# AVENER

# Green Hydrogen

Zero Emissions, Infinite Possibilities

**Industry Report** 

April 2025



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Future of green hydrogen

## Overview of Green Hydrogen in India

Fueling the future growth with Green Energy



## Unlocking Green Hydrogen - Opportunities

Driving Deep Decarbonization and Investment Momentum



### Green hydrogen fuels India's decarbonisation goals



Launch of National Green Hydrogen Mission in Jan'23



Replacement potential of 80% of **Energy Consumption** 



Net Zero by 2070

### ₹10 Lakh Cr

Opportunity

### ₹1 Lakh Cr

Reduction in fossil fuel imports

### 50 MMTPA

Abatement of GHG emissions

## **Policy Initiatives**

Aligning Indian and Global Policies with 2030 Vision



## Policy Initiatives for Implementation of Green Hydrogen in India

Multiple schemes announced to incentivize investments and promote domestic production



- Aimed to make India a global hub green hydrogen
- Outlay of INR 19,744 crore towards producing  $GH_2$
- To identify and develop regions capable of supporting large scale production



- Waiver of ISTS charges for 25 years for projects commissioned before 31st December, 2030
- Connectivity shall be granted on priority
- MNRE to establish single portal clearances



- Focus on establishment of domestic manufacturing
- Total outlay of INR 4,440 crore allocated till FY 2029-30
- SECI issued tenders under two tranches for electrolyser manufacturing



- Focus on establishment of domestic production
- Total outlay of INR 13,050 crore allocated till FY 2029-30
- SECI issued tenders under two tranches for green hydrogen manufacturing



- Granting of open access for RE energy within 15 days
- Incentive such as exemptions from cross-subsidy surcharge and additional surcharges
- Banking allowed for 30 days of energy used



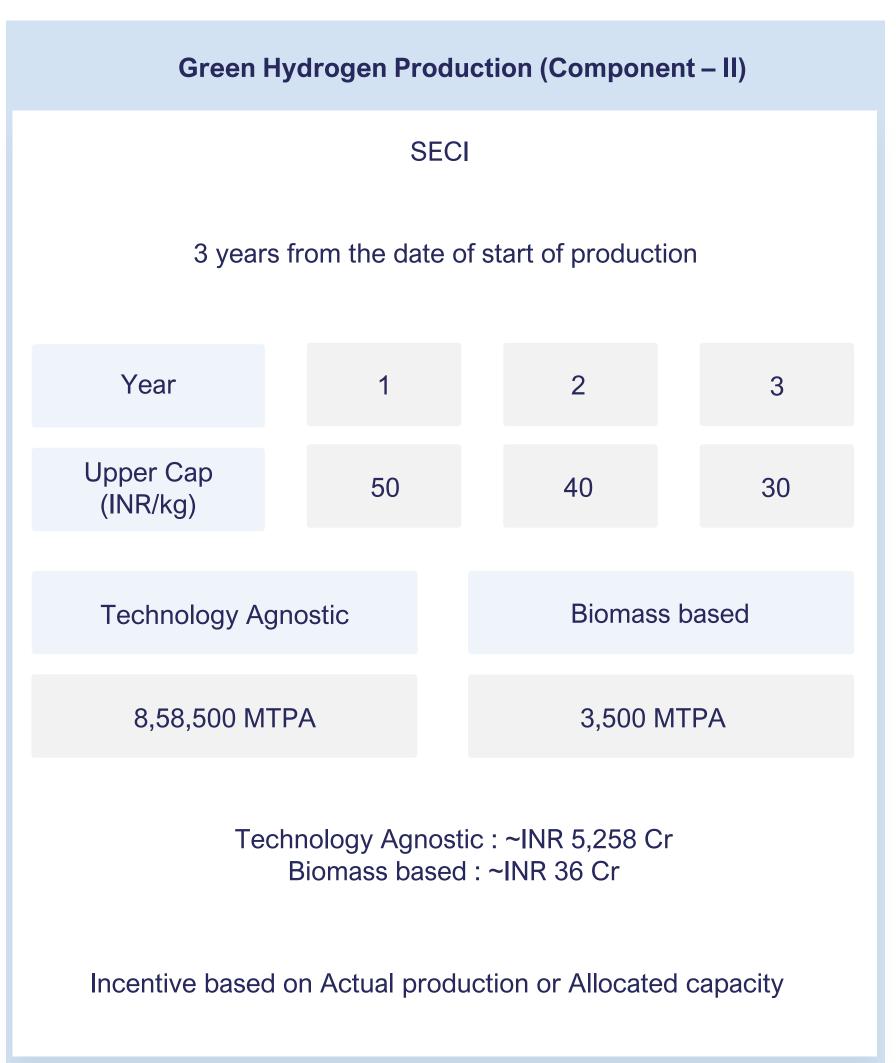
- Various states introduced GH2 policies – Mah, Guj, Raj, Kar, UP, AP, WB, etc
- Benefits as ED exemption, wheeling charges exemption
- Additional benefits such as classifying the projects under 'White category' status

