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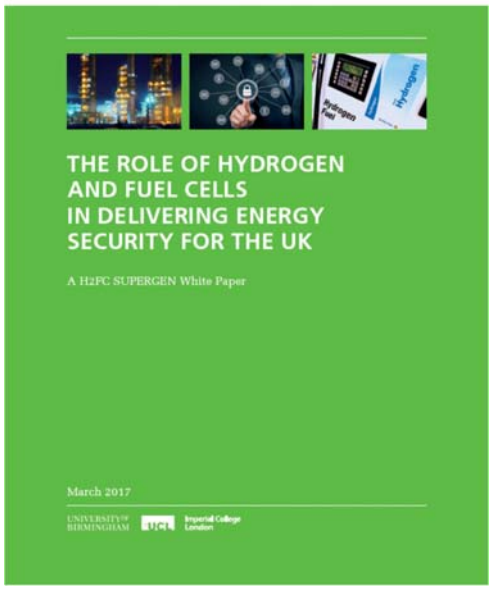
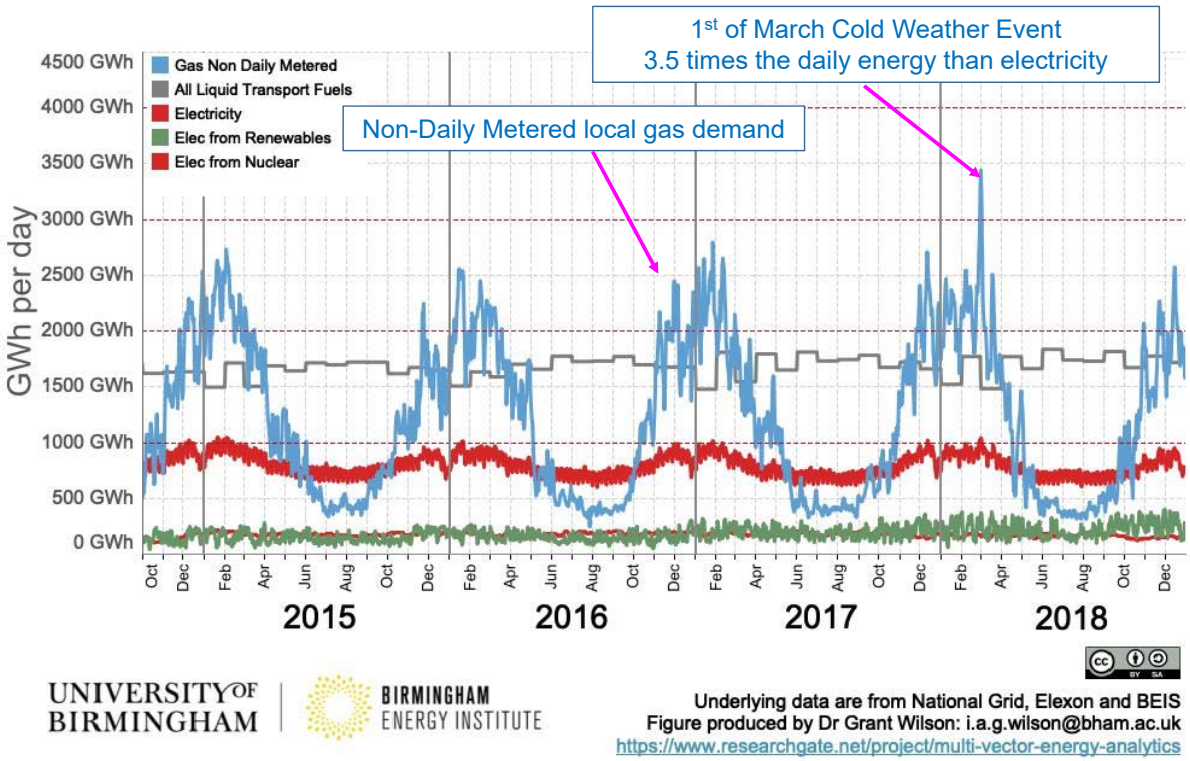


1. Sector Coupling

GB's Energy Vectors (excl. Power)



