Power-to-Hydrogen: Legal Barriers and Regulation

2016/05/04, Tobias Mischlau, Business Development Energy Storage
Uniper – new company since 2016

Energy has a new name
Uniper’s business portfolio – with Energy Storage as one pillar

**Power Generation**
Uniper owns and operates a sizeable portfolio of power plants located across Europe and Russia, encompassing the full range of generation technologies (predominantly hydro, gas as well as coal and oil).

**Global commodities**
Uniper’s commodity trading business is active in power, emission certificates, natural gas, LNG, coal, and freight.

**Energy storage**
Our gas storage facilities in Europe help ensure the reliability of the gas supply. We operate power-to-gas facilities and are engaged in the development of tomorrow’s energy technologies, such as large-scale battery solutions for power storage.

**Energy sales**
Through our sales organizations in Germany, France, and the Netherlands, we market a wide range of electricity and gas products to industrial customers, municipal utilities, and energy partners.

**Engineering Services**
Our engineering and technical expertise enable us to provide a broad range of engineering services, from pre-investment surveys right up to decommissioning.

**Third Party Services**
We provide flexible, bespoke services for the construction and operation of power stations, for fuel (coal, natural gas, LNG) procurement, for energy and commodity trading, and for energy marketing.
Trend 1: Growth of intermittent RES creates demand for flexibility sources in the energy system

**Strong growth of intermittent RES**
EU-27 – Installed capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>PV (Hi-RES)</th>
<th>Wind (Hi-RES)</th>
<th>Solar PV (reference)</th>
<th>Wind (reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2030</td>
<td>0</td>
<td>160</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>2050</td>
<td>0</td>
<td>800</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

**Increasingly volatile production**
Residual load patterns Germany

**Flexibility-based business small but growing**

- Electro-chemical
- Electro-mechanical
- Hydrogen Storage
- Thermal Storage

Comparison: installed base PHP ~ 127 GW (!)
Trend 2: The decarbonization strategy leads to rising target especially in the mobility sector

Biofuel targets already implemented in >40 countries worldwide
- Increasing security of supply
- Reduction of import dependency
- Support of domestic agriculture
- Climate protection

EU regulation influences biofuel targets on Member State level

Fuel Quality Directive (FQD)
- Mandatory 6% reduction of fuel CO₂ emissions until 2020

Renewable Energy Directive (RED)
- RES integration quota
- Specific quota for RES in transportation (10% until 2020)
- Limit on 1st generation biofuels (7%)
- Advanced biofuels count 2x (i.e. green H₂ for FCEV)

Outlook of future EU regulation
- Currently the commission is regulating so called “Upstream Emission Reduction” (EU Directive 2015/652, FQD).
- After 2020 regulation could look completely different (RED/FQD) but targets will remain high
- Increased CO₂ emission reduction targets are expected. Traditional biofuels alone can’t fulfill stricter targets

The high targets for emission reduction and biofuel blending cannot be fulfilled by traditional biofuels alone. Advanced biofuels need to be integrated.
Power-to-Gas can provide flexibility services to the grid and produce Green Hydrogen at the same time.

Flexibility services

Green Hydrogen usage

Certificate for green hydrogen

Certificate for green electricity

Renewable hydrogen ($H_2$)

Direct use

Pilot Projects:

Falkenhagen

Natural gas & „Green“ gas

Natural gas grid

H$_2$

SNG$^1$

CO$_2$

Power-to-Gas

Mobility

Industry

Heat

Power

P 1 SNG = Synthetic Natural Gas

2 GHG = Greenhouse gas

3 Indirect land use change

Power-to-Gas is bridging different energy systems. The produced hydrogen has a low CO$_2$ emission footprint and requires little land (ILUC$^3$).
**Power-to-Gas can be commercially used if some key barriers are removed**

<table>
<thead>
<tr>
<th>Industry Tasks</th>
<th>Regulatory Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Further improvement of technology and scaling up Power-to-Gas installations</td>
<td>• Level playing field for all flexibility options not yet established</td>
</tr>
<tr>
<td>• Reducing investment costs via economies of scale</td>
<td>• Fees and taxes currently hinder the commercial usage of Power-to-Gas</td>
</tr>
<tr>
<td>• Integrating Power-to-Gas into industrial and commercial processes and systems (including legal and administrative adaptations)</td>
<td>• Green Hydrogen in refineries is currently not acknowledged as biofuel</td>
</tr>
<tr>
<td></td>
<td>• A certification system for Green Hydrogen – similar to GoO for electricity – is not implemented yet</td>
</tr>
</tbody>
</table>

Removal of these barriers will allow for large scale commercial applications. This would directly result in large emission reductions and open new markets.
A possible roadmap for commercialization shows different stages for market entry of different use cases.

