Definition of a UK green hydrogen standard

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Government energy policy

- Secure
- Affordable
- Clean
  - Renewable
  - Low-carbon

How can we prove that our hydrogen is low-carbon or renewable?

Background to the project

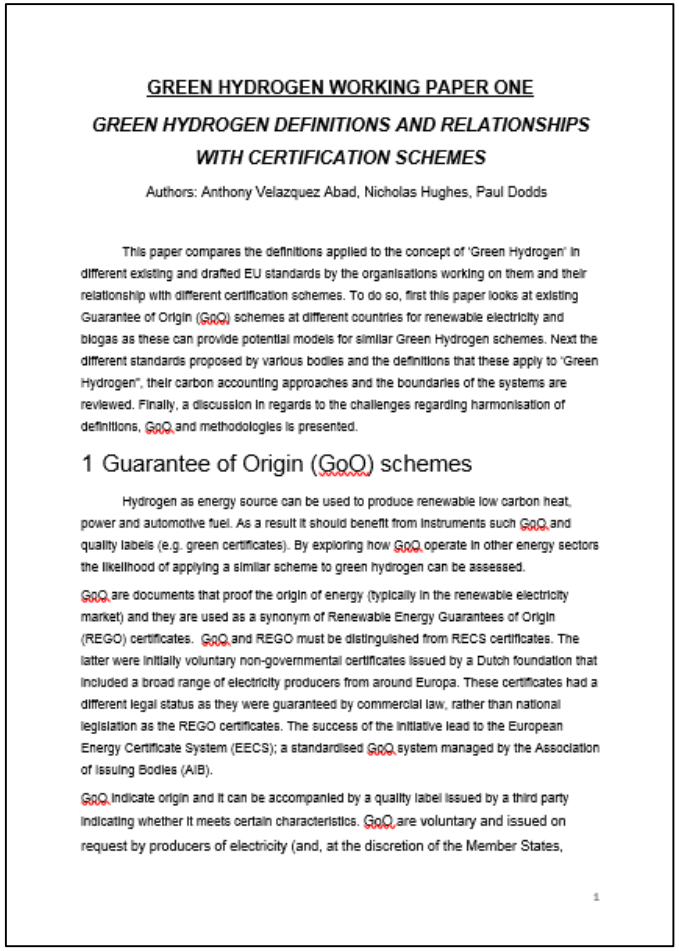
- The lack of a UK definition of “green” hydrogen is an obstacle to policy support for hydrogen and fuel cells.
- DECC convened (but subsequently closed) a working group to develop a UK standard for green hydrogen.
- Aims of this project are to understand:
  - how could a green hydrogen standard could 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?

Review of hydrogen and similar schemes for other energy vectors

- TŰV SŰD and CEP – German
- AFHYPAC – French
- DECC – UK (on hold)
- CertifHy – EU certification scheme

These schemes tend to assume "Green" hydrogen is derived from renewable fuels (apart from DECC).

Some schemes try to incentivise only new renewables deployment for hydrogen production.



GREEN HYDROGEN WORKING PAPER ONE

GREEN HYDROGEN DEFINITIONS AND RELATIONSHIPS WITH CERTIFICATION SCHEMES

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This paper compares the definitions applied to the concept of 'Green Hydrogen' in different existing and drafted EU standards by the organisations working on them and their relationship with different certification schemes. To do so, first this paper looks at existing Guarantee of Origin (GoO) schemes at different countries for renewable electricity and biogas as these can provide potential models for similar Green Hydrogen schemes. Next the different standards proposed by various bodies and the definitions that these apply to 'Green Hydrogen", their carbon accounting approaches and the boundaries of the systems are reviewed. Finally, a discussion in regards to the challenges regarding harmonisation of definitions, GoO and methodologies is presented.

1 Guarantee of Origin (GoO) schemes

Hydrogen as energy source can be used to produce renewable low carbon heat, power and automotive fuel. As a result it should benefit from instruments such GoO and quality labels (e.g. green certificates). By exploring how GoO operate in other energy sectors the likelihood of applying a similar scheme to green hydrogen can be assessed.

GoO are documents that proof the origin of energy (typically in the renewable electricity market) and they are used as a synonym of Renewable Energy Guarantees of Origin (REGO) certificates. GoO and REGO must be distinguished from RECS certificates. The latter were initially voluntary non-governmental certificates issued by a Dutch foundation that included a broad range of electricity producers from around Europa. These certificates had a different legal status as they were guaranteed by commercial law, rather than national legislation as the REGO certificates. The success of the initiative lead to the European Energy Certificate System (EECS); a standardised GoO system managed by the Association of Issuing Bodies (AIB).

