

Siemens Energy Hydrogen Day

Christian Bruch, CEO
March 19, 2021

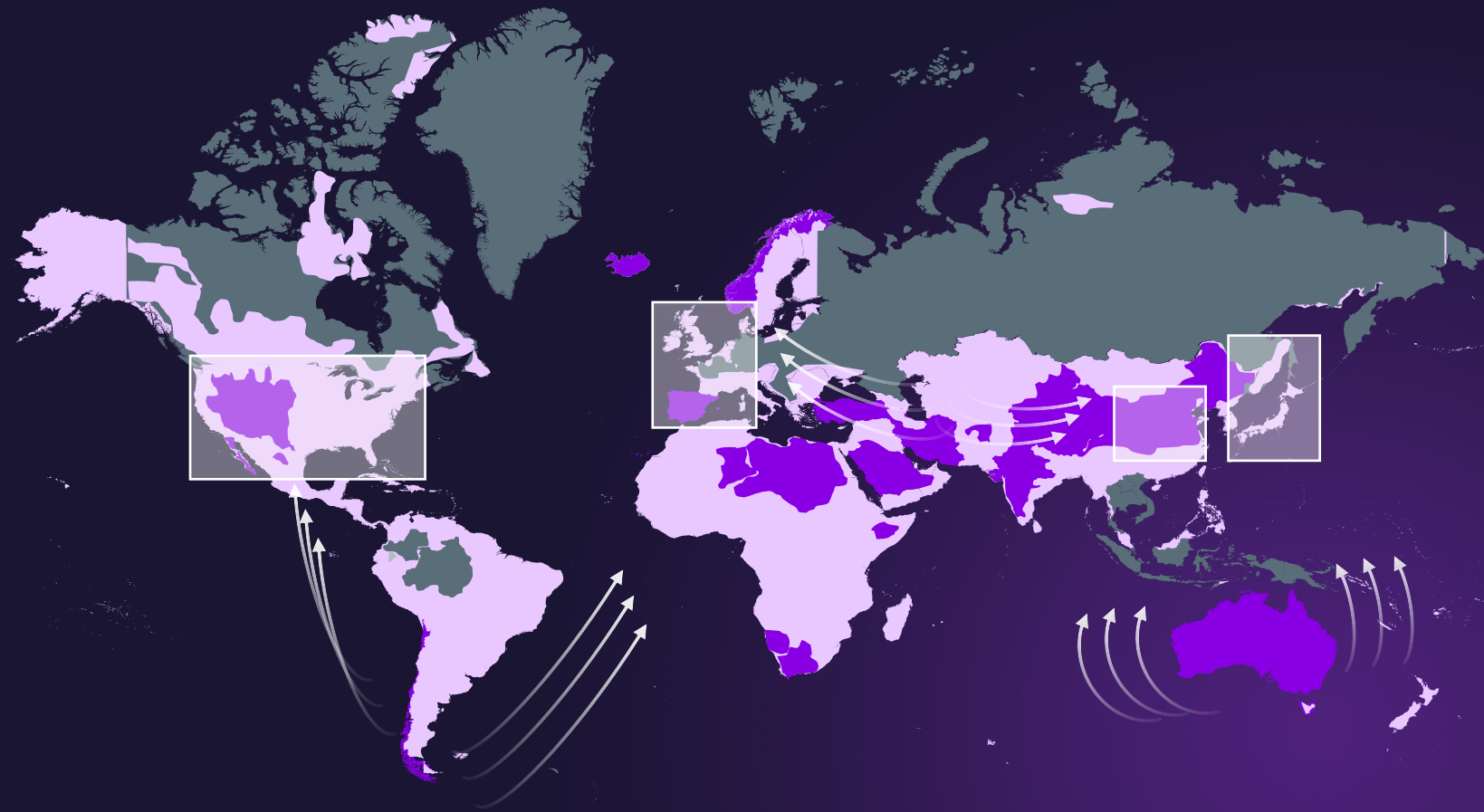


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Today's challenge: Green energy needs to travel from lowest cost regions to decarbonize demand centers



