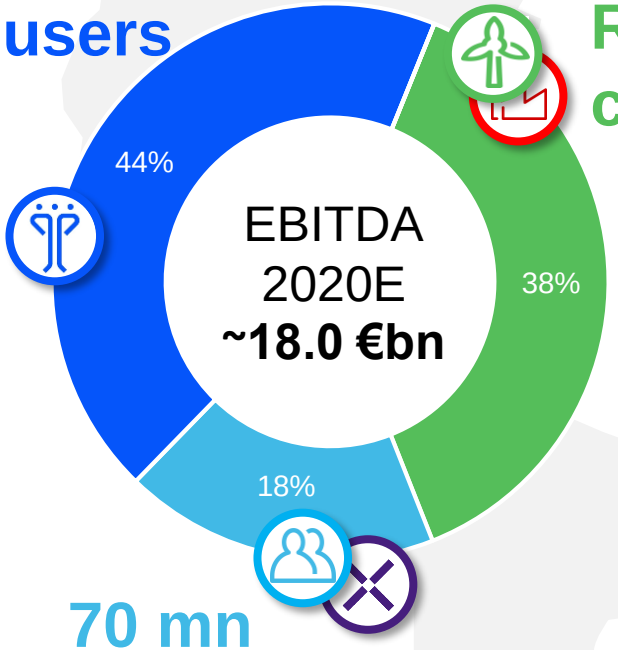
Green Hydrogen in Enel

April 22nd 2021

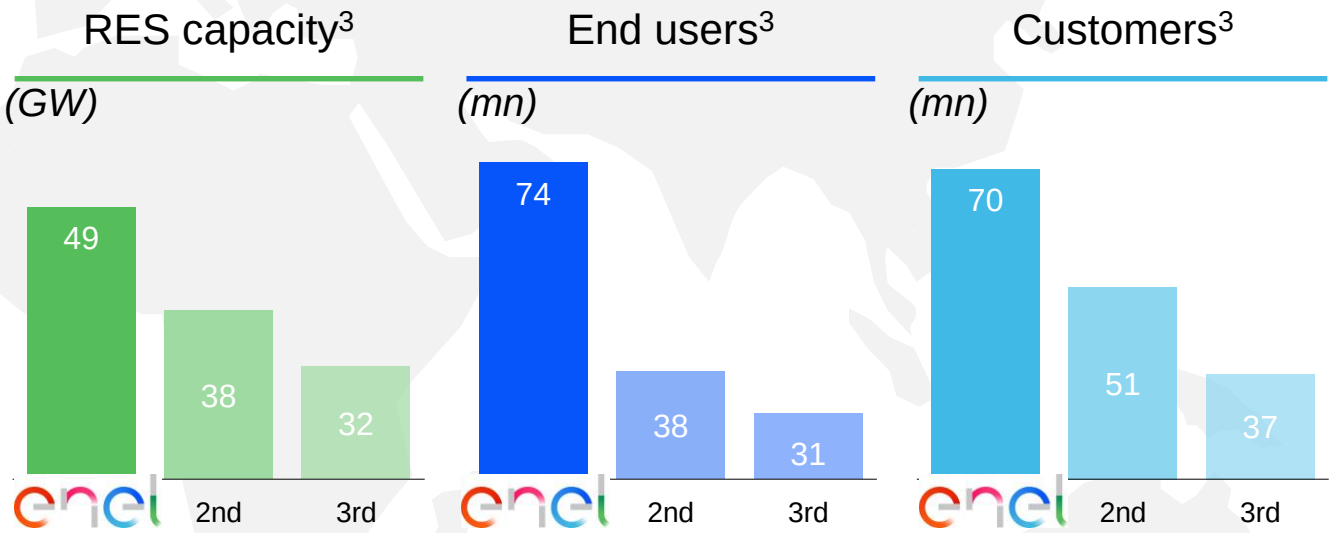
Enel is the leader in the asset classes that are at the center of the energy transformation

