

The Potential Role of Hydrogen in India – ‘Harnessing the Hype’

TERI Report Launch Event

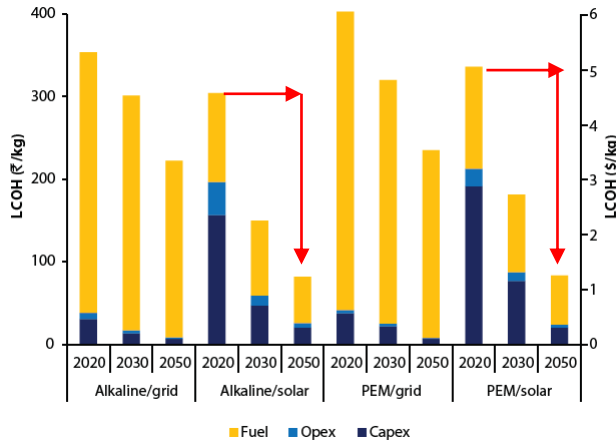
December 16, 2020

A pathway for scaling-up low carbon hydrogen across the economy

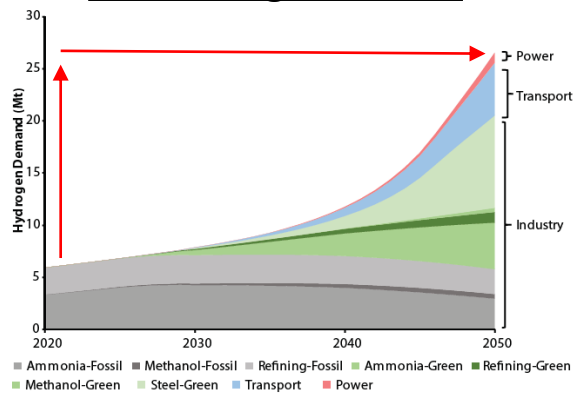
Will Hall, Thomas Spencer, Shruti Dayal, G. Renjith

Key Message 1: A Virtuous Circle For Hydrogen Technology Is Emerging

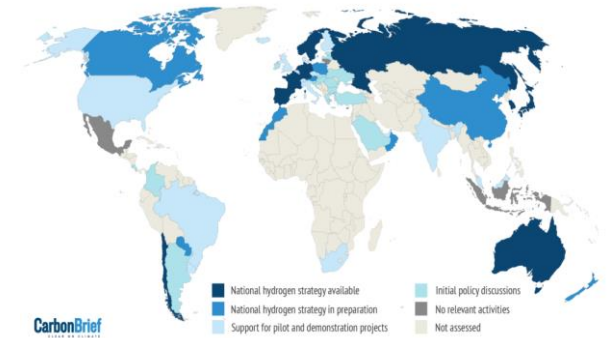
Falling Costs



Increasing Demand



Strengthening Policy



Key Message 2: Demand Can Grow Fivefold by 2050, But Supportive Policy Is Still Required to Derive The Full Benefits

