BLUE and GREEN hydrogen role in the future energy transition

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Introduction to De Nora:

“Sustainability is at the heart of our values”

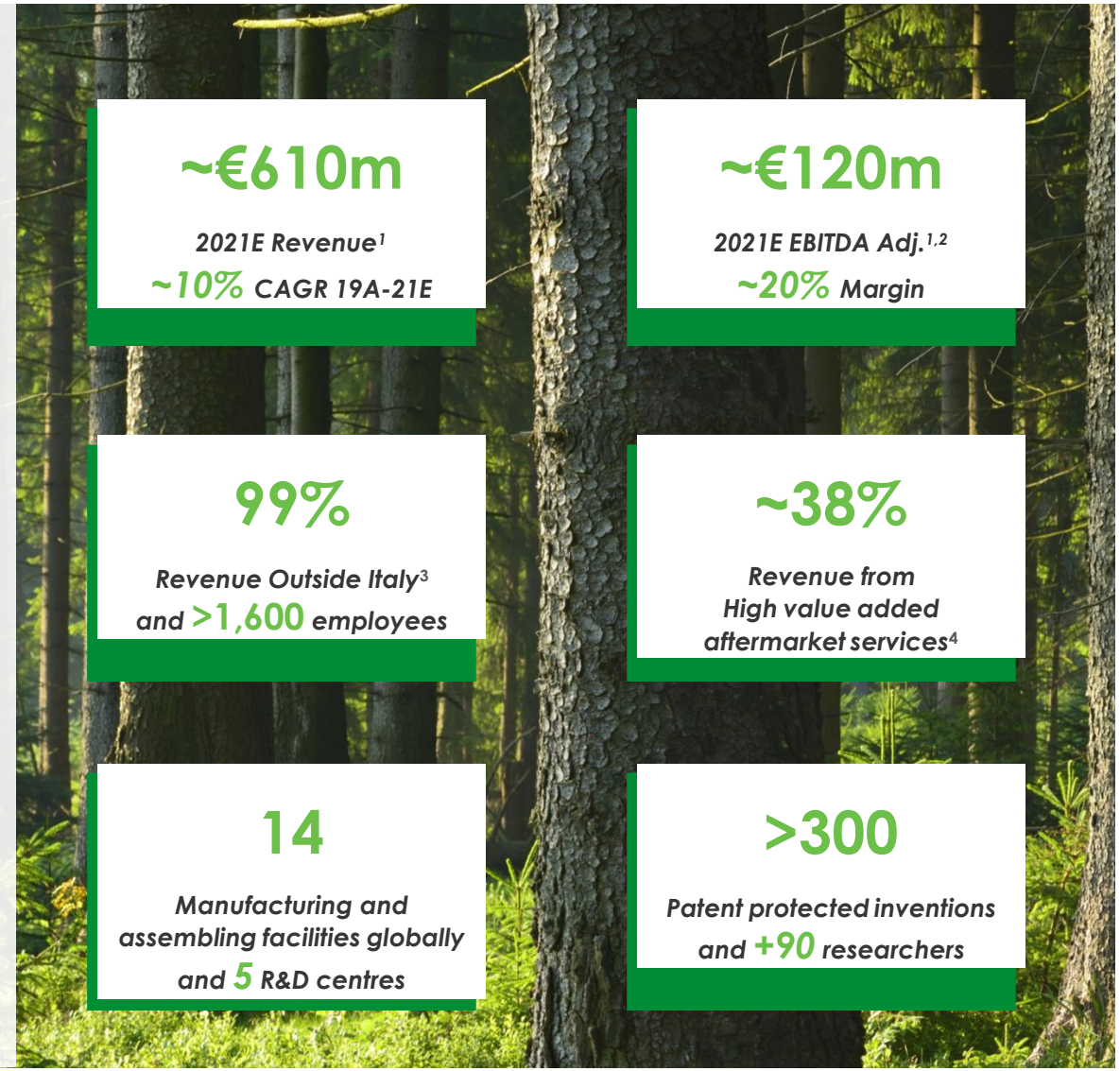
A global leading player in sustainable technologies

DE NORA

#1 largest supplier of metal-coated electrodes globally

Global leader in solutions for green hydrogen technologies

Leading positions in water and waste water treatment technologies



~€610m
2021E Revenue[1]
~10% CAGR 19A-21E

~€120m
2021E EBITDA Adj.[1,2]
~20% Margin

99%
Revenue Outside Italy[3] and >1,600 employees

~38%
Revenue from High value added aftermarket services[4]

14
Manufacturing and assembling facilities globally and 5 R&D centres

>300
Patent protected inventions and +90 researchers

Source: Company information, Roland Berger elaboration based on expert interviews.
[1] Reflect Management's current expectations for 2021 and are subject to change. [2] EBITDA Adjusted for non-recurring items
[3] Based on 2020A figures. [4] Average of 2019A – 2021E