## PLI Scheme for Green Hydrogen & Electrolysers

Bolstering local production through government incentives

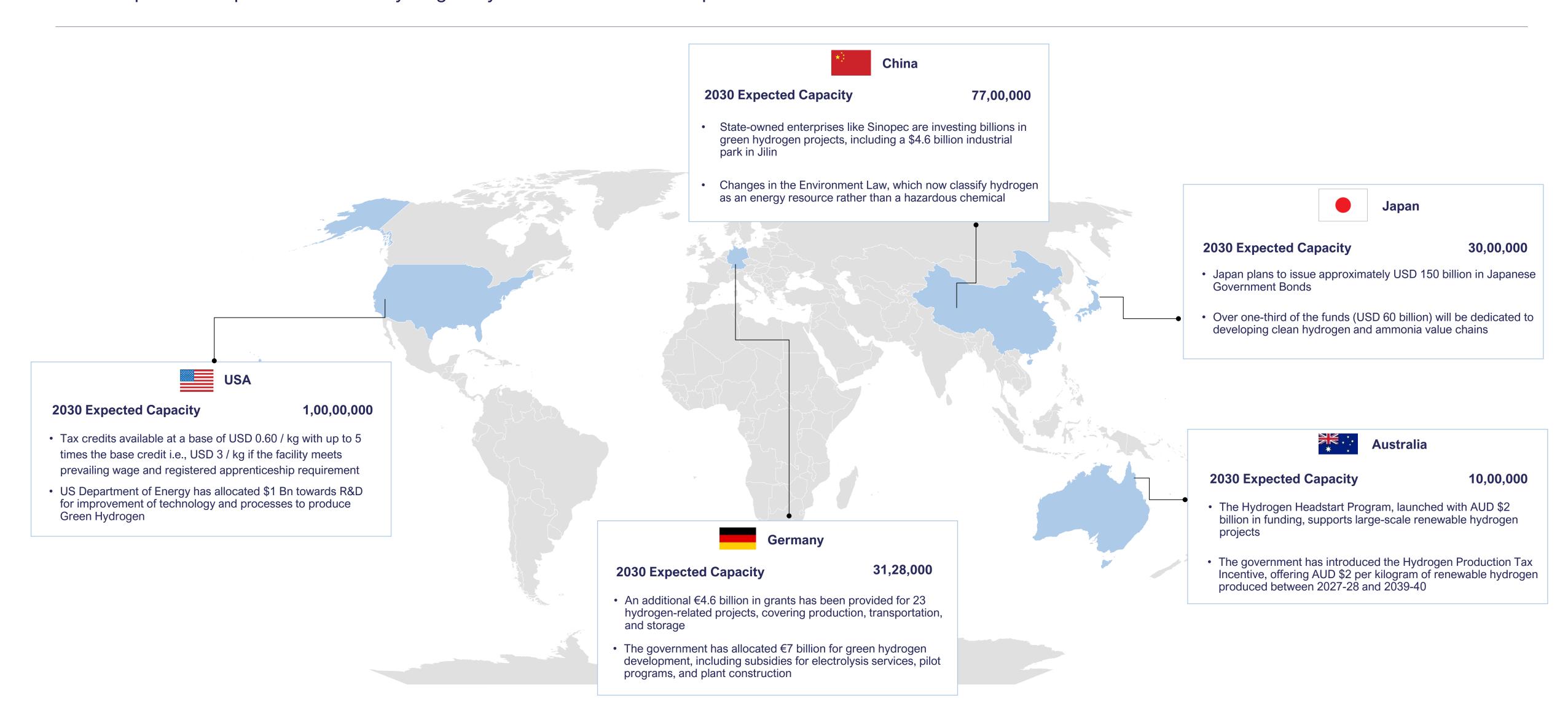
Electro	Electrolyser Manufacturing (Component – I)								
SECI									
5 years from the date of start of manufacturing									
Year	Year 1 2 3 4 5								
Base INR/KW	Base INR/KW 4,440 3,700 2,960 2,220 1,480								
Any stack tec	Any stack technology Indigenous Stack								
2,300 MW	2,300 MWPA 700 MWPA								
Any stack : ~INR 3,404 Cr Indigenous stack : ~INR 1,036 Cr									
Incentive based ele	•	•	tion + Energ		y for				





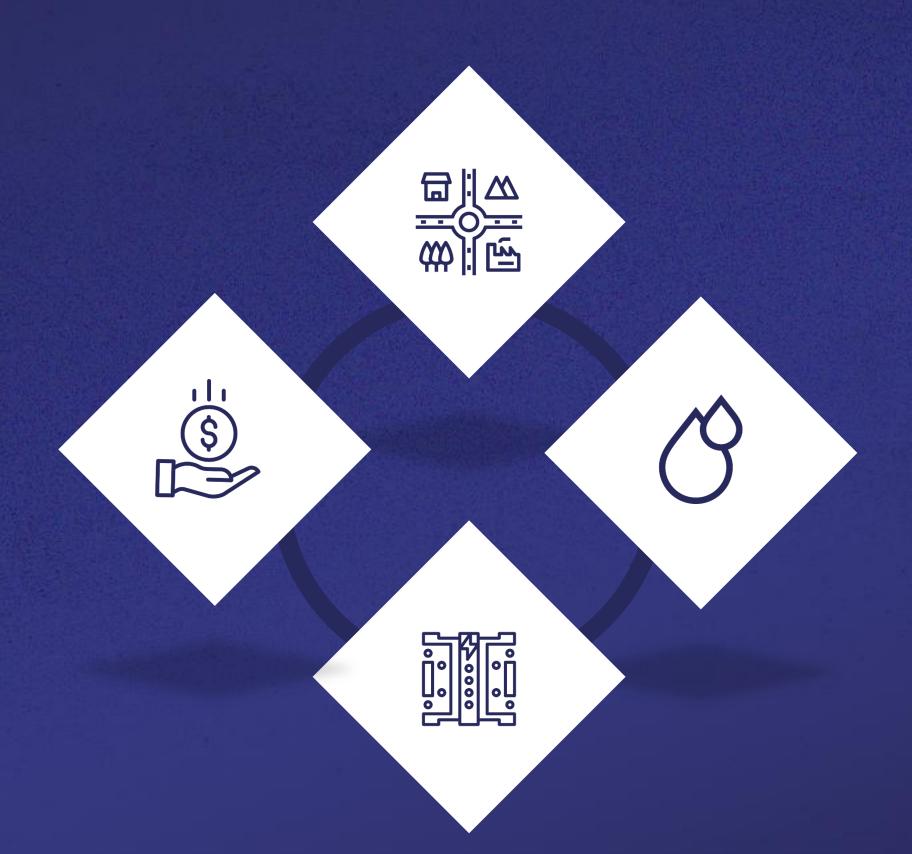
## Global Push for Green Hydrogen

Roadmap of development of Green Hydrogen by 2030 via Government policies and subsidies



