Potential of green hydrogen to drive energy transition beyond transport sector

Presenters:
- Emanuele Taibi, Power System Transformation Strategies, IRENA
- Raul Miranda, Associate Analyst, Energy Systems Modelling, IRENA

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SPEAKERS

Emanuele Taibi
Power System Transformation Strategies, IRENA

Raul Miranda
Associate Analyst, Energy Systems Modelling, IRENA
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IRENA’s work on Green Hydrogen

Knowledge

- Hydrogen from renewable power: Technology outlook for the energy transition (2018)
- Reaching Zero with Renewables (forthcoming in Q3 2020)

Outreach

- Thematic meeting “Decarbonizing complex sectors” at 18th Council (2019)
- Ministerial Roundtable on Green Hydrogen at 10th Assembly (January 2020)
- First meeting of the Collaborative Framework on Green Hydrogen (June 2020)
Hydrogen in the energy transition

Decarbonising Transport
- FCEVs: performances of conventional vehicles
- FCEVs are complementary to BEVs in decarbonising road transport
- FC/E-fuels for rail, aviation, maritime sector (deep decarbonization)

Decarbonising the gas grid
- Take advantage of low electricity prices
- Provide seasonal storage for solar and wind
- Provide grid services from electrolysers
- Distributed stationary fuel-cell for heat and power generation

Decarbonising Industry
- Replace fossil-fuel produced hydrogen
- Replace fossil-fuel based feedstocks
- New commodities e.g. iron pellets (DRI)

Source: IRENA (2018)
Hydrogen: A key part of future Energy Systems

Hydrogen’s role

• Solution for end-uses that are hard to directly electrify. Emission reduction (GRO 2050):
  • Green Hydrogen: 3%; Blue Hydrogen: 3% (PES)*
  • Green Hydrogen: 7%, Blue Hydrogen: 1% (TES)**

• Increase the flexibility of power systems at all timescales

Key Points in 2050 (TES)

• Hydrogen production costs: 0.9-2.0 USD/kg \( \text{H}_2 \)

• Electrolyser capacity: 1700 GW

• Electricity to produce green hydrogen: 7.5 PWh

• Solar and Wind capacity: at least 4 TW

* Reduction in Planned Energy Scenario (33 Gt in 2050) in relation to Baseline (43 Gt in 2050)
** Additional reduction in Transforming Energy Scenario (9.5 Gt in 2050) in relation to Planned Energy Scenario (33 Gt in 2050)
The role of green hydrogen in reaching zero emissions

Energy and industrial process-related CO₂ emission reductions (Gt CO₂)

From baseline to Planned Energy Scenario (PES)
-45% 26% 29% 3% of reduction 0.3 Gt/yr
-9.9 Gt reductions

From PES to Transforming Energy Scenario (TES)
-47% 24% 29% 6% of reduction 1.4 Gt/yr
-26.3 Gt reductions

From TES to DDP “zero”

14-23% of reduction 1.4-2.3 Gt/yr
-10.4 Gt reductions

Renewables Energy efficiency Behavioural changes (energy intensity improvement) Electric vehicles (RE power) Green hydrogen Blue hydrogen (CCS) CCS (industry) Carbon dioxide removal (CDR) Nuclear
Hydrogen production costs

Hydrogen from renewables has a great potential but electrolyser costs need to further decrease

Main assumptions about electrolyzers:
- Load factor: 4200 hours (48%), conversion efficiency 65% (today), 75% (2050)

Source: IRENA (2019)
IRENA’s Technology Brief: Green Hydrogen Electrolysers

Key drivers:

- **Renewable costs** continue to fall
- **Systems integration challenges**
- **Electrolysers projects rapidly growing in size and numbers**
- **Electrolysers cost is** projected to halve
- **Key solution** to reaching zero emissions by 2060

Main focus:

- **Project cost and equipment cost trends**
- **Efficiency and lifetime**
- **Compressor and on-site storage linkages with operation and capabilities to provide flexibility**
- **Additional revenues** for electrolyser operators
- **Potential of technological innovation**
- **Latest projects**

**Electrolysers**

- Use electricity to split water into hydrogen and oxygen
- Can provide demand-side flexibility by:
  - Adjusting hydrogen production to follow wind and solar generation profiles in periods of high resource availability
  - Store green electrons as green molecules
  - Provide grid balancing services

Q3/Q4 2020
Electrolysers – the role of economies of scale in reducing hydrogen cost

Source: NREL (2020)
Hydrogen from renewables has a great potential but electrolyser costs need to further decrease

- Electrolyser CAPEX and electricity price as well as operating hours are the main parameters determining the cost of producing Green Hydrogen
Hydrogen for seasonal storage

- Significant **storage needs in 2050** for VRE integration
- **Power-to-gas electricity** storage would be beneficial and economically viable in a high-renewables scenario.
- **Compressed or liquefied** (p.e.g. dedicated gas grids, geological structures), **mixed** with other elements or **blended with natural gas** in gas grids
  - Energy stored in the European gas grid: 1 200 TWh.

Provision of frequency containment reserve

- Major pilot project recently met requirements for participation in the German ancillary services market
  - **Full capacity within max. 30 seconds** and ability to maintain it for at least 15 minutes
- Plant operators can market their ability to adapt flexibly to electricity market prices and thus **generate additional revenues**

Source: LBST (2019)
“In addition to power sector, there are other sectors which are very important, iron and steel, chemicals, and so on, and hydrogen can be very important there to decarbonize those so-called hard to abate sectors.”

Fatih Birol
Executive-Director of IEA

“Green hydrogen is gaining unprecedented political and business momentum, with the number of policies and projects expanding rapidly around the world,”

Francesco La Camera
Director-General of IRENA

“The first thing which I feel is that costs of electrolyzers have to come down.”

Claude Turmes, Minister of Energy of Luxembourg
Collaborative Framework on Green Hydrogen

- Green Hydrogen Ministerial Roundtable at IRENA’s 10th Assembly
  - Members called upon IRENA to continue its work on hydrogen from renewable power
- IRENA is establishing a Collaborative Framework on Green Hydrogen
- A virtual meeting was held on 18 June 2020 to discuss the modalities and scope of work

Strategic direction from Members on the Framework:

- Establish a global knowledge database for green hydrogen
- Strengthen collaboration with existing hydrogen initiatives and other relevant stakeholders
- Evaluate the nexus between hydrogen and renewables as well as the flexibility from coupling power and hydrogen
- Disseminate knowledge on transport and distribution of hydrogen
- Disseminate and coordinate standards and regulatory frameworks
- Sharing of best practices on hydrogen projects financing
Thank you!

Emanuele Taibi
ETaibi@irena.org

Raul Miranda
RMiranda@irena.org
Q & A
10 min
MONDAY, 20 July 2020 • 16:00 – 17:00 CEST
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