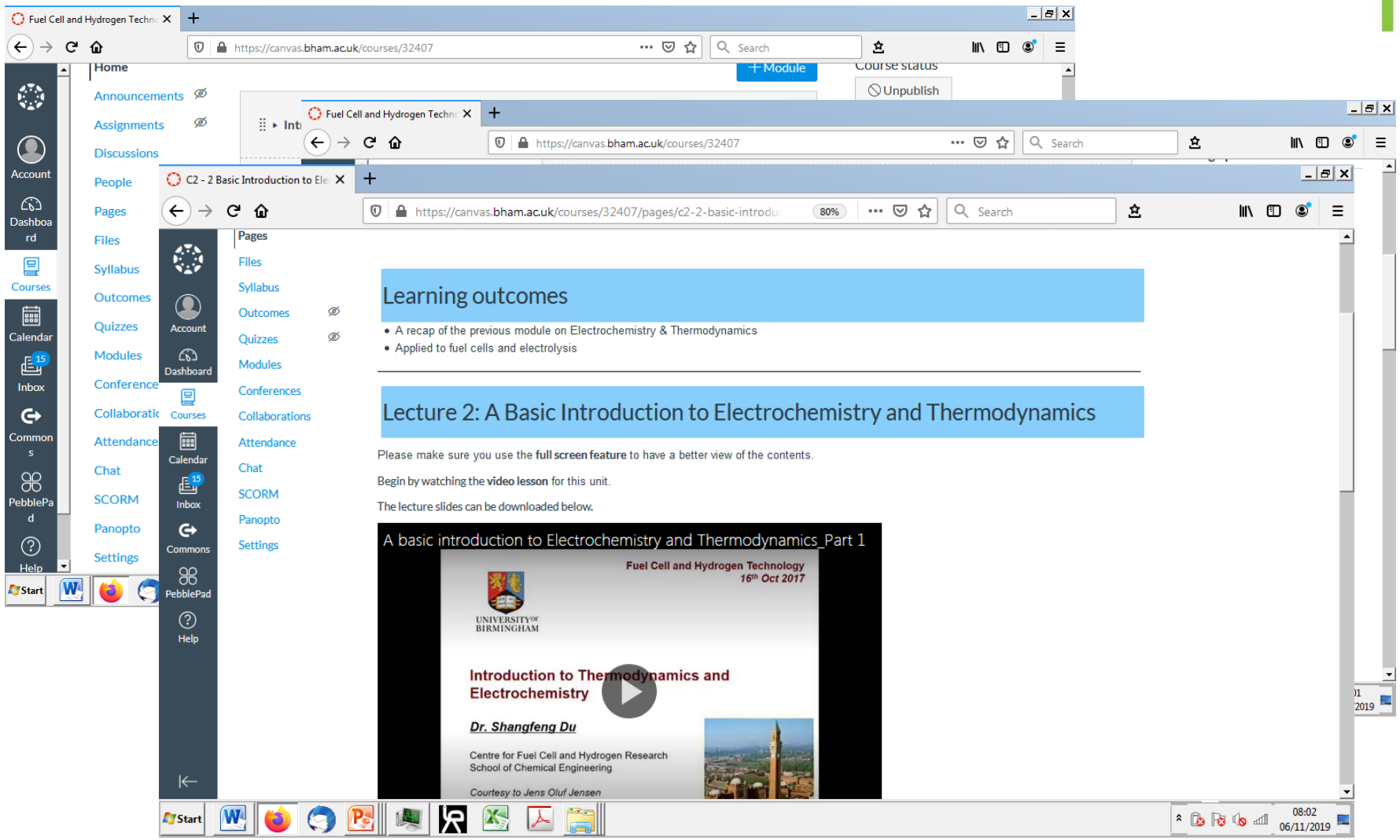
- programme of technician training in blended learning mode
- combination of e-learning content, use of simulation tools (‘serious games’) and background reading
- followed by lab-work session and an exam
- modules : Micro Fuel Cells, Combined Heat and Power Generation, Fuel Cell Based Generators, Fuel Cells for Transport Applications, Hydrogen Production and Handling