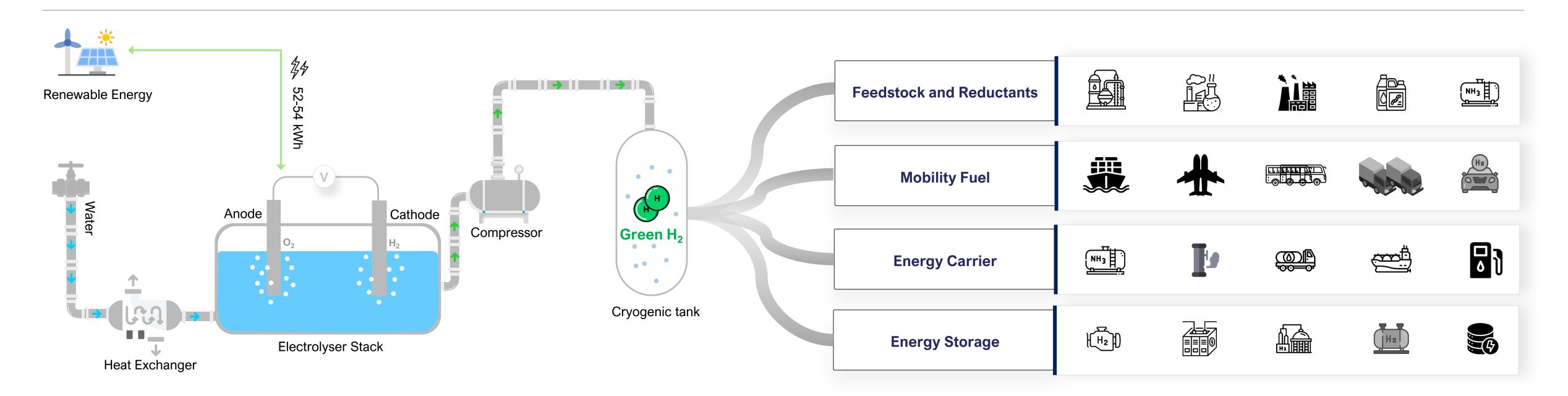
## **Process and Demand Dynamics**

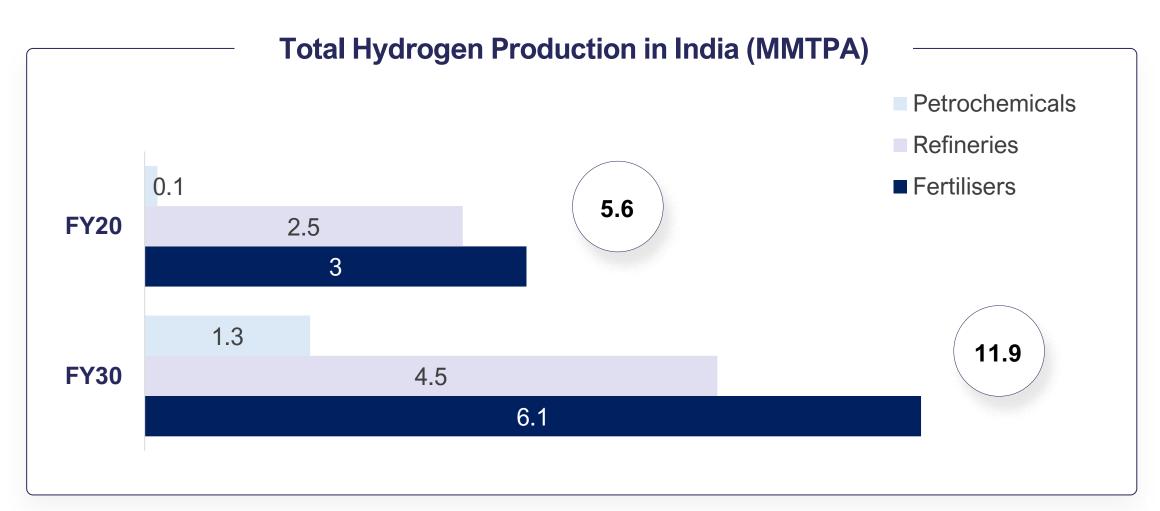
Green Hydrogen, Electrolysers and Ammonia

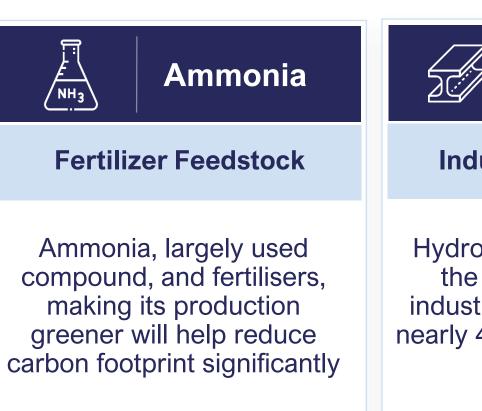


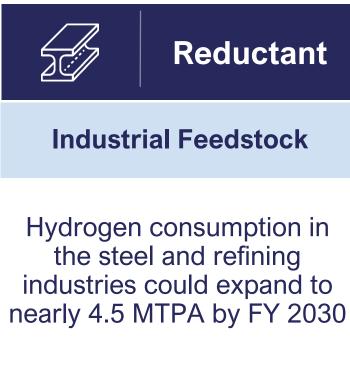
## Green Hydrogen

Produced through electrolysis of water using electricity through RE & its utility across sectors











### **Fuel Substitute**

Hydrogen is significantly more energy dense than batteries. Hence, for vehicles that have higher payloads, hydrogen refilling can be done in ~5 mins

AVENER 10 Source: CEEW | RE: Renewable Energy

### **Green Ammonia**

Analyzing the most prominent offshoot of Green Hydrogen in India



### **Second Largest Chemical Consumed**

- Supports food production for ~50% of global population
- Developed handling network
- Global Market of \$200 Bn

