

Session plan

- Introduction to Supergen 'Green Hydrogen Standard' project
- Why we need a green hydrogen standard?
- Green hydrogen challenges
- Opportunities
- Review of Green hydrogen standard initiatives
- Conclusion

Aims of our current research are to understand:

- how could a green hydrogen standard be defined?
- what are the options and implications of different low-carbon thresholds?
- how could a standard support the development of hydrogen and fuel cells through existing and new policy instruments in the future?
- should other “green” factors, such as improved air quality, be reflected in the standard?

What have we been doing?

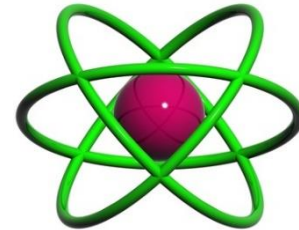
- Analysing responses to DECC's (now BEIS) green hydrogen standard consultation
- Understanding how such standards are being set up for hydrogen in other countries, and how have been created for electricity and biofuels in the past
- Developing a framework for calculating hydrogen emissions for the UK
- Identifying challenges for setting green hydrogen thresholds

Why do we need a Green Hydrogen Standard?

- The lack of a UK definition of “green” hydrogen is an obstacle to policy support for hydrogen and fuel cells.
- DECC convened (but subsequently closed) a working group to develop a UK standard for green hydrogen.

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 (with no CCS)
 - Examples:
 - Coal Gasification, SMR , 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

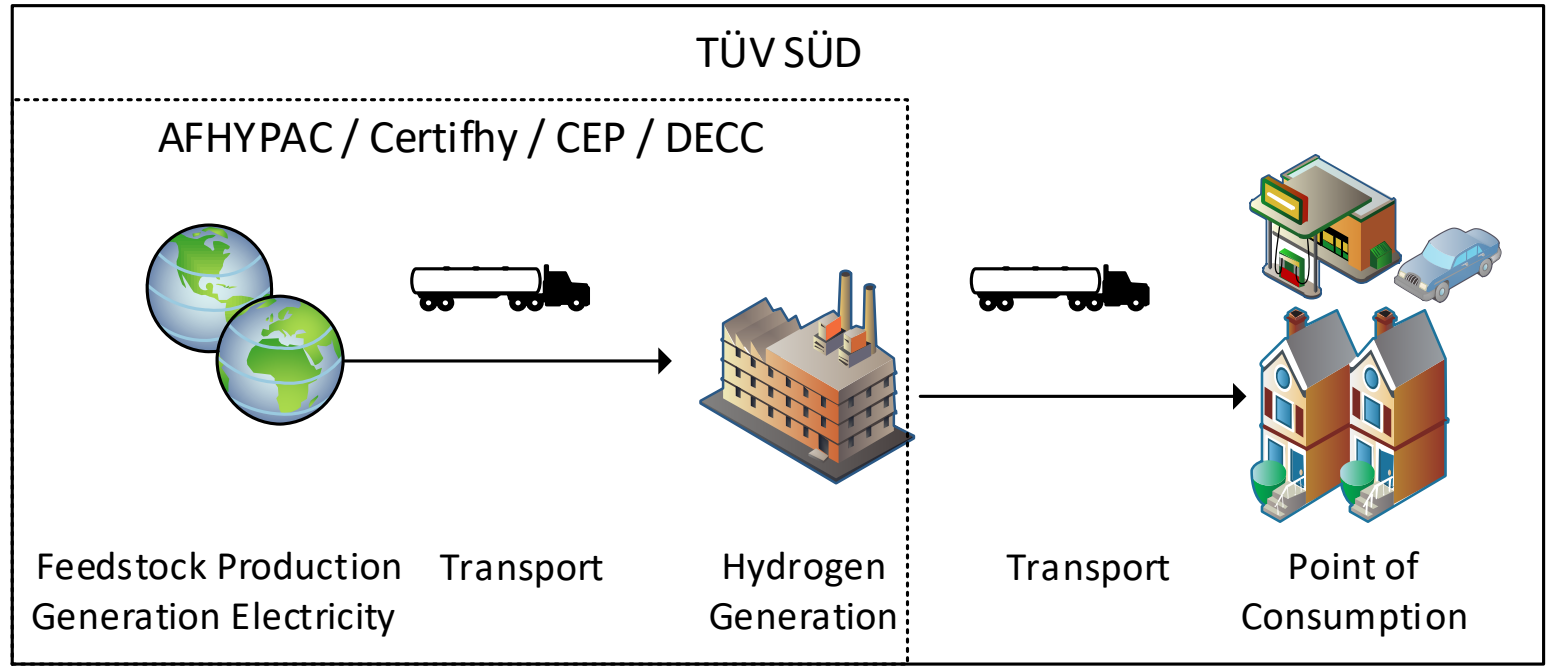
- RED Definition of renewable (2009/28/EC directive)

