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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**

TUESDAY, 7 JULY 2020 • 15:00-15:30 CEST

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SPEAKERS

Emanuele Taibi
Power System Transformation Strategies, **IRENA**

Raul Miranda
Associate Analyst, Energy Systems Modelling, **IRENA**

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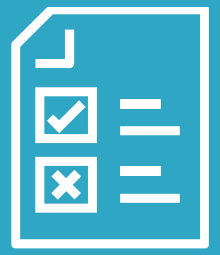

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IRENA's work on Green Hydrogen

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Knowledge

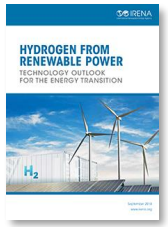
- **Hydrogen from renewable power: Technology outlook for the energy transition** (2018)
- **Hydrogen: A renewable energy perspective** (2019)
- **Reaching Zero with Renewables** (forthcoming in Q3 2020)
- **Technology Brief: Electrolyser Technologies** (forthcoming in Q4 2020)

Outreach

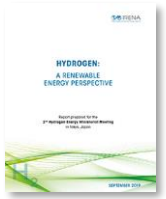
- **Session on "Electrification of Fuels: Hydrogen" at IRENA Innovation Week** (2018)
- **Thematic meeting "Decarbonizing complex sectors" at 18th Council** (2019)
- **Ministerial Roundtable on Green Hydrogen at 10th Assembly** (January 2020)
- **First meeting of the Collaborative Framework on Green Hydrogen** (June 2020)

2018

INNOVATION WEEK 2018
solutions for a renewable-powered future



2019



2020

Collaborative Framework on Green Hydrogen

Technology Brief Electrolyser Technologies

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Hydrogen in the energy transition

Decarbonisation
Deep Decarbonisation

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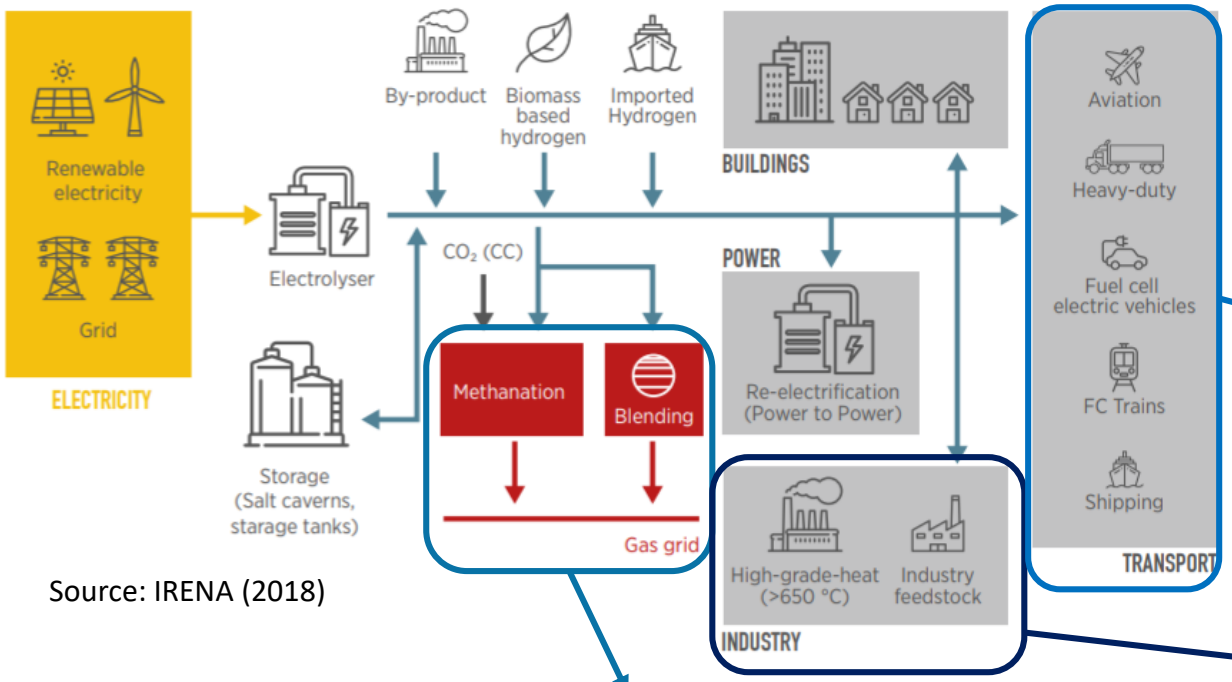

Source: IRENA (2018)

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)

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Hydrogen: A key part of future Energy Systems