2021

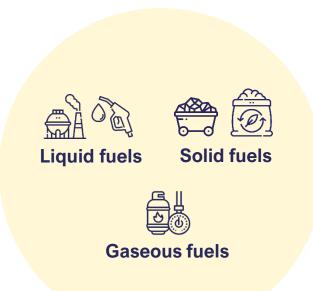
### Agriculture feedstock

- Around 70-80% of the ammonia produced globally is used to manufacture nitrogen-based fertilisers
- Can be directly injected into the soil as a nitrogen source for plants

### **Global Demand for Ammonia**

**680 MMT** 

2030



**Grey Ammonia** 

Supply





2050



### **Key drivers for investment in Green Ammonia**



### **Storage Efficiency**

- Green NH<sub>3</sub> has 1.5x volumetric energy density as compared to Green H<sub>2</sub>
- It stores at lower temperatures, requiring only standard refrigeration



### **Subsidized Regime**

- Govt. subsidies for Urea help domestic producers combat natural gas volatility. Retail Prices for Urea are capped in India
- Non-urea fertilisers are also provided with Nutrient based subsidies



### **Transport & Logistics**

- Flammability of Green NH<sub>3</sub> is much lesser than Green H<sub>2</sub> making its transport less riskier
- Cost of transportation is 60-70% lesser than Green H<sub>2</sub>



### **Emissions Reduction**

- · Since ammonia is a largely used compound in various industries, making its production greener will help reduce carbon footprint significantly
- · Carbon credits can be introduced

Fertilizers (~95%)

Urea

Non-urea (DAP and OCF)

**Demand** 



**Green Ammonia to replace Grey Ammonia** 

Other Primary (~5%)

- Maritime Fuel
- Power Generation
- Hydrogen Carrier

## Electrolysers

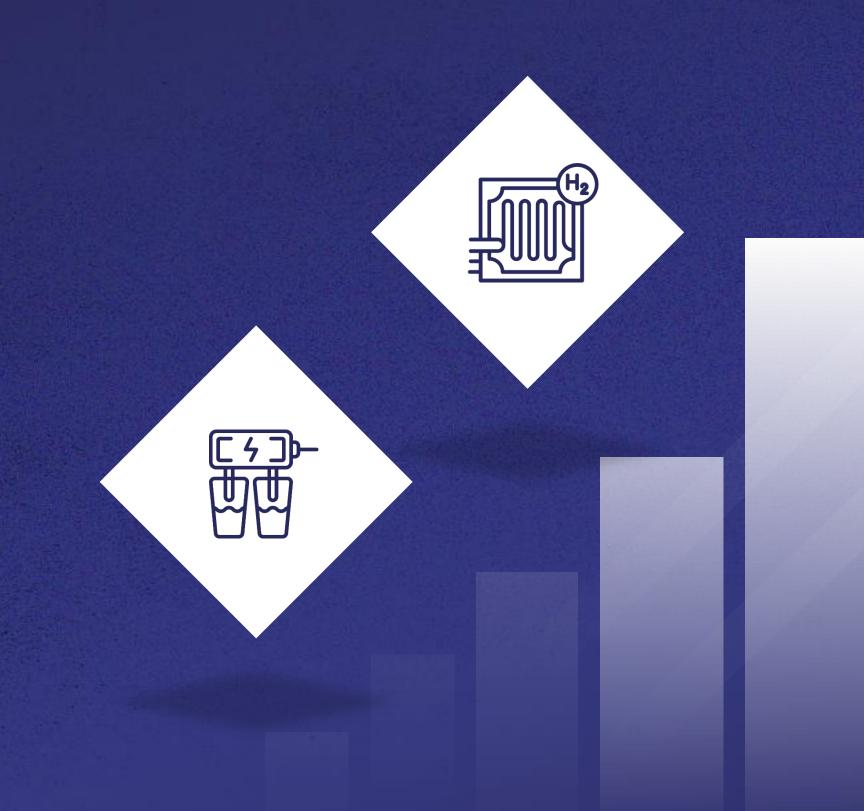
Technological advancements in electrolysers to improve efficiency



