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Hydrogen series – Part 2: Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5°C Climate Goal

TUESDAY, 23 MARCH 2021 • 10:00-10:30 CET

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SPEAKERS

Emanuele Taibi

Analyst – Power Sector Transformation Strategies

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Herib Blanco

Analyst – Hydrogen Energy (Power to X)

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The **slides** and a **recording** at https://irena.org/events/2020/Jun/IRENA-Insights & in the handouts section

You are all currently **muted** and will remain so throughout the webinar

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Why green hydrogen?

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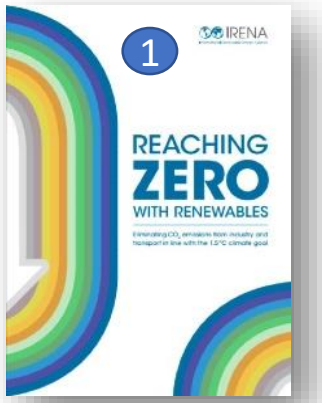
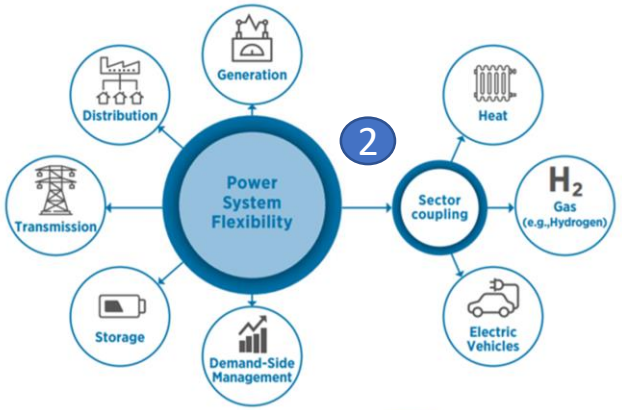
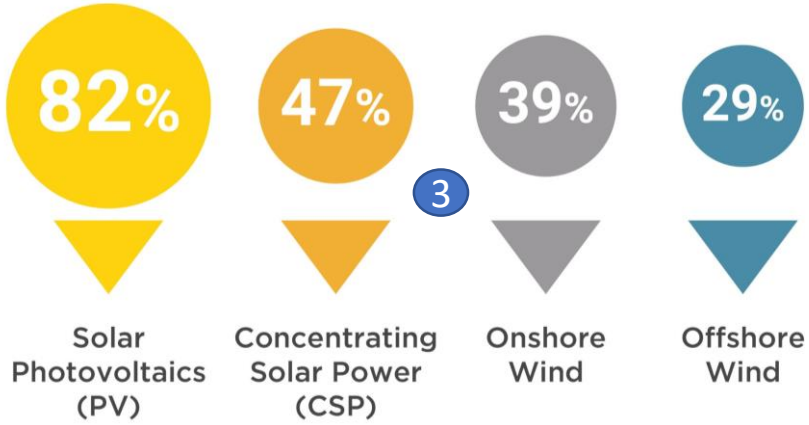
1. Focus on net zero emissions
2. Sector coupling
3. Plummeting cost of renewable electricity
4. Zero emissions in production and end use
5. Widespread support across multiple stakeholders







WORLD ECONOMIC FORUM
Hydrogen Council
California FUEL CELL PARTNERSHIP DRIVING FOR THE FUTURE
European Clean Hydrogen Alliance
FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING
5

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IRENA's Collaborative Framework on Green Hydrogen

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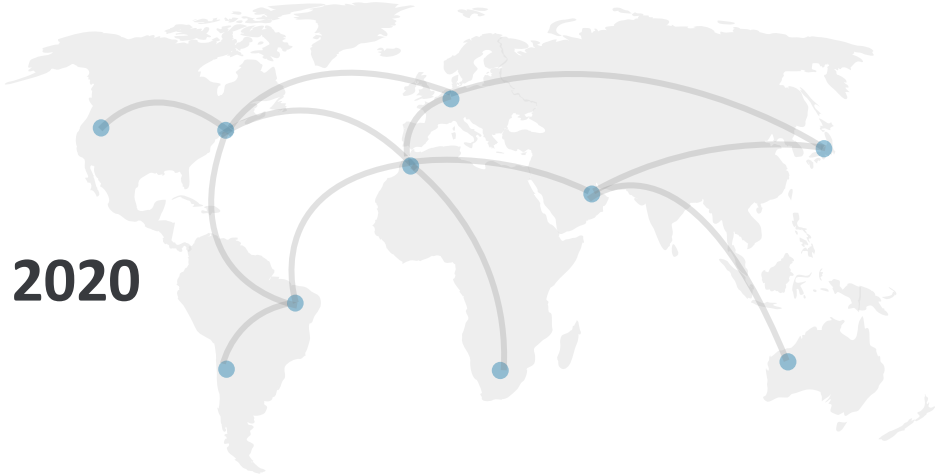
- **Green Hydrogen Ministerial Roundtable** at IRENA's 10th Assembly mandated IRENA to establish a **Collaborative Framework on Green Hydrogen**, **to foster dialogue between governments and private sector**



- **Established in June 2020**
- **Two plenary virtual meetings and one WG meeting in 2020**
- **Next plenary virtual meeting on 28 April 2021 (TBC)**
- Participation to date: **65 countries, Hydrogen Council and IPHE**
- Currently **co-facilitated by the European Commission and Morocco**