74 mn end users

49 GW RES capacity[1]



70 mn customers[2]



1. It Includes managed capacity
2. Power and gas customers
3. 2019 data for comps

Leveraging on Hybridization of renewables

Green hydrogen targets for 2023 and 2030

Value proposition

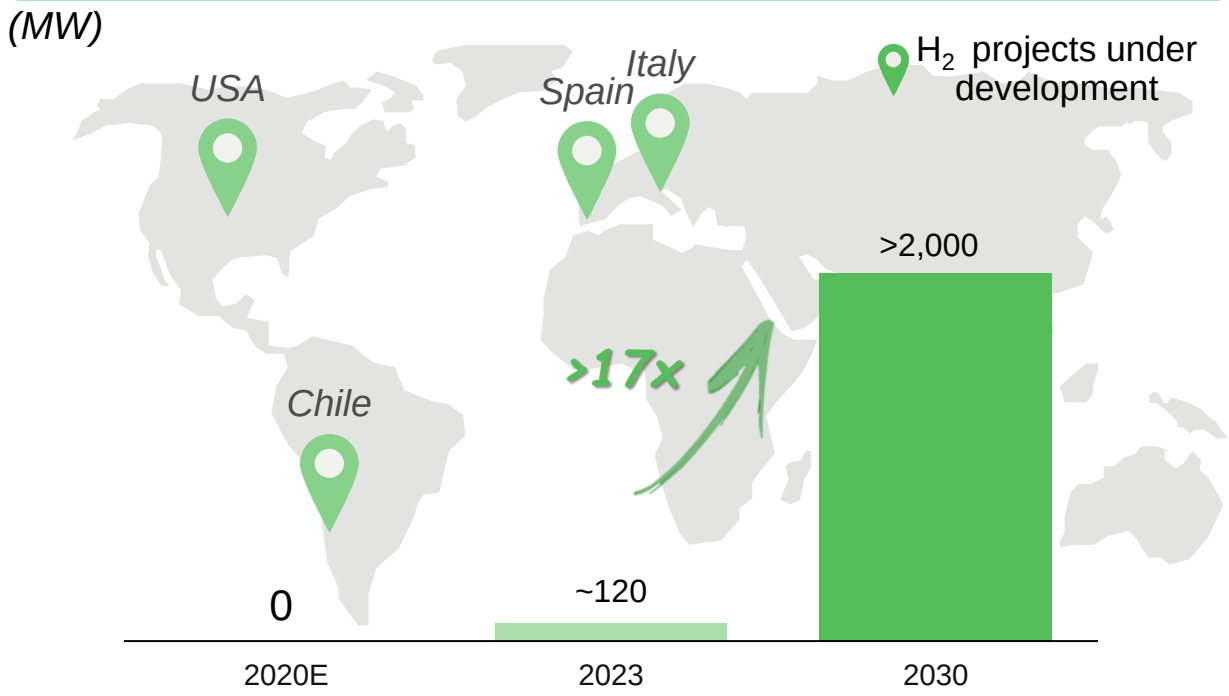
Competitive full decarbonization offer
bundling RES electricity and green H_2 supply

Main value drivers

- ✓ Sale of hydrogen to **industrial offtakers**
- ✓ RES plant **optimization**
- ✓ **Savings on Capex and Opex** arising from synergies with RES plant
- ✓ **Flexibility** services