Source: IRENA, IEA, IHS Markit, Avener Analysis | GW: Gigawatt Estimate

## Cost Breakdown and Outlook

Analyzing intricacies in structures for cost reductions



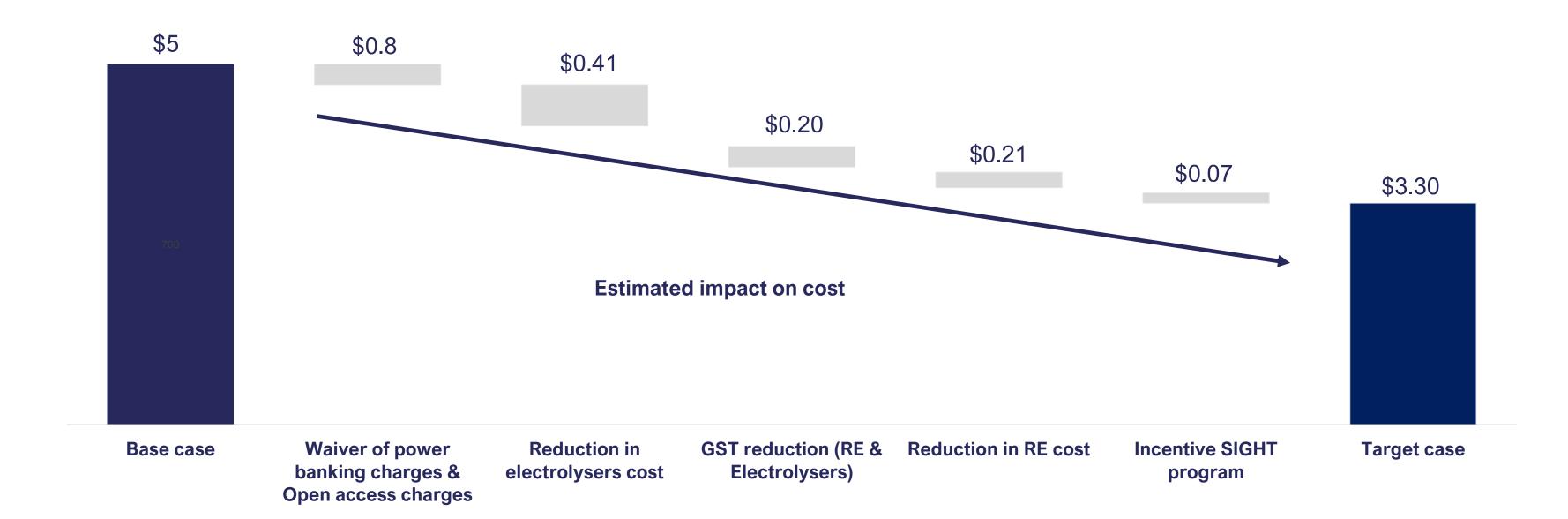
## Green Hydrogen

Project cost breakdown and impact on LCOH

### **Project Cost\***

### Value (c.) **Particulars RE** cost 45-50% Electrolysers 30-35% BoP & Other 15-25% Costs 100% **Total**

### Estimated reduction in green hydrogen production cost by 2030 (LCOH) (USD/Kg)



### **Electrolysers**



Reduction in cost of electrolysers with improvement in design enhance efficiencies and are market driven



LCOE for RE technologies, is expected to continue decreasing making them increasingly competitive with traditional fuels

### **Open access**



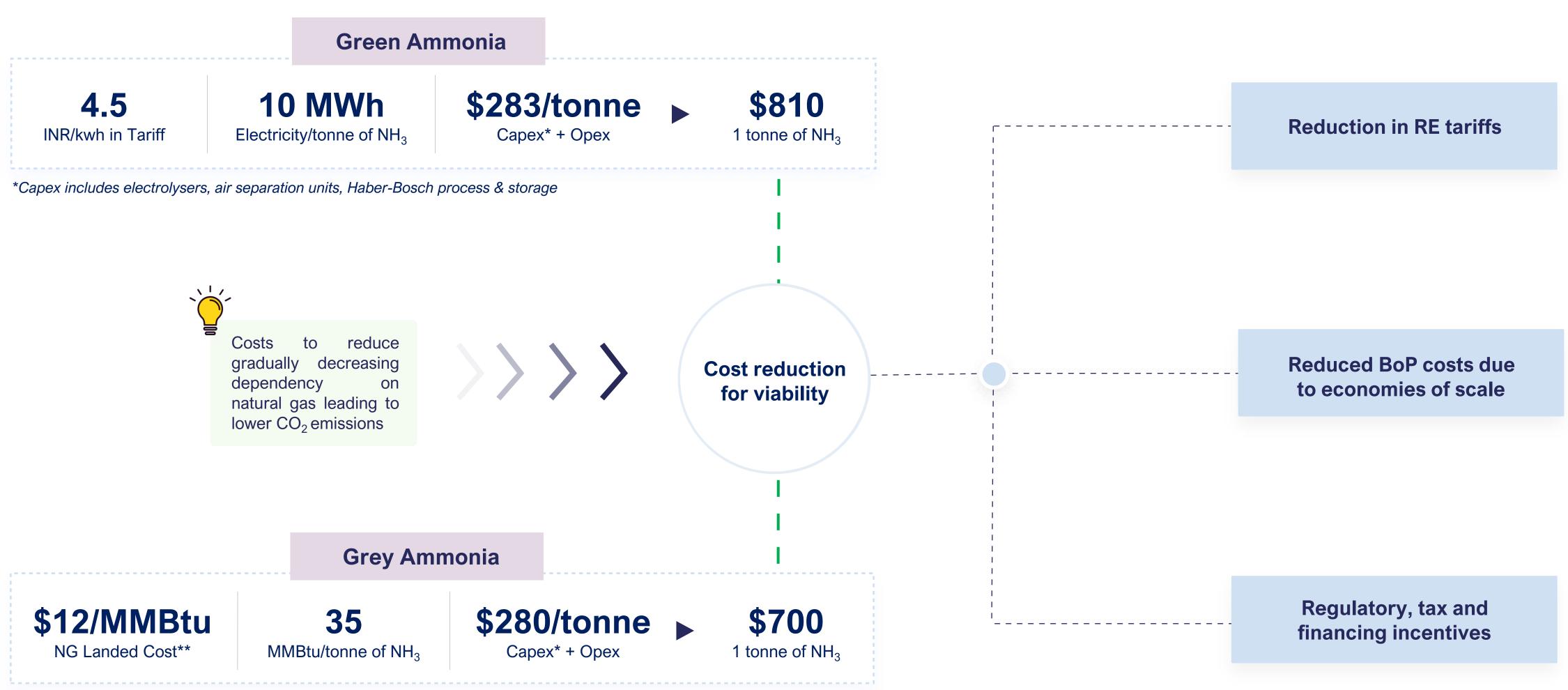
Waivers on open access charges considering distance from renewable assets to production sites

Government of India can reduce the GST for the components used in green hydrogen production