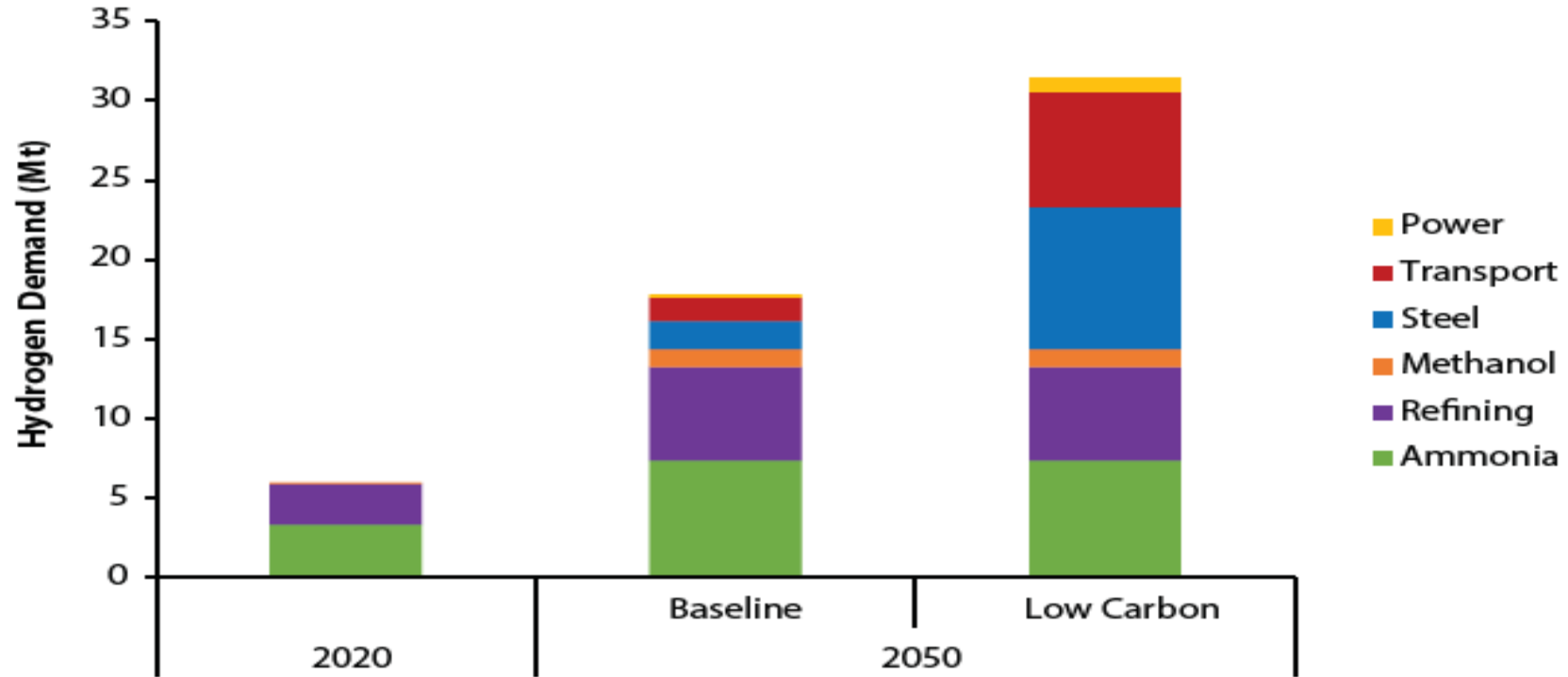


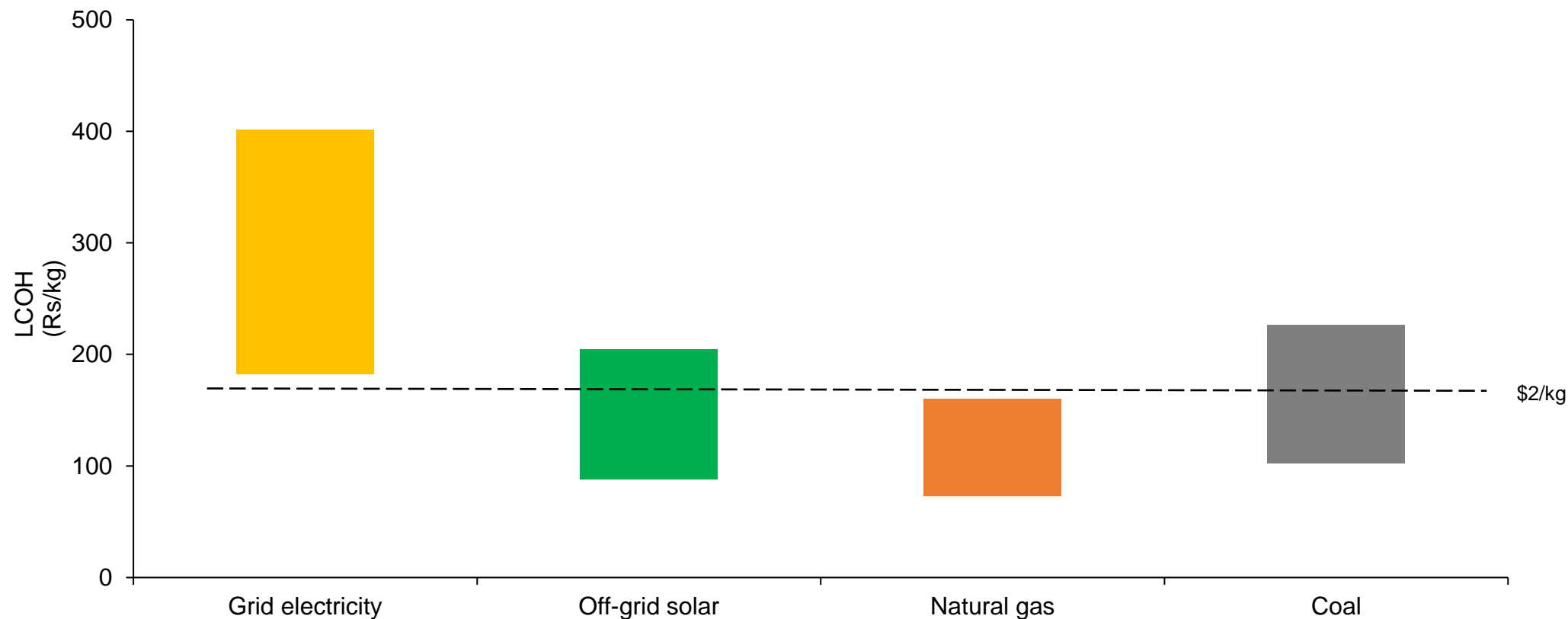
Figure 4: Baseline and Low Carbon scenarios, 2020 and 2050