Least ■ ■ ■ Most

PV/wind resources for renewable hydrogen production

X.X – CO₂-Emissions

Demand centers with high CO₂ emissions

36 Giga tons

total energy-related emissions in 2019

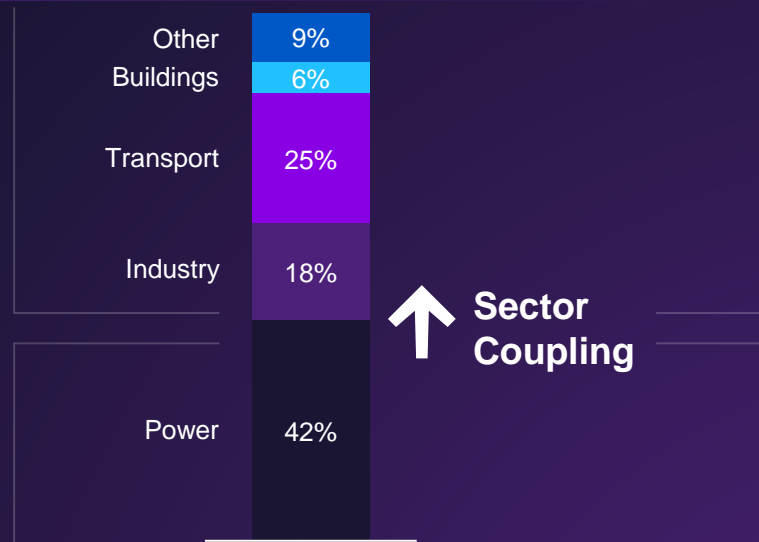
-  **10.2** Giga tons
-  **5.3** Giga tons
-  **2.6** Giga tons
-  **1.7** Giga tons
-  **1.1** Giga tons
-  **0.7** Giga tons

“Sector Coupling”

Key lever for decarbonization of all end-user sectors

Shares in global CO₂ emissions by sectors

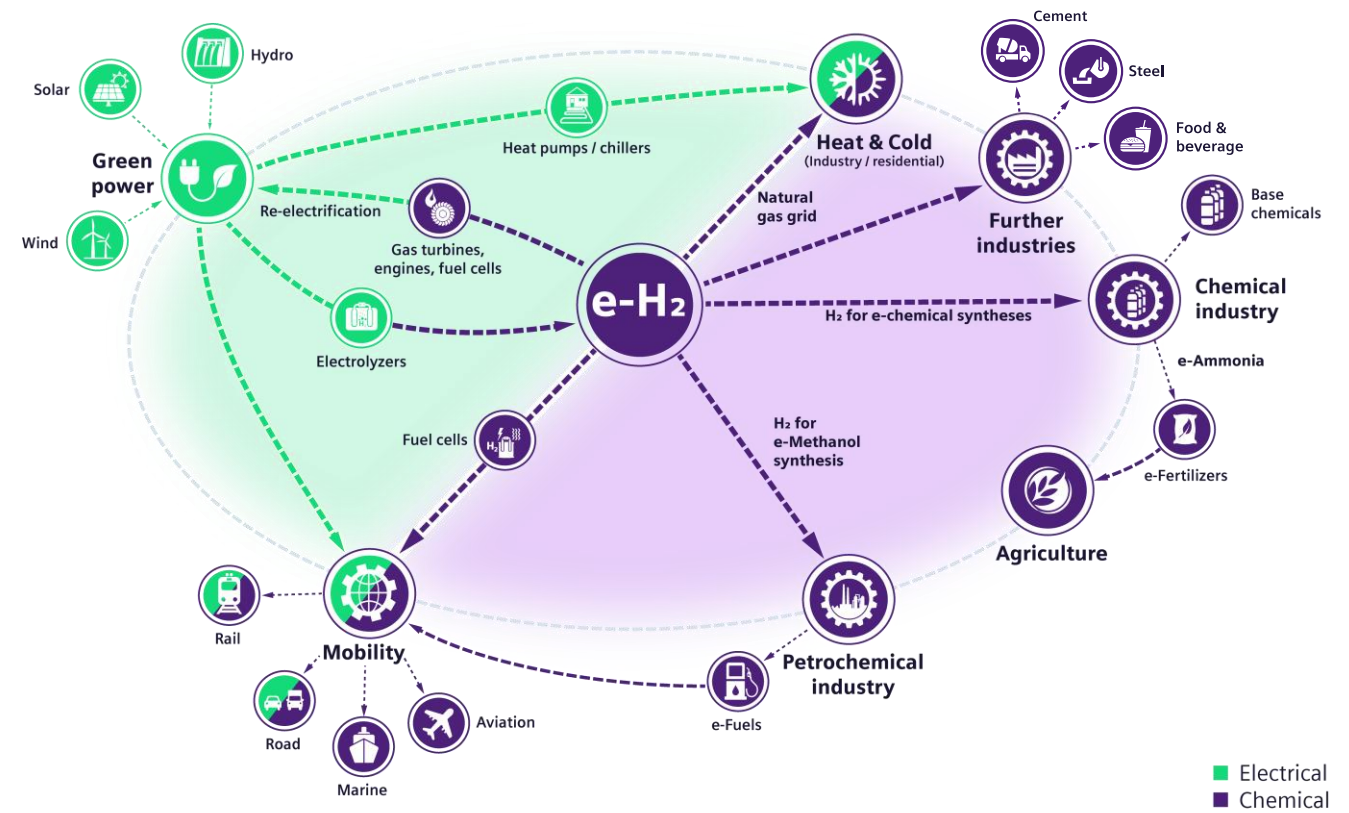
Leverage green electricity in other sectors
Share on CO₂ emissions: 58%
Share of Renewables: 11%



