THE ASSOCIATION
FOR RENEWABLE ENERGY
& CLEAN TECHNOLOGY

27th July 2022

REA / BEIS roundtable on alternative hydrogen production pathways

GREEN GAS

HYDROGEN

@REAssociation

Meeting Housekeeping

- All please join as *muted* & *without video*
- Please note where the *chat box* should you have any questions or wish to comment, or use the *raise your hand* button
- We will have Q&A and discussion sessions during the meeting

The session will be recorded for accurate note taking

Participants of the meeting will receive a copy of the slides.

Thank you

@REAssociation

Agenda

Item	Time
Welcome and introductions (REA, BEIS)	13:00 – 13:10
Policy landscape – intro of policy areas from officials in these teams relevant to H_2 production from bio/waste (BEIS)	13:10 – 13:40
Overview of sector – potential projects, location, and support required (REA)	13:40 – 13:55
Case studies from industry: • EQTEC (ACT of waste/biomass streams) • Enfinium (biopower to electrolysis)	13:55 -14:15
Q&A on survey and case studies (all)	14:15 – 14:25
Questions and discussion on HMG position (All)	14:25 – 14:45
Next steps and meeting close (all)	14:45 – 15:00

Attendees from industry

REA / REA members	
Kiara Zennaro	REA
Mark Sommerfeld	REA
Paul Thompson	REA
Pablo John	REA
Amy MacConnachie	REA
Isabel Boira-Segarra	Future Earth Energy
Adrian Smith	Future Earth Energy
Alan Douglas	Kew Technology
Wayne Robertson	Enfinium
Paul Green	Enfinium
Philip Curds	Enfinium
Duncan Coneybeare	HiiROC
Lisa Artemis	EQTEC
Mac Andrade	EQTEC
Jeffrey Vander Linden	EQTEC
Tony Smith	Peel NRE
Richard Barker	Peel NRE
Nathan Burkey	Advanced Biofuels Solutions
Alex Young	Bioenergy Infrastructure Group
Matt Adams	Drax
Alex Goodwin	Flint Global

Apologies from:	
Andrew Cornell	ABSL
Steve Jones	Bayo Tech
William Mezzullo	Centrica
Jack Richard	Bioenergy Infrastructure Group
Mark Redway	Omni CT

Attendees from Government

Name	Department	Relevant policy
Benjamin Harrop	BEIS	Hydrogen Production / Hydrogen Business Model
Henry Irvine	BEIS	Low Carbon Hydrogen Standard
Anna Mikis	BEIS	Biomass Strategy team
Paul Henderson	BEIS	Hydrogen Production Strategy
Gareth Mottram	DfT	RTFO
Charlie Clay	BEIS	Net Zero Hydrogen Fund
Jonathan Swan	BEIS	Hydrogen Production Pipeline
Alan Johnson	Defra	Household Waste and Recycling - Resources and Waste
Katherine Woods	BEIS	Energy innovation programme
Caroline Biotteau	BEIS	Hydrogen and Industrial Carbon Capture
Ed Howe	BEIS	CCUS

Pathways in scope

- *Advanced conversion* (e.g. gasification or pyrolysis) of *waste streams* such as refuse derived fuels, unrecyclable plastics and other wastes, which can be biogenic fractions, non-biogenic fractions or a mixture of both
- *Advanced conversion* (e.g. gasification or pyrolysis) of (non-waste) *biomass*
- *Advanced conversion* of *waste gases* from industrial processes
- *Steam methane reformation of biogas/biomethane*
- *Thermal Plasma Electrolysis* (TPE) from biogas/biomethane or other sources
- *Biopower*, produced from biomass or waste, *to electrolysis*

Roundtable objectives

- Give BEIS on overview of some projects that could be developed with the right support in place from Government
- Understand where these pathways fit within policy being developed across different Government departments
- Call for BEIS to provide financial support to these pathways e.g. in future Hydrogen Business Model (HBM) allocation rounds and other relevant policy developments
- Understand how and when concerns raised on the LCHS or other standards can be addressed and what evidence is needed
- Consolidate actions that can be taken forward by Government across different departments and industry to support these pathways, and agree a clear timetable/roadmap for these actions to be progressed
- Agree on the creation of a cross-Whitehall/industry expert group to design business models for these pathways