Source: TERI analysis

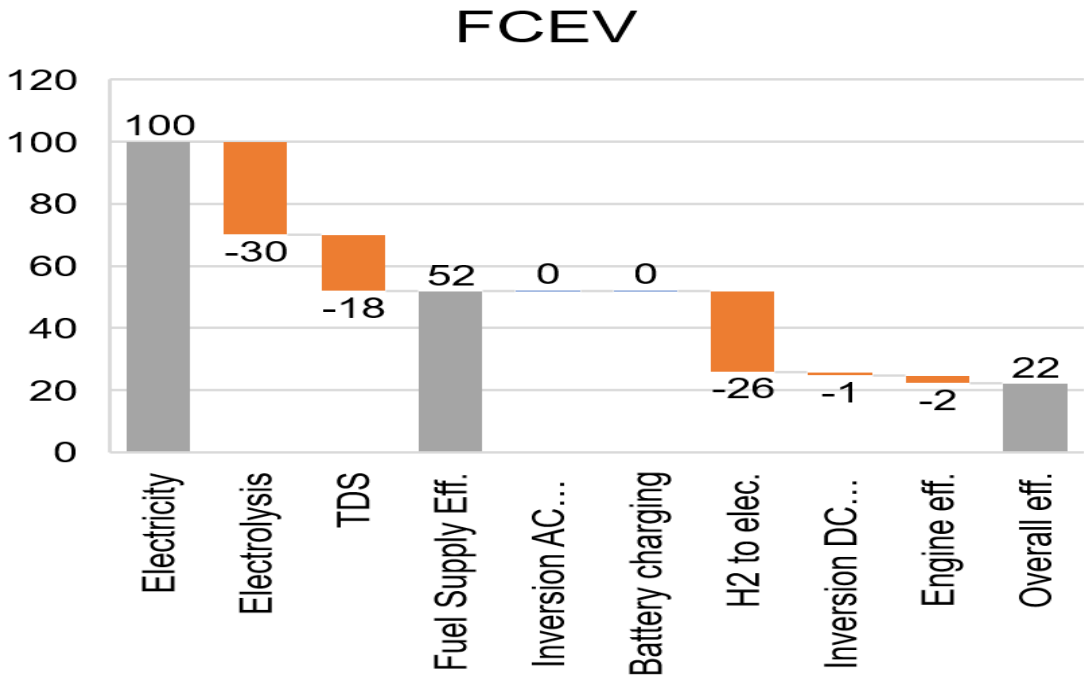
Note: Demand projections exclude potential use of hydrogen in shipping, aviation, and petrochemicals, which are not covered in this report.

Key Message 3: By 2030, Costs of “Green Hydrogen” From Renewables Will Fall More Than 50% and Will Start to Compete With Hydrogen From Fossil Fuels