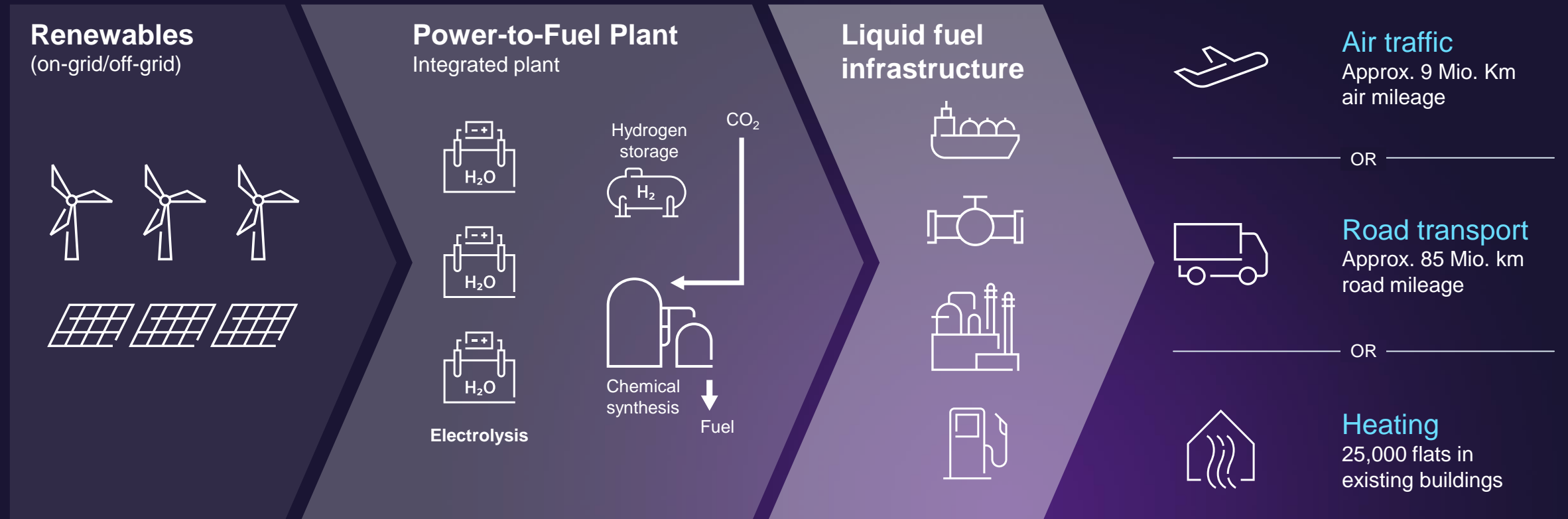
Successful integration of renewables in Power
Share on CO₂ emissions: 42%
Share of Renewables: 27%