GoO indicate origin and it can be accompanied by a quality label issued by a third party indicating whether it meets certain characteristics. GoO are voluntary and issued on request by producers of electricity (and, at the discretion of the Member States,

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Lessons from electricity: Guarantees of Origin

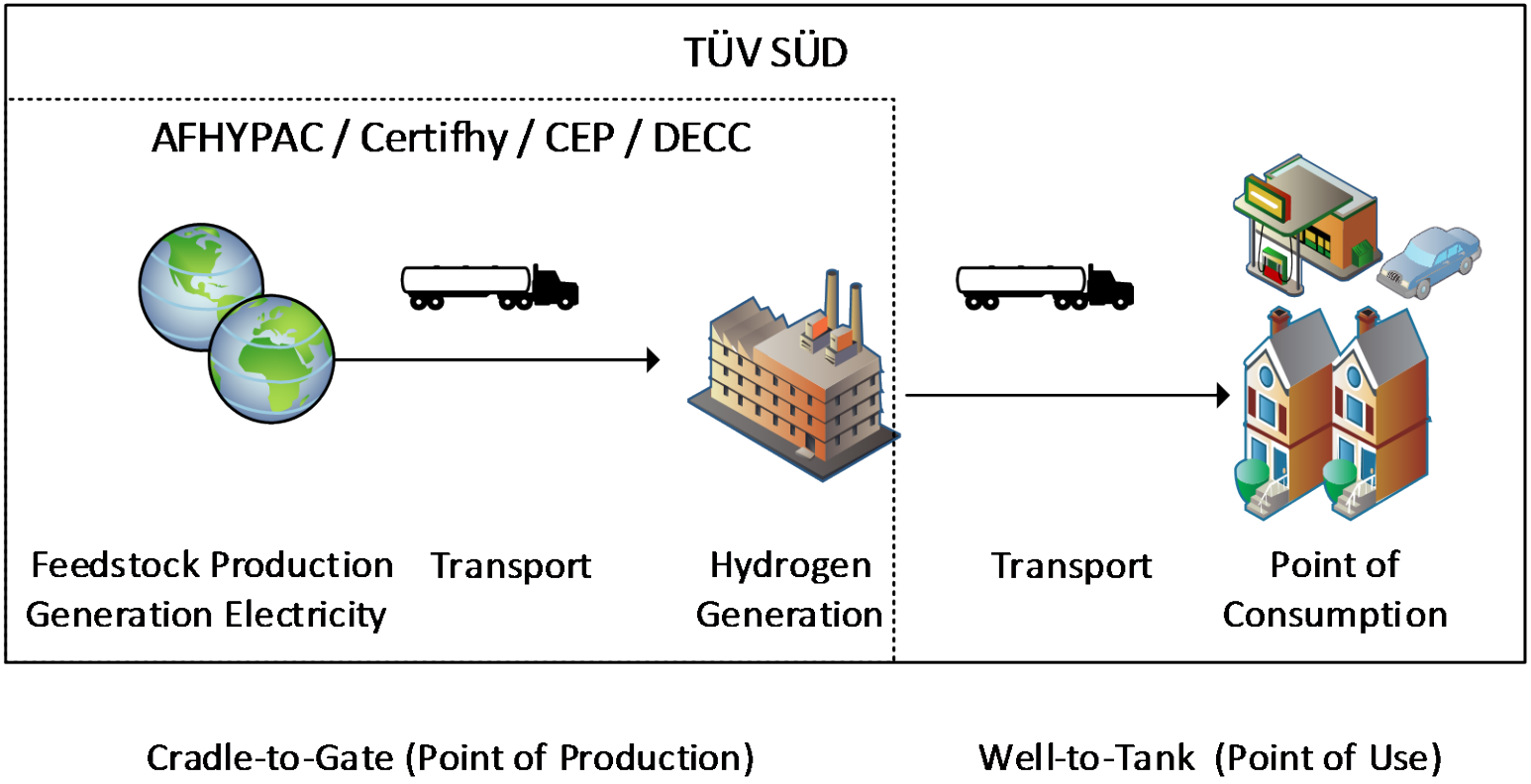
- Electricity has had the same challenge for 20 years
  - Renewable electricity is tracked
  - Low-carbon electricity is tracked

- Consumers can buy certified renewable or low-carbon electricity
- Policy support exists for sustainable generation
- Some issues have still not been overcome (e.g. what does “green” mean?