World Energy Transitions Outlook 2021

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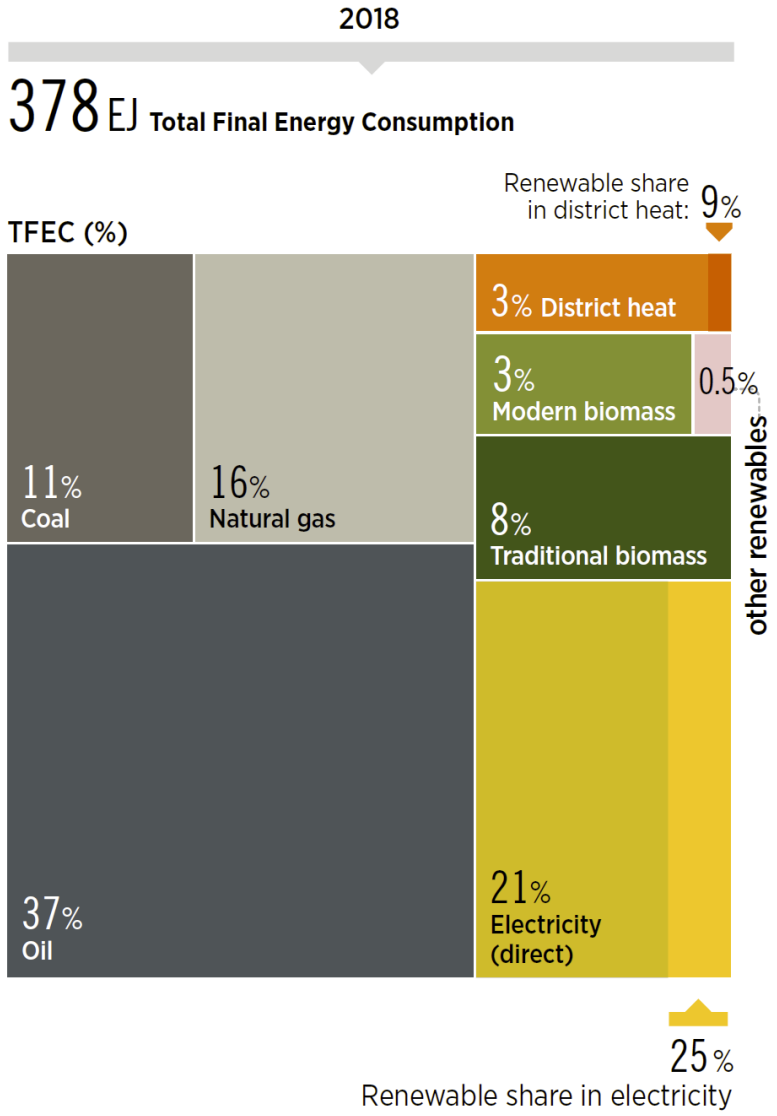
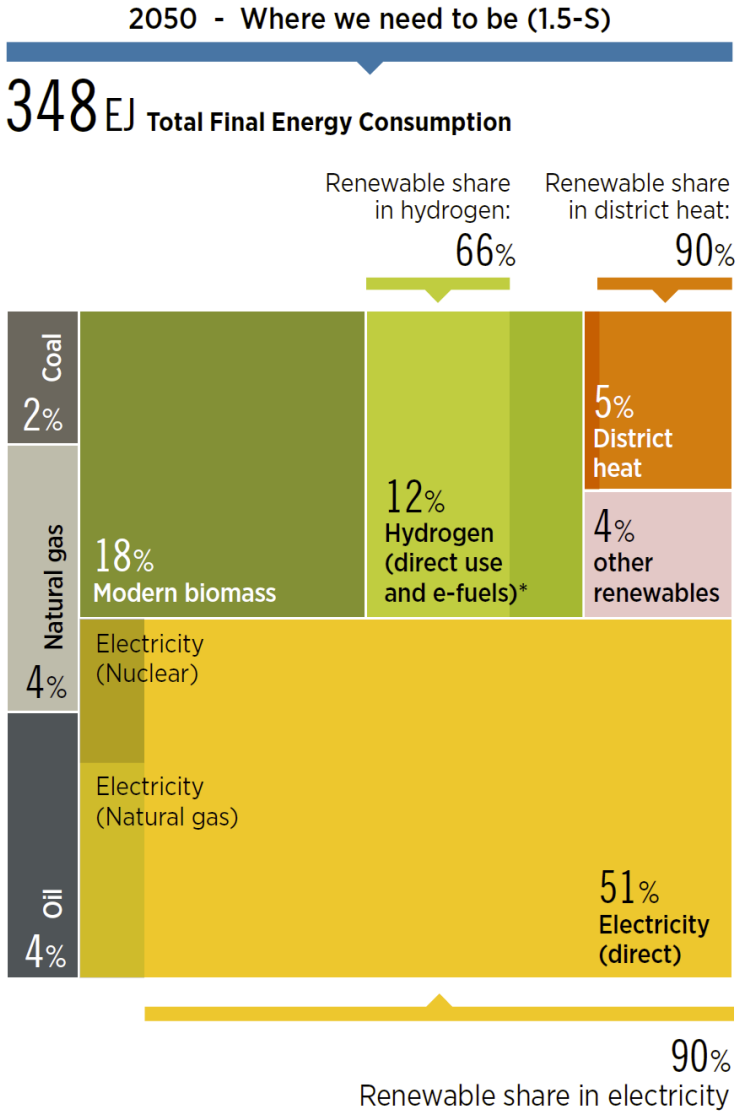
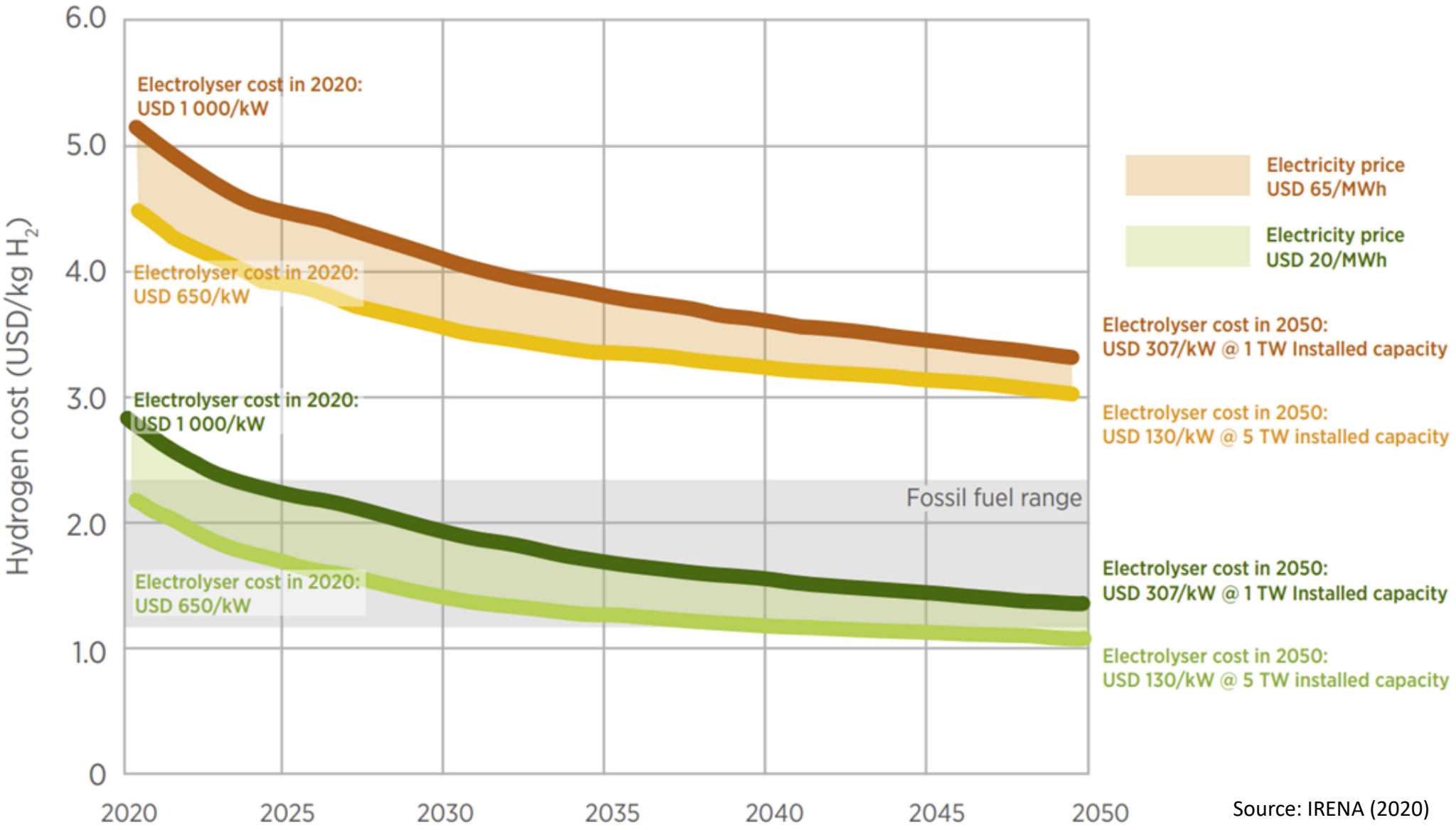
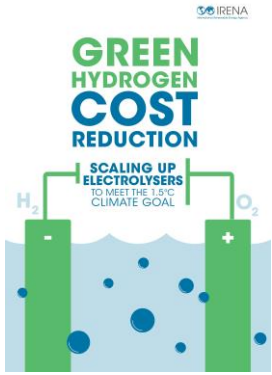