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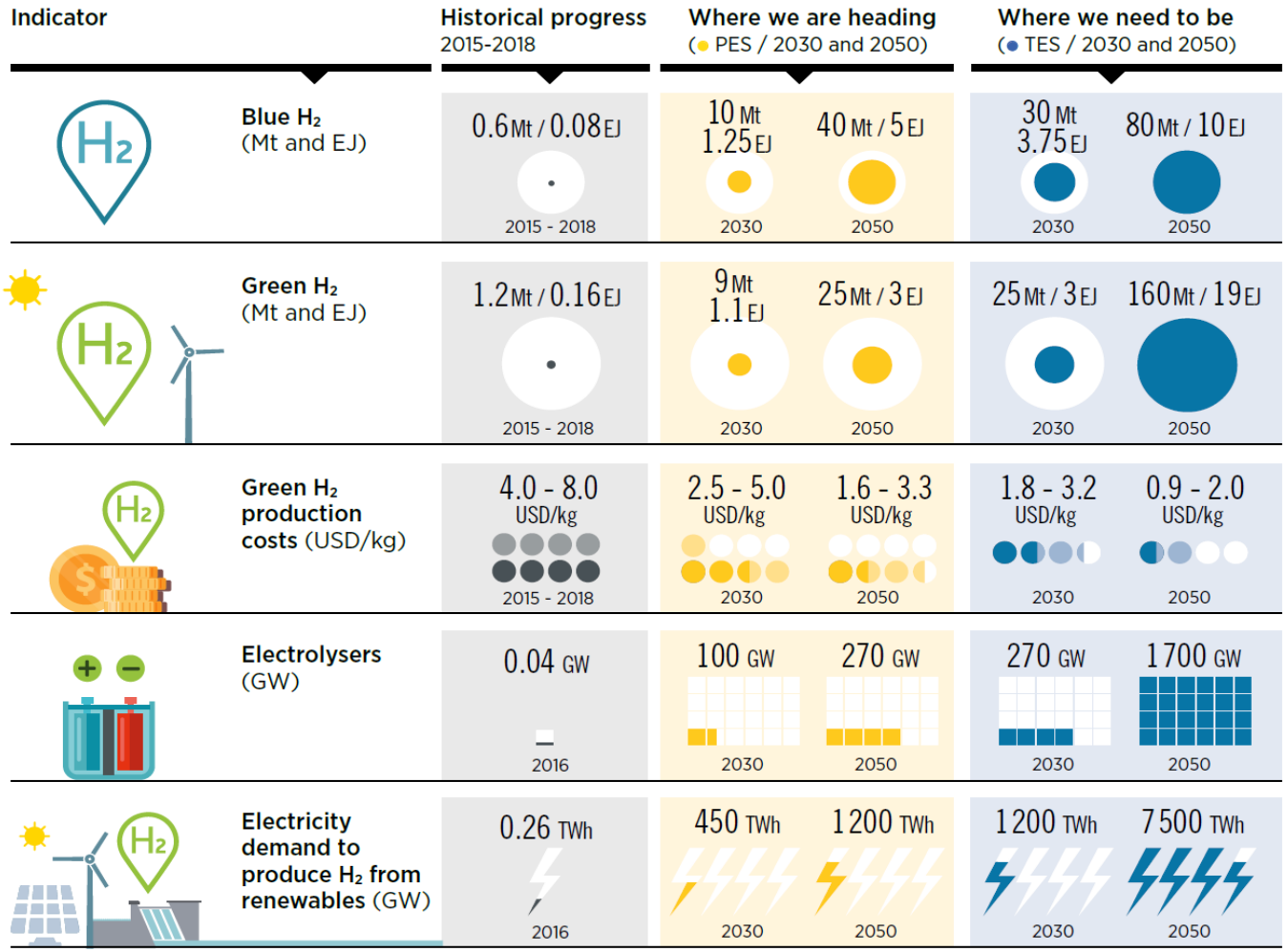
Hydrogen's role

- **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 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)**