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

1. Hydrogen system boundaries



2. Estimating GHG emissions for each production/well-to-tank process

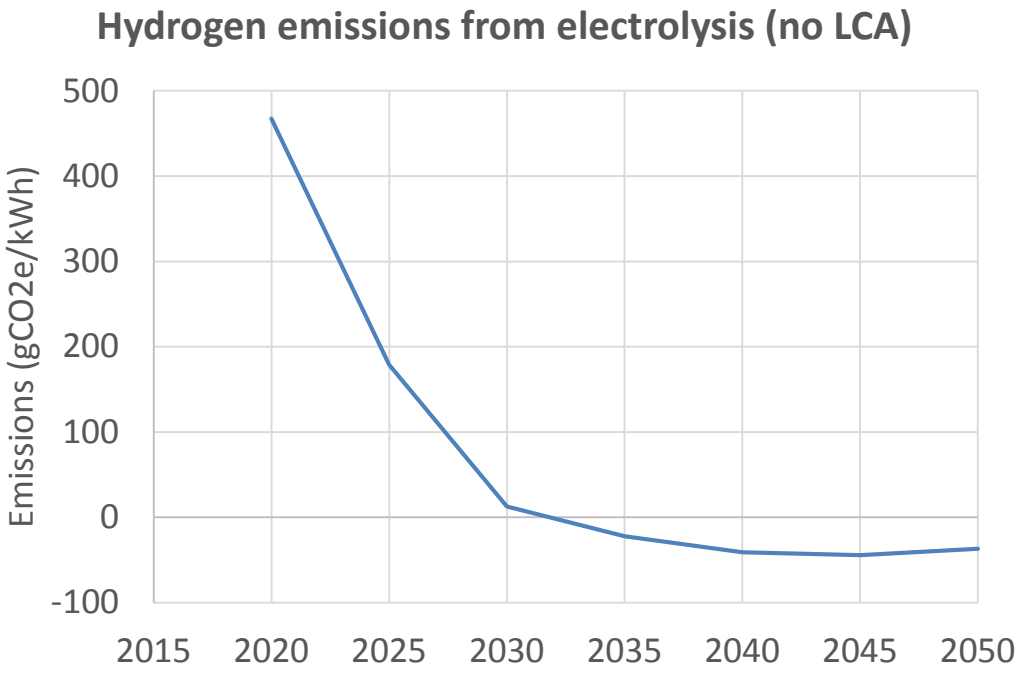
- Which LCA formulation? Or just feedstock emissions?
- Where do we get the data from?
- What is the balance between cost and accuracy?

- How do you stop people gaming the system?

Production emissions

Choice of unit: gCO_2e/kWh (similar to electricity)

- Considering only fuels is simpler
- However, feedstock emissions can vary over time
- LCA is much more complex (e.g. renewable generation 20–70 gCO2/kWh)
- Lifetime and capacity factor assumed for LCA



Hydrogen distribution emissions

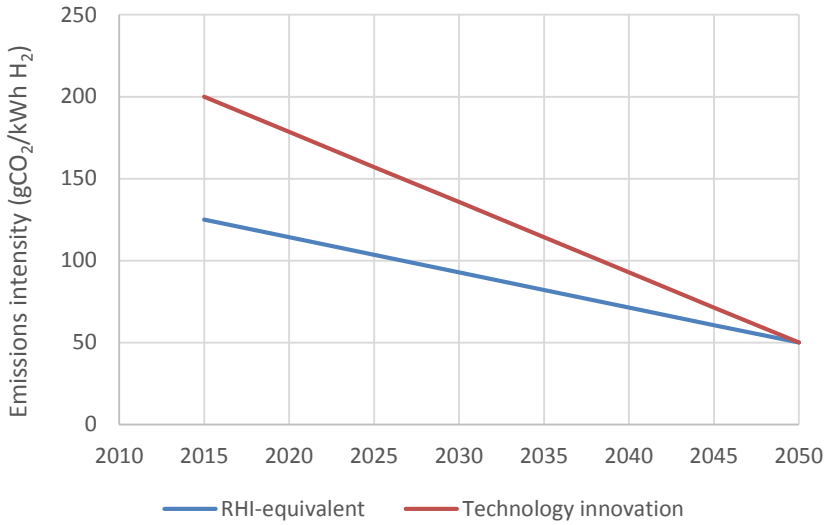
- Loss of hydrogen during refuelling is (relatively) straightforward to estimate – but can be strongly geographically-dependent.
- Embodied emissions in infrastructure is much more difficult to assess. What is the extent of a UK hydrogen pipeline system?

