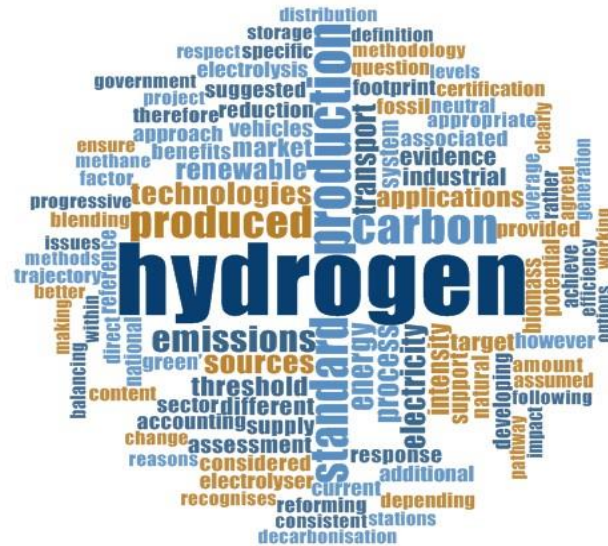


Development of a Green Hydrogen Standard for the UK



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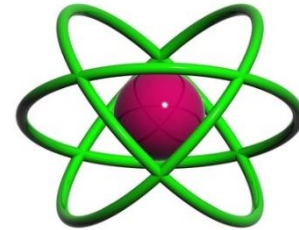
Definitions

- **LOW CARBON HYDROGEN**

- Non-renewable hydrogen
- Very low carbon intensity
- Examples:
 - Nuclear Electrolysis, Hydrogen as a by-product

- **BROWN / GREY / BLACK HYDROGEN**

- Non-renewable hydrogen
- High carbon intensity
- Examples:
 - Coal Gasification, Steam Reform of Methane, MSW Pyrolysis



Definitions

- GREEN HYDROGEN

- It must reduce carbon emissions!



- It must be renewable (except DECC standard)!



- Could it include enhanced sustainability criteria?



- Examples: Impact on air quality, water footprint

- RED Definition of renewable (2009/28/EC directive)

‘...energy from renewable non-fossil sources’

What are the challenges?

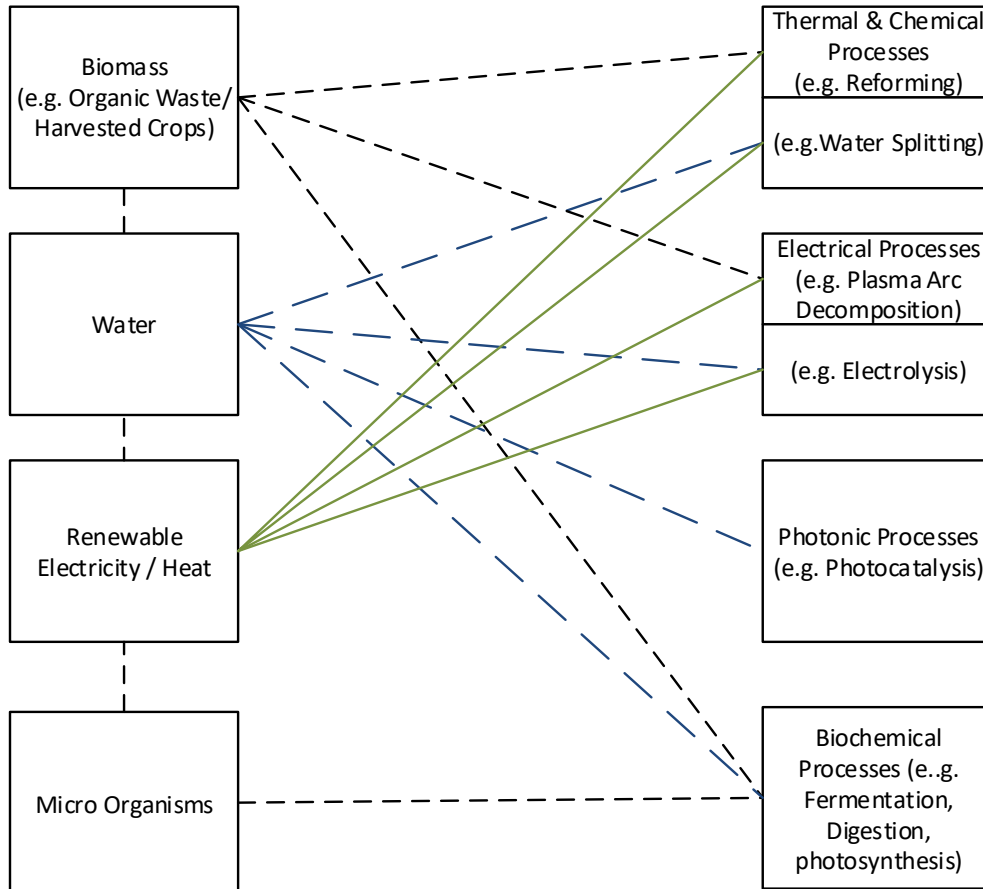
1. Defining the hydrogen system boundaries over which emissions are counted
2. Estimating the emissions for each production process
3. Deciding the appropriate emissions level(s) for processes to meet the standard for policy support