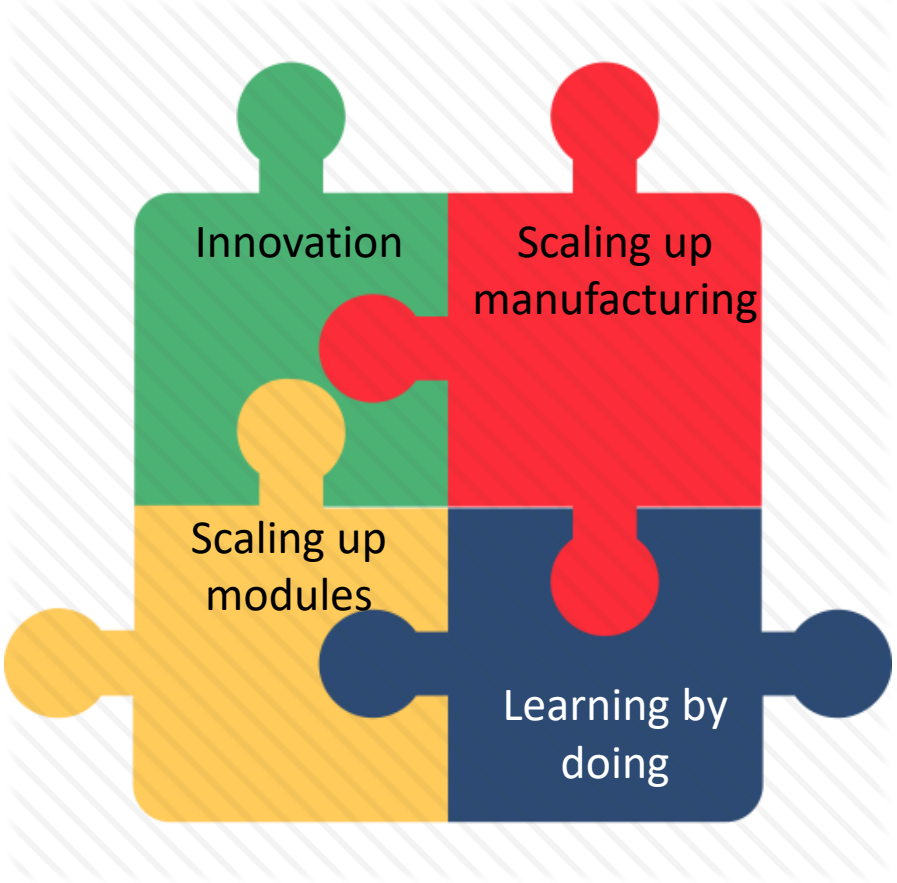
How to get to competitive green hydrogen?





