Medium and long-term prospects for green hydrogen production

Dr. Christoph Schäfers, Uniper SE

1. Dezember 2020
Hydrogen will emerge along three phases with a wide positioning along the value chain.

Great opportunities within the next 15 years:

- **Semi-commercial**
  - Grow from 10 to 100 MW installations.
  - Start commercial/sales activities (based on long-term supply partnerships).
  - Shape regulatory schemes and secure political subsidies.
  - Internal and external engineering services.

- **Industrial scale**
  - Grow to GW scale, Emerging sales business and small spot market.
  - Stabilise regulation, Extend engineering.

- **Economy wide**
  - Growing beyond GW+ scale via expanding to all relevant sectors and regions.
  - Significant free volumes and arbitrage opportunities.
  - High engineering capabilities.

Uniper to transform:

Unprecedented momentum for decarbonization and hence hydrogen ($\text{H}_2$)

- Uniper-wide business line
- ~1GW installed by 2030
- New commercial value pools
- $\text{H}_2$ readiness for fleets: Gas Turbine and Storage
- Strong cooperation with partners
- Key success factors: Clear scope and strong team
- Regulatory support required

Start today

Semi-commercial
Grow from 10 to 100 MW installations, Start commercial/sales activities (based on long-term supply partnerships), Shape regulatory schemes and secure political subsidies, Internal and external engineering services.

Industrial scale
Grow to GW scale, Emerging sales business and small spot market, Stabilise regulation, Extend engineering.

Economy wide
Growing beyond GW+ scale via expanding to all relevant sectors and regions, Significant free volumes and arbitrage opportunities, High engineering capabilities.
Uniper ready to scale up hydrogen and for sector coupling

WindGas Falkenhagen
- 2013 Start of operation
- 2018 Addition of methanation plant
- Production: \( \text{H}_2 \) injection into gas transportation pipeline

WindGas Hamburg
- 2015 Start of operation
- Production: \( \text{H}_2 \) injection into gas distribution pipeline

Reallabor Bad Lauchstädt
- 2019 Start of planning
- Industry: Shaping a (green) \( \text{H}_2 \) economy in the Central German Chemical Triangle

Uniper installed gas turbines
- Power generation: Gas turbines hydrogen compatible
Importance of the different types of hydrogen

**H₂-related requirements: the color of hydrogen**

**Around 2030**
- Renewable and fossil-based hydrogen (with and without CCS) are generally considered viable medium-term sources.
- Methane pyrolysis for hydrogen production is mainly discussed as option in the German and Russian strategies.

**Towards 2050**
- Renewable hydrogen is the most favorable hydrogen quality in the long-term. Various countries considering it the only viable long-term option.
- Fossil based hydrogen with CCS is regarded a feasible hydrogen source in the long-term in a range of countries.

## Main hydrogen sources

<table>
<thead>
<tr>
<th></th>
<th>EU</th>
<th>DE</th>
<th>NL</th>
<th>FR</th>
<th>ES</th>
<th>IT</th>
<th>UK</th>
<th>NO</th>
<th>CH</th>
<th>UA</th>
<th>RU</th>
<th>JP</th>
<th>KR</th>
<th>CN</th>
<th>AU</th>
<th>CA</th>
<th>MO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Around 2030</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Towards 2050</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Renewable
- Fossil based with CCS
- Methane pyrolysis
- Fossil

* In Russia in 2050 mainly based on nuclear power
Hydrogen imports will be needed

German green hydrogen production planned to be at 14 TWh

German Hydrogen demand is projected at 90–110 TWh

Gap 2030 ≥ 76 TWh

Source: National German Hydrogen Strategy
Conclusions

- Political momentum to develop a $\text{H}_2$ market in Germany / EU
- Adaptation of the levy and charge system necessary to allow the effective establishment of a hydrogen market with simultaneous recognition of the green characteristic (RED 2)
- Technological openness in production and consumption is essential to make decarbonisation as cost-effective as possible
- Germany has a large import demand for hydrogen
- Russia has great potential for hydrogen production
- Introduction of Guarantees of Origin required for green and decarbonised gases
- On the basis of the long-standing energy partnership, Russia is a key partner for Germany and beyond in building a hydrogen economy
- Chances for value creating partnerships for Russian and German companies
Our Purpose

Empower
Energy
Evolution