A comprehensive portfolio of mission-critical solutions and high-value added aftermarket services…

DE NORA

Products and Solutions

Electrode Technologies

Anodes, Cathodes, Catalytic Coatings
Gas Diffusion Electrodes

Energy Transition

DSA® Electrodes for AWE, Electrolysis Cells, GDE, Electrodes for Fuel Cells

Water Technologies

Electro-chlorination Plants, Disinfection and Filtration Technologies, Ballast Water Treatment

Services

- Electrodes recoating, repair services, and spare parts
- Performance upgrades and retrofits
- Engineering design
- Supply and maintenance agreements
- Technical assistance and remote support services
- Analytic services

...addressing well-diversified end markets and applications while serving a large customer base

Electrode Technologies

Chlor-alkali

Electronics

Mining

Energy Transition

Hydrogen production

Hydrogen storage and transportation

Fuel cells

Water Technologies

Swimming pools

Municipal and Industrial water & wastewater treatment

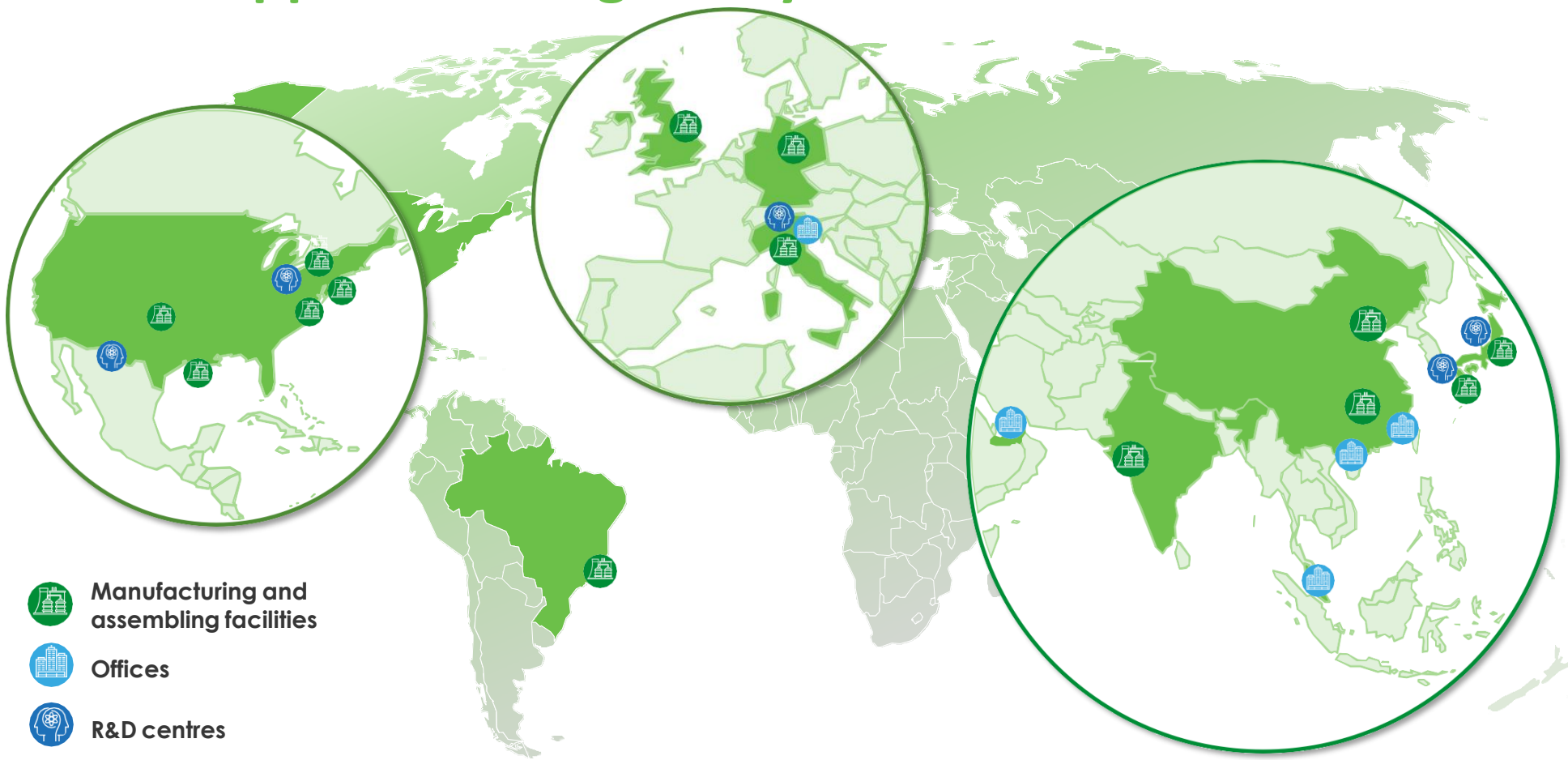
Power and Marine water & wastewater treatment

Customer Base

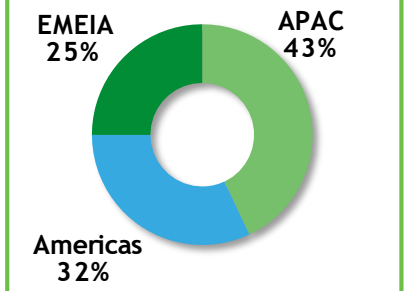
- Top-quality customer base across several markets
- Low customer concentration
- ~30%
  Top-20 customers revenues %[1]
- Long term tenure
- High revenue visibility based on product life cycle

Source: Company information. [1] % of total revenues based on 2020 figures excluding tk nucera.

