3rd International Hydrogen Congress

Bogota, Colombia
9-11th April 2024

CLEAN HYDROGEN IN ASIA: LESSONS LEARNED FROM INDIA

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SNAPSHOT ABOUT JAPAN

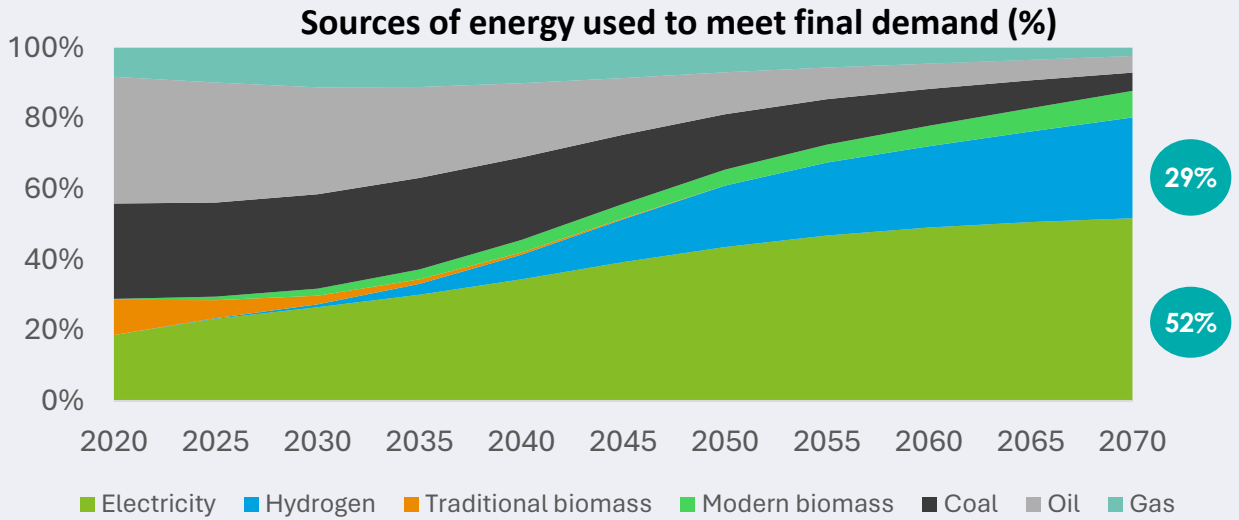
- ✓ **Japan** aims to develop not only the domestic market but also expand into **overseas market** on both hydrogen and facilities/infrastructures to produce, transport and consume it.
- In addition to the **direct use of hydrogen** to decarbonize hard-to-abate industries, like steel or chemical products and for hydrogen-fueled vessels, Japan's includes hydrogen **derivatives**: **ammonia, e-methane and e-fuel.**
- The country has an **objective** of expanding **consumption** of hydrogen to around **3 million tons** per year by **2030.** About **12 million tons** per year (including ammonia) for **2040**, and about **20 million tons** per year by **2050.**
- Japan-related companies' global water **electrolysis capacity** target is set at **15 GW for 2030**.
- The Japanese government wants to secure **6 million to 12 million tons** of annual **CO2 storage by 2030**.
- **The government has issued a Hydrogen National Strategy** and includes hydrogen within its LT-LEDS.
- Japan has **technological strengths in consumption and transportation technology, including fuel cells.** The country aims to establish Japan's position as a platform **provider** by ensuring that Japanese fuel cells are available anytime and anywhere in the world.
- Over the **next 10 years**, the purpose is to develop about **three large-scale hydrogen/ammonia clusters**, mainly in metropolitan regions, and about five medium-scale hydrogen/ammonia clusters that will take advantage of their industrial characteristics to **accumulate hydrogen/ammonia demand.**