	2020E	*2030*
% Plants hybridized with green hydrogen[1]	0%	>8%

Green hydrogen capacity

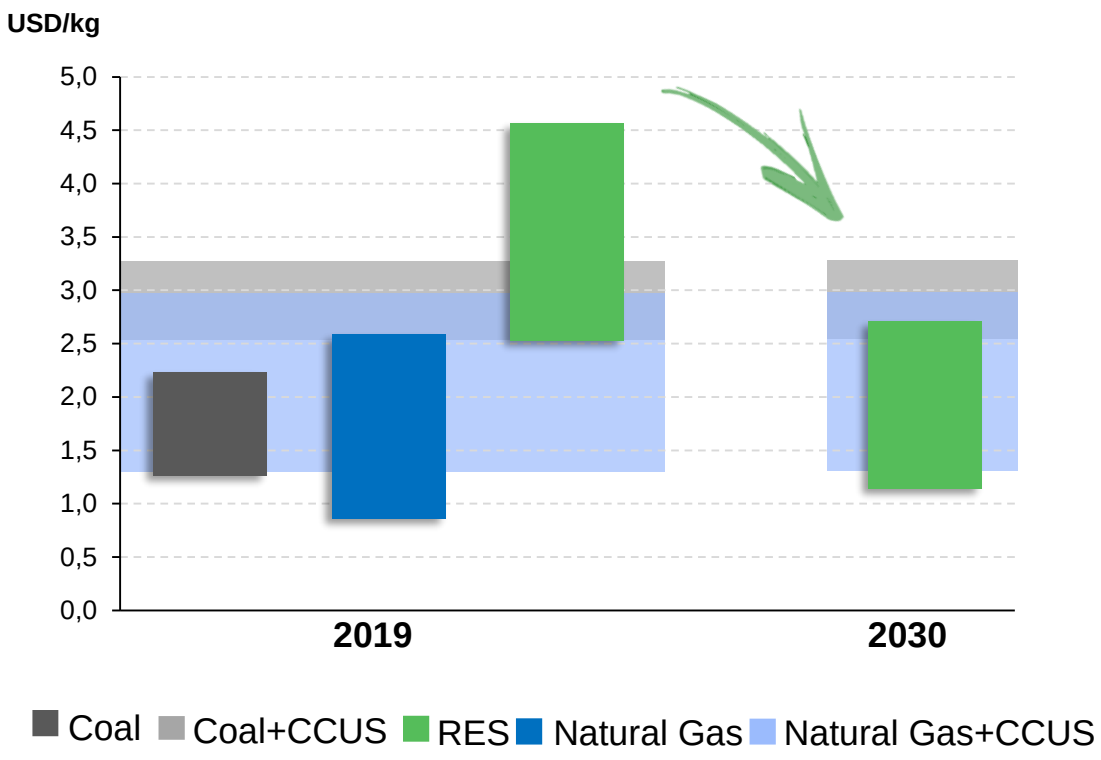


	2020E	2023	2030
Production (kton)	0	~5	>90

1. Calculated on ~95 GW additional capacity

Renewable hydrogen is currently expensive, but costs will decrease

Production Costs (LCOH)[1]



To allow competitiveness of green hydrogen, the **cost of electrolyzers will need to decrease by about 6x[2]**

Technological Evolution Examples in 2010-2020[2]

	Capex Reduction	Efficiency Increase
	9X	**+31%** capacity factor[3]
	9X	**+49%** energy density Wh/Kg

Sources: 1. Costs : BNEF - Hydrogen Economy Outlook (Mar 2020) 2. Internal analysis | 3. BNEF | 4. IRENA 2010-19 |