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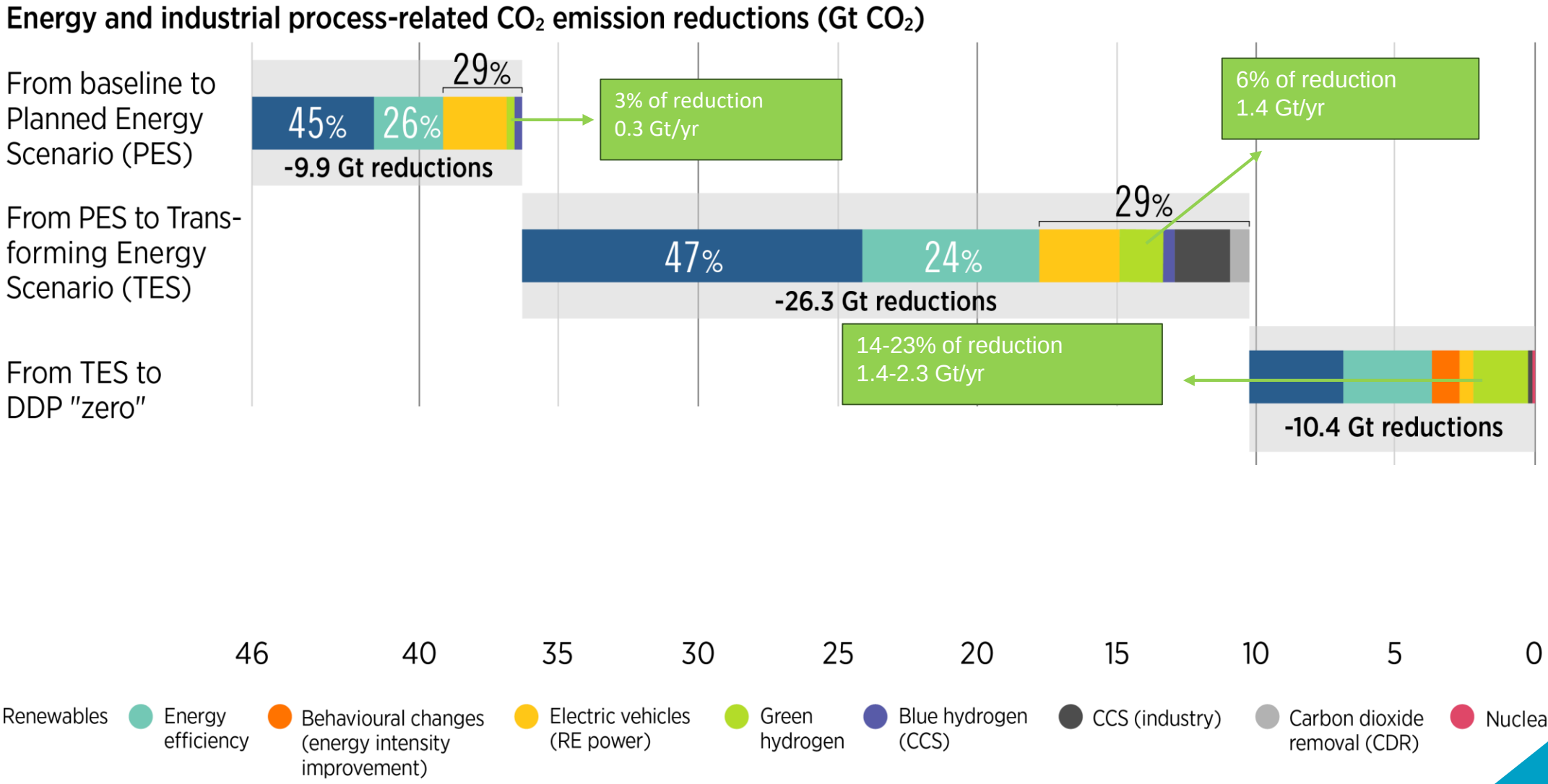
The role of green hydrogen in reaching zero emissions