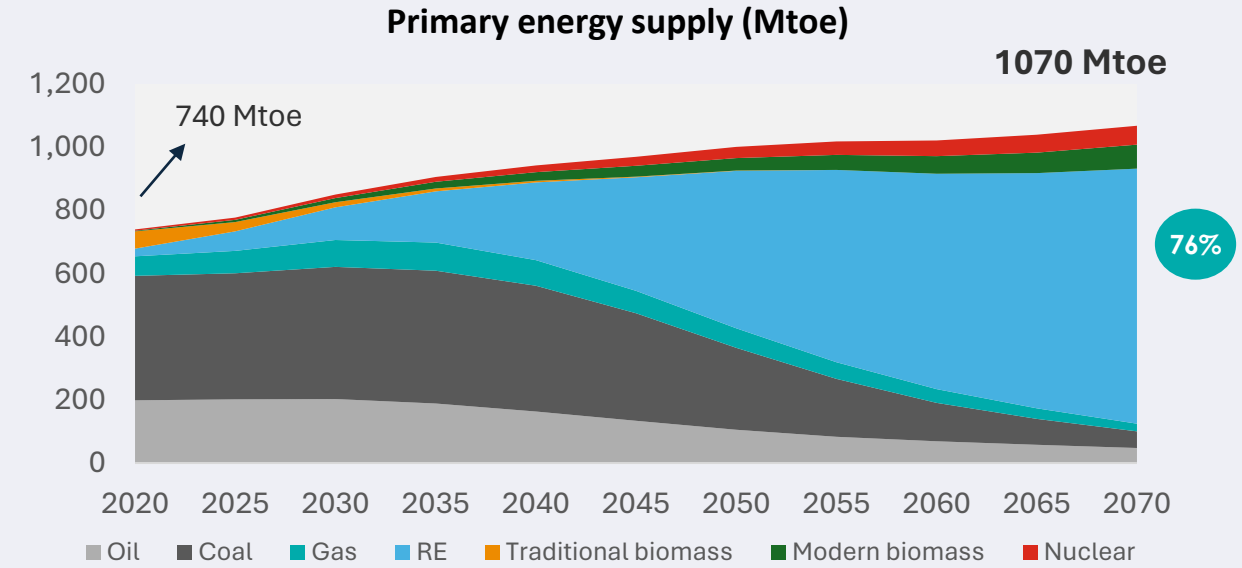
SNAPSHOT ABOUT CHINA

✓ **China** is the **world's largest hydrogen market**. Three large renewable hydrogen projects achieved FID.

- Of the 34 Mt hydrogen that China produced in 2021, 80.3% was produced from fossil fuels, 18.5% was industrial by-product (coke oven gas) and 1.2% was from electrolysis
- The country is aiming to produce 5 **Mt of renewable hydrogen by 2030**, **20–25% of total EMDC** production.
- Currently, China's clean hydrogen supply ambitions do not foresee **massive exports**.
- **The government has issued a Hydrogen National Strategy** (both national and subnational-province level) and includes hydrogen within its LT-LEDS.
- China's share of investment for clean hydrogen projects **represents18% of the global pipeline (in terms of value).**
- China's **largest renewable hydrogen project in Songyuan**— a $4 billion, 640 MW ammonia/methanol facility—**has started construction**.
- BloombergNEF reported that Chinese electrolyzers are already being sold for 75% less than Western equivalents. Three Chinese **electrolyzer makers** — Longi, Peric and Sungrow — are leading the global market in terms of annual manufacturing capacity.