Industry - Green Hydrogen is best used in hard-to-abate sectors

Power to Chemical

replacement of grey hydrogen *as a feedstock*

e.g. in refining and ammonia industries

Power to Heat

replacement of fossil fuels *used to produce high grade heat*

e.g. in glass, ceramic and cement industries

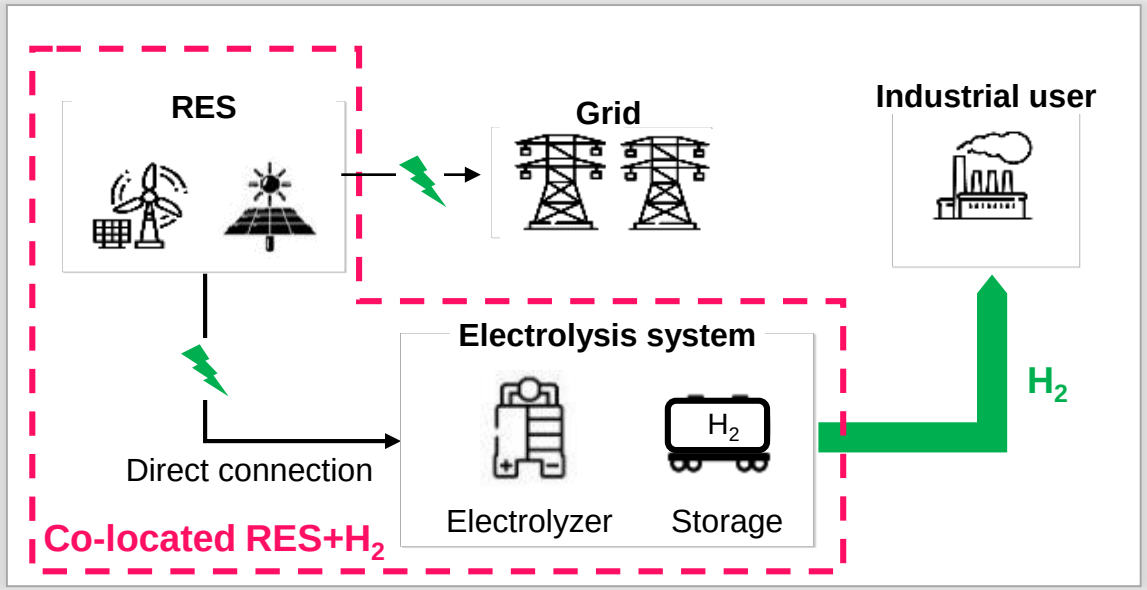
1 Source: IEA

Enel hydrogen business models

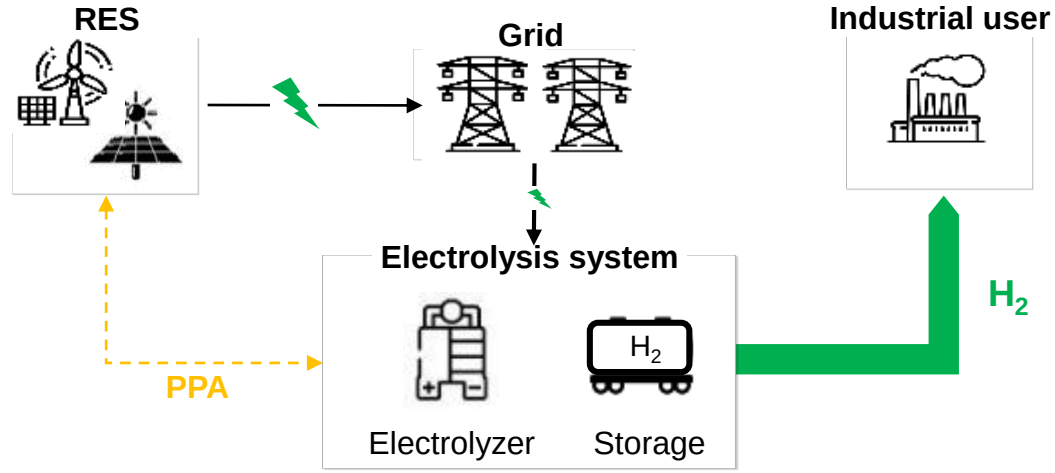
Green hydrogen is a scarce and precious resource

Physical flow
Commercial flow

Co-located RES+H2



Stand-alone



Main value drivers / potential issues

- ⊕ **Possibility of selecting best renewable** resource
- ⊕ **Shorter time to market with RES** project in advanced development status and **no constrains on RES capacity source**
- ⊕ **Exploiting synergies bewteen RES plant + hydrogen project**
- ⊕ **Ancillary services as a further revenue stream**
- ⊖ **Transport** costs (pipeline or trucks) may affect profitability