What are the Challenges?



Inputs

Production Methods



+ DELIVERY

(Road / Pipeline / Ship)

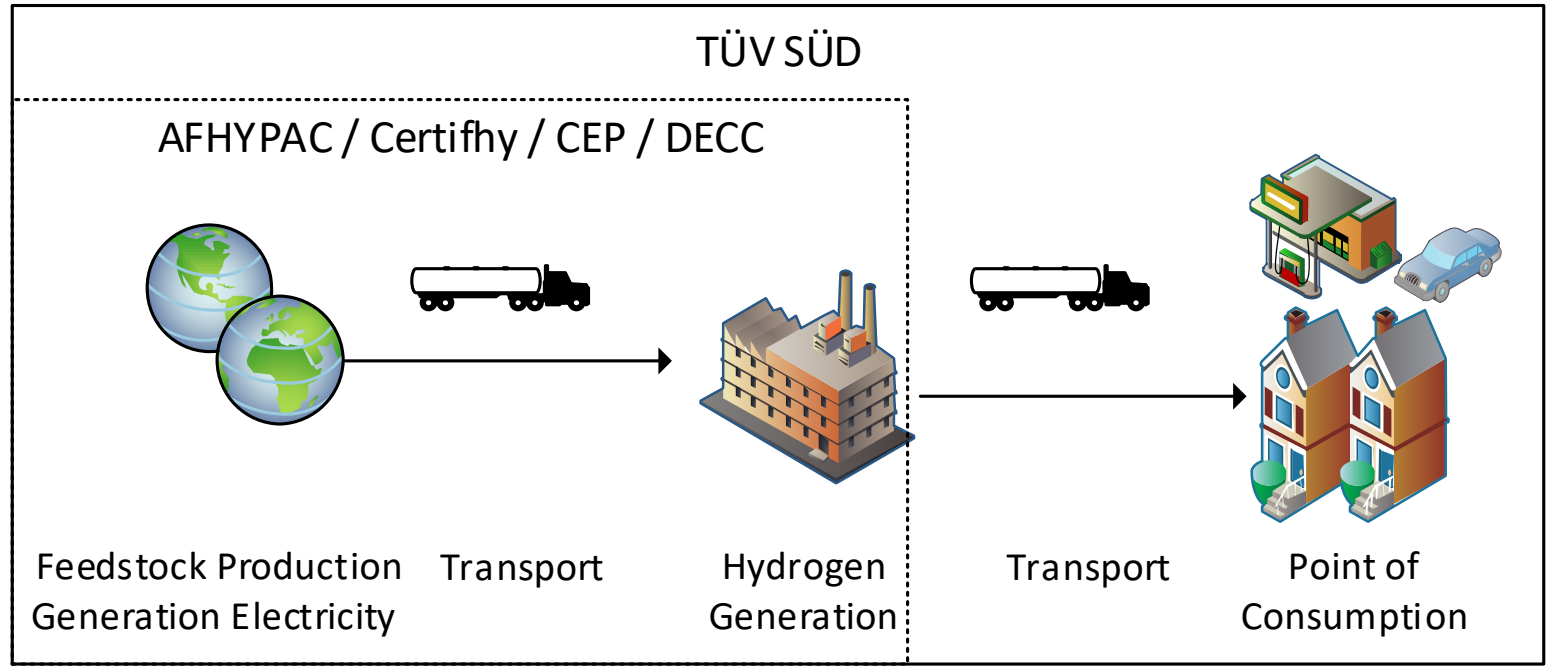
+ STORAGE

(CH/LH/ Other vectors)

+ DISPENSING



1 - The Boundary Issue



Cradle-to-Gate (Point of Production)

Well-to-Tank (Point of Use)

