

Hydrogen and Net Zero

Understanding hydrogen's role in the energy transition and decarbonisation

DAY 1 – Hydrogen sources in the context of Net Zero

Opening remarks

NET ZERO – WHAT DOES IT MEAN?

Everything produces greenhouse gases

- Imbalances in the carbon cycle
- Sources of green house gases: power, heating, transportation and industry
- Reducing and removing carbon – is it possible and how quickly can we do it?
- Country (and company) commitments
- Can hydrogen play a role?

Hydrogen – Why the fuss?

- Reflections on the energy transition
- How energy has powered civilization
- Going electric is fine but not enough
- Hydrogen's potential role in the transition (as fuel, in power, grid balancing, etc.)
- Defining the types of hydrogen: grey, blue, green and others

HYDROGEN WORLDS

The world of hydrogen today – it's mostly grey!

- Hydrogen is already a large business
- Conventional supply: methane reforming and coal gasification; water-gas shift reaction
- Technologies and licensors
- Conventional uses:
 - Refineries
 - Desulphurisation
 - Ammonia and fertilizers
 - Methanol
 - Fuels via GTL or CTL (Fischer Tropsch)*
 - Oil hydrogenation
- Supply and demand: largest producers and consumers

Blue hydrogen – reducing greenhouse gases

- Reforming and gasification require a lot of fuel!
- Grey hydrogen and CO₂
- Carbon capture and storage (CCS) – challenges
- Accommodating existing fossil fuels with CCS
- Carbon negative technologies

Green hydrogen – a brave new world

- Hydrogen from water and renewables
- Water electrolysis
 - Alkaline electrolysis cells (AEC)
 - Proton exchange membrane (PEM)
 - Solid oxide electrolysis (SOE)
 - Other emerging processes
- Technology comparison and prospects

Other sources of hydrogen

- Methane splitting (turquoise hydrogen)
- From gasification
- Using nuclear power

Ammonia and methanol – parallel worlds

- Using methanol and ammonia as hydrogen carriers
- Direct combustion; ammonia as a fuel
- Role in power generation and shipping
- A practical complement in the transition

ECONOMIC ASSESSMENT

Costs to produce and transport hydrogen

- Calculating cost of production
- CAPEX categories
- Challenges in hydrogen cost assessment
- Hydrogen pathways: cost comparison

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DAY 2 – Hydrogen markets and economics and decarbonising chemicals

THE HYDROGEN SUPPLY CHAIN

- Hydrogen as an energy carrier: what are the options for storage and transportation?
- Opportunities and challenges
- Liquid organic hydrogen carriers (LOHCs)
- Integrated storage and fuel cell technology
- **Hydrogen safety**
- Can we use natural gas grids and infrastructure?

HYDROGEN DEMAND PATHWAYS

Conventional uses

- Growth in hydrogen's existing applications
- Developments in fertilizers
- Methanol's new applications
- Developments in refining

Demand growth beyond conventional uses

- Hydrogen in transportation: direct fuel cells
- Electric versus hydrogen cars – which one is better?
- Auto manufacturers interested in hydrogen
- Hydrogen in rail and shipping
- Stationary and back-up power
- Synthetic fuels

Hydrogen demand growth scenarios

- Assumptions for growth
- Interdependence with renewable electricity

REGULATION AND POLITICS

Regulatory environment

- Building consensus
- The Hydrogen Council
- Hydrogen strategies in the EU and the UK
- Overview of developments in other regions
- Research and development requirements
- Government and regulatory requirements

DECARBONISING CHEMICALS

How can chemicals become Net-Zero?

- How large is the chemical industry's footprint?
- Green ethylene and green ammonia
- Emerging options:
 - Electric furnaces and reformers
 - Using renewable feedstocks
 - Using waste as a raw material
 - Carbon capture and storage (CCUS)
 - Switching to hydrogen fuel
 - Offsets
- Technology licensors offering solutions
- Country and company developments

Summary and final thoughts

- Putting the pieces together
- Not “or” but “and” – hydrogen is part of the transition
- Embracing a total systems solution

Workshop conclusion

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