Hydrogen production costs

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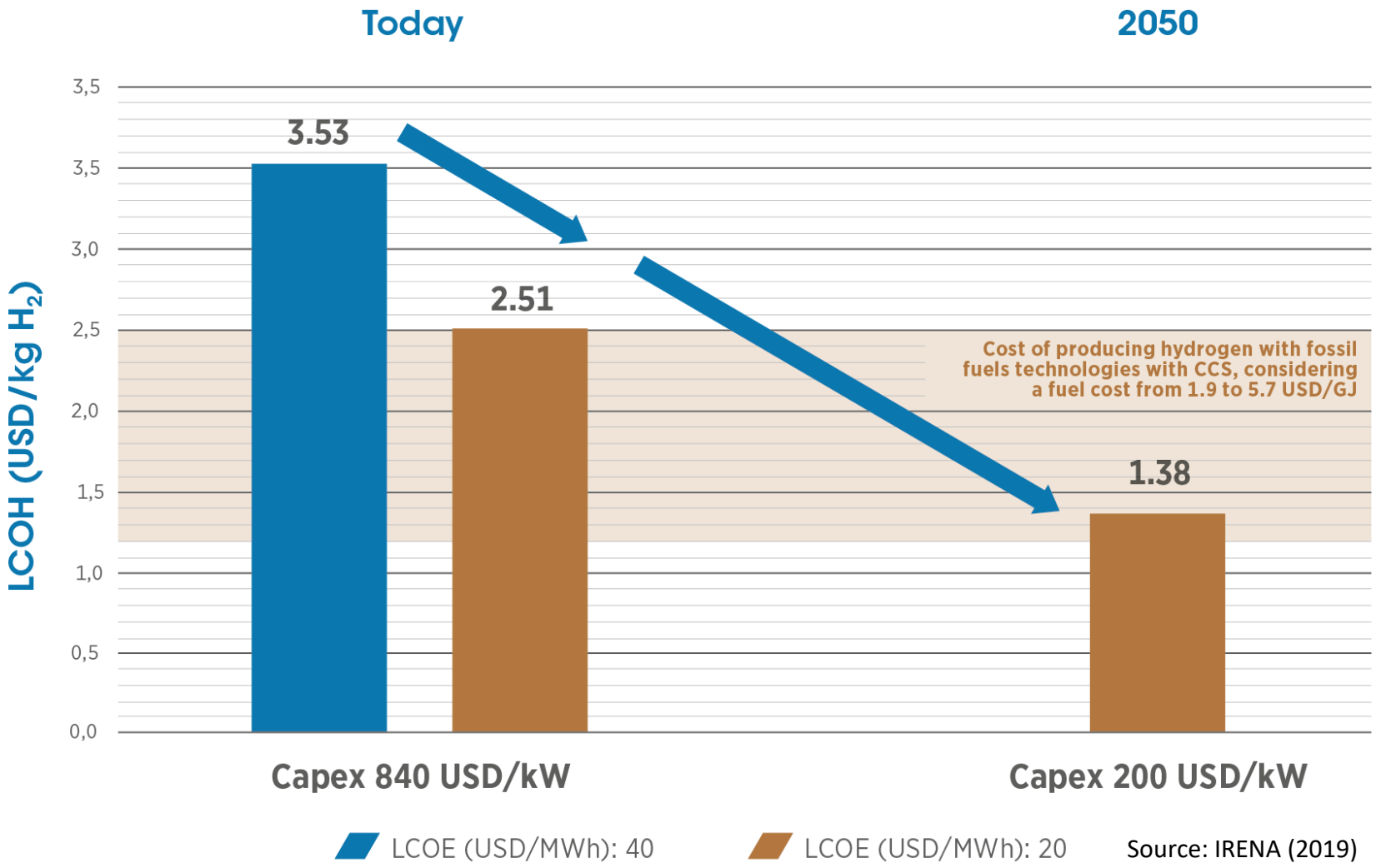
Hydrogen from renewables has a great potential but electrolyser costs need to further decrease



Source: IRENA (2019)

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

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IRENA's Technology Brief: Green Hydrogen Electrolysers

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Key drivers:

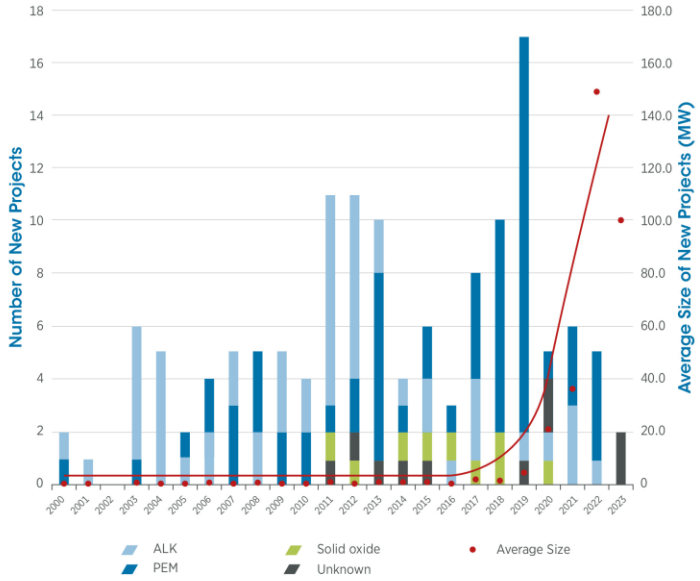
- **Renewable costs** continue to fall
- Systems **integration challenges**
- **Electrolyser projects rapidly growing in size and numbers**
- **Electrolysers cost is** projected to halve
- **Key solution** to reaching zero emissions by 2060

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**



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Electrolysers – the role of economies of scale in reducing hydrogen cost