**GST** 

### **Green Ammonia**

Green Ammonia providing sustainable alternative to grey ammonia



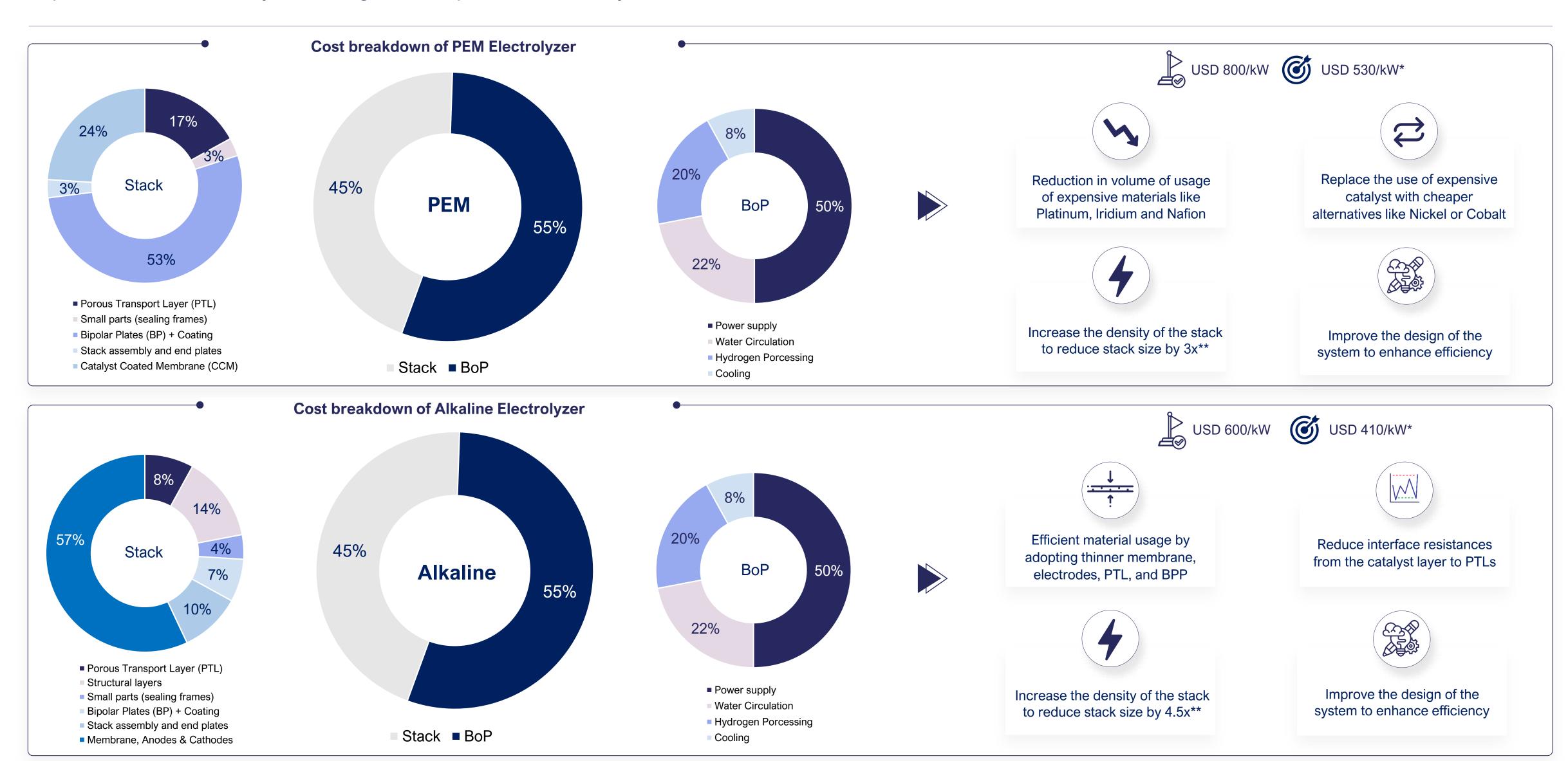
<sup>\*</sup>Capex includes steam methane reforming, air separation units and Haber-Bosch process

Source: CEEW, Indo-German Energy Forum, Avener Analysis | NH3: Ammonia

<sup>\*\*</sup>Taking into consideration APM, Premium Domestic Gas & Imported Costs in Long term LNG contracts and Spot LNG

## Electrolysers

Improvement in efficiency and design can help reduce electrolyser cost



## Value Chain and Potential Offtakers

Well-integrated value chain with sizeable potential offtakers



### **Value Chain**

Key Players across the value chain spectrum

Electrolyzer Technology & Manufacturing



























**EPC Project** Implementation

















Standalone Green Hydrogen Producers











Integrated Players with **RE** Capacity





















### **Potential Offtakers**

Key consumers of Green Hydrogen and Green Ammonia

Transportation & Storage













Steel Manufacturers













Green Ammonia















Refineries/Gas Blend

















Mobility





















Fuel Cells



**Bloomenergy**®







## **Bid Awards**

SECI Awards and Incentives



## Recent Contract Awards - Green Hydrogen (1/2)

Developer	Reliance Industries Limited	ACME   SOLAR	grœnk∍	am green*	WAAREE® One with the Sun		sembcorp	HYGENCO	WELSPUN
Technology	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technolog Agnostic
Capacity	1,39,000	90,000	90,000	90,000	90,000	90,000	90,000	75,000	20,000
Tranche	1 & 2	1	1	2	2	2	2	1	1
Allocated Incentive	877	810	810	513	510	300	437	563	120

## Recent Contract Awards - Green Hydrogen (2/2)

Developer	InSolare Solar Power Virtualid	+orrent-	CESC LIMITED	GH2 Solar	OUPL	TrueRE ORIANA POWER LIMITED	Energy	Bharat Petroleum	MATRIX Gas & Renewables
Technology	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Technology Agnostic	Biomass based	Biomass based
Capacity	19,000	18,000	10,500	10,500	10,000	10,000	6,500	2,000	1,500
Tranche	2	1	1	2	1	2	1	1	2
Allocated Incentive	46	156	0	47	0	0	68	18	18

## Recent Contract Awards - Electrolysers (1/2)

Developer	Newage Green Electro	Reliance	John Cockerill		InSolare Salan Power Underslad	adani	WAAREE® One with the Sun	
		Industries Limited	————	ADVAIT INFRATECH LIMITED		Green Hydrogen		ohmium ————
Гесhnology	Any stack + Indigenous	Any stack	Any stack	Any stack	Indigenous stack	Indigenous stack	Any stack	Any stack
apacity MW	300	300	300	300	10	300	300	274
Tranche	2	1	1	1 & 2	2	1 & 2	2	1 & 2
Allocated Incentive	444	444	444	444	15	444	444	406

