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Renewable hydrogen: what way forward?

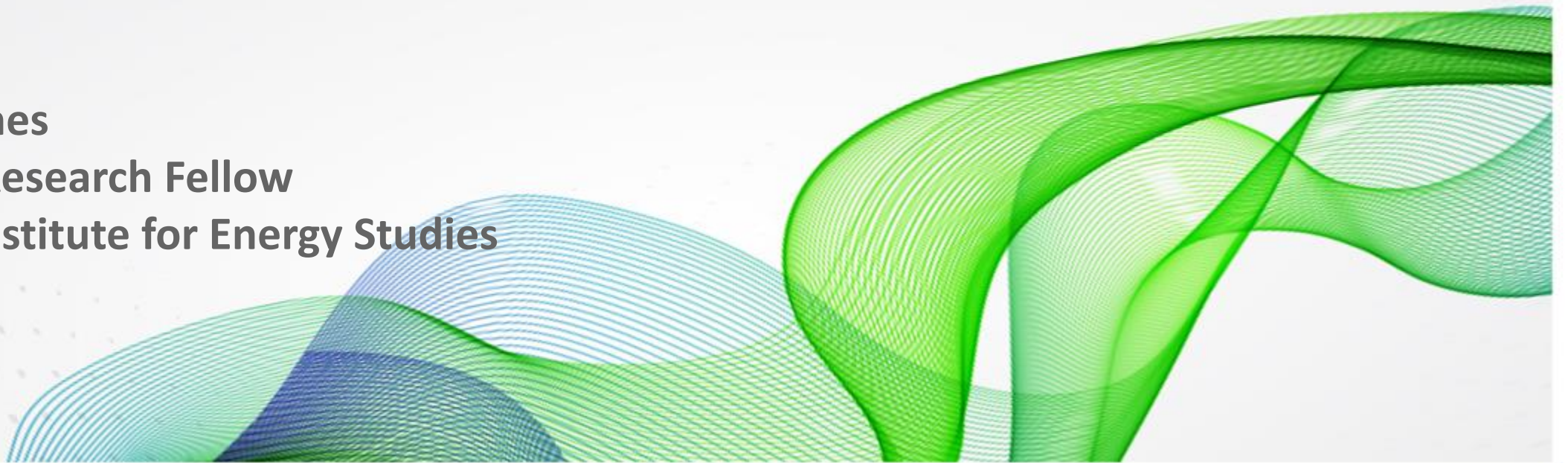
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Overview of UK Hydrogen Strategy

- 5 GW low carbon hydrogen production by 2030 – electrolytic and CCS enabled
 - Up to 450 TWh by 2050 / 35% final energy demand - based on UK Carbon Budget 6 net zero scenario.
- Variety of funding mechanisms
 - Hydrogen Production Business Model – Contract for Difference (CfD) support for hydrogen production.
 - Hydrogen Transport and Storage Business Model – Regulated Asset Base approach for transport and revenue support for storage
 - CCS cluster funding with support for CO2 transportation and storage – East Coast Cluster, HyNet, Acorn
 - Net Zero Hydrogen Fund – DEVEX and CAPEX support for projects
- Hydrogen Allocation Rounds (HAR)
 - Projects apply and shortlisted projects negotiate funding with government – HAR 1 aim award contracts Q4 2023. HAR 2 launch Q4 2023 – contract awards early 2025?
 - Government aims to move towards competitive price-based allocation for future rounds by 2025.



Why is certification important?

- Confusion of terms for hydrogen - clean (US), low carbon (UK and EU), renewable (EU) all can use nuclear or fossil fuel-based electricity in their production
- Means of production is not the important factor here – GHG intensity / savings of the hydrogen should be the key driver
- Rules on which emissions to include vary:
 - System boundary
 - Emissions Scope
 - Emissions values for inputs or activities
- Expectation that hydrogen or its derivatives (e.g. ammonia, methanol, synthetic fuels, e-methane) will be traded – need to know the ‘quality’ of what is being traded