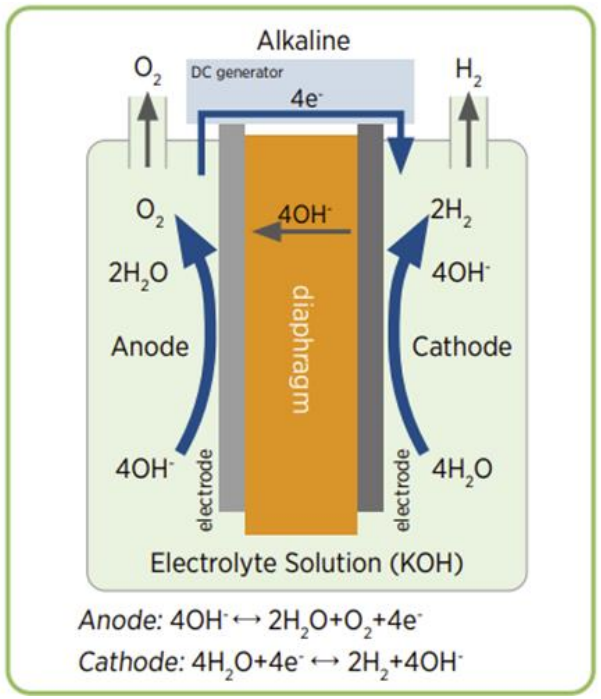
Source: IRENA (2020)

How to achieve a low cost for the electrolyzer?

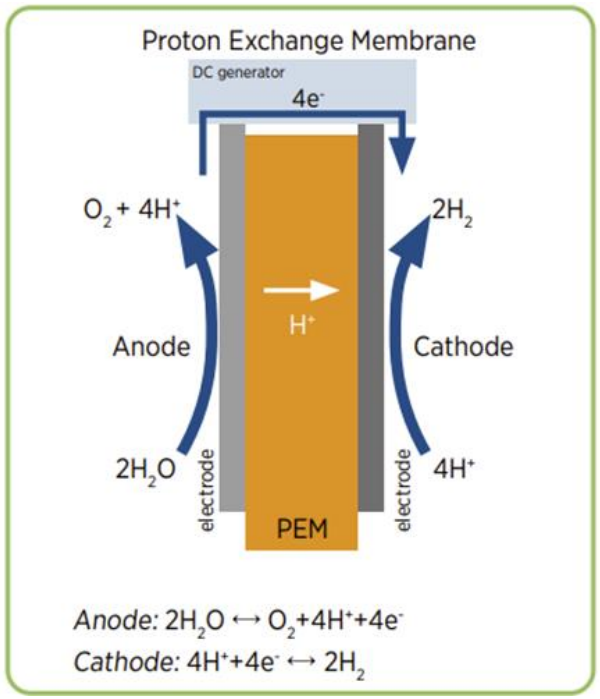


The four strategies are intertwined and a combination of them is what allows achieving large cost reductions

There are four electrolyzer technologies



TRL 8-9



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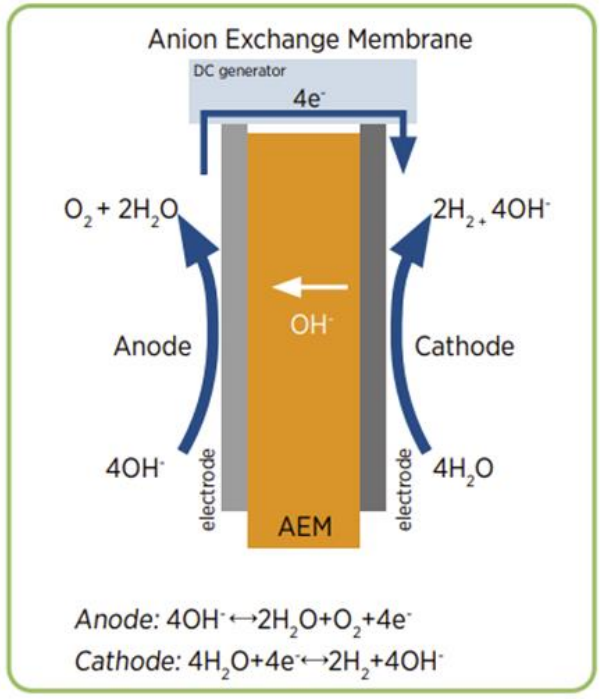
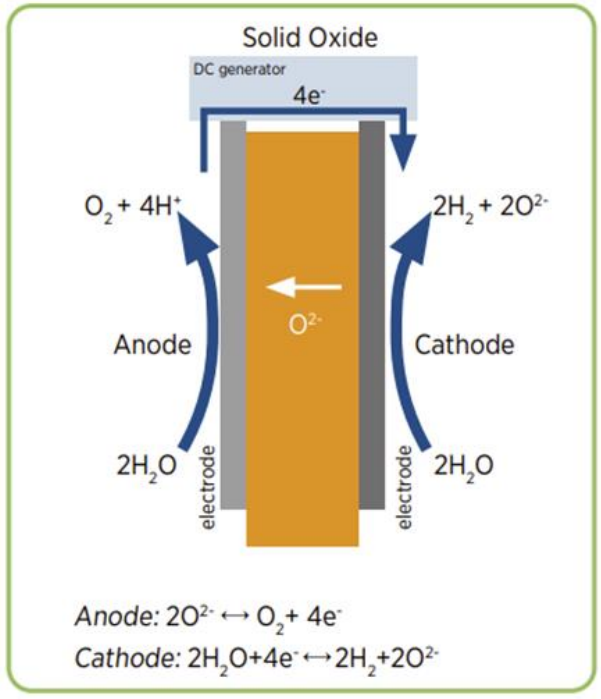