FOR NET-ZERO BY 2070 IN INDIA:
GREEN ELECTRICITY AND GREEN HYDROGEN WOULD MEET BULK OF DEMAND

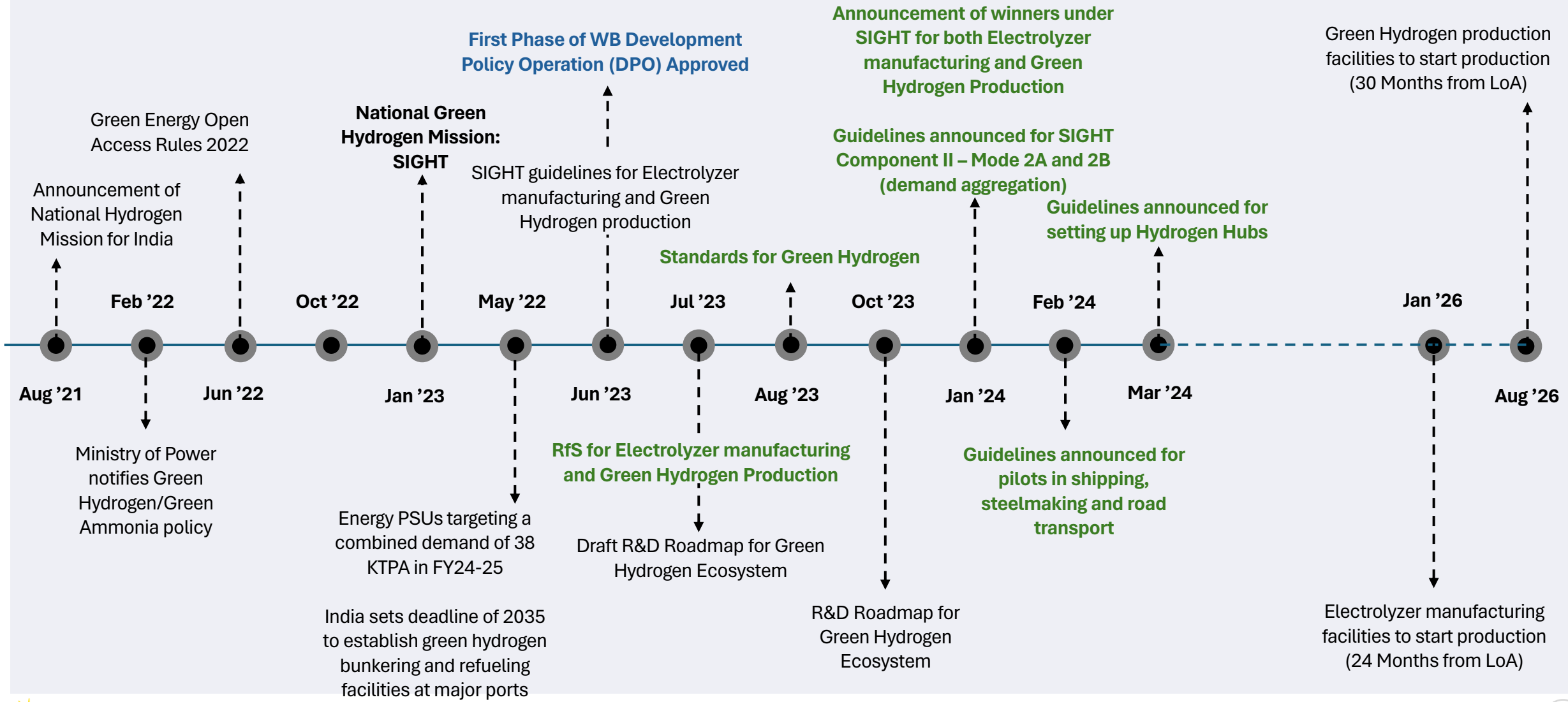




- The first and most important step is to electrify end-use sectors as much as possible, and decarbonize the power sector 10-15 years ahead of economy-wide net zero targets
- The share of electricity would increase from 18% in 2020 to over 50% by 2070 to meet the final energy demand, most which would be from RE
- Green hydrogen (GH) would provide an additional 30% to meet the final energy demand from RE
- Decarbonizing the industrial sector would require green hydrogen (particularly in fertilizer, refineries, and steel production) and the use of CCS
- 2/3 of solar PV and wind would be used to generate electricity, and 1/3 to produce green hydrogen by 2070

