Hydrogen Mobility @Shell

GPPS Forum20 Zurich

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FUTURE OF TRANSPORT
A RANGE OF FACTORS ARE CHANGING THE TRANSPORT SECTOR...

Increasing demand for energy and transport

Climate change and air pollution

New technologies available

New transport policies
New Fuels

Biofuels
Conventional & advanced biofuels
Biogas

Hydrogen
Active in hydrogen electric

Electric Mobility
Active in EVs charging infrastructure and technology

Gas for transport
Offering gas to liquids (GTL) and liquefied natural gas (LNG)

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HYDROGEN AS A TRANSPORT FUEL
Fuel cell electric vehicle convert compressed hydrogen into electricity. The only exhaust emissions from a fuel cell vehicle is water vapour.

Hydrogen can help reduce CO₂ emissions from transport if it is made from renewable or low carbon sources:

- Using electrolysis and electricity from renewable sources
- From biogas
- From natural gas with CCS

**HYDROGEN AS A TRANSPORT FUEL**

**BENEFITS**

<table>
<thead>
<tr>
<th>Use of hydrogen fuel</th>
<th>Production of hydrogen fuel</th>
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<tbody>
<tr>
<td><strong>Improve air quality in short term</strong></td>
<td><strong>Low-carbon transport in the longer term</strong></td>
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</tbody>
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HYDROGEN AS A TRANSPORT FUEL

HOW IS HYDROGEN PRODUCED?

Hydrogen can be produced by

**Natural gas reforming**
Methane can be converted into hydrogen.

**Gasification**
Hydrogen can also be made from organic materials like agricultural waste.

**Electrolysis**
Splitting water with electricity releases hydrogen and oxygen.

- Methane from biogas
- Electricity from renewable sources
All that comes out of the hydrogen fuel cell electric vehicle tailpipe is water vapour.

FCEVs generate electricity for the electric motor by using the hydrogen in the tank and oxygen from the outside air.

Fuel cell electric vehicles (FCEVs) offer the performance, acceleration and range of conventional automobiles and the quiet driving experience of battery electric vehicles.

Energy easily stored, in the form of compressed hydrogen fuel.

High range – can drive up to 700 km per refill.

Takes only a couple of minutes to refuel.
COLLABORATION IS KEY FOR H2 SUCCESS
COLLABORATION IS KEY FOR H₂ SUCCESS

The future success of hydrogen as a sustainable transport option will require actions by all players

**Car manufacturers**
- to continue developing hydrogen fuel cell vehicles and reduce costs

**Governments**
- to support the choice for hydrogen fuel cell vehicles

**Customers**
- Greater hydrogen infrastructure and more hydrogen car models to choose

**Energy industry**
- to invest in infrastructure and offer fuel at competitive price
COLLABORATION IS KEY FOR H₂ SUCCESS
H₂ MOBILITY IN GERMANY

H₂ mobility JV is a collaboration across the entire value chain, from the energy industry to vehicle manufacturers and funding bodies.

<table>
<thead>
<tr>
<th>Founding Partners</th>
<th>DAIMLER</th>
<th>Shell</th>
<th>THE LINDE GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMV</td>
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<tr>
<th>Associated Partners</th>
<th>VOLKSWAGEN</th>
<th>BMW</th>
<th>Intelligent Energy</th>
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<td>TOYOTA</td>
<td>HONDA</td>
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H₂ Mobility aims to overcome the challenges facing commercialisation bringing together and coordinating cross-industry action, aligning the ramp-up of fuel cell electric vehicles (FCEVs) and retail sites.

Funded by Government & EU
- Supported by the European Commission as a key ‘strategic project’
- Funding grants from the German Government & EU (50 – 70% funding rates)
COLLABORATION IS KEY FOR H₂ SUCCESS
H₂ MOBILITY IN GERMANY

H₂ Mobility Germany – up and running

- Hydrogen refueling stations network to reach 100 stations in 2019
- Overall investment of 350mln planned
- Foundation of Joint Venture company by the six shareholders in January 2015
- Example of industry partnership that shares the risks across the value chain, supported by Government

Founding Partners

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THE SHELL HYDROGEN JOURNEY - LOCATIONS
CALIFORNIA USA

7 stations Northern CA
From 2018
Info In association with Honda and Toyota

2 stations Southern CA
Since 2010 Torrance, LA
Since 2012 New Port Beach
THE SHELL HYDROGEN JOURNEY - LOCATIONS

UK
THE NEAR FUTURE FOR HYDROGEN AT SHELL
In California, Shell is part of a consortium to develop three new large-capacity refuelling stations for heavy-duty hydrogen fuel-cell trucks being developed by Toyota and Kenworth Truck Company.

These stations will form the first hydrogen truck refuelling network in California, between the Port of Los Angeles and a major warehouse complex inland.
REFHYNE
BUILDING A 10MW PEM ELECTROLYSER

Building a 10-megawatt PEM (polymer electrolyte membrane) electrolyser, the largest of its kind, to produce hydrogen at the Rhineland refinery in Germany.

This project is supported by the European Union.
**New hydrogen dispenser**

Improving customer’s refuelling experience

- Collaboration with BMW Designworks
- Release of prototype at the Dutch Petrol Retail Exhibition in the Netherlands in November 2018
- Final release in 3rd quarter 2019
THE NEAR FUTURE FOR HYDROGEN AT SHELL

H₂ STATIONS TESTING DIFFERENT SUPPLY OPTIONS

- SMR steam methane reforming
- Compressed H₂ gas delivery
- Electrolyser
- Liquid H₂ gas delivery
- Pipeline gas
THE NEAR FUTURE FOR HYDROGEN AT SHELL

HYDROGEN RESEARCH & DEVELOPMENT

Developing other aspects of value chain, e.g. wind to hydrogen

Leader in establishing standards for safe dispensing
HYDROGEN AS A TRANSPORT FUEL

PRODUCTION OF HYDROGEN

CO₂ reduction

Hydrogen can be made with electricity from renewable sources or using biogas.

Hydrogen can help balancing the electricity grid

The production of hydrogen can use electricity which would otherwise be lost to be stored and used to power cars.

This helps to optimize the power markets and balance the intermittencies brought by the introduction of more electricity from renewable sources.