## Recent Contract Awards - Electrolysers (2/2)

Developer	MATRIX Gas & Renewables	GH2 Solar	<b>homi</b> Hydrogen		AVAADA	EASTERN ELECTROLYSER LTD Your Hydrogen Solutions Partner	newtrace
Technology	Any stack	Any stack	Indigenous stack	Any stack	Any stack	Indigenous stack	Indigenous stack
Capacity MW	300	105	102	300	50	30	30
Tranche	1 & 2	2	1	1	2	2	2
Allocated Incentive	444	155	150	444	73	44	44

## Global Deals & Partnerships

Marquee deals and partnerships in the Green Hydrogen and Electrolyser space



## Marquee Global Green Hydrogen Deals

Significant capital infusion has happened in recent years owing to the robust pipeline

	2025	2024	2024	2023	2022	2022
Target	TOP END —ENERGY— THE ENERGY OF TOMORROW	Hydrogen pro	<b>G</b> hydrom Hydrogen Oman	TotalEnergies	FORTESCUE FUTURE INDUSTRIES	PRODUCTS 1
Deal Size	10	8	11,000	635	127	4,000
Investors	SERPENTINE ENERGY	ANDRIL	Consortium I  Yamna  Consortium II  FORTESCUE FUTURE INDUSTRIES  Consortium II	Air Liquide	OTES	aes
Type	Acquisition	Strategic investment	Bid Awards	Joint Venture	Strategic Collaboration	Joint Venture

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## Marquee Global Electrolysers Deals

Significant capital infusion has happened in recent years owing to the robust pipeline

Target	2025 SAMSUNG E&A	2023  Ohmium	2023  EVERDAGY	2023  newtrace	2023  Advanced lonics	2022  H <sub>2</sub> PR©	2022  ## ELECTRIC HYDROGEN
Deal Size	33	250	73	6	13	75	198
Investors	nel•	TPG RISE CLIMATE	Shell Ventures TEMASEK	SEQUOIA 些  (Apithan CAPITAL  AAVISHKAAR GROUP	bp	Horizons Ventures  TEMASEK	FIFTH WALL
Technology	Alkaline	PEM	Alkaline/PEM	PEM		E-TAC*	PEM
Туре	Minority Stake	Series C	Series B		Series A	Series B	Series B and VC Debt

<sup>\*</sup>E-TAC: Proprietary H<sub>2</sub> Production Technology by H<sub>2</sub>Pro Deal Size in USD Mn

## Green Hydrogen Developers Partnership across Value Chain

Major Partnerships Reshaping the Industry Landscape

#### Dec'24





#### **Strategic Partnership**

- Introducing EODev's hydrogen fuel cell power generator 'GEH2' in India and Nepal
- Greenzo to provide distribution, maintenance services and local assembly for EODEV's products in agriculture, telecom and transport

#### **Nov'24**





#### **Strategic MoU**

- Aims to develop joint tenders for export of Green H<sub>2</sub> from India
- It also involves knowledge sharing about global market dynamics, trade logistics and stakeholder engagement

#### Oct'24





#### **Trading market**

- Involves establishing a hydrogen trading market in India
- It entails gathering market insights, engaging stakeholders and creating an Indian hydrogen price index

#### Oct'24





#### **Deployment of solar unit**

- Collaboration to deploy a solar hydrogen-based microgrid system of 200kW for off-grid Army locations in Ladakh
- NTPC will manage and maintain the project for 25 years

#### Oct'24





#### **Strategic MOU**

- Hero Future Energies has signed an MoU with Govt of Karnataka to invest INR 110 billion in RE and Green Hydrogen
- NTPC will manage and maintain the project for 25 years

### Oct'24





#### **Green hydrogen mobility**

- NTPC signed tripartite MoU with Grid Corporation of Odisha (GRIDCO) for advancement of green hydrogen mobility in Bhubaneshwar
- NTPC will establish green hydrogen fueling station and deploy hydrogen powered buses

### Sep'24





### Long term supply agreement

- Long-term supply of up to 250,000 tons of green ammonia per year from its plants in India
- Initially, 50,000 tons will be produced at the Kakinada site, and up to 200,000 tons will come from the Tuticorin facility

### Sep'24







#### **BOO** Hydrogen valley project

- BOO project will be developed using electrolysis method
- Green H2 produced will be supplied to the specialty chemical sector in Pune on an RTC basis

### Aug'24





### Strategic Partnership

- To explore delivering green hydrogen and ammonia-fired gas turbine combined cycle (GTCC) power plants
- NTPC will establish green hydrogen fueling station and deploy hydrogen powered buses

### Aug'24





### Technology agreement

- Guofu Hydrogen will provide AIL with essential tech documentation, expertise, and training for alkalinebased electrolyser technology
- AIL plans to use this tech for manufacturing and assembling equipment for Green H<sub>2</sub> production starting with 300MW/yr

### Aug'24





#### **Green NH**<sub>3</sub> Exports

- MNRE announced India's first ever agreement to export Green NH<sub>3</sub> to Japan
- Sembcorp will produce Green NH3in India, Kyushu will use it to reduce coal usage in Japan and NYK Line will manage the transport

#### Jun'24





#### Joint venture

- MoU for supply of 1,00,000 metric tonnes of Green NH3
- Avaada plans to establish a 0.5 MTPA Green H<sub>2</sub> and Ammonia facility at Tata Steel SEZ Industrial Park in Odisha

Source: JMK Research & Analytics

# Way Ahead



## **Export Infrastructure in Indian Green Hydrogen Space**

Key players are exploring to establish plants near ports to cater exponential global demand