2030 Cost Range for H2 Production Routes in India

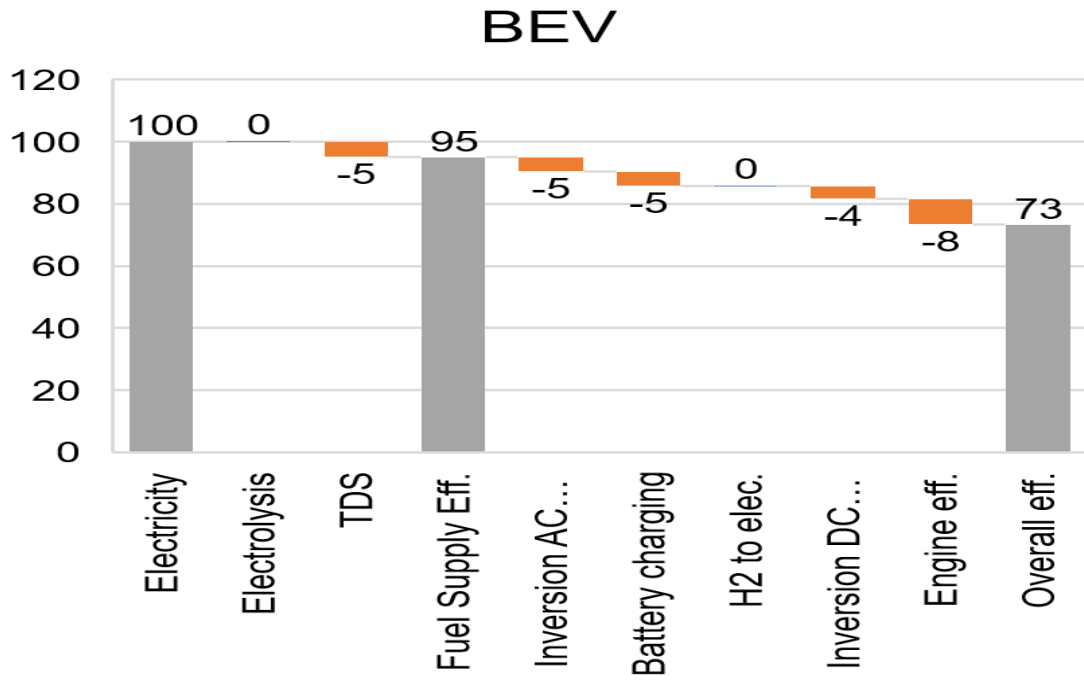


Key Message 4: Hydrogen Is Not Always the Most Efficient Option, And Its Use Should Be Reserved For Cases Where No Alternatives Exist