Source: 2018-2019 data from IEA and own estimates
 2021-03-19

The role of hydrogen – A versatile molecule



Power-to-Fuel plants as missing link for electricity based fuels and utilization of existing liquid fuel infrastructure

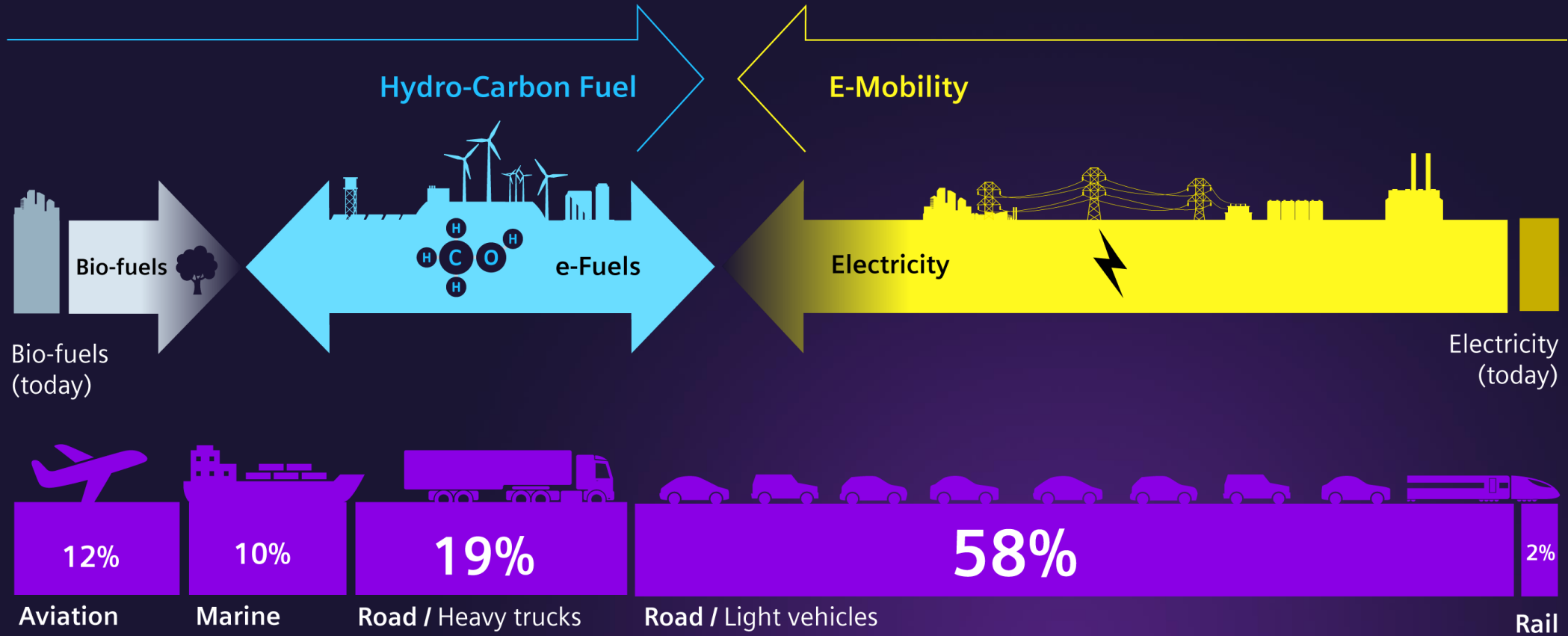