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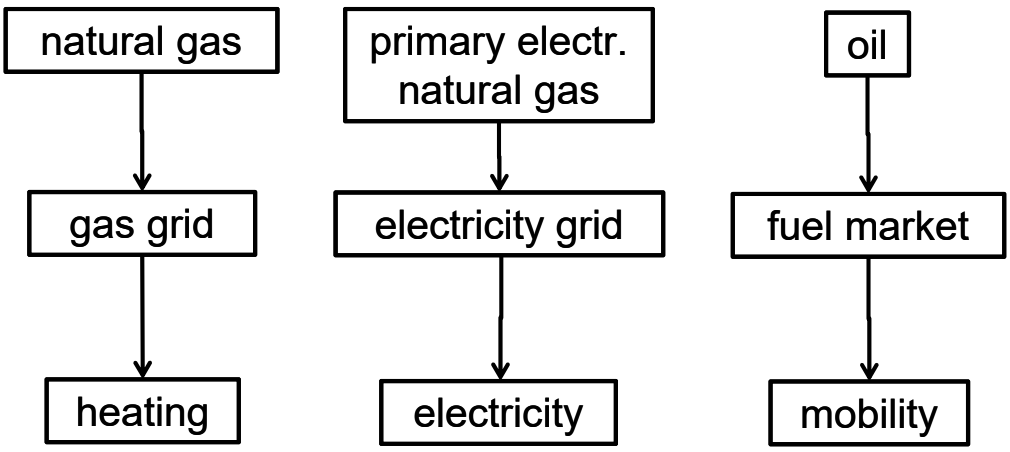
Underlying data are from National Grid, Elexon and BEIS
Figure produced by Dr Grant Wilson: i.a.g.wilson@bham.ac.uk
https://www.researchgate.net/project/multi-vector-energy-analytics

Conventional Energy Infrastructure

Risks: import dependence, loss of GDP to imports, political influencing



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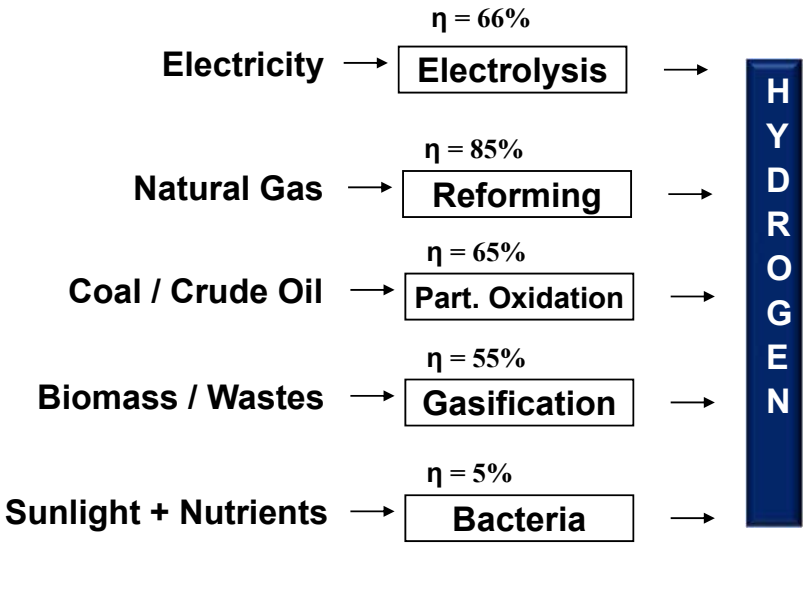
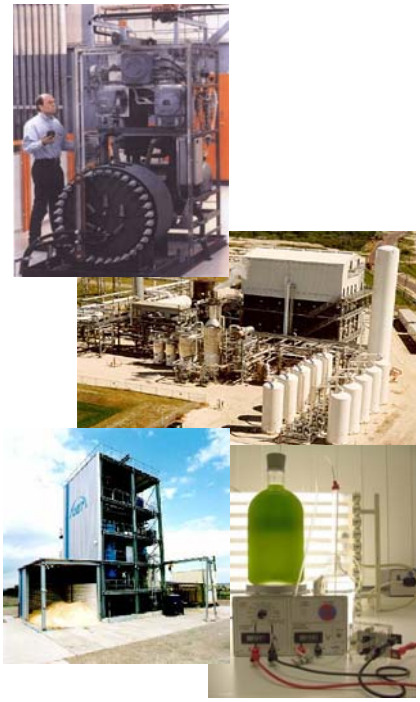
Hydrogen Production: Variety of Sources