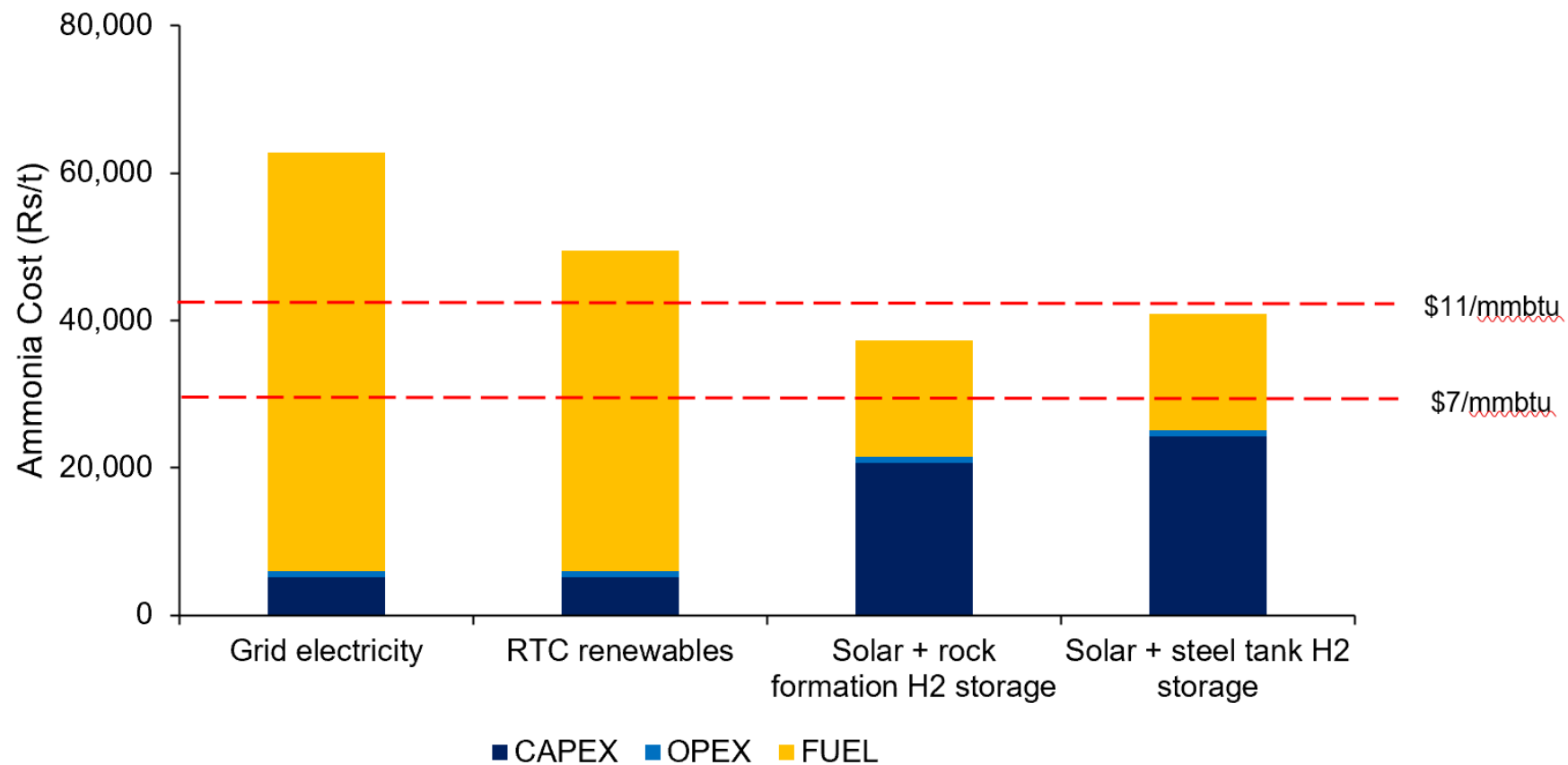
Total conversion efficiency

22%

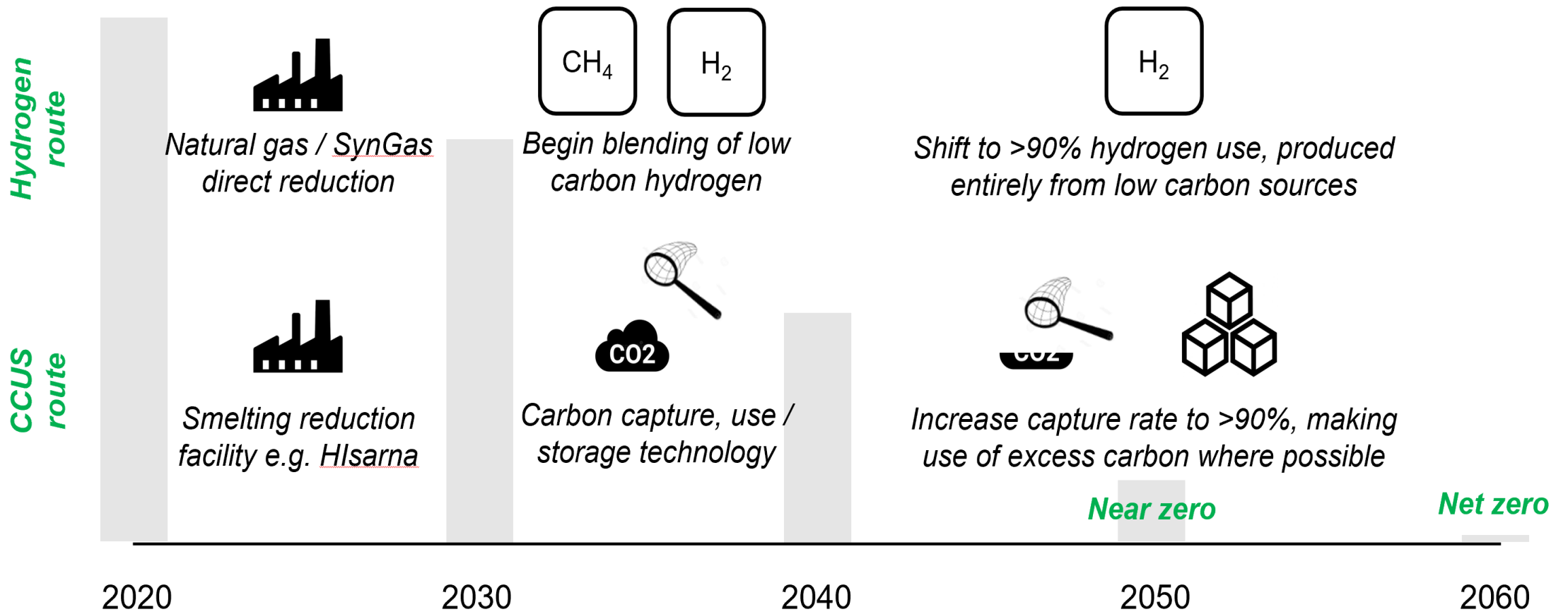


73%

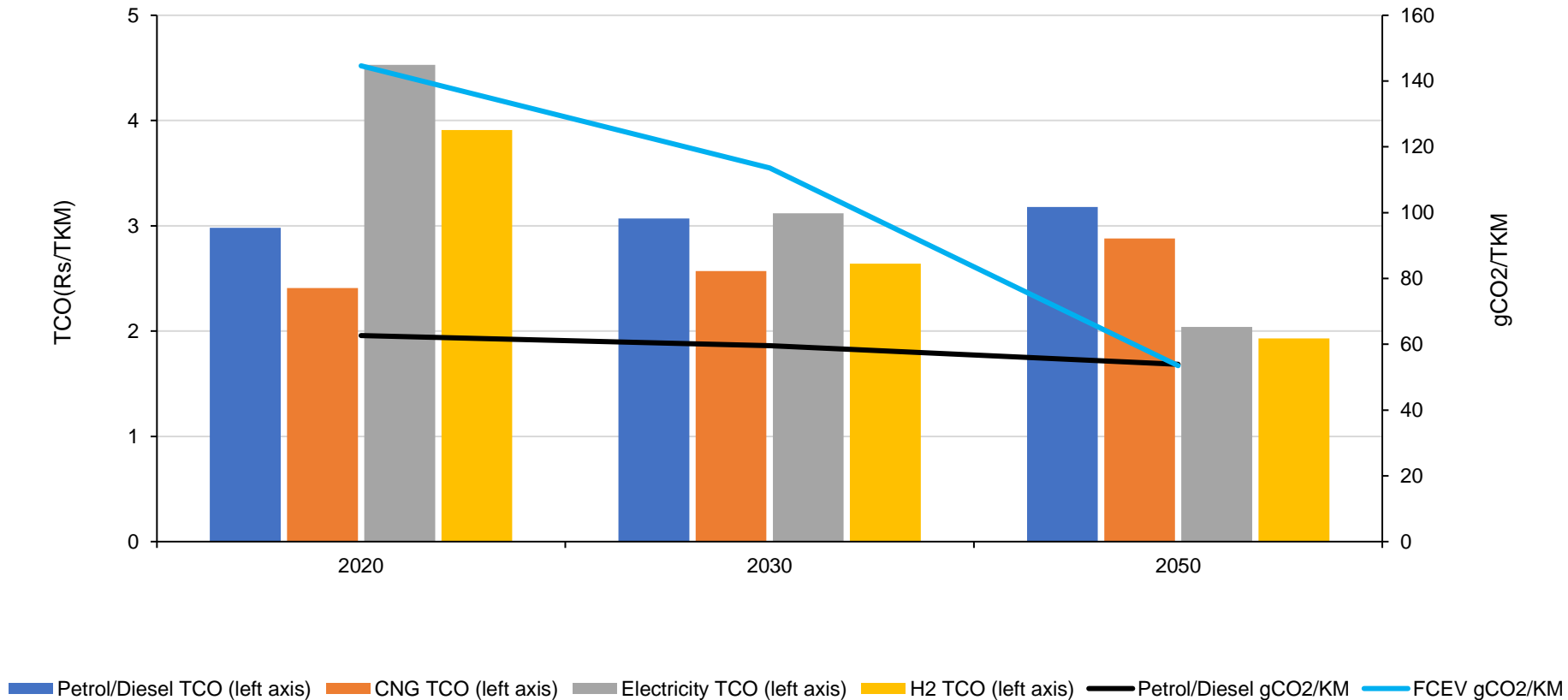
Key Message 5: In Industry, Hydrogen Can Start to Compete With Fossil Fuels In Certain Applications Already by 2030



Key Message 5.1: In Industry, Hydrogen Can Be Part of a Cost-Competitive, Step-Wise Route to Decarbonization by 2060