200 MW wind farm producing 560 GWh_{el}

280 GWh green fuel equiv. to 28m liters Diesel

Numbers per annum derived from own assumptions

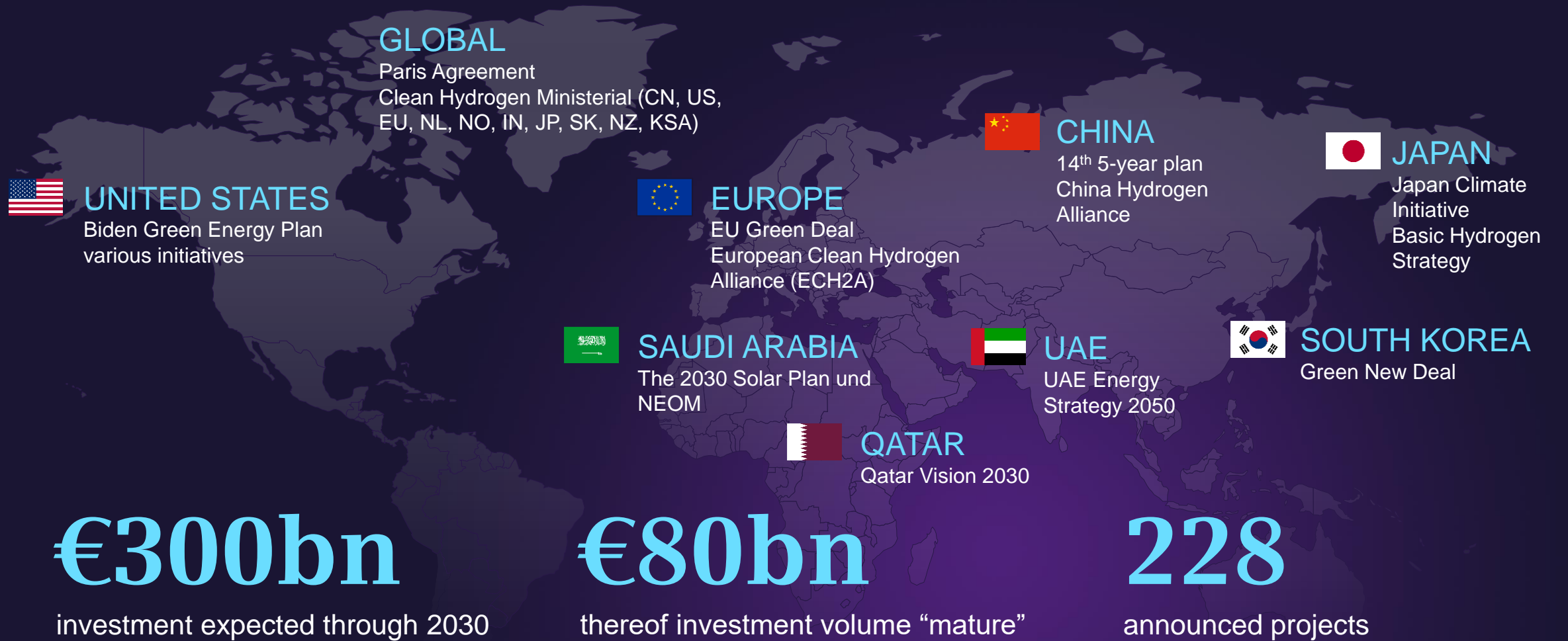
E-fuels required to reduce CO₂ emissions related to transport



2,920
Mtoe (~33,960 TWh)
Global energy consumption in transport (2019)