TRL 2-3



TRL 5-6

Two technologies are ready for commercial deployment and two other technologies have promising performance but have a lower technological development

Strategy 1: Innovation

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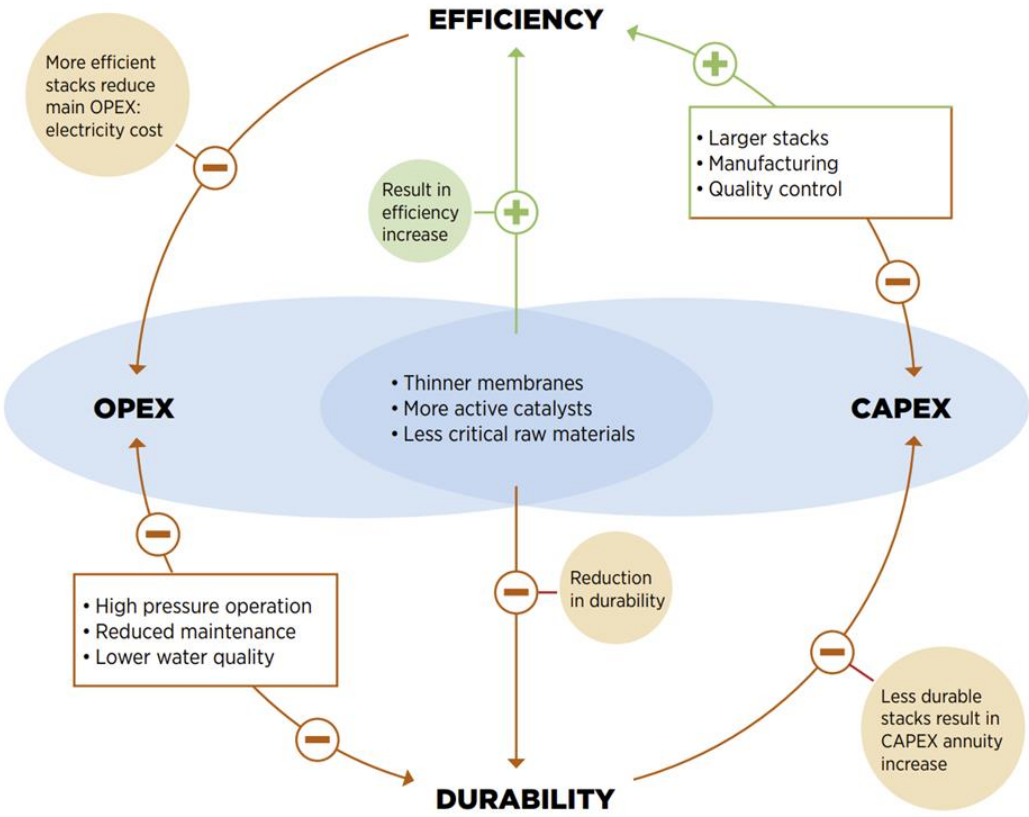
- ↑ Current densities → ↑ Production rate
- ↑ Membrane thickness → ↑ Efficiency
- ↓ Gas permeation → ↑ Purity, lifetime
- ↓ Catalyst layers → ↑ Lifetime
- ↓ Critical materials → ↑ Cost ↓ Lifetime



One parameter can usually not be improved without a detrimental effect in another one, which leads to optimizing design based on trade-offs and applications

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Needs for material use reduction