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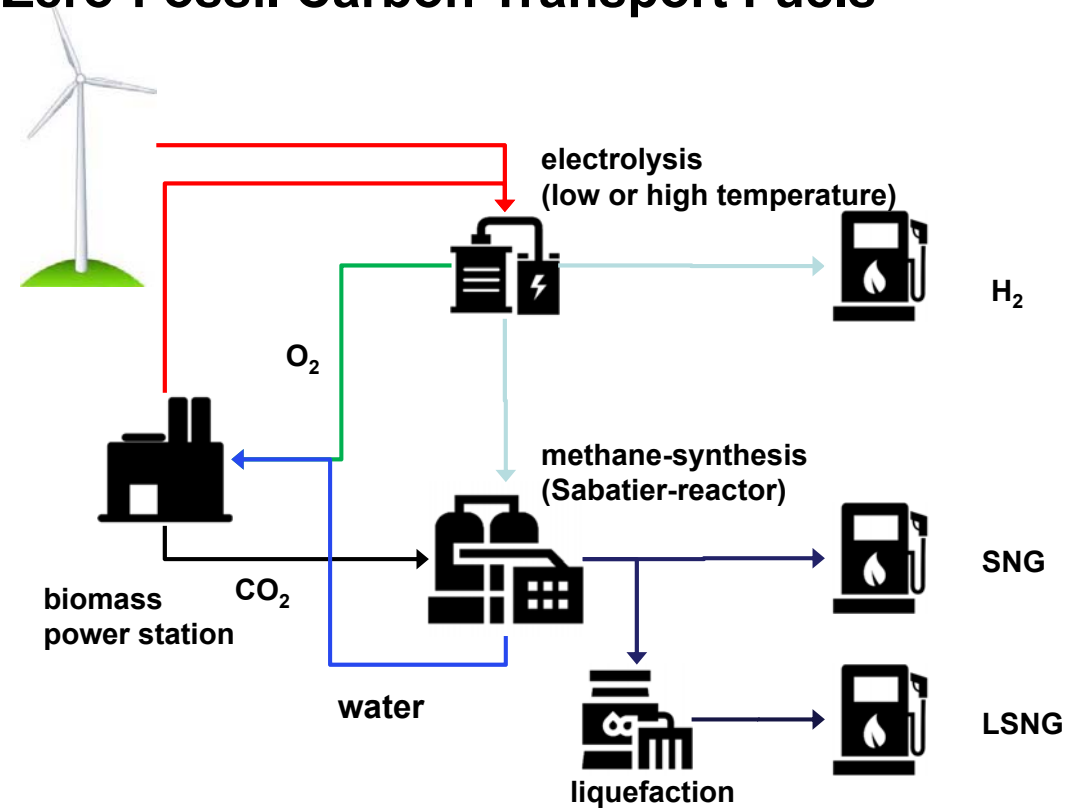
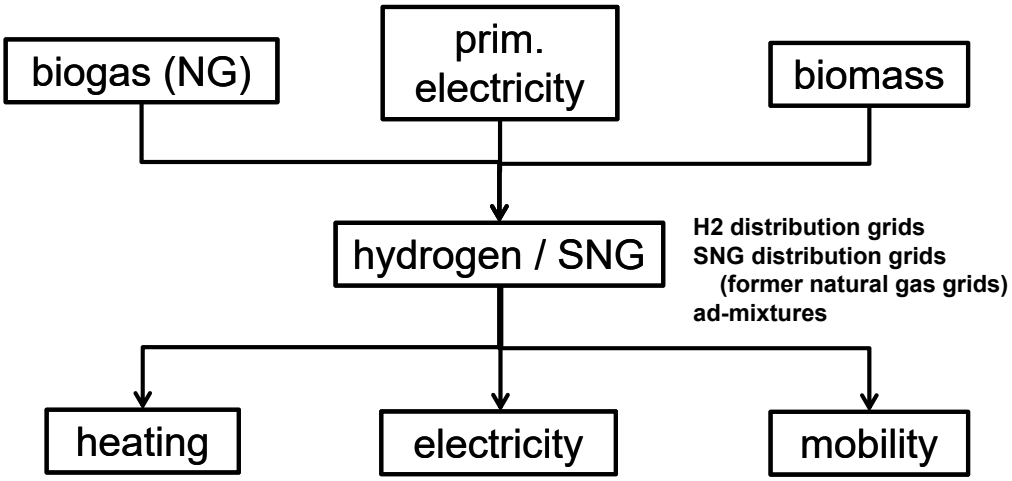
Zero-Fossil Carbon Transport Fuels