Boundary conditions are changing

Major green initiatives drive hydrogen related initiatives and investments



Strong growth in green hydrogen production drives cost competitiveness



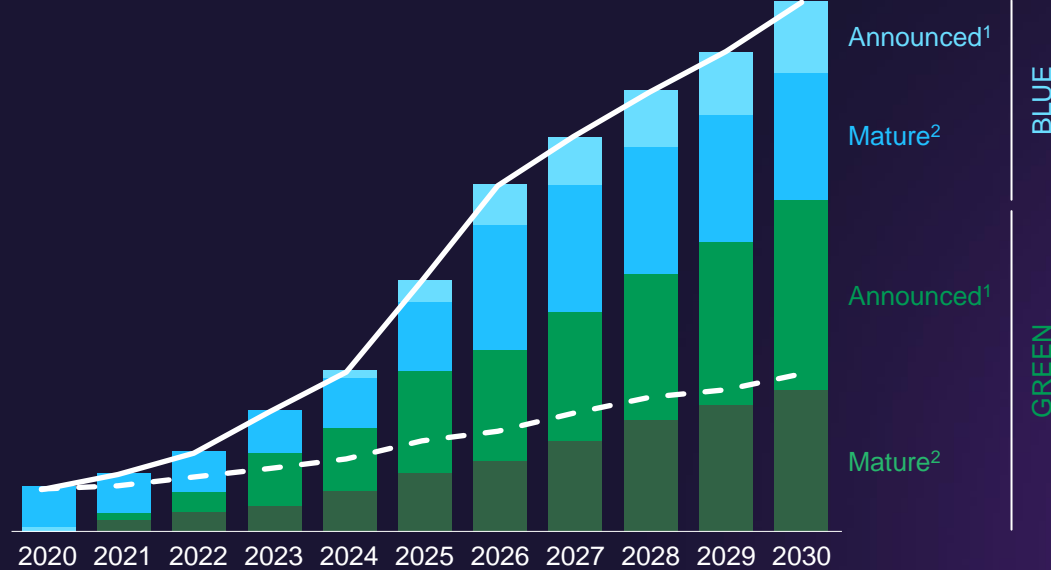
Announced clean hydrogen capacity through 2030

Production capacity
Mt p.a.

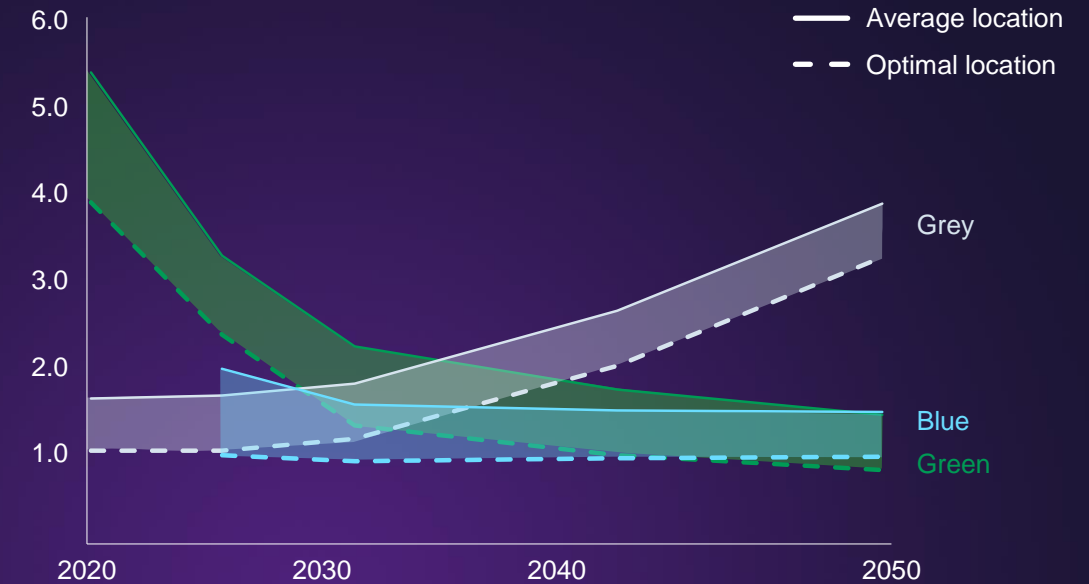
Hydrogen production pathways, including carbon costs