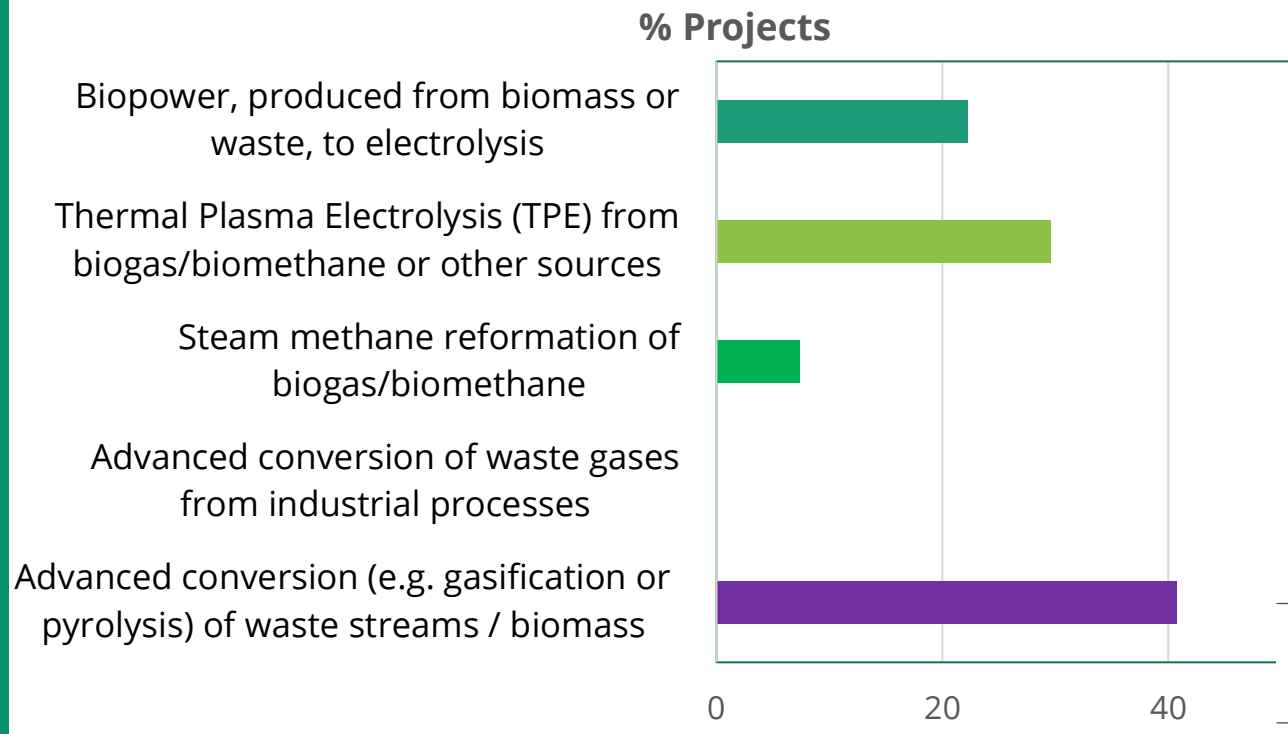
Presentation from BEIS

Policy landscape – intro of policy areas from officials in these teams relevant to H_2 production from bio/waste (BEIS)

Overview of sector

- On *18th July* the REA sent out to members a survey on the potential projects that could come online over the next few years if the right support is in place.
- *Survey scope*: alternative hydrogen production pathways shown in previous slide.
- Responses received for **27 projects** at different stages of development with some gaps in the information provided. Summary of results shown in following slides.

Key pathways



Pathway	Project
Advanced conversion (e.g. gasification or pyrolysis) of waste streams / biomass	11
Advanced conversion of waste gases from industrial processes	0
Steam methane reformation of biogas/biomethane	2
Thermal Plasma Electrolysis (TPE) from biogas/biomethane or other sources	8
Biopower, produced from biomass or waste, to electrolysis	6
TOTAL	**27**

Project location and CCS clusters

Key industrial clusters from Government CCUS Roadmap

- Projects processing a range of 25,000 - 200,000 tpa of waste/biomass feedstocks (once operating at a commercial scale)
- Overall hydrogen produced across 23 out of 27 projects: **> 77,000 tonnes per annum ~ > 2.6 TWh/annum** (but only a snapshot of data based on our members' responses - likely to be an underestimate; could be considerably larger)

Feedstock types and biogenic content

Advanced conversion (e.g. gasification or pyrolysis) of waste streams	60+ feedstocks including a range of forestry biomass, agricultural biomass, industrial waste and sludge, RDF, SRF and contaminated plastics (x 3)	Range of biogenic contents depending on project
	RDF, waste wood, other biogenic waste materials (x 1)	60% biogenic
	Residual waste including residual plastic (x 1)	46% biogenic
	RDF (x 1)	
	RDF and grade C waste wood (x3)	60% biogenic
	Non-recyclable plastics (x 2)	0% biogenic
Thermal Plasma Electrolysis (TPE) from biogas/biomethane or other sources	Waste / flare gas otherwise flared or cold flared (x 1)	0% biogenic
	Natural gas (x 4)	0% biogenic
	Biomethane (x 2)	100% biogenic
	Volatile organic compounds captured from industrial paint shop processes (x 1)	0% biogenic
Biopower, produced from biomass or waste, to electrolysis	Municipal solid waste, RDF and similar commercial and industrial waste (x 6)	53% biogenic
Steam methane reformation of biogas/biomethane	Biomethane from food waste (x 1)	100% biogenic
	Biomethane from agricultural waste, waste water slurry, abattoir waste, other forms of waste (x 1)	100% biogenic