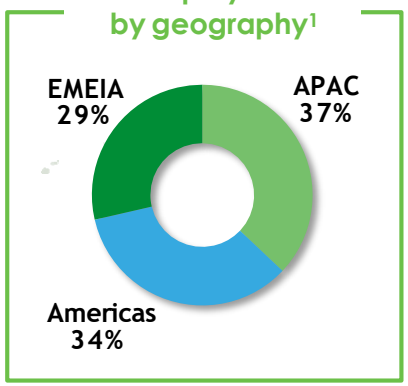
State-of-the-art manufacturing footprint to address market opportunities globally



Revenue by geography[1]



Employees by geography[1]



>1,600	144	26	14	5	+90
Employees	*Countries of presence*	*Operating companies / branches[2]*	*Manufacturing and assembling facilities*	*R&D centers*	*Researchers*

Source: Company information. [1] Based on 2020 figures. [2] Data as of December 2021. Includes the Parent company Industrie De Nora S.p.A.

The hydrogen colors:

“Not all hydrogens are created equal …”

Hydrogen colors and sources

H2 is a versatile energy vector that can be produced through several industrial processes

Hydrogen production methods and colors:

Black	**Coal gasification** Reacting coal with oxygen and steam	***Current production methods***
Gray	**Natural Gas reforming** Reacting Methane and Steam (SMR)	
Brown	**Gasification** Fossil fuels gasification	
White	**By product of industrial processes**	
Yellow	**Electrolysis** Powered by the GRID	
Blue	**Black / Gray / Brown with Carbon Capture & Storage (CCS)**	**Low Carbon Hydrogen**
Green	**Electrolysis** Water electrolysis powered by Renewables	
Purple	**Electrolysis** Powered by nuclear energy	

Low Carbon Hydrogen processes:

Blue Hydrogen

COAL METHANE + STEAM REFORMING

+

CO_2

CO2 MANAGEMENT (CCS – Carbon Capture and Storage)

Green Hydrogen

RENEWABLE ELECTRICITY + ELECTROLYSIS

Purple Hydrogen

NUCLEAR ELECTRICITY + ELECTROLYSIS

Low carbon hydrogen production on large scale: an enabling factor for the energy transition

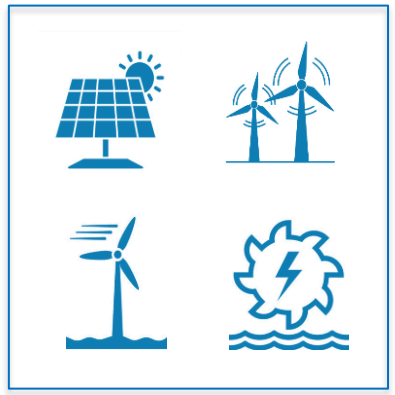
“Hydrogen offers the only long-term, scalable, and cost-effective option for deep decarbonization in sectors such as steel, maritime, aviation, and ammonia …”

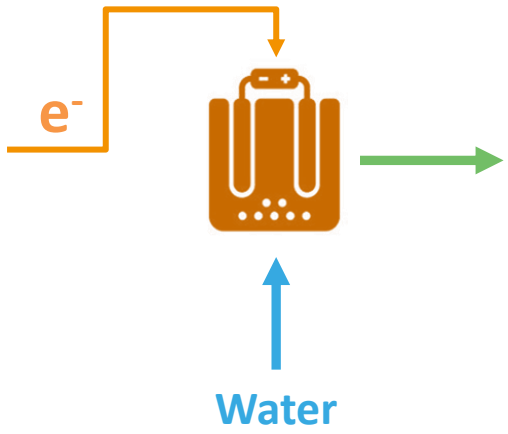
(the hydrogen council)