Production cost of hydrogen
USD/kg

Projections as of 2020

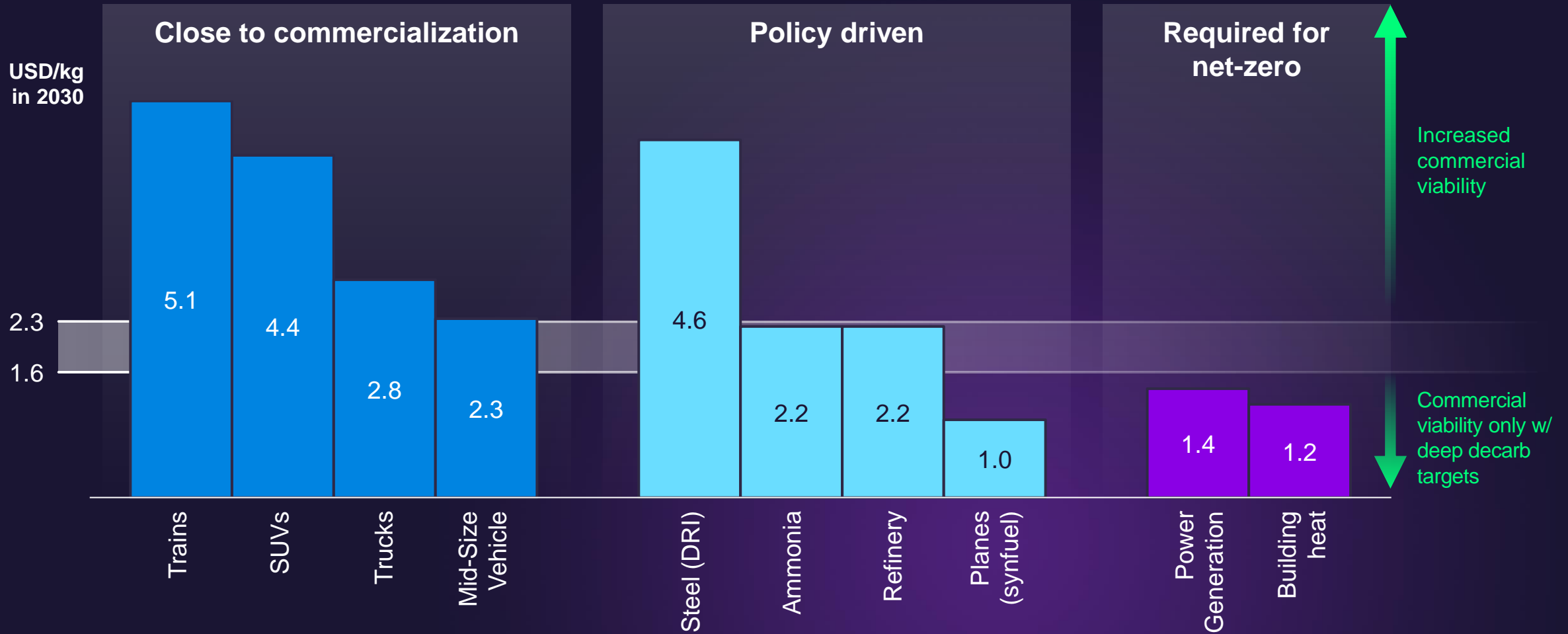


1. Includes projects at preliminary studies or at press announcement stage; 2. Includes projects that are at the feasibility study or front-end engineering and design stage or where a final investment decision (FID) has been taken, under construction, commissioned or operational



Key assumptions: Gas price 2.6–6.8 USD/Mmbtu
 Cost USD/Ton CO₂ 30 (2020), 50 (2030), 150 (2040) and 300 (2050)
 LCOE USD/MWh 25 – 73 (2020), 13 – 37 (2030) and 7 – 25 (2050)