Gd, Zr, La, Ce, Y

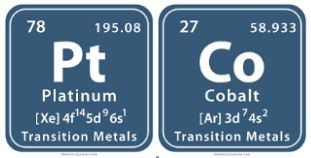
No critical materials

Alkaline

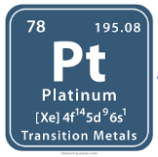
Proton Exchange Membrane

Solid Oxide

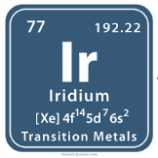
Anion Exchange Membrane



✓ Already today some manufacturers provide Pt-, Co-free designs



Global Pt production = 200 GW/yr



Global Ir production = 3-7.5 GW/yr

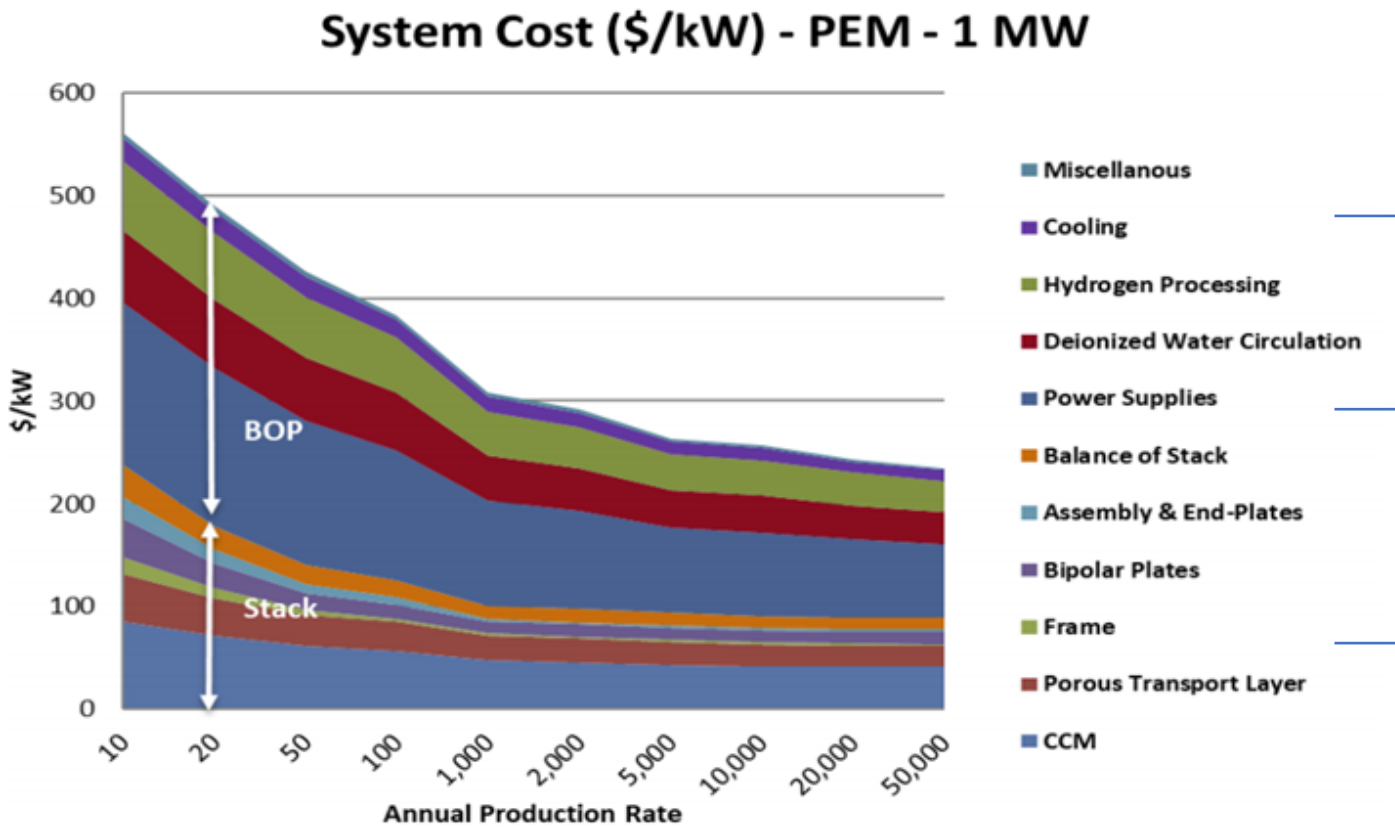
Current government targets for 2030 = 105 GW

✓ Reduce materials
✓ Increase yield
✓ Recycling

Parameter	Today	Future
Current density (A/cm^2)	2	5
Electrode area (cm^2)	1200	5000
Iridium loading (g/kW)	1.3	0.4
Platinum loading (g/kW)	0.5	<0.1

PEM electrolyzer has the most limitations from materials supply. Several strategies are already part of the research agenda and can help overcoming this barrier

Strategy 2: Increasing manufacturing capacity



Thyssenkrupp → 1 GW/yr (2020)