The TeacHy MSc Syllabus

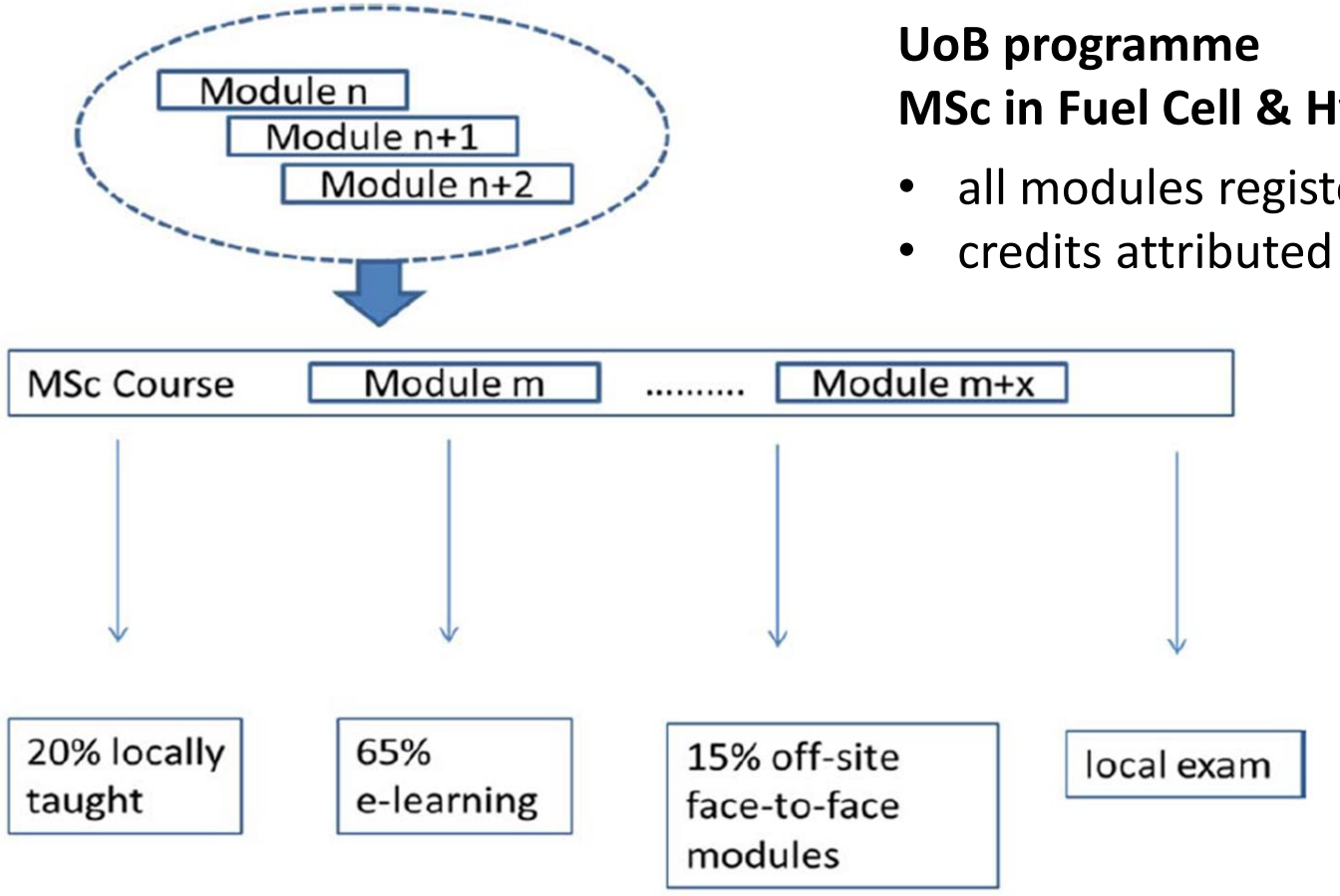
	Introductory modules (30 credits)	Core modules (40 to 50 credits)	Optional modules	Research Project
Fuel Cells Hydrogen Low temperature technology (PEFC, AFC, DMFC) High temperature technology (SOFC) Fuel Cell Systems, energy systems and storage	▪ Electro-chemistry ▪ Fuel Cell Technology ▪ Hydrogen & Hydrogen-Based Fuels	▪ Modelling ▪ Chracterisation ▪ FCH Lab ▪ Hydrogen Safety (20 credits, Ulster Uni) or ▪ Hydrogen Safety (10 credits, internal)	▪ Low / High Temperature Fuel Cells ▪ Fuel Cell Systems ▪ Energy Storage ▪ Renewable Energy Systems ▪ Hydrogen Policies and Standards ▪ Advanced Electrochemical Applications ▪ Electrolysers ▪ Hydrogen Infrastructure ▪ Fuel Cell Electric Vehicles ▪ Innovation Management and Business Development	work with academics on the final research project