Green H2 role in Energy Transition

As renewable power prices *decrease* …

… and electrolyzer cost *decrease*…





Cement Industry

Iron & Steel Industry

Ammonia/ Methanol/Chemical

Refining/ Petrochemical

Heavy & Light Duty Vehicles

Shipping

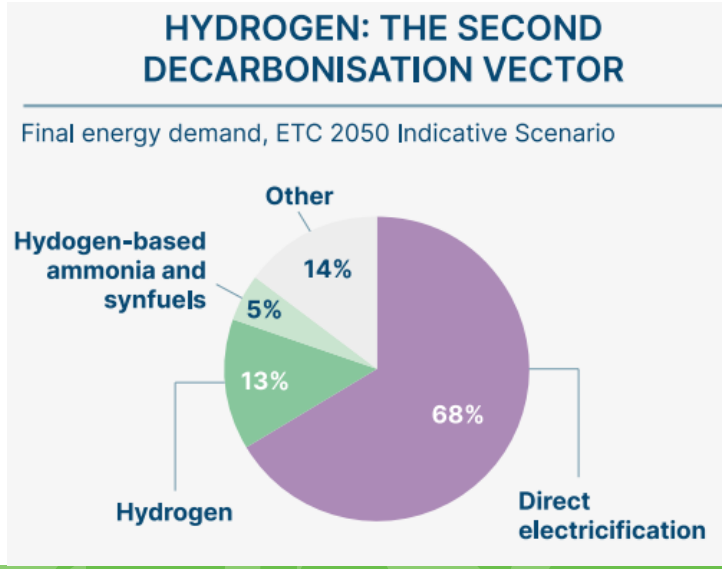
Rail transport

Aviation

Building / Industrial Heat & Power

Energy Storage

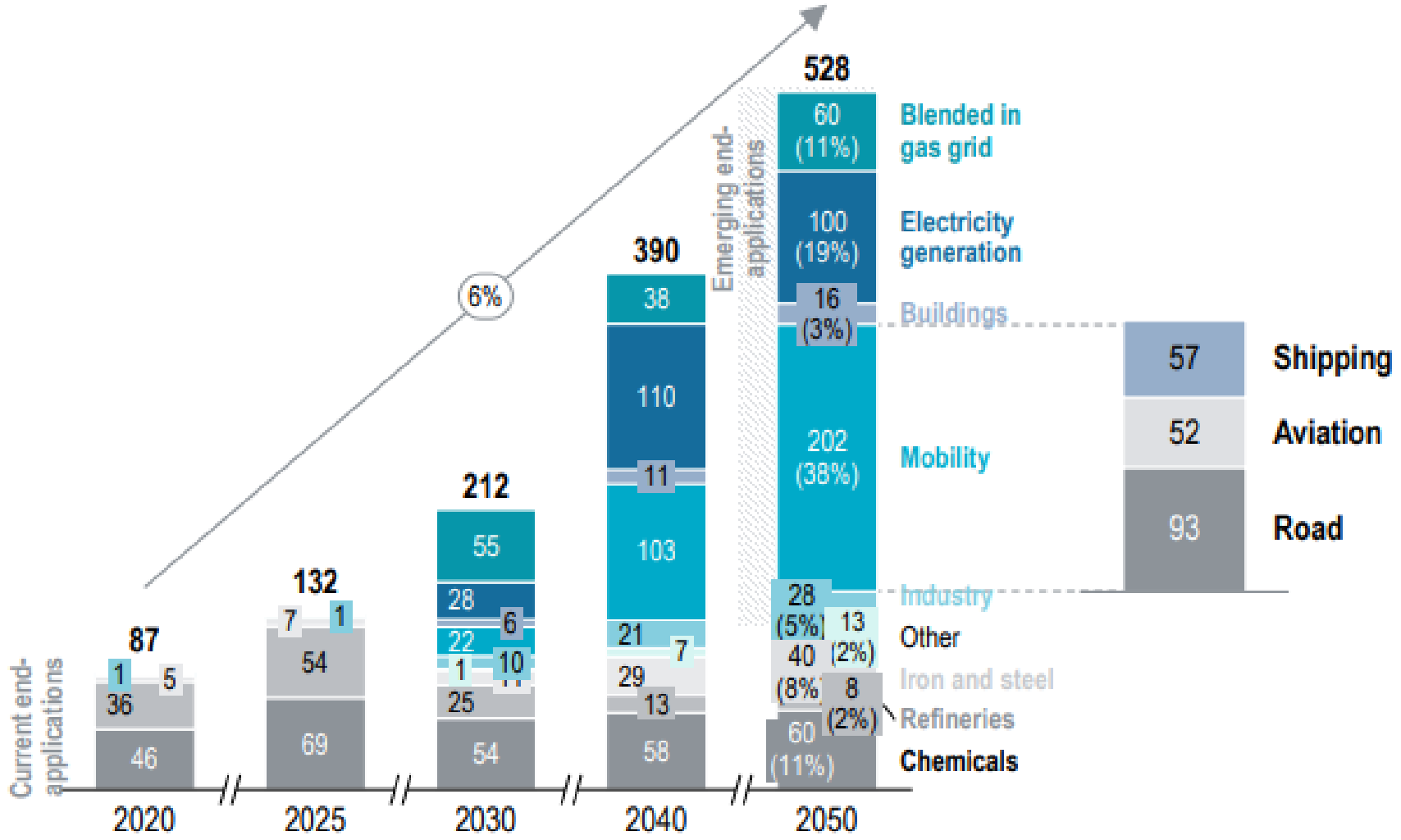
… hydrogen end markets will rise



Source: Hydrogen Council 2050 / ETC (Energy Transition Commission

Hydrogen demand is expected to grow by c. 6% p.a. between 2020÷50 driven by multiple end markets