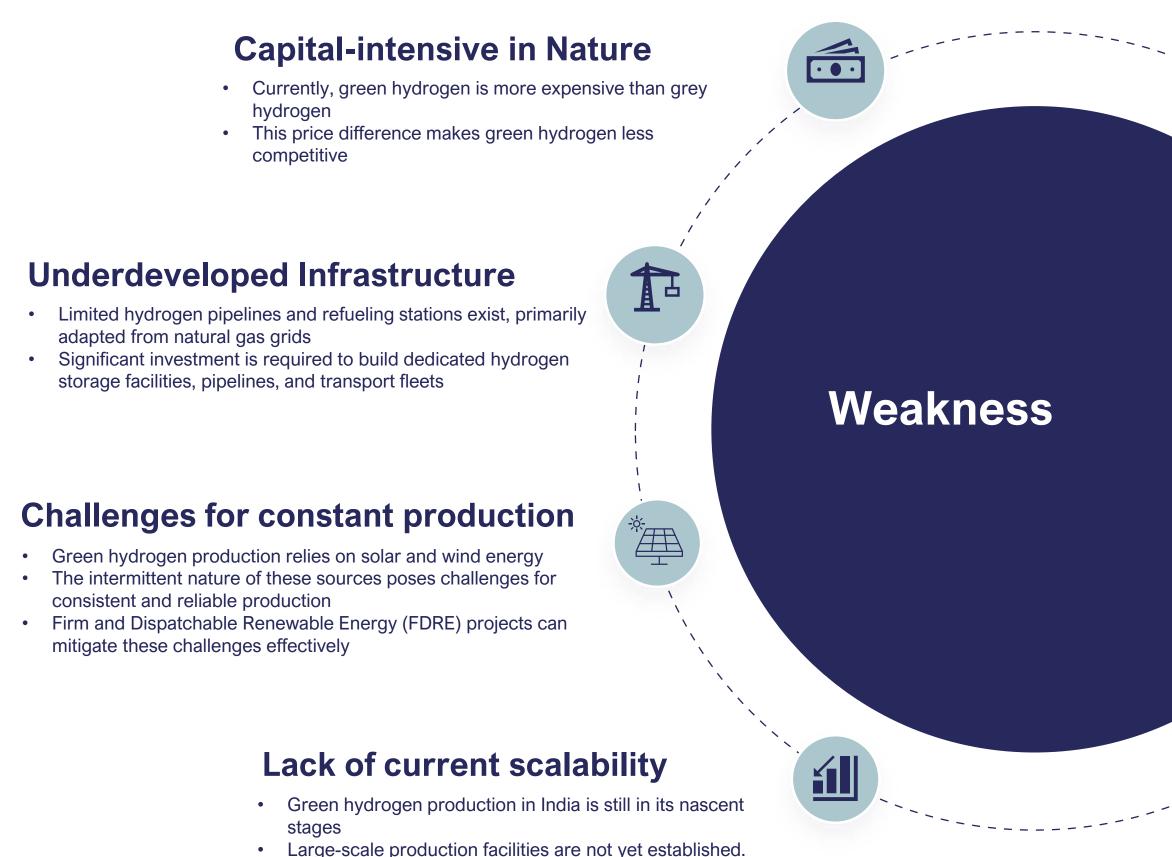
### **Benefits**

- Manufacturers of Green Hydrogen/ Green Ammonia shall be allowed to set up bunkers near Ports for storage of Green Ammonia for export/use of shipping
- The land for storage purpose shall be provided by respective port authorities at applicable charges
- National strategies emphasize the development of bunkering facilities at major ports by 2035 to support long-term storage and distribution
- Ports equipped with bunkering stations can supply green hydrogen as fuel for ships, helping decarbonize the maritime sector and reduce greenhouse gas emission

## Green Hydrogen: Powering tomorrow naturally

Scalable and Sustainable despite cost and efficiency Barriers





Integrated (IPPs + Green Hydrogen producers) and Non-Integrated players are well placed to ride India's Green Hydrogen expansion, driven by falling RE costs and tech gains

About Avener



## Investment Banking | Infrastructure & Real Assets

Leading financial advisors in the Infrastructure & Real Assets space in India with cumulative team experience of 100+ years

### Renowned experts in Indian Infrastructure and Real Assets space



Platform, equity, M&A and debt transaction closures by the team till date



\$ 15 Bn+

Total fund raising by the team till date



25+

Among the largest teams in the country dedicated towards the Infra space



**Policy Formulation** 

Part of committees of various regulatory bodies

### **Transaction Footprint in FY24**

70+

18

Total deals



Total deal value



06

M&A/ **Private Equity** Value: \$ 1.3 Bn

04

**Project Finance** Value: \$ 1.4 Bn 80

Refinancing/ **Structured Debt** 

Value: \$ 1.9 Bn

### **Accolades**

"Emerging Investment Bank of the year" FY24



Ranked 5<sup>th</sup> in M&A & 7<sup>th</sup> in PE in YTD24



Ranked 8th in PE in 2021 & 2019



Ranked among the Top 10 advisors for Asia & Australia by Finance Asia in 2023



Ranked among the Top 25 bookrunners in Asia by Thomson Reuters in 2019

### **Key Clientele - Leaders of Respective Sectors**





























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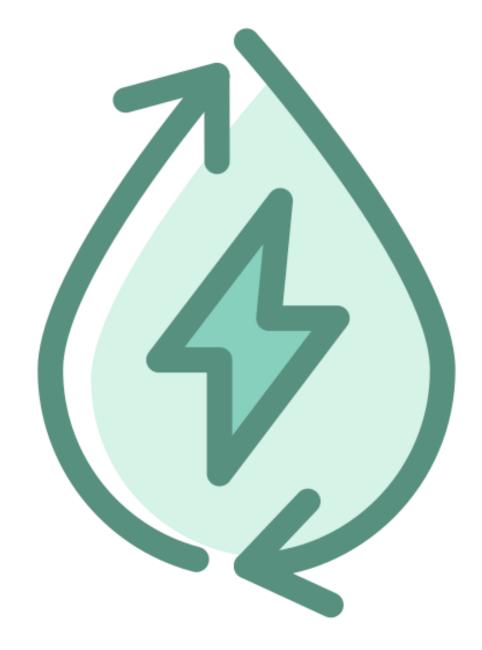
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# Thank You

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