Industrial Clusters and Hydrogen Production: uncertainties and opportunities ahead

Guy Phillips, Business Development Manager, Hydrogen
WEF, 7 December 2021
Agenda

1. About Uniper and hydrogen
2. Uniper Humber Hub development
3. Cluster development perspectives
Uniper at a glance

12,000 employees in over 40 countries.

MDAX
MSCI Germany

50.97 billion euros in sales (2020)

998 million euros
Adj. EBIT (2020)

~ 35 GW generation capacity
Uniper supports market development of all types of hydrogen that help to reduce carbon emissions

- **Project Air (Perstop)**
  - Green H₂ for chemical >25 MW

- **Barsebäck**
  - Green H₂ for industry

- **Flotta Hydrogen Hub**
  - Green H₂

- **Power-To-Gas Hamburg**
  - Green H₂ – 1.5 MW

- **Wilhelmshaven**
  - Green H₂ for steel, >400 MW
  - Ammonia imports

- **Humber Hub**
  - Green + blue H₂ for industry 700 MW

- **North Wales**
  - Green + blue H₂ for industry and fuel switching, >200 MW

- **Project Cavendish**
  - Blue H₂ for fuel switching >700 MW

- **Hydrogen to Maasvlakte**
  - Green H₂ for industry >100 MW

- **Raahe**
  - Green H₂ for direct reduction of iron (DRI) ~ 500 MW

- **Oskarshamn**
  - Pink H₂ - 0.7 MW

- **Hamburg**
  - Green H₂ for industry

- **Huntorf (CHESS)**
  - Green H₂ for power, transport, storage >30 MW (→ 300 MW)

- **Power-To-Gas Falkenhaben & Store&Go methanation**
  - Green H₂, 2 MW

- **Bad Lauchstädt**
  - Green H₂ for chemical >30 MW

- **Scholven**
  - Green H₂ based gas turbine

- **Bierwang**
  - H₂ storage in subsurface porous rock formations

- **GETH2 (Epe)**
  - H₂ storage in subsurface salt caverns
Large scale hydrogen deployment will start in industrial clusters

THE UK’S LARGEST CLUSTERS BY INDUSTRIAL EMISSIONS ONLY

- **Grangemouth**: 4.3 MtCO₂
- **Teesside**: 3.1 MtCO₂
- **Merseyside**: 2.6 MtCO₂
- **South Wales**: 8.2 MtCO₂
- **Southampton**: 2.6 MtCO₂
- **Humberside**: 12.4 MtCO₂

**Key:**

- 1 MtCO₂ = million tonnes of carbon dioxide (CO₂) emissions per year

**Map:**

- **East Coast Cluster**
- **North Sea**
- **Endurance**
- **York**
- **Hull**
- **Grimsby**
- **Scunthorpe**
- **Leeds**
- **Sheffield**
- **Midlands**
- **North West**
- **ZeroCarbon Humber**

**Route corridor options**

- Indicative route corridor options
- Major emitters

**Illustrative example:** Not to scale
Uniper is focussed on hydrogen supply to South Humber / Immingham industrial area
Humber Hub

- Concept development
- EIA
- Business Model Development
- FEED
- FID & EPC
- COD Green
- COD Blue

Timeline:
- 2021
- 2022
- 2023
- 2024
- 2025
- 2026/27

Key points:
- CO2 1.6mt/y
- 720MW
- Blue hydrogen
- Green hydrogen
- CCS Capture
- Killingholme OCGT
- Offshore CO2 storage
- H2S Saltend
- Hydrogen Hub
- Easington

Energy sectors:
- Industry
- Power
- Transport
- Blending

Zero Carbon Humber

EAST CO2AST CLUSTER
Developing a transferrable hydrogen supply to ports model, starting with the Port of Immingham

Mayflower: port decarbonisation with green hydrogen

Renewable Power Direct or Grid + PPA
- Define plant requirements
- Assessment of connection options
- Green power sourcing

(1) 20MW Electrolysis
- Define plant requirements
- Assessment of existing infrastructure
- Permitting strategy
- Define demand profile working with end users

(2) H2 transport & Storage
- Assessment of requirements and definition of solutions

(3) H2 fueled port equipment
- Assessment of requirements and definition of solutions working with port end users

(4) Ammonia synthesis
- Assessment of requirements and definition of solutions working with port end users and technology suppliers

(5) Bunkering

Low carbon shipping fuels

Transition from fossil based to hydrogen based energy in the maritime sector due to
(1) Deployment of an 17.5 MW electrolyser
(2) Creation of hydrogen distribution and storage
(3) Adjustment of port equipment
(4) Deployment of ammonia synthesis
(5) Creation of ammonia bunkering
→ Provision of clean hydrogen and ammonia

Output of Feasibility Study
- Report outlining technical and economic feasibility of reducing port user emissions with green hydrogen
- Clear plan for deployment

Developing a transferrable hydrogen supply to ports model, starting with the Port of Immingham
**Humber Hub Technical Concept**

**Humber Hub** combine Uniper’s interests in the regional collaboration projects Zero Carbon Humber (ZCH) and Project Mayflower (Mayflower), in a phased development of both blue and green hydrogen production facilities at Killingholme power station site.

- **Natural Gas**: EAST COAST CLUSTER
- **RES (options)**: national grid
- **CO₂**: ZERO CARBON HUMBER
- **PPA+GoO**: uniper

**Humber Hub**
- **NG**: 720MW Blue
- **Water**: Phased Development
- **O₂**: 20-100% blend

**End Uses**
- **CO₂**: END USES
- **RES**: END USES
- **O₂**: END USES

**Notes**:
- NG – Natural Gas; CO₂ – Carbon Dioxide; RES – Renewable Energy Source; O₂ – Oxygen;
Killingholme: all the right ingredients for large scale hydrogen production
Collaboration versus competition in industrial clusters

**Funding opportunities**
- Targeted, with specific criteria (e.g. ISCF, IETF, Industrial Fuel Switching)
- Promotes and enables partnerships and cooperation
- Resource intensive process

**Cluster sequencing**
- Competition for initial business model funding and CO2 storage capacity
- Can narrow focus on own decarbonisation initiatives
- Resource intensive process
Managing production and demand risk in an emerging market

- No wholesale market; multiple offtake routes increases project complexity
- Industry; different customer decarbonisation ambitions, requirements and timelines
- Power; co-located production or regional pipeline supply?
- Transport; timing of deployment and hydrogen quality
- Regional hydrogen networks; will they come forward, when and on what terms?
- Gas blending; destination for surplus hydrogen if there is a business model
Project risk as hydrogen and CCS policy develops

- Sufficient incentive to support first mover project in a long term competitive market
- Initial hydrogen production business model accommodates some demand risk
- Visibility of future support to enable follow on projects, future expansion and supply chain growth
- Clarity on how business models interact (e.g. CO2 transport and storage with hydrogen production and future hydrogen network regulation)
- Demand side policy essential to stimulate fuel switching whilst minimising carbon leakage
If you need any further information, please contact us:

Guy Phillips
Uniper Hydrogen UK Limited
guy.phillips@uniper.energy
www.uniper.energy

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