- ⊕ **Electrolyzer located at user site** (water and land easily available)
- ⊕ Proximity of hydrogen production and usage
- ⊕ **Possibility of exploiting project in advanced status of development**, shorter time to market.
- ⊕ **Not constrains on RES capacity source**
- ⊖ **Grid connection charges**
- ⊖ **No synergies between RES plant and hydrogen project** in terms of **Capex and Opex**

Green Hydrogen in the Power-to-Chemical Applications

Green Hydrogen projects at Refineries

- **10 MW Electrolyzer for refinery**

prod.	*consump.*	
H2		
600 t/y	~7k m3/y	~35 GWh/y

- **20 MW Electrolyzer for biorefinery**

prod.	*consump.*	
H2		
1200 t/y	~13k m3/y	~70 GWh/y

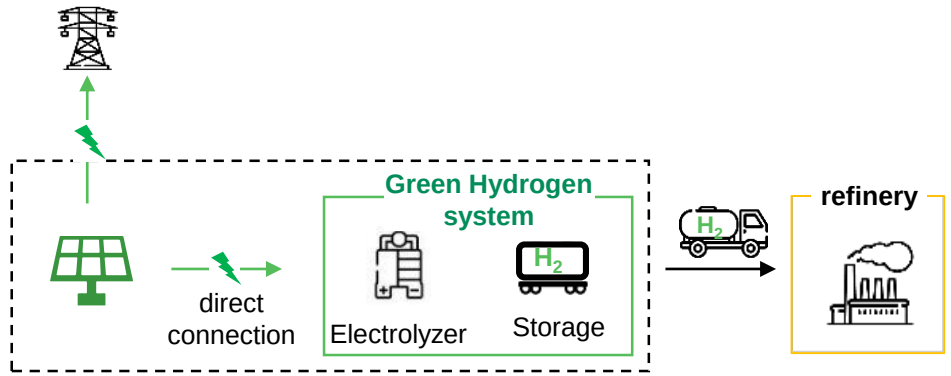
- **20 MW Electrolyzer for refinery**

prod.	*consump.*	
H2		
3000 t/y	~32k m3/y	~165 GWh/y

Each project may have alternative implementation options

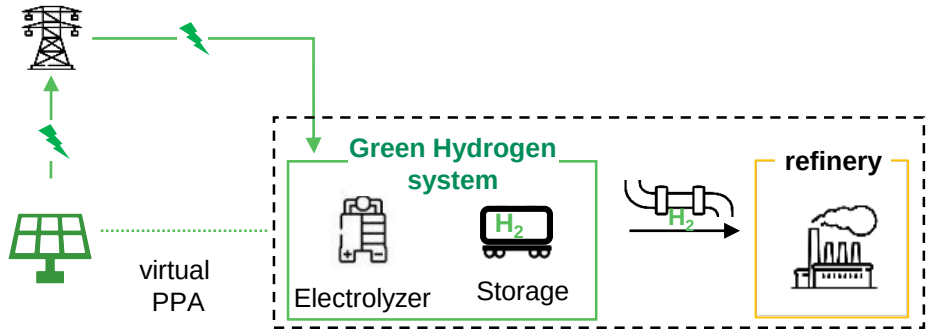
Facilities located at the same premises

Hydrogen system at EGP plant



Distance from PV site circa 30 km

Grid-connected Hydrogen system at the refinery



Enel vision on hydrogen

Electrification offers the cheapest and simplest route to decarbonize large portions of total final energy uses

Green Hydrogen's best use is as a complement to electrification, and not a competitor, to decarbonize hard-to-abate sectors

Hydrogen needs to be powered by 100% renewable electricity: it is the only truly sustainable production pathway

A domestic production of renewable hydrogen can lower dependency on fossil fuel imports and strengthen security of supply

The integrated configuration Renewables+Hydrogen, using the electrolyzer as a variable load, will enhance ancillary services, making the renewable plant more flexible.