Global hydrogen market[1] by end market (2020÷2050; Mton)



Key highlights

- **Several reputable sources are providing estimates** of the growing hydrogen market

2050 global H2 Market (*Mton*)	
IRENA[2]	~600
Energy Transitions Commission[3]	~800
Bloomberg NEW ENERGY FINANCE[4]	~800
Hydrogen Council[5]	~660

- **Central role of Hydrogen in reaching net zero** emissions and limiting global warming to 1.5°C
- Critical in **achieving decarbonization of hard-to-abate** sectors
- An **enabler in the energy system**
- Potential as an **energy vector for a wide range of applications** in transport, buildings, and industry

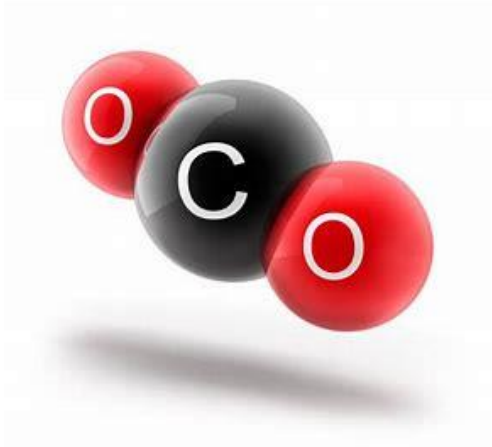
[1] Roland Berger elaboration based on IEA, Hydrogen Council. Values include hydrogen and hydrogen contained in ammonia and synthetic fuels. [2] Referring to IRENA 1.5°C scenario. Source: IRENA (Geopolitics of the Energy Transformation: The Hydrogen Factor). [3] Referring to Energy Transitions Commission (ETC) Supply-side decarbonization only scenario. [4] Referring to BNEF Green Scenario. [5] Referring to Hydrogen Council scenario.

BLUE and GREEN Hydrogen: PROS, CONS and future mix

“BLUE will help in accelerating the hydrogen adoption in H2A sectors, but GREEN will dominate the scene after 2030 ”

	BLUE Hydrogen	GREEN Hydrogen
PROS	• Possible retrofit of existing GREY H2 facilities • Fast market entry • Possible CO_2 utilization (CCU) • **Lower cost (?)**	• Lower CO_2 footprint (GREEN) • Flexible production process → direct interface with RE • EChem allows a modular approach in sizing up this kind of production plants • Side production of pure Oxygen
CONS	• CO_2 capture efficiency (65% - 90%) • CH_4 fugitive leaks (3,5% of total CH_4) • 10% -15% reduction in total GHG emissions • CO_2 storage requires large volumes • Hydrogen cost linked to NG cost • CO_2 capture cost and energy consumptions (+23% to energy and NG required compared to GREY)	• **Higher cost (?)** • Availability of RE → slower market entrance

CO2 production by process:



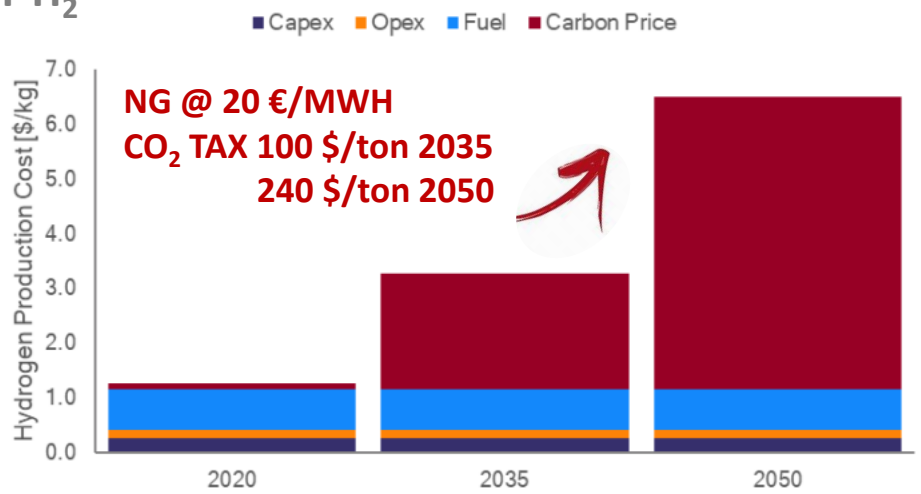
GREY: 22 ton/ton of H2

BLUE: 16,5 ton/ton of H2

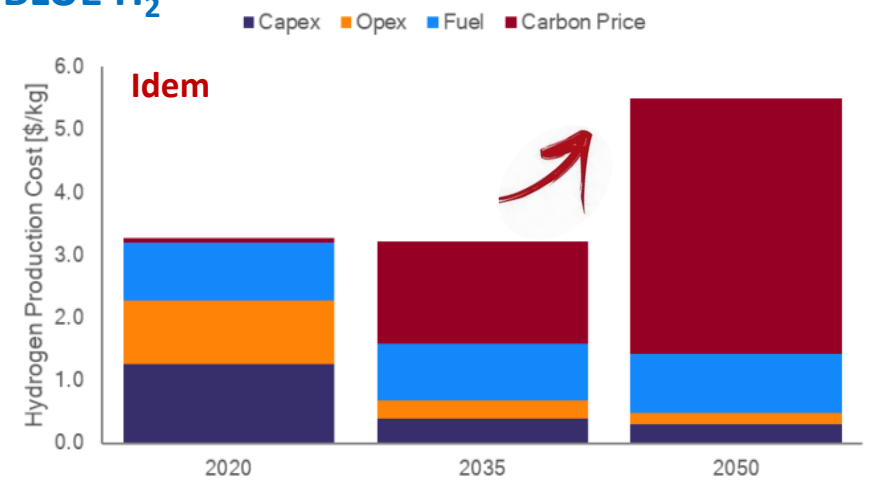
GREEN: potentially zero

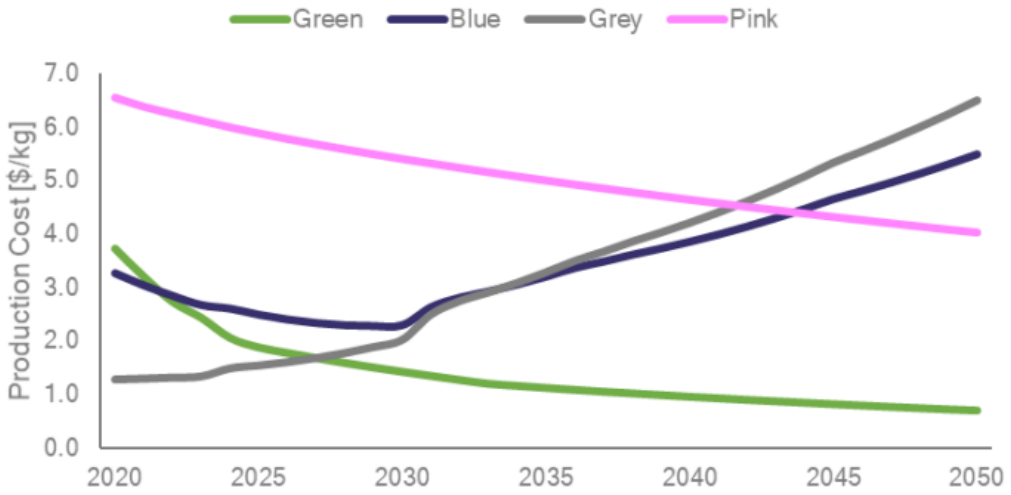
Hydrogen cost breakdown(*)