Delivery route	% H_2 loss
Centralised delivery by HP pipeline, compression and refuelling	10%
Centralised transport by liquid H_2 road tanker + cryogenic refuelling	25%
Centralised transport by compressed H_2 tube trailer + refuelling	13%
Decentralised compressed H_2 Treatment and refuelling	8%

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 – e.g. FCEV vs ICE

3. Defining the appropriate emission levels for low-carbon



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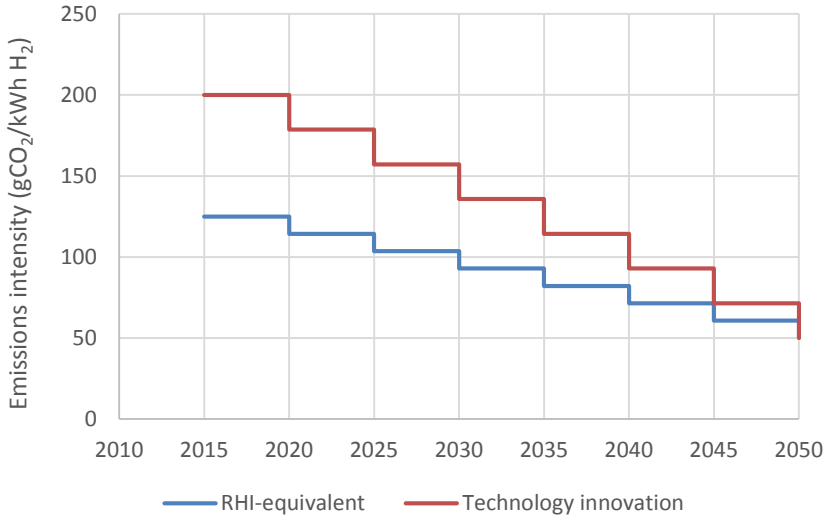
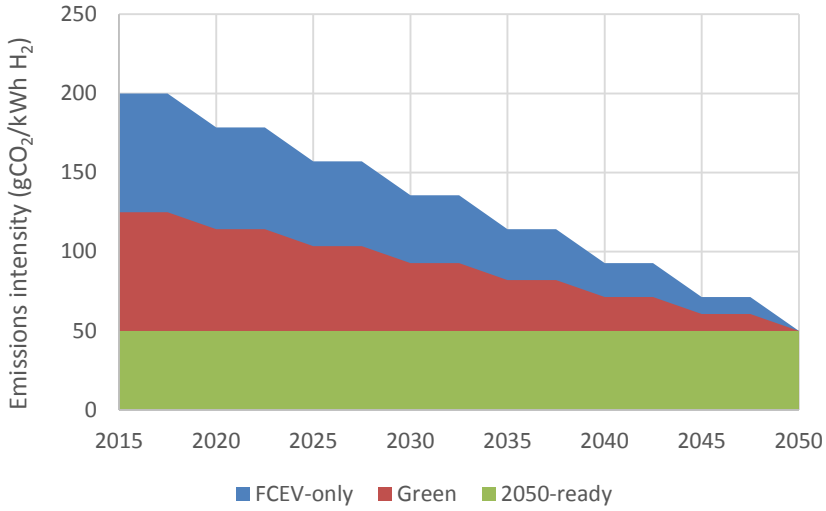




Defining tighter thresholds: transport

Vehicle type	Year	Production emissions* (gCO_2e/kWh)	End-use emissions* (gCO_2e/km)
Diesel ICE, bought today	2015	239	162
Diesel hybrid ICE, in 2050	2050	239	92
Hydrogen FCVs			
SMR	2020	248	99
SMR+CCS	2020	27	11
Electrolysis from grid	2020	467	186
Electrolysis from renewables	2020	0	0

* Excludes embodied emissions in infrastructure/devices

Defining tighter thresholds: heat

Technology	Year	Production emissions* (gCO_2e/kWh)	End-use emissions* (gCO_2e/kWh)
Gas boiler, bought today	2015	186	206
Hydrogen boilers			
SMR	2020	248	326
SMR+CCS	2020	27	35

* Excludes embodied emissions in infrastructure/devices

What have we been doing?