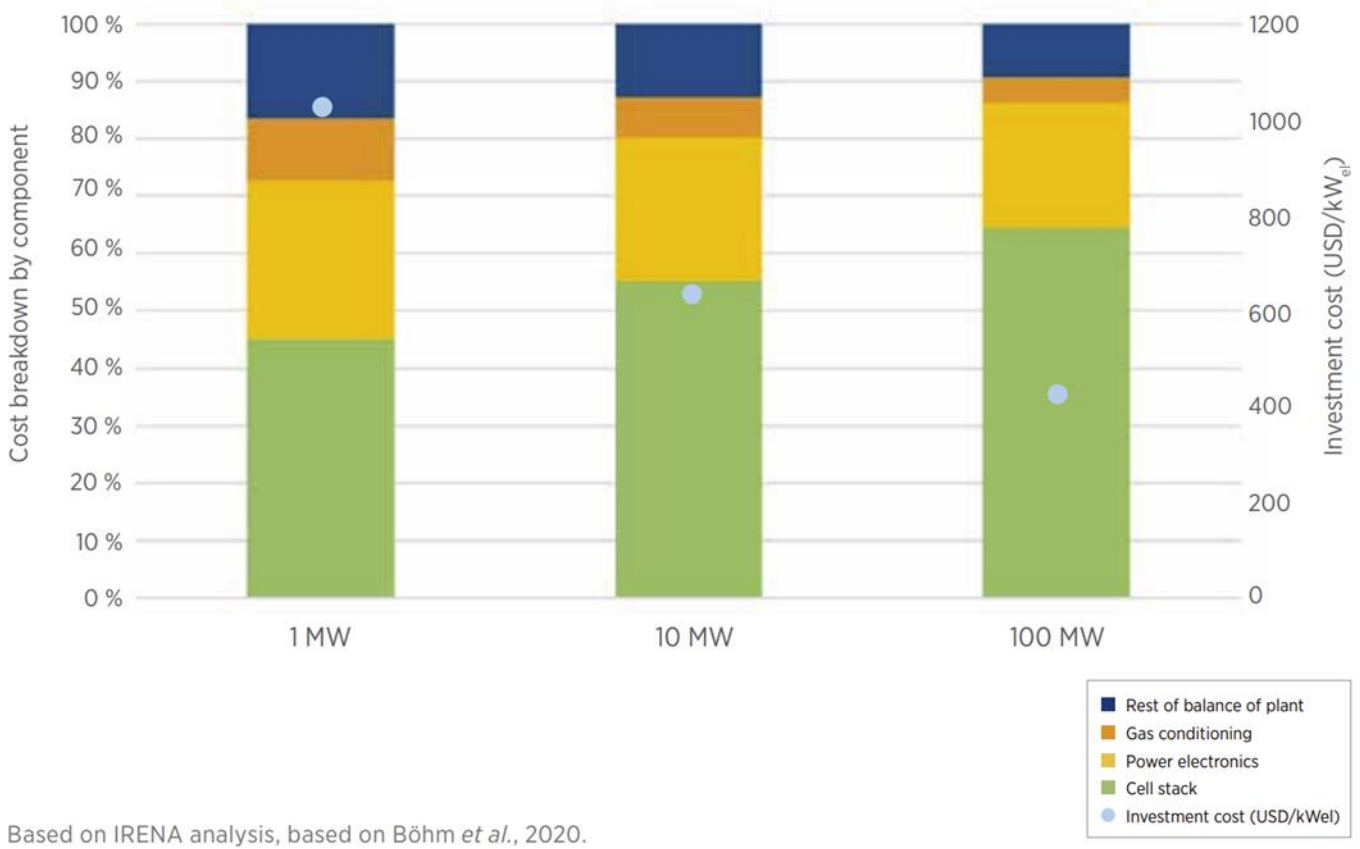
NEL → 2 GW/yr announced (2021)
75% cost reduction
USD 1.5/kg target by 2025

ITM → 350 MW/yr (2020)
GBP 800/kW to GBP 500/kW in 3 years

Increasing manufacturing scale has the largest benefit on the stack cost

Mayyas, A. et al. (2019), Manufacturing cost analysis for proton exchange membrane water electrolyzers, Technical Report NREL/TP-6A20-72740, National Renewable Energy Laboratory, Golden, CO, United States.

Strategy 3: Increasing module size



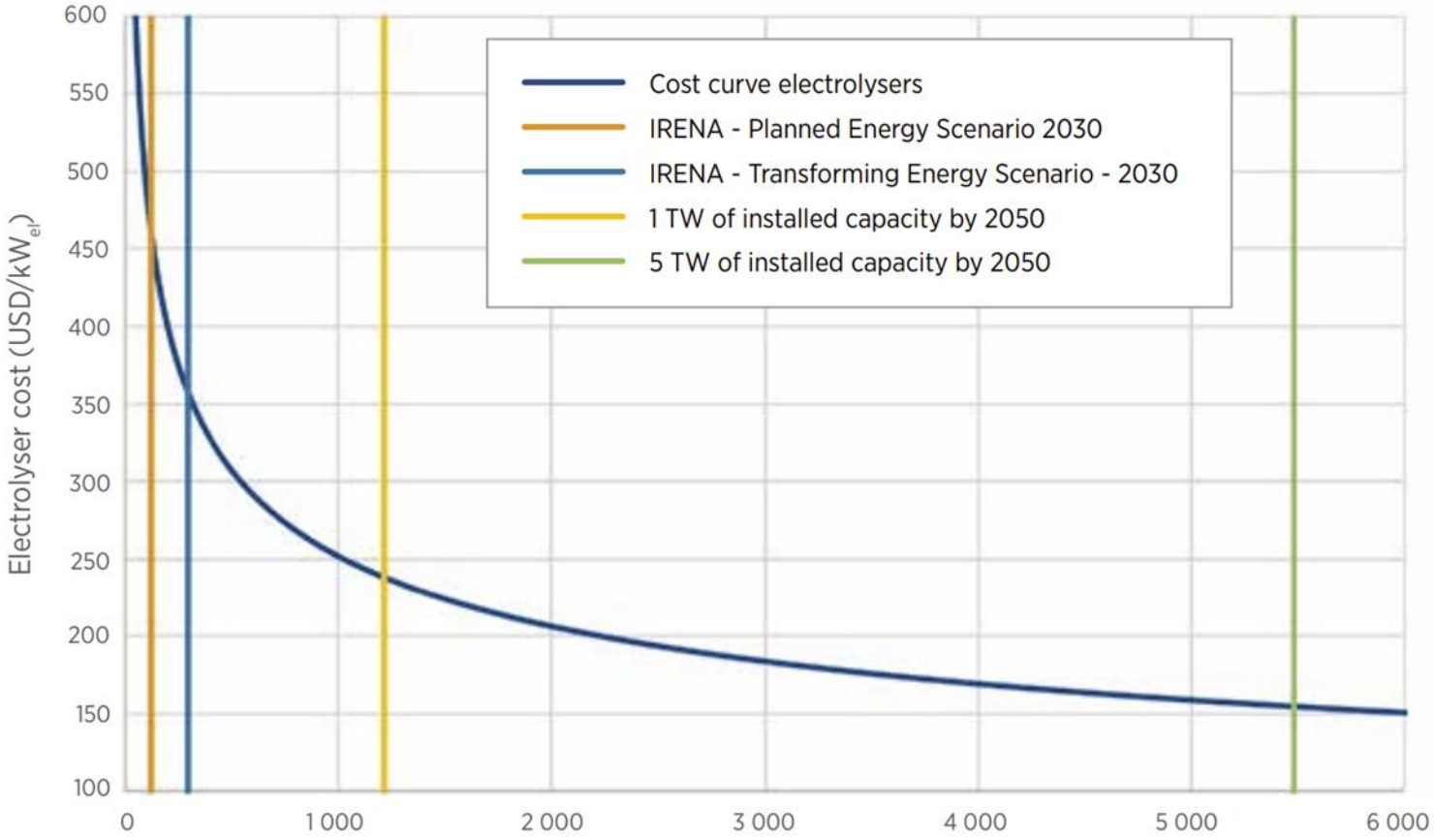
Based on IRENA analysis, based on Böhm *et al.*, 2020.