‘...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

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)

Further challenges

- Which LCA formulation?
- Where do we get the data from?
- What is the balance between cost and accuracy?
- How do you stop people gaming the system?

Defining the Appropriate Emission Levels for Low-carbon

- Should these thresholds 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!!

Opportunities – Guarantees of Origin

(47) Guarantees of origin, which are currently in place for renewable electricity and renewable heating and cooling, should be extended to cover renewable gas. This would provide a consistent means of proving to final customers the origin of renewable gases such as biomethane and would facilitate greater cross-border trade in such gases. **It would also enable the creation of guarantees of origin for other renewable gases such as hydrogen.**

Source: EU Directive Proposal on the promotion of the use of energy from renewable source COM(2016) 767 final 2016/0382 (COD), 30th Nov 2016...

Opportunities

- Defining clearly what green hydrogen is, would allow the creation of a GoO Scheme for Premium Hydrogen.
 - Create a market for premium hydrogen which may steer investment on cleaner pathways (market pull)
 - Facilitate trading across the EU
 - Improve transparency

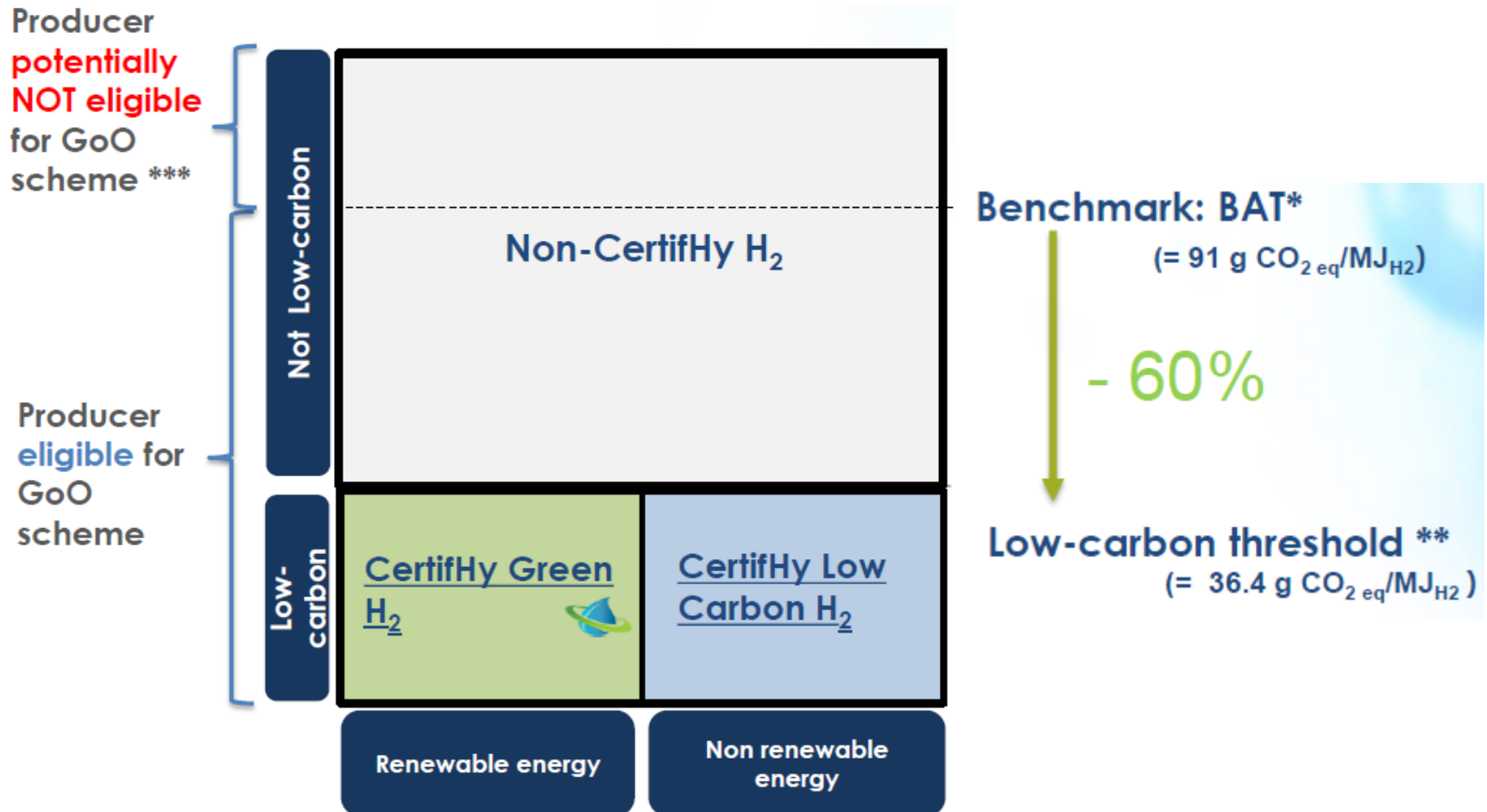
Main challenges of GoO

- Double counting - Subsidies
- Details in the certificates may vary between countries:
 - Expiration date: 1 year / 2 Years
 - Accepted pathways
 - Conversion 1 GOO = 1MWh = Problematic as GHG emissions from 1MWh depends on Pathway.

Review of Green Hydrogen standardisation 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. Point of use.
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. PoP.
AFHYPAC	Renewable energy source	None	Must be 100% renewable	Renewable electrolysis; reforming of biomethane. PoP
BEIS (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. Point of production.
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./MJ H ₂ for the past 12 months)	Any as long as meet the qualification level. Purification quality 99.5%. Point of Production.

EU CertifHy



Summary of Green Hydrogen standardisation initiatives

GREEN HYDROGEN WORKING PAPER ONE
GREEN HYDROGEN DEFINITIONS AND RELATIONSHIPS WITH CERTIFICATION SCHEMES
 Authors: Anthony Woodhead, Alan, Nicholas Hughes, Paul Davis