Point of Production (PoP) vs. Point of Use (PoU)
Well-to-tank (WTT ~ PoU) vs. Well-to-wheel (WTW)

2 - Production Methods

PRODUCTION PROCESS*	H ₂ YIELD	COSTS	GHG EMISSIONS	AIR QUALITY	MATURITY
SMR	++	++	--	-	++
BIOMASS GASIFICATION	+	+	++	--	++
COAL GASIFICATION	+	+	--	--	++
ELECTROLYSIS	++	+	++	++	++
WATER SPLITTING	--	-	++	++	--
BIOLOGICAL (PHOTOLYSIS)	-	--	++	++	--

* Without CCS

- Which LCA formulation?
- Where do we get the data from?
- What is the balance between cost and accuracy?

3 - Defining the Appropriate Emission Levels for Low-carbon

- Should these change over time in line with carbon targets?
- Is there a balance to find between stifling innovation and having plausible thresholds?
- Different technologies use different amounts of hydrogen to provide the same service!!

3 - Defining the Appropriate Emission Levels for Low-carbon

- Should these change over time in line with carbon targets?
- Where do we get the data from?
- What is the balance between cost and accuracy?

Green Hydrogen Initiatives

Initiative	Objective	Baseline	Qualification level	Qualifying processes
TÜV SÜD	Greenhouse gas reduction potential	NG reformed hydrogen, or fossil fuels, depending on process	35-75% emissions reduction below baseline, depending on production process, and time phase (83.8-89.7 gCO ₂ e/MJ)	Renewable electrolysis; steam-reforming of biomethane; pyro-reforming of glycerine
Clean Energy Partnership (CEP)	Renewable energy source / CO ₂ emissions	None for electrolytic hydrogen; for biomass-based hydrogen the baseline is NG reformed hydrogen	For biomass-based hydrogen, lower emissions than the baseline, level not specified	Renewable electrolysis; hydrogen from biomass produced in certified green thermochemical or biological conversion processes
CERTIFHY	Renewable energy source / CO ₂ emissions	SMR of natural gas	At least 60% lower than SMR of natural gas (under 91 gCO ₂ eq. for the past 12 months)	Any as long as meet the qualification level.
AFHYPAC	Renewable energy source	None	Must be 100% renewable	Renewable electrolysis; reforming of biomethane
DECC	CO ₂ emissions	To be determined and revisable according to carbon budgets.	To be determined. A single threshold differentiated according to end use (e.g. transport)	Technology neutral.

Enhanced Sustainability Criteria: Quality Labels

Certification Body	Quality Label Name	Countries where it operates	Biogas (BG) / Renewable Electricity (RE)	Additional criteria
VUE	Naturemade Basic / Star	Switzerland	BG / RE	Impact on biodiversity
TUV SUD	TUV SUD EEO1	Germany	RE	30% power from new plants. Commitment to promotion renewables
EKOenergy	Energia Verde (Italy) Planète OUI (France)	EU wide	BG / RE	Sustainability requirements set by the EKOenergy Network (e.g. protected areas)

Guarantee of Origin Certificates

Lessons from electricity

- Should all hydrogen have a certificate?
- Should hydrogen be classified as low-carbon or renewable, but not both?
- Need to define pathways, technologies and sustainability criteria in advance
- Need to account for distribution losses
- Robust, harmonised, independently-verified scheme needed
- A straightforward scheme enables customer choice
- No consensus on what “green” means
- Certificates need to be time-limited – to prevent stockpiling
- Conversion 1 GOO = 1MWh. Problematic as GHG emissions from 1MWh depends on the production process.

Guarantee of Origin Certificates

Lessons from electricity

We are in an EU market:

- Semantics are important – definitions of “renewable” vary across the EU.
- The energy content and lifetime of certificates varies between countries.
- Certificate issuance in some countries depends on whether the power plant was subsidised.
- Few countries issue certificates for non-renewable generation.
- Some countries do not accept certificates, and cross-border trade of certificates can be blocked.
- National certificate registries are not linked.
- Ecological/sustainable criteria still do not exist.
- There’s no information about GHG emissions on renewable certificates.
- Disclosure systems are different between countries, leading to double-accounting.
- Eco-labels for electricity were developed before certificates.

Conclusions

- Defining green hydrogen is an important step towards a hydrogen economy
- Several initiatives are underway across Europe to produce certification schemes for hydrogen, including in the UK
- There are numerous difficulties to overcome, as demonstrated by the electricity schemes
- Opportunity for including other sustainability criteria (e.g. air quality); partially covered by quality labels.

Thank you for listening