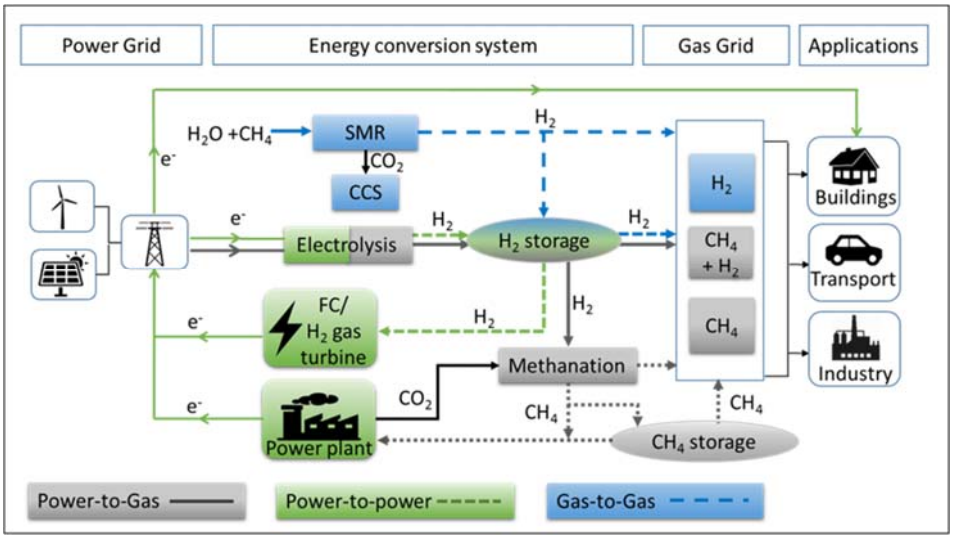
Future Hydrogen Energy Infrastructure

Benefits: increase in flexibility, reduction in import dependence, reduction of supply shortages

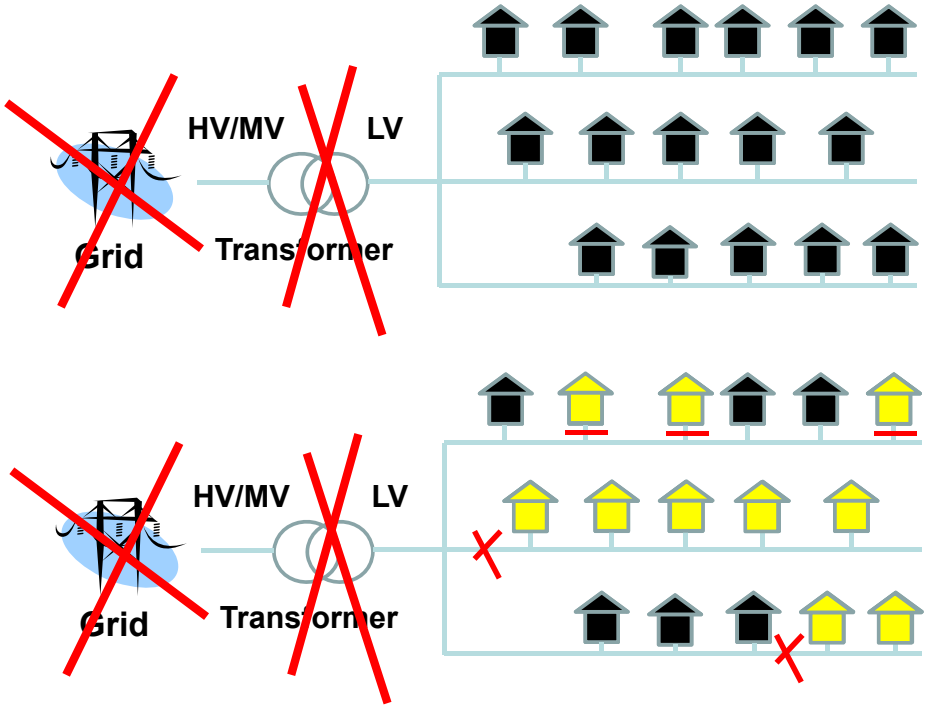


Linking Energy Sectors

Fuel Cells and electrolysis as complementary technologies linking the electricity and gas markets (as well as transport fuels).
They provide balancing power for renewable electricity systems.