The paper introduces the definitions applied in the context of Green hydrogen in different countries and outlines the criteria for the registration, monitoring and verification of different certification schemes. To do so, the paper looks at existing schemes of origin (GO), which are effective measures to increase market confidence in these and other possible schemes to create Green hydrogen schemes. Most of the different standards presented in this paper and the definition that these apply to 'green hydrogen'. The various accounting approaches and the boundaries of the systems are outlined. Finally, a discussion is given to the challenges regarding harmonisation of definitions. GOs and methodologies in progress.

1 Quantification of Origin (GO) schemes

Origin in energy sector can be used as a proxy indicator for carbon footprints and a desirable one. As a result a direct benefit from renewable and GOs and partly offset by a green certificate. An existing GOs scheme is other energy sources the maximum of applying a similar criteria to green hydrogen can be assessed.

GOs are documents that provide the origin of energy produced by the renewable resources, stored and then are used as a verification of Renewable Energy Quantities of Origin (RECO) certificates. GOs and RECOs include information from RECO certificates. The other main effect, besides the government certificate issued by Green Foundation that includes a total energy of electricity produced from wind power. These certificates have different legal status in the same government by commercial use. After that national agreement on the RECO certificates. The success of the initiative will be the European Energy Certificate System (ECS), a standardised GOs system managed by the Association of Energy Producers (AEP).

GOs include origin and it can be accompanied by a quality seal issued by a third party, resulting in a more robust certification. GOs are voluntary and issued or required by producers of electricity (and, at the discretion of the Member States,

Initiative	Country	Carbon intensity threshold	Renewable Origin	Boundary	Discrimination pathways	Other non carbon targets
TÜV SÜD	Germany	Yes	Yes	PoU	Yes	No
CEP	Germany	'Lower'	Yes	PoP	Yes	No
AFHYPAC	France	No	Yes	PoP	Yes	No
DECC	UK	Intended	Yes	PoP	No	No
CertifHy	EU wide (aimed)	Yes	No	PoP	No	No

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 !



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