Technology demand complementary to the increase of installed capacity of renewables.

Timeline: 2016, 2030, 2050

- Batteries, Power-to-Heat, E-Mobility
- Hydrogen for refineries, chemical industry as feedstock
- Hydrogen for steel industry
- Hydrogen for mobility (fuel cell)
- Hydrogen for heat and mobility (H₂-injection into NG grid CH₄)
- Hydrogen for power with CH₄ / without CH₄

Innovation Hydrogen economy?

Earlier or later?

Share of renewable energy

Pumped Hydro Storage
Natural Gas storage (CH₄)
Especially the direct usage of Green Hydrogen in refineries can help reduce emissions.

Conventional process:
- Fossil energy source
  - Natural gas
  - Steam methane reformer (SMR)
- Steam methane reformer (SMR)
  - Grey hydrogen
- Renewable energy source
  - Biomass
  - Fermentation
  - Biodiesel / Bioethanol
- Crude oil
- Refinery
- Low-carbon fuel with renewable content
- Power grid
- Tank
- Certificate
- Bioethanol
- Power-to-Gas can be used in refineries without major infrastructural changes.

Proposed process:
- Fossil energy source
  - Natural gas
  - Steam methane reformer (SMR)
- Steam methane reformer (SMR)
  - Grey hydrogen
- Renewable energy source
  - Electricity
  - Electrolysis
- Power grid
- Flexibility services
- Certificate
- Green Hydrogen
- H2
- CH4
- H2

Regulatory proposals should be implemented to allow for the commercial usage of Power-to-Gas

**Certification system**
- The project “CertifHy” is developing a certification system for Green Hydrogen
- This certification system should work according to GoO certificates for green electricity and set reliable industry standards
- Uniper supports this project and welcomes fast implementation

**Fees and taxes**
- Energy storage systems are treated as end consumers
- Therefore business cases for Power-to-Gas are hindered by grid fees, taxes and even renewable charges (GER: EEG fee)
- These barriers need to be reduced

**Green Hydrogen as advanced biofuel**
- Green Hydrogen should be acknowledged as advanced biofuel – also when used in refineries
- FQD and RED should be adapted accordingly
- Member states should implement these changes accordingly

### Fees and taxes for Power-to-Gas

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>31.7%</td>
</tr>
<tr>
<td>Grid fee</td>
<td>11.7%</td>
</tr>
<tr>
<td>EEG fee</td>
<td>33.4%</td>
</tr>
<tr>
<td>Tax</td>
<td>13.0%</td>
</tr>
</tbody>
</table>

### Car fleet GER in 2015

- Gasoline
- Diesel
- LNG
- NG
- Hybrid
- EV
Amendments to EU regulation need to be implemented on European level and by member states

Regulatory status quo

- Renewable & low carbon H₂ only recognized as (advanced) biofuel when used in FCEV or after methanation as CNG
- Renewable & low carbon H₂ used in refineries is not an end-product and therefore not eligible
- Standard emission values for gasoline / diesel (end products), irrespective of production chain
- H₂ used in refineries does not change end-product and emission values. However, recent changes in EU regulation mentions Upstream Emission Reduction (Directive 2015/652)

How could it look like?

- Recognition of Green Hydrogen in the production process of fuels via Upstream Emission Reduction (Directive 2015/652, FQD) as well as advanced biofuel within the Renewable Energy Directive:
  - Green Hydrogen as an input for the refinery (emissions are reduced before the use in refinery and therefore upstream)
  - Tracking of green attribute: Contract flow defines environmental attribute flow (not molecule flow)
  - Emission reduction can be proven by own calculation; with the introduction of Guarantees of Origin (GoO) for Green Hydrogen it is even easier (such a certification scheme is in development → project CertifHy)

Green Hydrogen is an advanced biofuel but not acknowledged when used directly in refineries.