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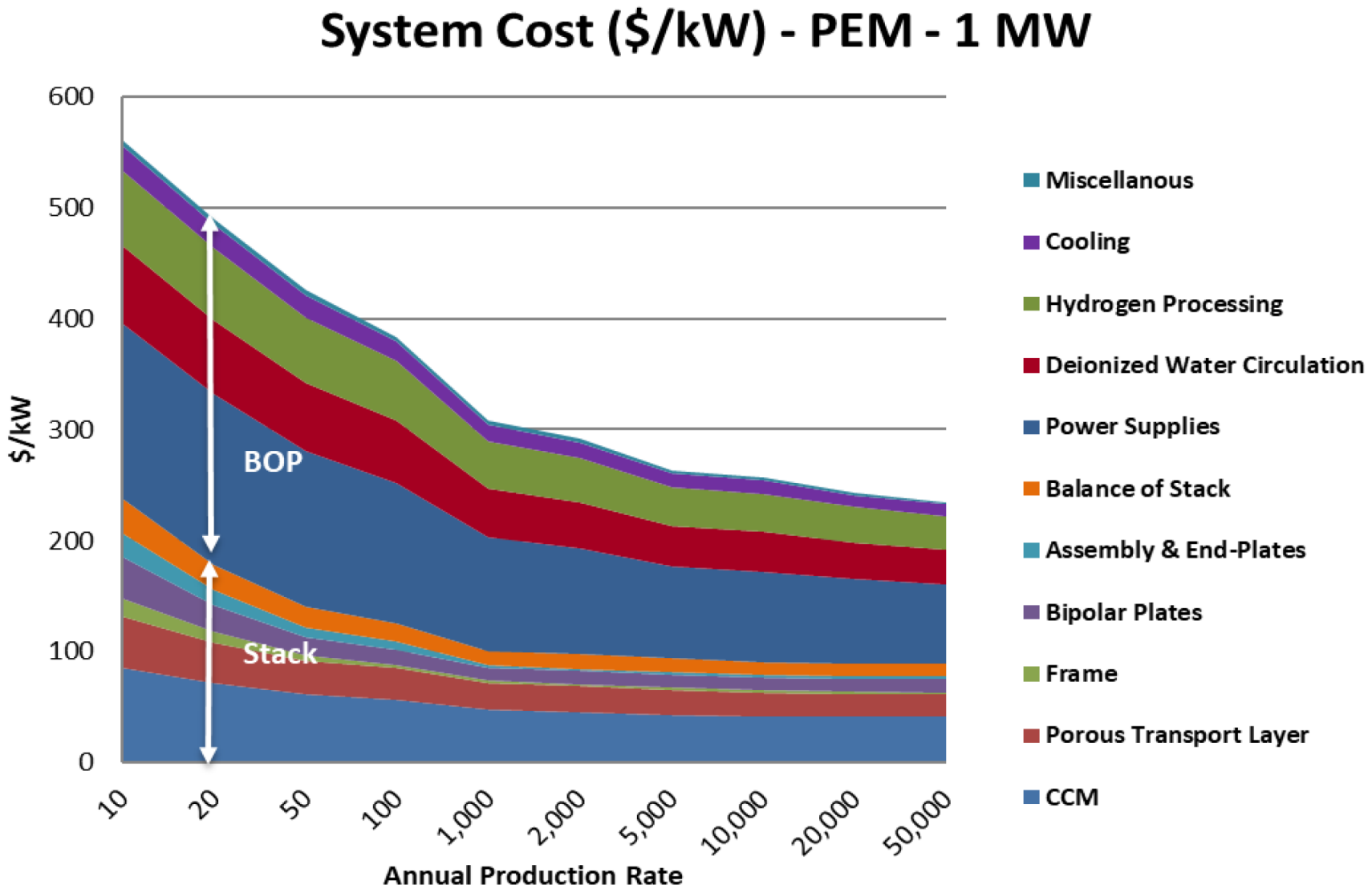

Source: NREL (2020)

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Hydrogen production costs: renewable electricity, CAPEX of electrolysers and operating hours