GREY H_2

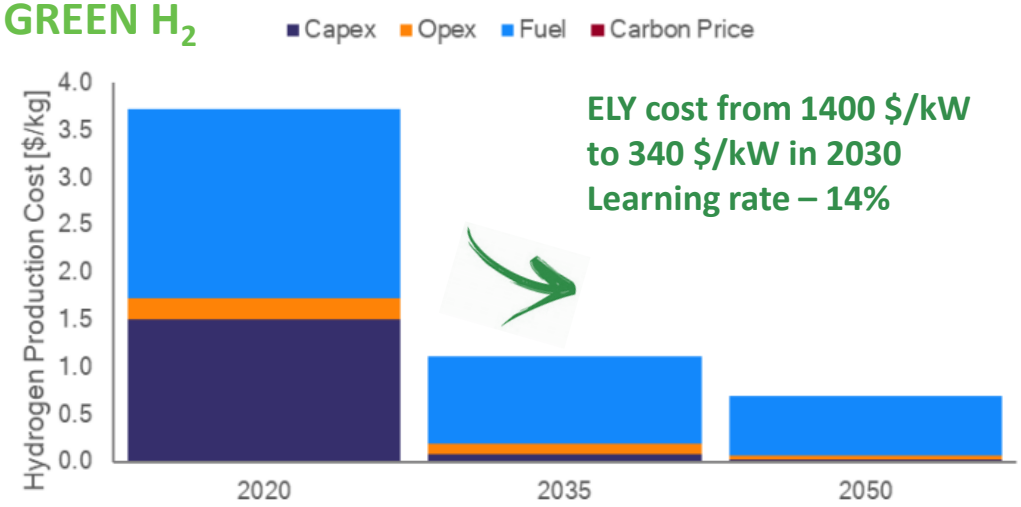


BLUE H_2





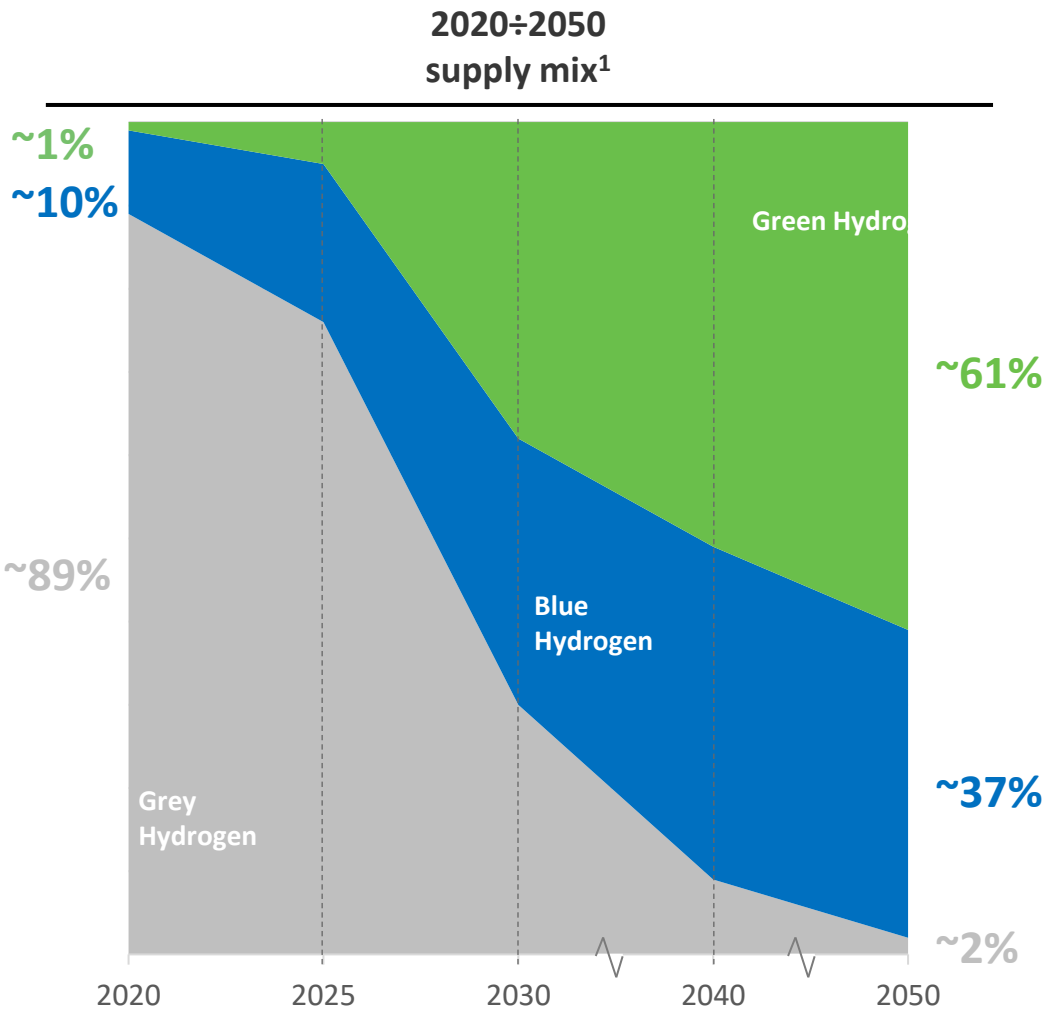
GREEN H_2



(*) ReTHINK Energy forecast to 2050

The world is running towards green hydrogen

	Inputs	Most common Process	Emission impact
Green hydrogen	Renewable energy Water	Electrolysis	NO CO_2 EMITTED
Blue hydrogen	Natural Gas Biomethane Biomass	Reforming	CO_2 stored / reused
Grey/ Brown hydrogen	Coal Natural Gas Biomethane	Reforming / Gasification	CO_2 emitted