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Implementation on CANVAS LMS



Flexible building of programmes: Choose & Mix



example:

UoB programme
MSc in Fuel Cell & Hydrogen Technologies

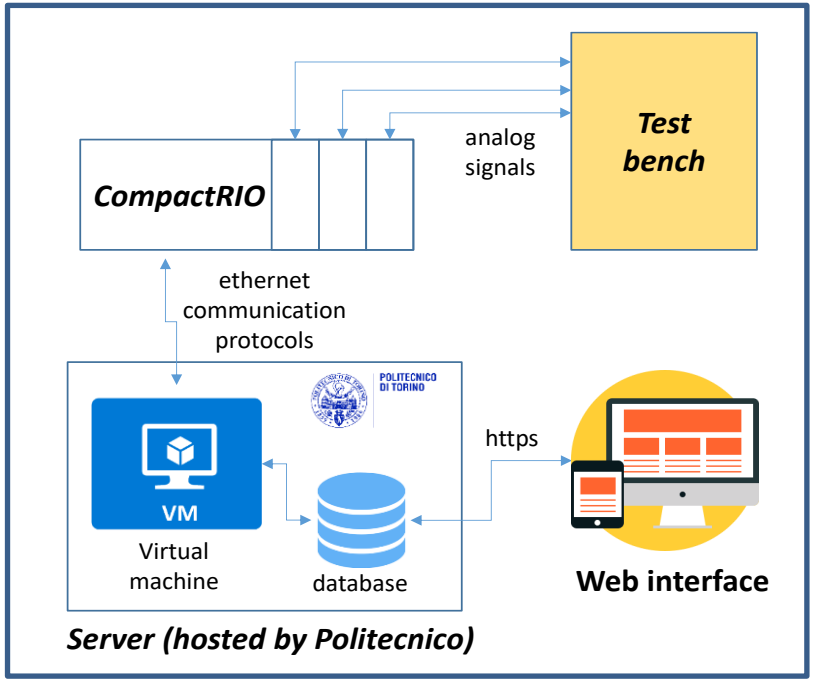
- all modules registered for CPD
- credits attributed upon assessment

Practical Training in times of e-learning

- practical training is key to technology development
- online learning needs an interface to developing practical skills

Potential approaches:

- shared use of training facilities
- use of simulation and video to prepare for practical sessions in a lab
- use of Serious Games
- web interface to a real-world lab



Critical Issues

Recognising qualifications

- universities can grant ‘credit points’ (equiv. to ECTS)
- currently no transferrable point system for vocational training

Changes in training topics

- qualifications of ‘safe handling of hydrogen’
- add more electrochemistry to educational curricula (also includes batteries!)

Financial issues

- who pays for up-skilling society?

Opportunities

- European Year of Skills

Upcoming events:

Fuel Cell Systems Workshop –
09/10 May 2023, Bruges

JESS 2023 – Joint European Summer School,
11 to 15 & 18 to 22 Sept 2023,
Athens

www.jess-summerschool.eu

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Thank you for your Attention!

Any Questions?

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