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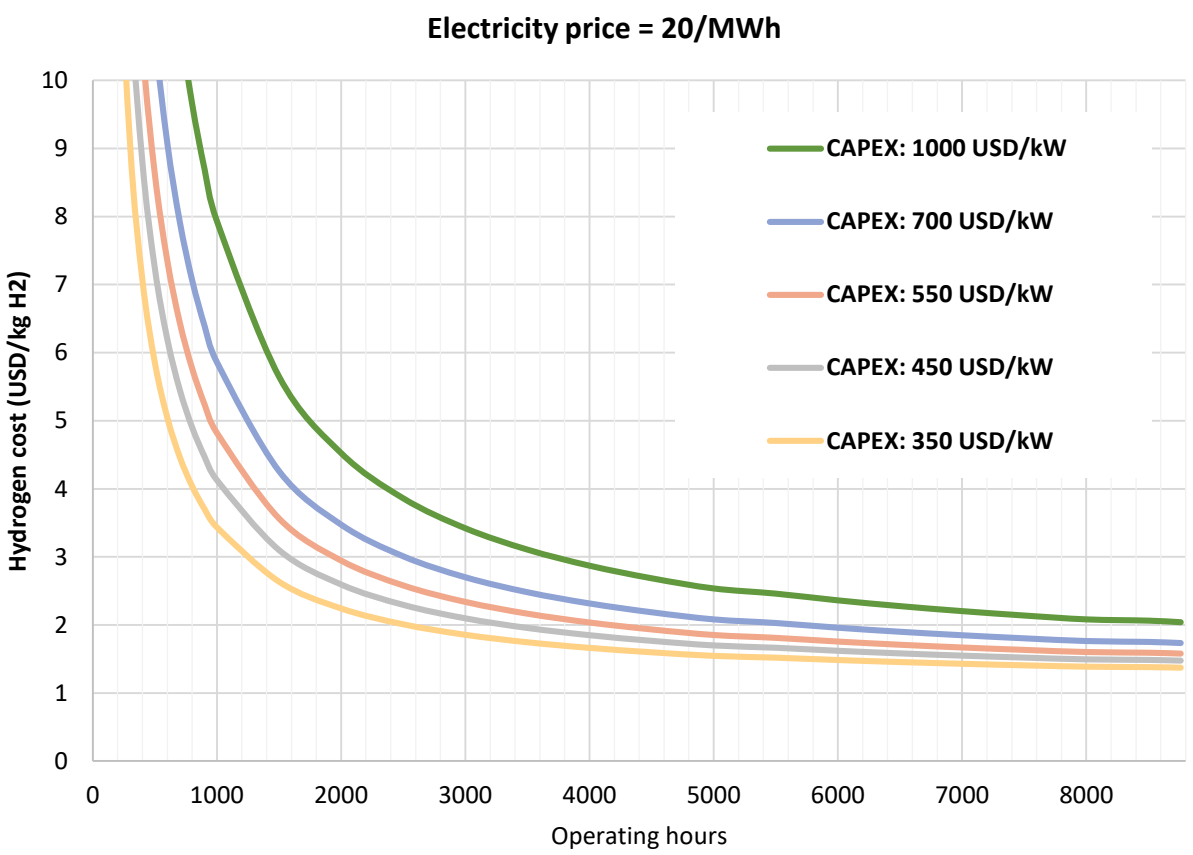