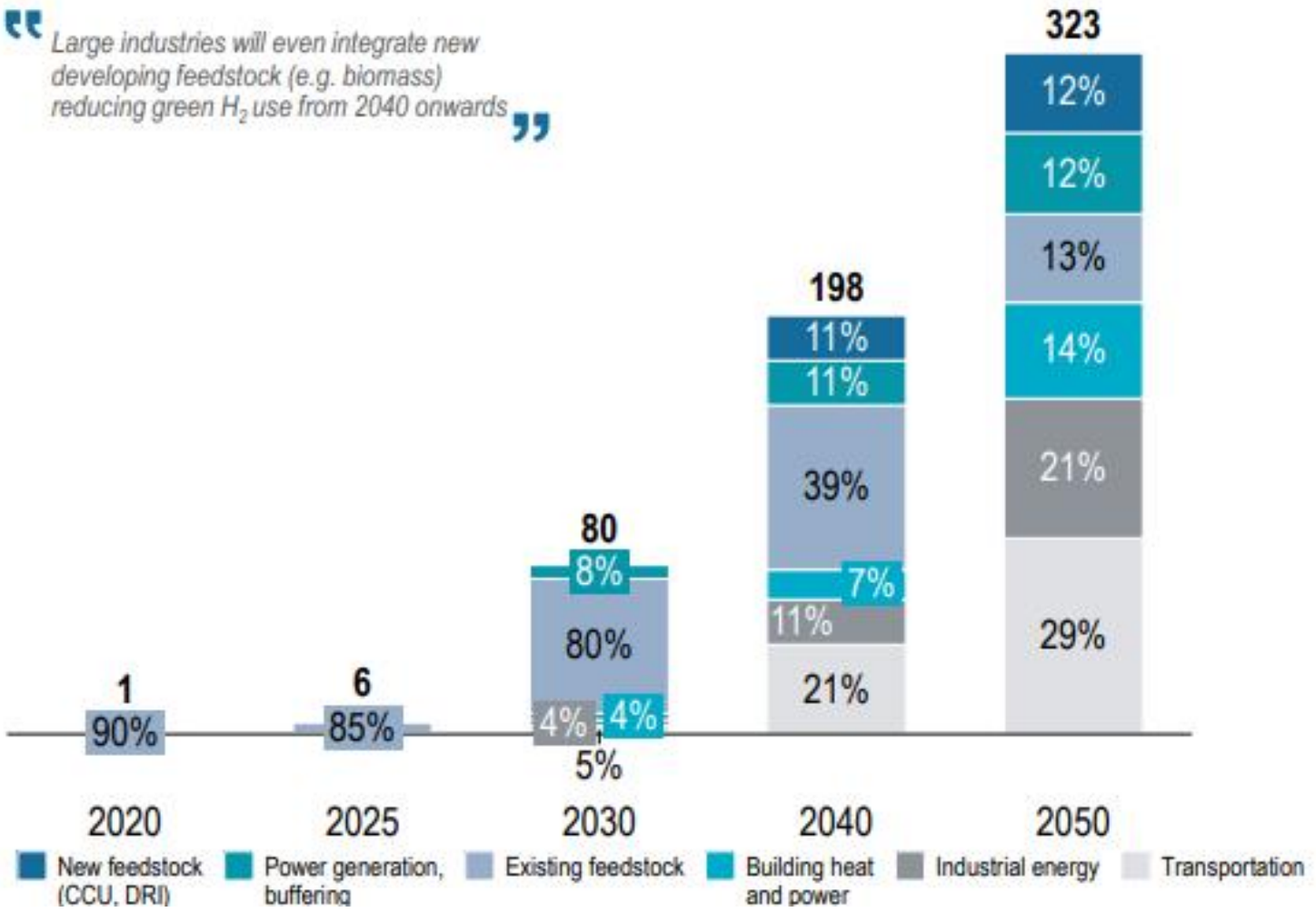
Green H_2 is expected to achieve the highest share of the supply mix by 2030 supported by reduced LCOH[2] and no CO_2 emissions

[1] *Elaboration of Roland Berger. Values include hydrogen and hydrogen contained in ammonia and synthetic fuel.*
[2] *LCOH = Levelized Cost Of Hydrogen*

Green hydrogen demand evolution between 2020÷50

Around half of the total green hydrogen is expected to be used in transportation and industrial energy by 2050

Global green hydrogen market[1] by end market (2020÷2050; Mton)



Key highlights

- Before 2030 the so-called "existing feedstocks" sector: ammonia, methanol, refining, … present the most rapid demand acceleration
- **In 2030 existing feedstocks will represent > 85% of the overall green hydrogen demand**
- Over the years, particularly from 2030 onwards, new markets that use H2 as an energy carrier, rather than as feedstock, are expected to emerge
- **Main growth in hydrogen demand by 2050** is expected to come from – Transportation – Industrial energy – Building Heat & Power

[1] *Elaboration of Roland Berger*

Main Green Hydrogen project under execution

“>2 GW Secured green H2 projects”

De Nora on leading projects for H2 development

DE NORA

NEOM Project
(Largest Hydrogen Project Globally)

Project Size: **> 2 GW**
tk Nucera project

Hydrogen Holland I Project
(Largest Hydrogen Project in Europe)

Project Size: **200 MW**
tk Nucera project

Casa Grande – Arizona, USA

Project Size: **40 MW**
tk Nucera project

Delfzijl Industrial Park – The Netherlands

Project Size: **20 MW**

Camacari Industrial Complex
(First industrial-scale green Hydrogen Site in Brazil)

I Phase Project Size: **60 MW**
tk Nucera project

Based on publicly available info


DE NORA
discover more