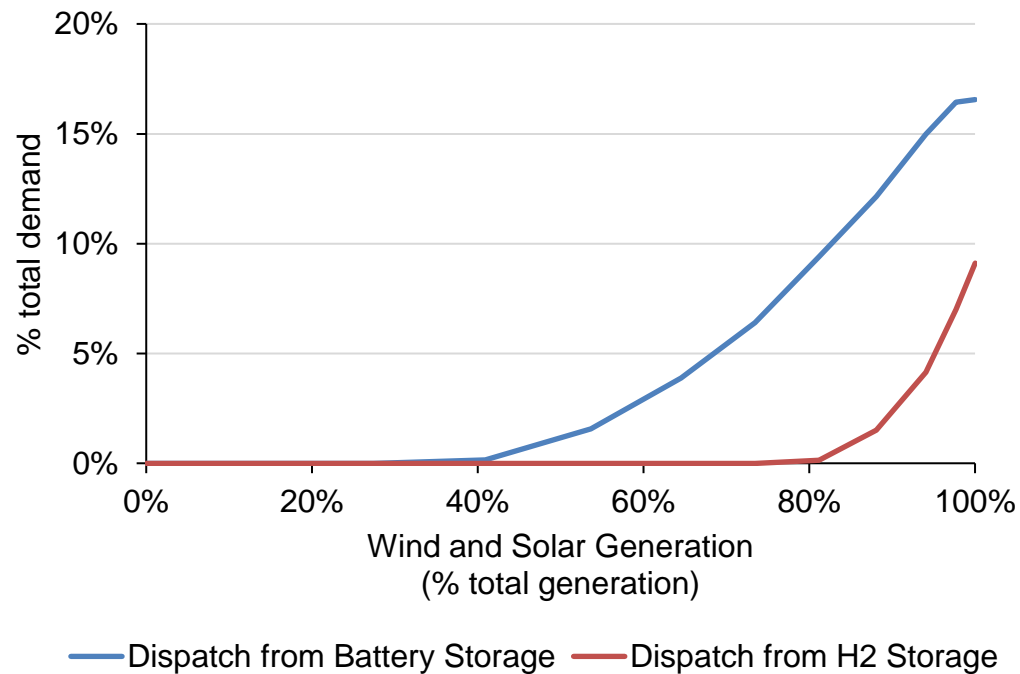


Key Message 6: In Transport, Even In Heavy Duty Segments, BEV Vehicles Will Become Very Competitive, Reducing the Use of H2 To Very Long Distance Transport

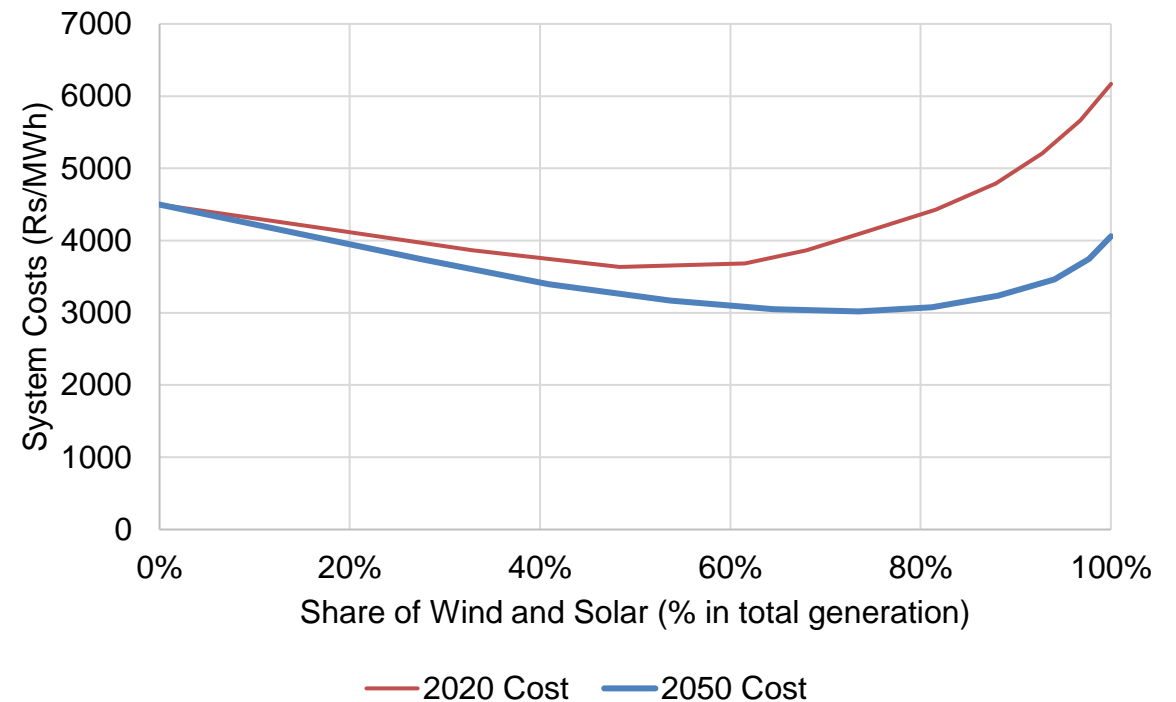


Key Message 7: In Power, H2 Could Provide An Important Source of Seasonal Storage, But Is Expensive and Only Required in High RE Systems