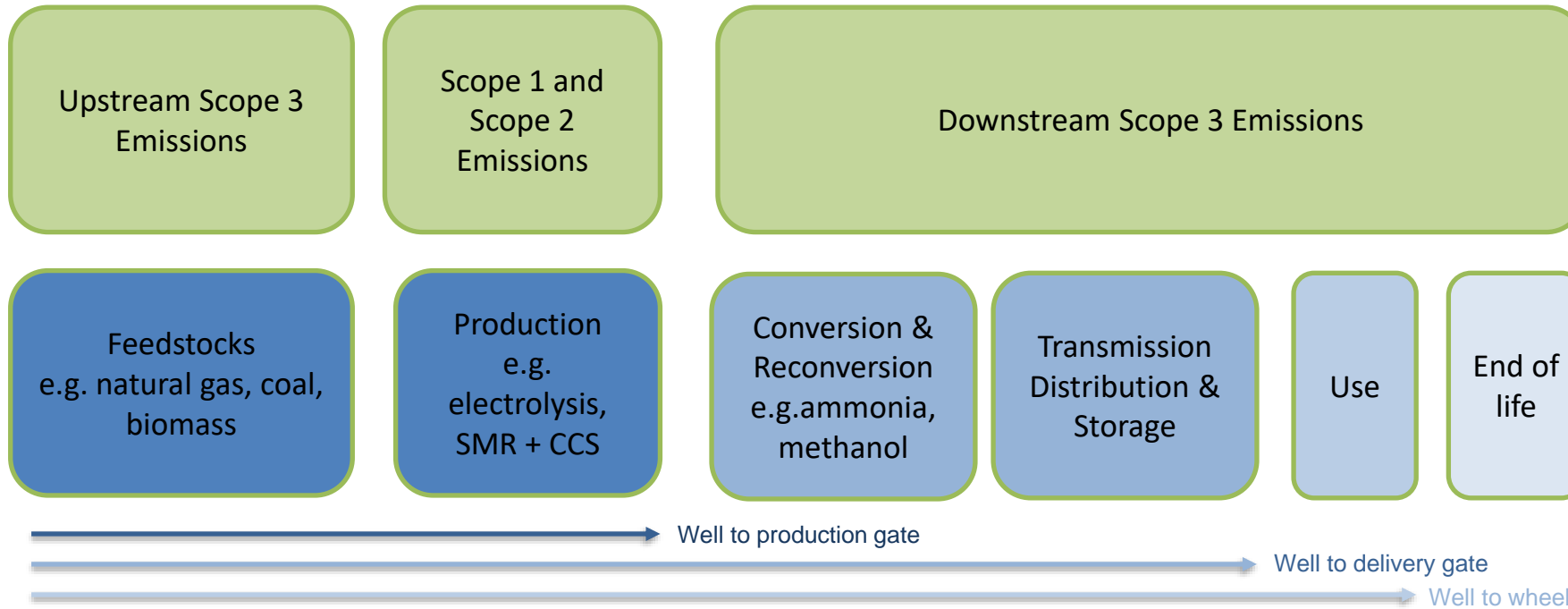


Key issues

- Upstream emissions – e.g. methane emissions in production and supply of oil, gas or coal used to produce hydrogen
 - Methane emissions Monitoring, Verification and Reporting is variable and patchy across producing countries
- Electricity emissions are very complex
 - Lack of electricity storage and intermittency of renewable electricity makes temporal correlation important when determining GHG intensity of electricity used and hence of electrolytic hydrogen – risk that longer correlation period increases the GHG intensity of electricity used
 - Risk of cannibalization of existing renewable electricity generation could increase system emissions because of conversion losses when producing hydrogen – additionality rules may reduce this risk
 - Use of lifecycle GHG accounting (e.g. well to wheel) can avoid these problems – but depends on definitions (e.g. EU Delegated Act on electricity used in RFNBO production).



System Boundary and Emissions scope



IPHE developing common methodology for measuring GHG intensity of hydrogen and derivatives

Scope 1 Emissions: Direct GHG emissions from the hydrogen production process

Scope 2 Emissions: GHG emissions associated with the generation of electricity outside of the hydrogen production facility, heating/cooling, or steam purchased for own consumption.

Scope 3 Emissions: A production pathway's indirect GHG emissions other than those covered in scope 2.

Which scope emissions to include varies – e.g. UK includes Scope 3 upstream natural gas production and transportation and downstream conversion emissions but not emissions from the manufacture of equipment used in hydrogen production.



Hydrogen definitions – two different approaches

	EU	UK
GHG intensity threshold	3.4kgCO ₂ e/kgH ₂ 28gCO ₂ e/MJ	2.4kgCO ₂ e/kgH ₂ 20 gCO ₂ e/MJ
System boundary	Well to wheel	Well to production gate
Hydrogen type*	Differentiates renewable and low carbon	Low carbon (all production methods)
Additionality for renewable electricity*	Yes – up to 36 months prior to hydrogen production start	No
GHG intensity of electricity*	Zero for renewable electricity <i>OR</i> default national grid values <i>OR</i> 0gCO ₂ e/MJ if renewable or nuclear electricity set the price <i>OR</i> 183gCO ₂ e/MJ <i>OR</i> GHG of marginal generating unit if known	Based on 30-minute correlation of electricity used
Temporal correlation*	Monthly to end 2029, then hourly unless grid is more than 90% renewable <i>OR</i> the imbalance period if hydrogen production reduces curtailment of renewable electricity generation	30 minutes
Electricity connection requirements*	Direct connection; PPA in same or adjacent bidding zone	Direct connection; PPA; grid connection

*EU rules only known for renewable hydrogen; detailed low carbon hydrogen rules expected in 2024. Renewable electricity must meet delegated act rules. Electricity can be counted as partly renewable based on share of renewable electricity in the grid over the past two years.



Certification schemes

- EU allows recognition of both voluntary and national schemes for certification
 - Hydrogen which does not comply with EU standards may be traded but will not be recognized as ‘renewable’ or ‘low carbon.’
 - Union Database will track all renewable and low carbon files from production to point of use and include GHG intensity
 - Guarantees of Origin must be cancelled before entry into Union Database
 - MS must use mass balance system to track fuels for them to count towards EU targets
 - Rules apply to both EU production and imports
- UK Low Carbon Hydrogen Standard is contractual requirement for hydrogen which receives government subsidy -
 - Government consulting on Low Carbon Hydrogen Certification System to aid trading