Project location in relation to feedstocks, output utilisation and CCS cluster

Project location	No projects
Place of feedstock generation	14
Place of utilisation of the outputs	22
Other (where existing AD plant is located)	1
TOTAL	**Doesn't add up as multiple answers provided**

Close to CCS cluster?	No projects	% projects
Yes	20	74%
No	7	25%
TOTAL	**27**	

CCS plans	No projects
CCS from the start	5
CCS-ready	9
No current plans for CCS	3
Not Applicable (carbon captured as solid carbon)	10
TOTAL	**27**

Technology readiness level and project stage

Project development stage	No projects
Feasibility	10
Concept design	6
Pre-FEED / FEED	6
Detailed design	1
Awaiting funding and clarity on DfT / RTFO rules	1
Almost FID	1
No answer provided	2
TOTAL	**27**

Estimated Technology Readiness Level (TRL)	No projects
TRL 5-6	1
TRL 7	12
TRL 8-9	10 – *for some of these projects respondents have said different components have TRL of 8 or 9 but these will be integrated for the first time*
No Answer provided	4
Total	**27**

Project	COD / initial hydrogen production by:	FID & Lead-in time / project commencement:
Project 1	2026	
Project 2	2027	
Project 3	2027	
Project 4	Late 2025	FID late 2023; 24 months
Project 5	Early 2024	FID early 2023; 12 months
Project 6	Early 2025	FID early 2023; 24 months
Project 7		1.5-2 years if viable business case
Project 8	Final development underway. Physical deployment in 2023.	NR
Project 9	Full production end 2025 early 2026.	NR
Project 10	NR	NR
Project 11	NR	NR
Project 12	NR	6 months pf prep - 12 months from FID to H2 generation
Project 13	First half of 2023	NR
Project 14	NR	NR
Project 15	NR	NR
Project 16	NR	6-12 months once offtake arrangements are confirmed
Project 17	NR	6-12 months once offtake arrangements are confirmed
Project 18	NR	6-12 months once offtake arrangements are confirmed
Project 19	NR	6-12 months once offtake arrangements are confirmed
Project 20	Late 2025 / early 2026	Commence pilot mid-2023
Project 21	Late 2025 / early 2026	Commence late 2023
Project 22	Late 2025 / early 2026	Commence 2023
Project 23	Late 2025 / early 2026	Commence pilot 2023
Project 24	Late 2025 / early 2026	Commence 2023
Project 25	Late 2025 / early 2026	Commence pilot early 2023
Project 26	Late 2023	Commence late 2022/early 2023
Project 27	Late 2025	Commencing late 2022, depending on funding availability. Approx 2 years.

Key driver for projects and offtakes

Note: *numbers of projects don't add up as respondents have given multiple drivers and offtakers for each project*

Key drivers	No projects
Decarbonisation of industrial processes	20
Production of hydrogen	15
Decarbonisation of transport/reducing air emissions	11
Clean energy production/decarbonisation	9
Flexible use of energy	6
Waste management	5
Capture of biogenic carbon dioxide	3
Decarbonisation of electricity grid (peak demand)	1
Demonstration of hydrogen used in domestic heating	1
Reduce carbon footprint for off taker (scope 1 emissions)	1

Offtakes	No projects
Transport / vehicle refuelling	12
Industrial use (heat, power or chemical feedstocks)	18
Residential heating and domestic use	1
Decarbonisation of ground service equipment and for use in hydrogen propulsion systems	1
Production of liquid hydrocarbons via Fischer-Tropsch	1
Blending	1
Fuelling gas peaker engines for short-duration electricity demand response	1

Support needed for project to go ahead

Financial support

- **Investment framework needed for these projects to be progressed**
- Need for an Hydrogen Business Model that includes alternative pathways for hydrogen production and supports the business case
- Funding support for pilots and projects / grant to make the hydrogen pricing more competitive and to attract investors into the project
- Support for negative carbon emissions, development fuel certificates under RTFO for biogenic hydrogen even if no CCS is present but the project is CCS ready (i.e. add in the future once the market can sustain it)
- Clarification on level and type of support for hydrogen produced from these pathways

Other market considerations

Low carbon Hydrogen Standard, RTFO and GHG emission calculation

- Confirmation that the hydrogen produced from alternative pathways is eligible to meet the Low Carbon Hydrogen Standard and the relevant transport standards for the use of hydrogen (RTFO)
- Standardisation of greenhouse gas methodologies across all Government departments
- Consistent view across BEIS and other departments of how solid carbon is viewed and categorised