Module size is not defined by cost only, but also by the application (e.g., refueling station, residential are much smaller)

Increasing module size has the largest benefit for the cost of the balance of plant

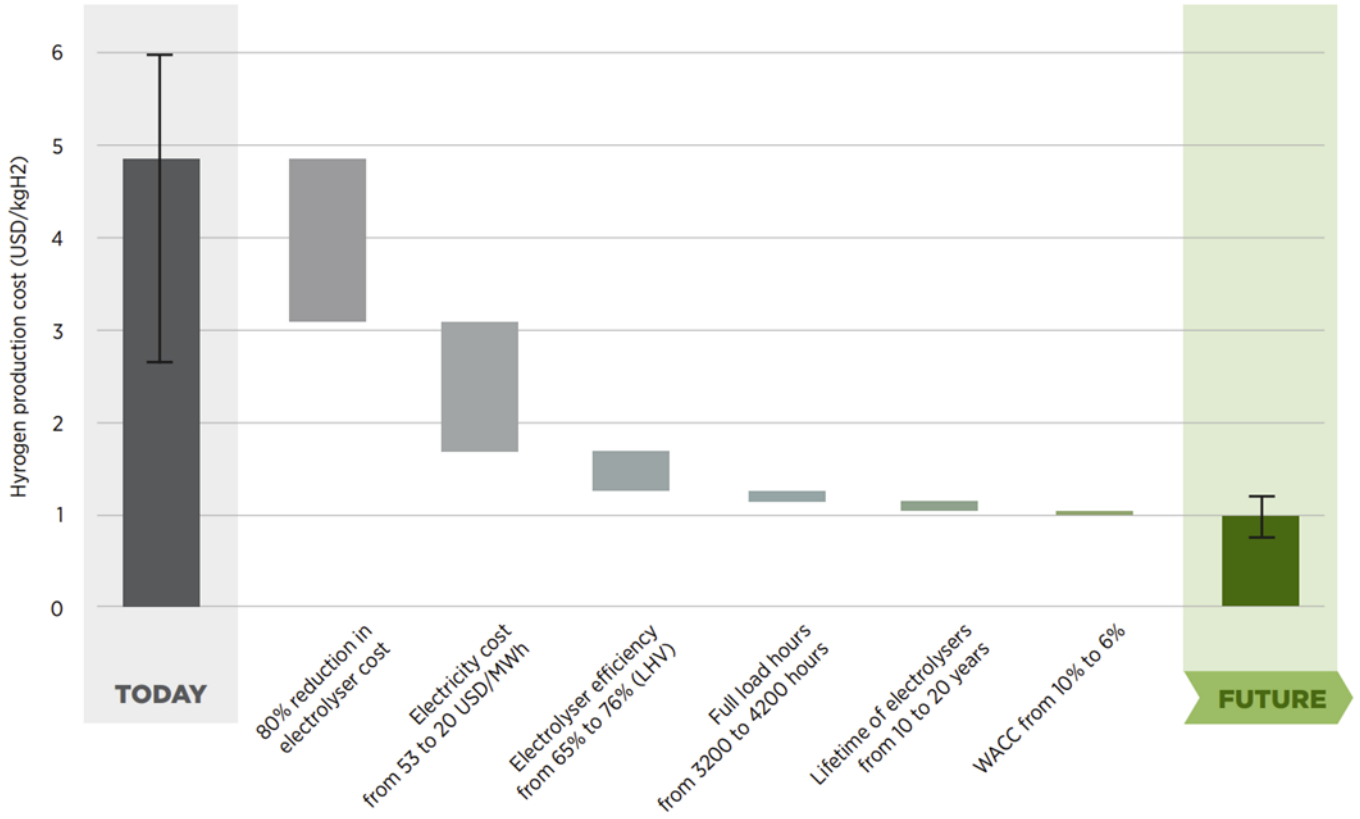
Böhm, H. et al. (2020), https://dx.doi.org/10.1016/j. apenergy.2020.114780

Strategy 4: Learning by doing



Implementing the announced capacity targets in strategies would already lead to 40% cost reduction by 2030

What is the impact on competitiveness?



Reduction in electrolyzer cost and lower electricity price represents the bulk of total cost reduction to reach the 2 USD/kg mark

Thanks for your attention

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Upcoming (2021):

- Sectoral policy briefs on electrolysis, infrastructure, industry, aviation, shipping

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Q & A
10 min

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