Role of Seasonal and Intraday Storage With Increasing Share of VRE



System Wide Costs With Increasing Shares of VRE, 2020 and 2050 Technology Costs



Key Message 8: Green Hydrogen Production Could Require Around 1000 TWh of Green Electricity by 2050, Placing Further Pressure on Power System Decarbonization

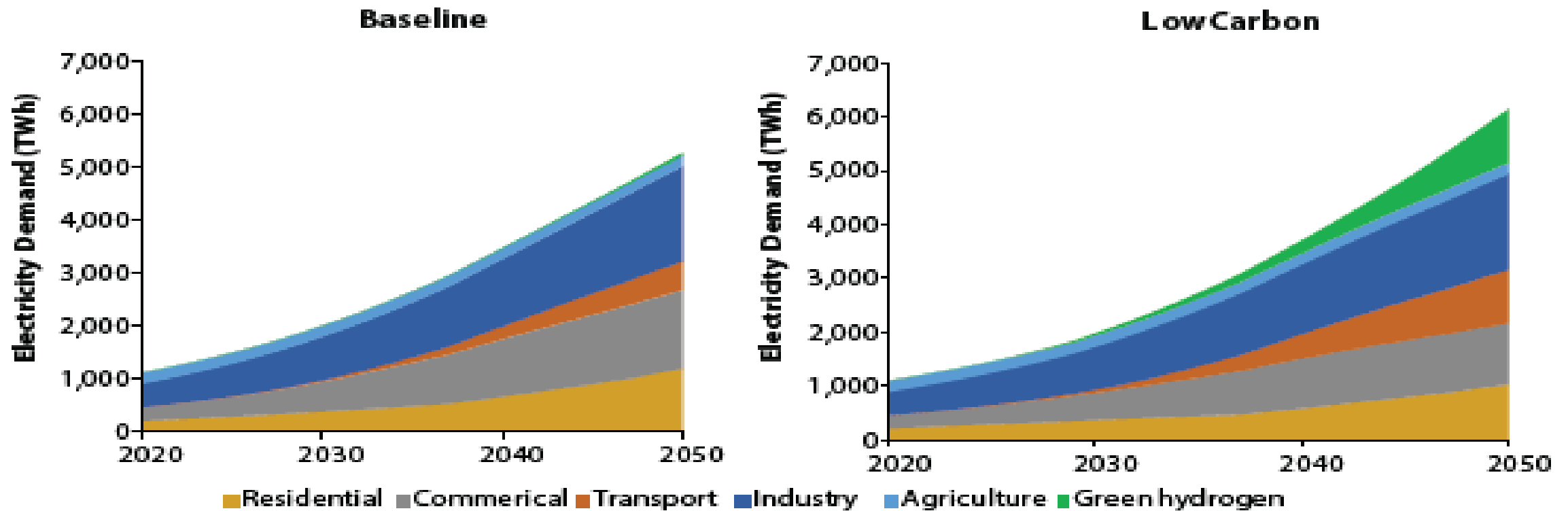


Figure 50: Annual electricity demand by major end-use sector, Baseline and Low-Carbon Scenarios

Source: TERI analysis

Key Message 9: Constant H2 Supply to Industry is Possible and Cost-Effective with VRE, But Open Access RE, Curtailment and H2 Storage Characterise the Optimal System

Costs of H2 in a typical Gujarat cluster

Item	Unit	2020	2030	2050
Optimal PV	MW	41	72	86
Optimal Wind	MW	84	41	17
Optimal Electrolyser	MW	42	53	62
Optimal Battery	MWh	0	0	0
Optimal H2 Store	MWh	414	699	6062
Solar Curtailment	%	26%	22%	11%
Wind Curtailment	%	17%	6%	2%
Grid Consumption	%	14%	6%	0%
Levelised Cost, Scenario 1	Rs/kg	288	152	93
	\$/kg	3.89	2.06	1.26
Levelised Cost, Scenario 2*	Rs/kg	260	132	81
	\$/kg	3.52	1.78	1.10

Key Take Aways

1. The hype is real – by 2030, low-cost green hydrogen will be competitive.
2. Hydrogen is not a panacea for the energy system.
3. To capture the full benefits, policy is required:
 1. R&D.
 2. Demonstration and commercialization in key sectors.
 3. Infrastructure and incentives.
 4. Optimise the deployment of H2 from a system-wise perspective.
 5. International partnerships and funding.

THANK YOU