Technical

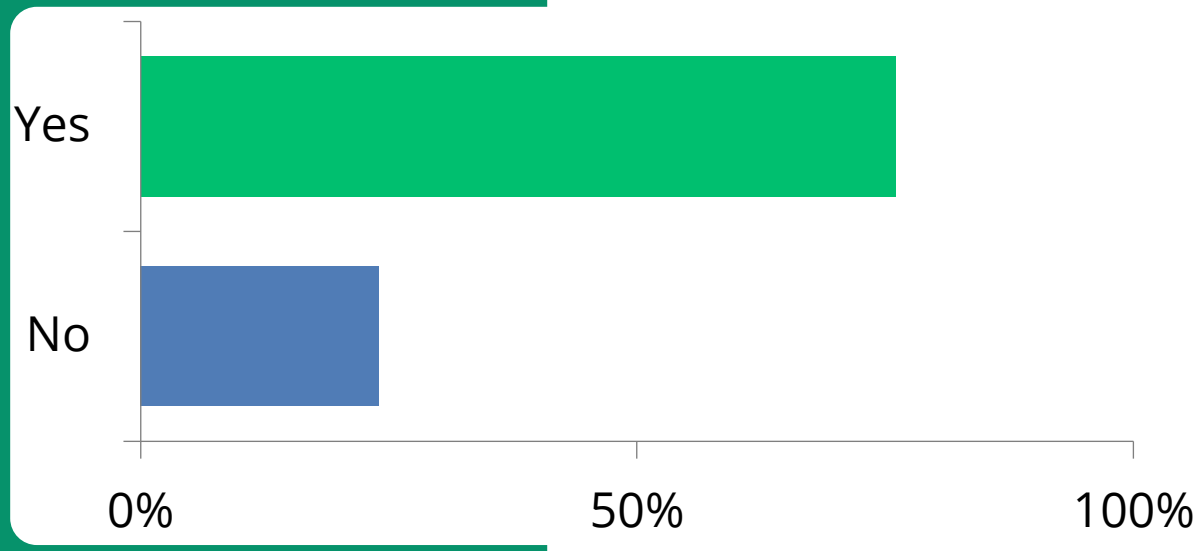
- Technology guarantees are needed for existing proven technologies in order that the technologies can demonstrate commerciality in more, new applications

Regulatory

- Classification of flare gas as waste gas
- Government / Ofgem to bring forward regulation to support timely deployment of converted & new build hydrogen infrastructure and blending decision by 2023
- Ensure development of fair regulatory environment for advanced conversion technologies

Waste allocation

- Ensure deployment of technologies continues to deliver against the waste hierarchy ie appropriate use of feedstocks in line with the waste hierarchy



- Hydrogen produced by ACT plants will meet the low carbon hydrogen standard with CCS. With no CCS, then only the biogenic proportion would meet the standard.
- It does not cover residual waste with low or no biogenic content as a feedstock. Our projects could use 100% residual plastic and thus avoid landfilling this type of waste.
- Clarity needed on how solid carbon is categorised.

Any concerns about the Low Carbon Hydrogen Standard?

- Level playfield needed with electrolysis and CCUS-enabled in terms of "standardisation" and complexity
- Overly stringent requirements for small scale SMR plus CCS - at present there are no real CCS locations yet (particularly if the production site is inland).
- Current rising gas prices also hamper projects as the pipeline injection of biomethane is dominated by gas prices - so that sets a 'floor price' for biomethane which is very high at present – when that is coupled with the requirement for CCS/permanent storage then it is a tough hill to climb.
- Calculations do not appear to include anything from accidental release of CO_2 from permanent sequestration.

Discussion

Multiple benefits of these projects, including but not limited to:

- Significant volumes of low carbon hydrogen to meet Government ambition once they operate at commercial scale
- Diverting unrecyclable wastes from landfill or from other forms of recovery that are lower in the waste hierarchy / circular economy benefits
- Decarbonisation of energy sectors (heat, power and transport) as well as industry and agriculture
- Negative GHG emissions – with CCS – which are seen as critical by CCC and Government to reach net zero

But policy and support needed as well as clarity and consistency across standards.

Questions and discussion on HMG position (All)

- Does this set a clear policy approach?
- Areas of policy requiring further development?
- Are there specific evidence sources we are missing?

- What's missing from an industry's perspective?
- What does BEIS need to include these pathways in future hydrogen business model allocations? What stands on the way?
- What evidence does Government need to support the inclusion of the fossil waste counterfactual and categorise solid carbon as permanent sequestration?
- How do we continue this dialogue with BEIS in the near future to ensure these pathways are supported and any issues concerning standards are addressed?

Some industry desired outcomes:

- creation of expert group, cross Whitehall, and
- support alternative hydrogen production in next phase of Business model allocation.

Next steps

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Thank you

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