HyLAW – Hydrogen technologies, new possibilities and current barriers

Marcin Błesznowski, Jakub Kupecki, Konrad Motyliński

Department of High Temperature Electrochemical Processes (HiTEP)
Institute of Power Engineering, Warsaw, Poland

October the 25th, 2018, Gdynia, Poland
Outline of presentation

- Hydrogen economy – concept
- Hydrogen economy – current state
- Goals of project HyLAW
- Regulatory framework
- Conclusions
Hydrogen economy - concept

Renewables are undergoing substantial cost reductions, transforming electricity markets.

<table>
<thead>
<tr>
<th>Region</th>
<th>Capacity</th>
<th>Global share</th>
<th>Change</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>348 GW</td>
<td>16%</td>
<td>+16 GW</td>
<td>+4.9%</td>
</tr>
<tr>
<td>Central America</td>
<td>14 GW</td>
<td>1%</td>
<td>+0.4 GW</td>
<td>+2.9%</td>
</tr>
<tr>
<td>South America</td>
<td>202 GW</td>
<td>9%</td>
<td>+9.0 GW</td>
<td>+4.7%</td>
</tr>
<tr>
<td>Europe</td>
<td>512 GW</td>
<td>24%</td>
<td>+24 GW</td>
<td>+4.8%</td>
</tr>
<tr>
<td>Middle East</td>
<td>20 GW</td>
<td>1%</td>
<td>+0.9 GW</td>
<td>+5.0%</td>
</tr>
<tr>
<td>Eurasia</td>
<td>96 GW</td>
<td>4%</td>
<td>+4.9 GW</td>
<td>+5.4%</td>
</tr>
<tr>
<td>Asia</td>
<td>919 GW</td>
<td>42%</td>
<td>+106 GW</td>
<td>+13.1%</td>
</tr>
<tr>
<td>Africa</td>
<td>42 GW</td>
<td>2%</td>
<td>+3.5 GW</td>
<td>+9.2%</td>
</tr>
<tr>
<td>Oceania</td>
<td>27 GW</td>
<td>1%</td>
<td>+1.5 GW</td>
<td>+5.9%</td>
</tr>
</tbody>
</table>

Hydrogen economy - concept

Hydrogen economy - concept

Where are we?

- **Hopes grow rapidly**
  - Benefits of H2 society
  - National/local policies
  - Vanguard corporate strategies

- **Issues become apparent** (Hopes may wither)
  - Technical issues
  - Cost issues
  - Policy, psychological issues

- **Hydrogen society judged to have value worth pursuing**
  - Energy issues
  - Environmental issues
  - Community revitalization
  - Industrial competitiveness

What should national/local governments and companies do to minimize disappointment and get over it quickly?

Present → Time axis → 2035

Fujitsu Research Institute (2016)
Hydrogen economy – current state

Production methods and global production

- Methane steam reforming
- Partial oxidation
- Autotermal process
- Electrolysis
- Thermochemical reaction
- Microbial conversion
- Photosynthesis process

Hydrogen economy – current state

Energy storage & conversion

Map of P2G (demonstration) projects in Europe

- **Operational**
  - 🟢 Hydrogen
  - 🟠 Methane
  - ⭐ Hydrogen/Methane

- **Planned**
  - 🟢 Hydrogen
  - ⭐ Hydrogen/Methane
  - 🔴 Methane

- **Project finished**
  - 🔴 Methane
  - 🟢 Hydrogen

- **Unknown**
  - 🔴 Hydrogen
  - 🟠 Methane
Hydrogen economy – current state

Energy storage & conversion

Two mode operation with Solid Oxide Cells

Graves C., Ebbesen S.D., Mogensen M., Lackner K.S., Sustainable hydrocarbon fuels by recycling CO2 and H2O with renewable or nuclear energy, Renewable and Sustainable Energy Reviews, 15, 1-23 (2011).
Hydrogen economy – current state

Energy storage & conversion

Single cell → Solid Oxide Cell stack → First polish micro-CHP unit (2 kWe) based on SOC cells
Hydrogen economy – current state

Transport

Toyota’s vehicle electrification milestones

IEA, 2017)
Hydrogen economy – current state

Transport

Orlen 1st hydrogen refuelling station in Germany

© Copyright: Ludwik Bolkow-Systemtechnik
Hydrogen economy – current state

Vestenskov – 1st hydrogen village

Green Hydrogen’ in Orkney islands (BIG HIT) project
Hydrogen economy – current state

Tokyo

Olympic Village after the Tokyo 2020 Games (image)

### Targets for FCVs

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 000 vehicles and least 100 buses</td>
<td>100 000 vehicles</td>
<td>200 000 vehicles</td>
</tr>
</tbody>
</table>

### Targets for hydrogen stations

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>80</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Goals of project HyLAW

Identification of legal rules and administrative processes applicable to Fuel Cell and Hydrogen technologies’ deployment, identification of legal barriers and advocacy towards their removal

Coordinator: Hydrogen Europe

Duration: 01.2017 – 12.2018

Web site: hylaw.eu
Goals of project HyLAW

Project’s main outputs

• An online and publicly available database compiling legal and administrative processes applicable to hydrogen and fuel cell technologies in 18 countries across Europe.
• National policy papers describing each legal and administrative process, highlighting best practices, legal barriers and providing policy recommendations.
• A pan-European policy paper targeted towards European decision makers.
• National and European workshops for dissemination of the findings and convincing public authorities to remove barriers.
Regulatory framework

Lack of harmonization within EU countries:

- Lack of specific requirements or zone prohibitions for hydrogen storages, hydrogen production facility in the land use plans.
- Different steps and duration of permitting process.
- Not unified situation in case of parking and travelling via bridges with FCEVs.
- No standards for maximum limit of quantity and pressure for $H_2$.
- Fuel origin - no binding or uniform guarantee certification system for $H_2$.
- No standards for measuring the quality of $H_2$. 
Regulatory framework

Lack of harmonization within EU countries:

- Not unified type approval, maintenance and inspections rules for vehicles.
- There are no legal requirements in place for technical inspections of motorcycles, bikes and quadricycles at EU level.
- Blending and injection of H₂ to the gas grid.
- Inconsistency of legal definition for P2G or P2P facilities.
- No regulation concerning safety distances.
Conclusions

• Sustainable development is the best answer to undesirable impacts which origin from the place where we rest and work.

• This issue needs complex solution and involvement into transformation proces all stakeholders (EU level, national level, city authorities, standarization authorities, industry and business…).

• Power-to-gas technologies and gas can play a major role in coupling different sectors and networks.

• Hydrogen as the future energy vector enables effective usage of it with minimal negative impact on environment.

• Lack of consistent EU legislation dedicated to H$_2$.

• Project HyLAW as w tool towards the removal of barriers for hydrogen technologies development.
Upcoming workshops

**HyLaw EU Workshop**
Place: Brussels  
Date: 6th of December 2018  
Contact: Alexandru Floristean, a.floristean@hydrogeneurope.eu

**HyLaw National, Polish Workshop**  
Place: Warsaw  
Date: 21st of November 2018  
Contact: Marcin Błesznowski, marcin.blesznowski@ien.com.pl
Acknowledgement

Project HyLAW - (Identification of legal rules and administrative processes applicable to Fuel Cell and Hydrogen technologies’ deployment, identification of legal barriers and advocacy towards their removal) has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 737977.
Thank you for your attention!