Attractive use cases for hydrogen by 2030



Three pillars to support our strategy



Low- or zero-emission
power generation



Transport of electricity
and storage



Reducing CO₂ footprint and energy
consumption in industrial processes



Decarbonization is a core component of our ESG Targets



WE ENERGIZE SOCIETY

RESPONSIBLE OPERATIONS

DECARBONIZING OUR BUSINESS

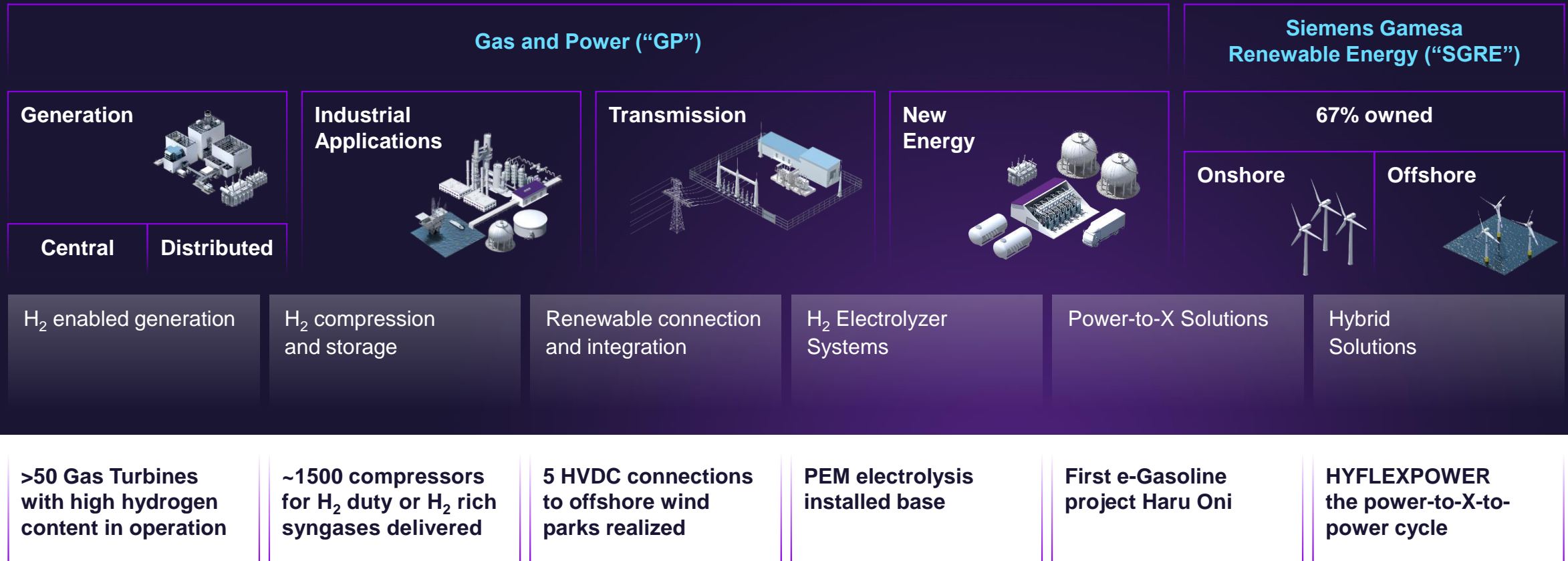
SOCIETAL IMPACT



We are a unique player in the hydrogen value chain



Siemens Energy AG



Our system competence makes us a partner of choice in development projects



Mobility



Industry



Energy

Project	Haru Oni (Patagonia, Chile), 2021	H ₂ Future, voestalpine (Linz, Austria), 2019	Braskem (Sao Paulo, Brazil), 2021
Application	E-fuel for passenger cars	Steel	Steam and Electricity
Product	e-Fuel (rising to >550m litres/a)	1,200 Nm ₃ of H ₂ for the steel plant gas grid	160 tons of steam per hour and 38MW power output
SE scope (select.)	Siemens Energy Electrolyzer	Silyzer 300 (12 modules, 6MW)	2x SGT-600 in combined cycle application and H ₂ co-firing (60%)
Partners	AME, Porsche, Federal Ministry of Economic Affairs and Energy Germany	VERBUND, voestalpine, APG, TNO & K1-MET, EU funding	“Energy-as-a-service” approach with BOO model

Technology expertise in Electrolysis

Our electrolyzer portfolio scales up by factor 10 every 4 – 5 years



0.1 MW

1 MW

10 MW

100 MW

1,000 MW

2011

Silyzer 100
Lab scale demo

2015

Silyzer 200



2018

Silyzer 300



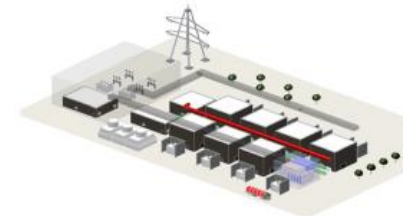
2023+

Silyzer 300 plant



2028+

Co-Development with partners in **verticals**



Our current focus

Early projects in **Reference Applications**

Establish **partner network** in hydrogen

Automation of fabrication
and development of **supply chain**

Technological improvements ●