Resilience of Distributed and Linked Systems



FCH

H2FCSUPERGEN
THE HYDROGEN AND FUEL CELL RESEARCH HUB

UKRI Innovate UK

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EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
Ulster University
Grenoble INP
TU Delft Delft University of Technology
ULB UNIVERSITÉ LIBRE DE BRUXELLES
UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE
Technical University of Denmark
DTU
KIT Karlsruher Institut für Technologie

2. Education, Training, and Skills Development

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Workforce Numbers: EU SET-Plan Education (2013)

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

2030									
	Est. annual production		Market value	CAGR	Number of companies involved		Employment		
Application area	Unit		(M€)	2020-2030	SMEs	Large companies	Workers	Technicians	Engineers
Fuel cell electric vehicles	#	500 000	12 500	7%	2	15	62 500	31 250	31 250
Hydrogen refuelling infrastructure	#	300							
Hydrogen Production	ton	425 635							
Stationary fuel cells	#	150 000							
Early markets - forklifts	#	30 000							
Early markets - power generation	#	30 000							
TOTAL									

Employment

Workers	Technicians	Engineers
88 850	50 737	50 737

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Education: TeacHy – an MSc Course in FCH

- **JESS - Joint European Summer School** in FC, ELY, and Battery Technologies
- **KnowHy** blended learning course for technician training

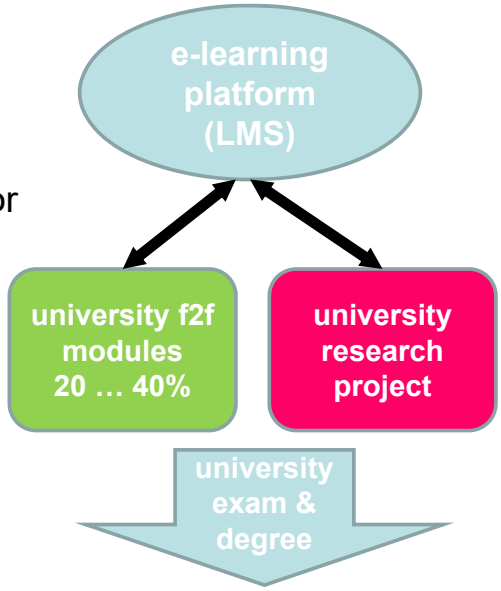
→ **MSc course coordinated across European HEI institutions**

- 12/18/24 months course (1 year taught, ½ to 1 year thesis)
- delivering in various European languages

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Project Approach

- TeacHy offers a ‘blended’ approach in which a university covers 20 to 40% in face2face teaching and draws the remainder from the TeacHy e-learning platform
- project responds to increasing demand for education and training in FCH technologies
- project builds on broad experience with online education prior to and through the pandemic



TeacHy Module List 2021/22

start of 1st course at UoB 27/09/2021

Section	No.	Title
Core / Mandatory	C1	Introduction to Electrochemistry
	C2	Fuel Cell Technologies and Applications
	C3	Hydrogen and hydrogen-based fuels
	C4	Fuel cell modelling tools and control
	C5	Characterisation methods
	C6	Fuel Cell and Hydrogen Lab
	C7	Principles of Hydrogen safety
Optional / Elected	O1	Low temperature fuel cells
	O2	High temperature fuel cells
	O3	Advanced electrochemical characterisation
	O4	Fuel cell electric vehicles
	O5	Energy systems and storage

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

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

JESS - PhD Summer School

Joint European Summer School on Fuel Cell, Electrolyser, and Battery Technologies

Week 1 – 06/11 Sept 2021

- Low Temp FCs
- High Temp FCs
- Batteries

Week 2 – 13/18 Sept 2021

- Innovation & Business Development
- FC Vehicles
- H_2 Safety

www.jess-summerschool.eu

Thank you for your attention!

r.steinbergerwilckens@bham.ac.uk