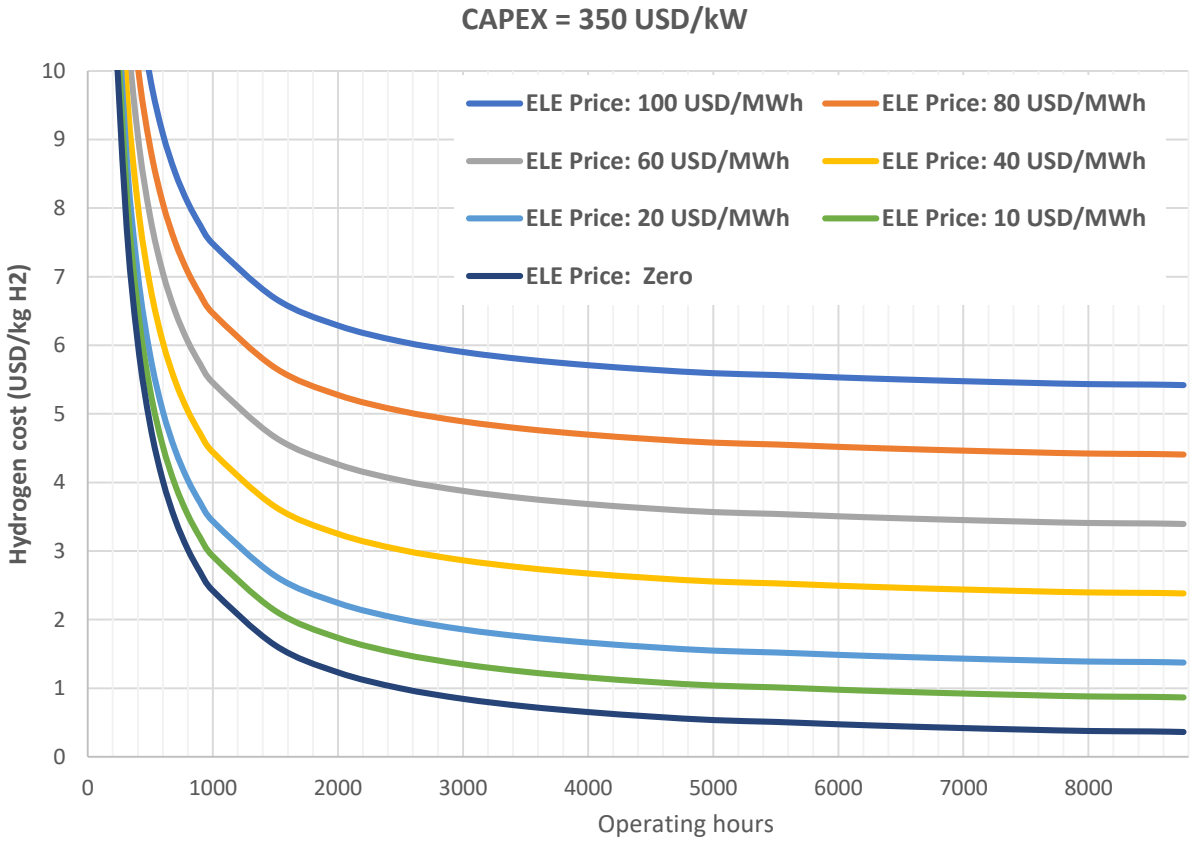

Hydrogen from renewables has a great potential but electrolyser costs need to further decrease

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

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Power-to-hydrogen: Demand-side flexibility and grid services

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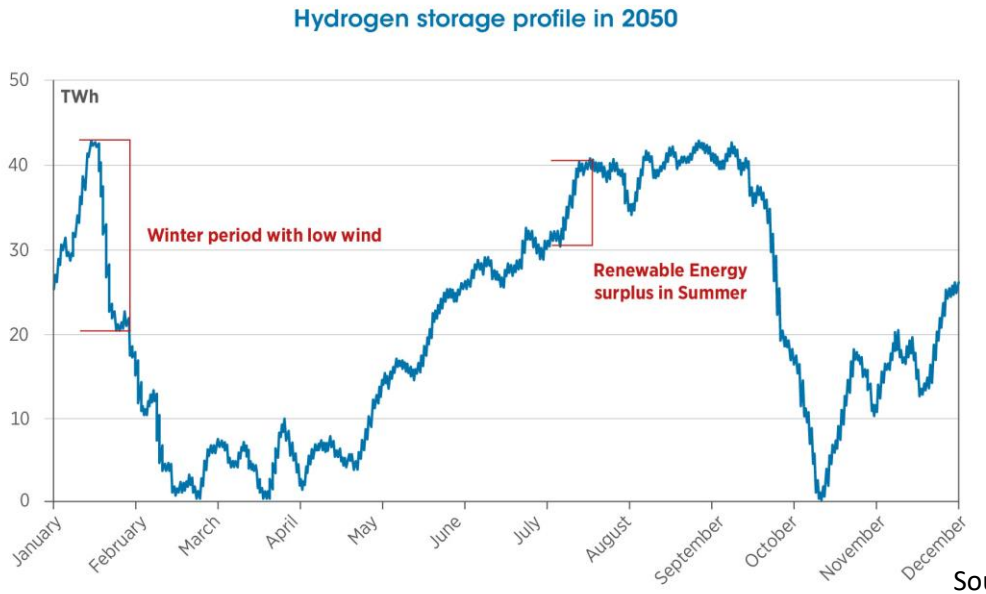
Hydrogen for seasonal storage

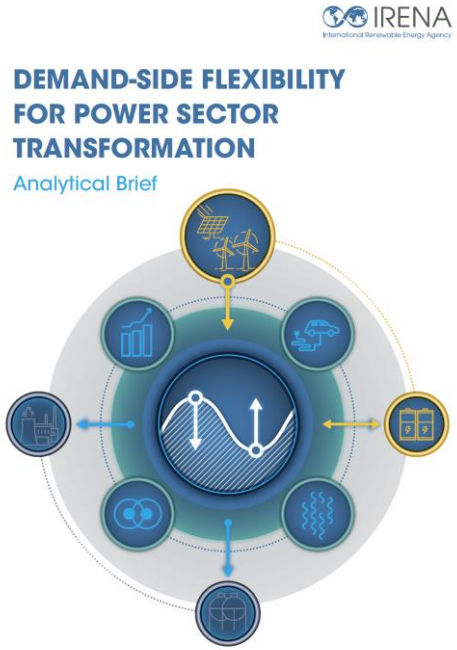
- Significant **storage needs in 2050** for VRE integration
- **Power-to-gas electricity** storage would be beneficial and economically viable in a high-renewables scenario.
- **Compressed or liquefied** (p.eg. dedicated gas grids, geological structures), **mixed** with other elements or **blended with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



Source: LBST (2019)

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**



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Ministerial Roundtable on Green Hydrogen

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"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

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Collaborative Framework on Green Hydrogen