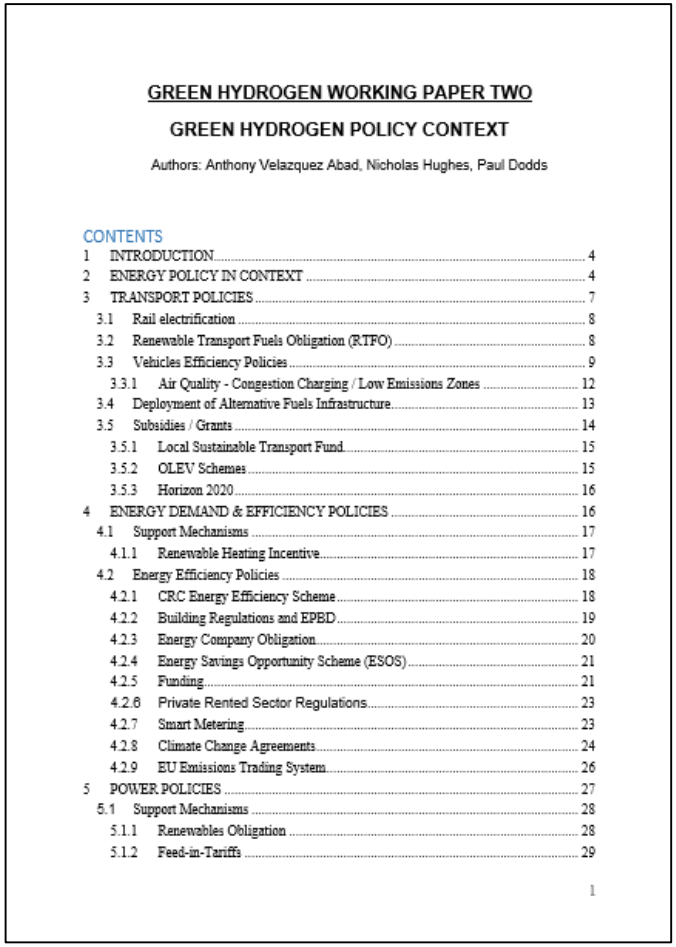
- Analysing responses to DECC's green hydrogen standard consultation
- Understanding how such standards are being set up for hydrogen in other countries, and have been created for electricity and biofuels in the past
- Developing a framework for calculating hydrogen emissions for the UK
- Identifying UK low-carbon policies and considering how they might use a green hydrogen standard
- Identifying challenges for setting green hydrogen thresholds

How could a green hydrogen standard have a meaningful impact?

Where might a green hydrogen standard be introduced into existing UK energy policies?

- Transport policies
- Heat, energy demand and energy efficiency policies
- Electricity system policies

How do we avoid double-subsidies for hydrogen production?



GREEN HYDROGEN WORKING PAPER TWO

GREEN HYDROGEN POLICY CONTEXT

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CONTENTS

1 INTRODUCTION 4
2 ENERGY POLICY IN CONTEXT 4
3 TRANSPORT POLICIES 7
3.1 Rail electrification 8
3.2 Renewable Transport Fuels Obligation (RTFO) 8
3.3 Vehicles Efficiency Policies 9
3.3.1 Air Quality - Congestion Charging / Low Emissions Zones 12
3.4 Deployment of Alternative Fuels Infrastructure 13
3.5 Subsidies / Grants 14
3.5.1 Local Sustainable Transport Fund 15
3.5.2 OLEV Schemes 15
3.5.3 Horizon 2020 16
4 ENERGY DEMAND & EFFICIENCY POLICIES 16
4.1 Support Mechanisms 17
4.1.1 Renewable Heating Incentive 17
4.2 Energy Efficiency Policies 18
4.2.1 CRC Energy Efficiency Scheme 18
4.2.2 Building Regulations and EPBD 19
4.2.3 Energy Company Obligation 20
4.2.4 Energy Savings Opportunity Scheme (ESOS) 21
4.2.5 Funding 21
4.2.6 Private Rented Sector Regulations 23
4.2.7 Smart Metering 23
4.2.8 Climate Change Agreements 24
4.2.9 EU Emissions Trading System 26
5 POWER POLICIES 27
5.1 Support Mechanisms 28
5.1.1 Renewables Obligation 28
5.1.2 Feed-in-Tariffs 29

1

Conclusions

- Defining green hydrogen is an important step towards supporting hydrogen-fuelled technologies
- 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

Thank you for listening