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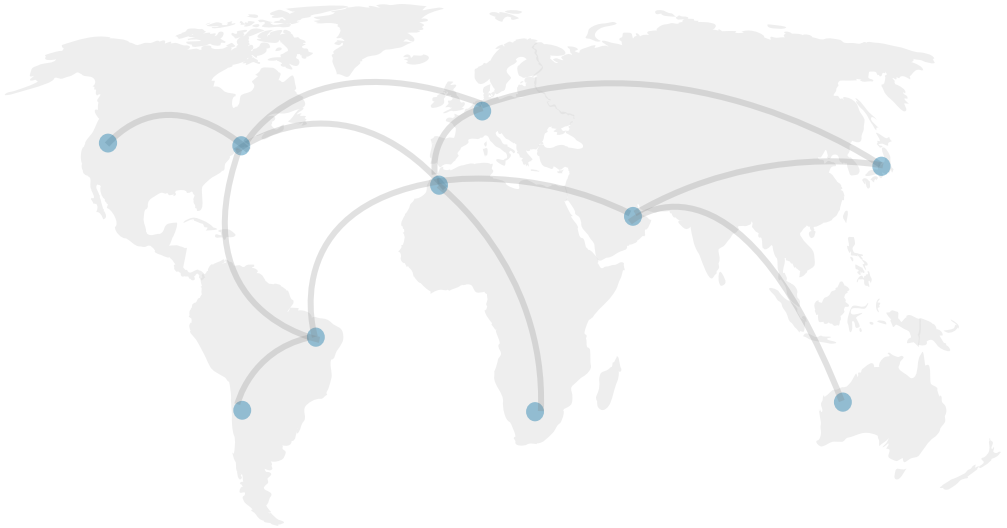
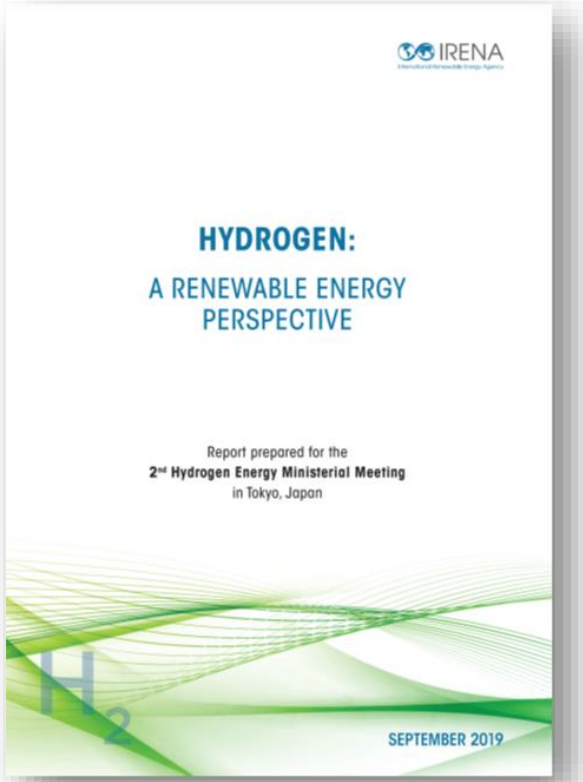
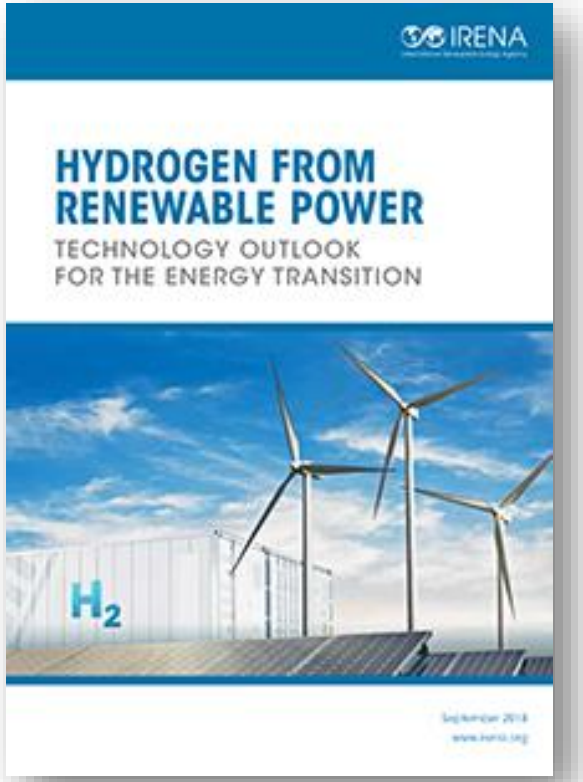
- **Green Hydrogen Ministerial Roundtable** at IRENA's 10th Assembly
  - Members called upon IRENA to **continue its work on hydrogen from renewable power**
- IRENA is establishing a **Collaborative Framework on Green Hydrogen**
- A virtual **meeting** was held on 18 June 2020 **to discuss the modalities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





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Thank you!

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Q & A
10 min

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