INDIA'S JOURNEY TOWARDS A GREEN HYDROGEN ECOSYSTEM

Clean Hydrogen in Asia:
Lessons learned from India



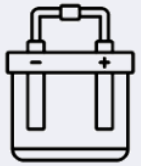
NATIONAL GREEN HYDROGEN MISSION

	Mission component	Amount (USD in M)	Amount (USD in M)
Outlay recommended till 2029-30	Strategic Interventions for Green Hydrogen Transition (SIGHT)	2,101.67	2178.92 (2.18 B)
	Support for low-carbon Steel Projects	54.67	
	Human Resource Development	4.2	
	Public Awareness & Outreach	8.41	
	Programme Management	9.97	
Outlay recommended till 2025-26	Support for Shipping and Ports project	13,82	193,59
	Support for Mobility project	59,6	
	GH2 Hubs	48,07	
	Research & Development	48,07	
	Testing Facilities & Development of Standards	24,03	

*Exchange rate of April 9, 2024 1 crore ₹=120164 USD

NATIONAL GREEN HYDROGEN MISSION

At least 5 Million Metric Tonnes per annum of Green hydrogen production



60 – 100 GW of domestic electrolyzer capacity

Leveraging investment of at least USD 100 Billion

125 GW of RE Capacity for Green Hydrogen generation & associated transmission network

Create 600,000 jobs

Reducing the dependency on imported fossil fuels by US$ 12.5 billion

Strategic Interventions for Green Hydrogen Transition (SIGHT)

- Introduces two distinct financial incentive mechanisms. These mechanisms target **incentivizing domestic manufacturing of electrolyzers** and **green hydrogen production**.

Incentives for manufacturing electrolyzers	Incentives for green hydrogen production
Objective: Targeting the establishment of **1,500 megawatts (MW)** of electrolyzer manufacturing capacity in India	Objective: Green hydrogen production capacity was distributed with **450,000 metric tonnes a year (MTPA)**
US$541 million ~ $36/KW	US$1.59 billion ~ .5$/kg

INDIA LOW-CARBON ENERGY
PROGRAMMATIC DPO: $3B SUPPORT

- **PDO:** To accelerate the development of low-carbon energy in India

- **Programmatic two-phase Development Policy Operation (DPO):**
  - **First phase of the DPO:** $1.5 billion approved by the Board in June 2023.
    - To support the approval of the NGHM, RE scale up and grid integration, and climate financing
  - **Second phase of the DPO:** $1.5 billion to be submitted to the Board in Q4 FY2024
    - To support the implementation of NGHM to reduce costs and increase domestic demand, improving RE grid integration, and carbon market
  - **Policy support** and **technical assistance** at national and state level

- **Results:** 75 GW of RE enabled, 450,000 tons of GH incentivized, and 40 million tons of GHG emissions avoided

INDIA LOW-CARBON ENERGY DPO-1: PRIOR ACTIONS

Pillar 1: Promoting Green Hydrogen

- Approve the NGHM
- Issue GH safety regulations, standards, codes, best practices, and procedures
- Extension of the waiver of the inter-state transmission charges towards RE for GH

Pillar 2: Scaling Up Renewable Energy

- Issue a government order on RE Purchase Obligations and Energy Storage Obligations
- Issue and notified the Ancillary Services Regulations
- Issue a regulation to guide the bidding of 50 GW of RE capacity each year FY23-28
- Adopt an offshore wind strategy; and extend the waiver of the inter-state transmission charges for offshore wind
- Policy to provide production-linked incentives to high-efficiency solar PV

Pillar 3: Enhancing climate financing for low-carbon energy investments

- Amend the Energy Conservation Act that provide the legal framework for the launch of a national carbon market
- Issue amendments to the existing regulatory framework for GDS issuance
- Issue a transparent Sovereign Green Bond Framework

INDIA LOW-CARBON ENERGY DPO-2: PRIOR ACTIONS

Pillar 1: Promoting Green Hydrogen

- Incentive schemes for GH production and electrolyzer manufacturing, and appointed SECI as the implementing agency to manage the incentive schemes
- Issue guidelines for transparent and competitive bidding process on the demand aggregation model to increase the domestic consumption of GH and green ammonia in key demand sectors
- Notify a GH standard

Pillar 2: Scaling Up Renewable Energy

- Amend the Indian Electricity Grid Code
- Approve an incentive scheme for battery energy storage system

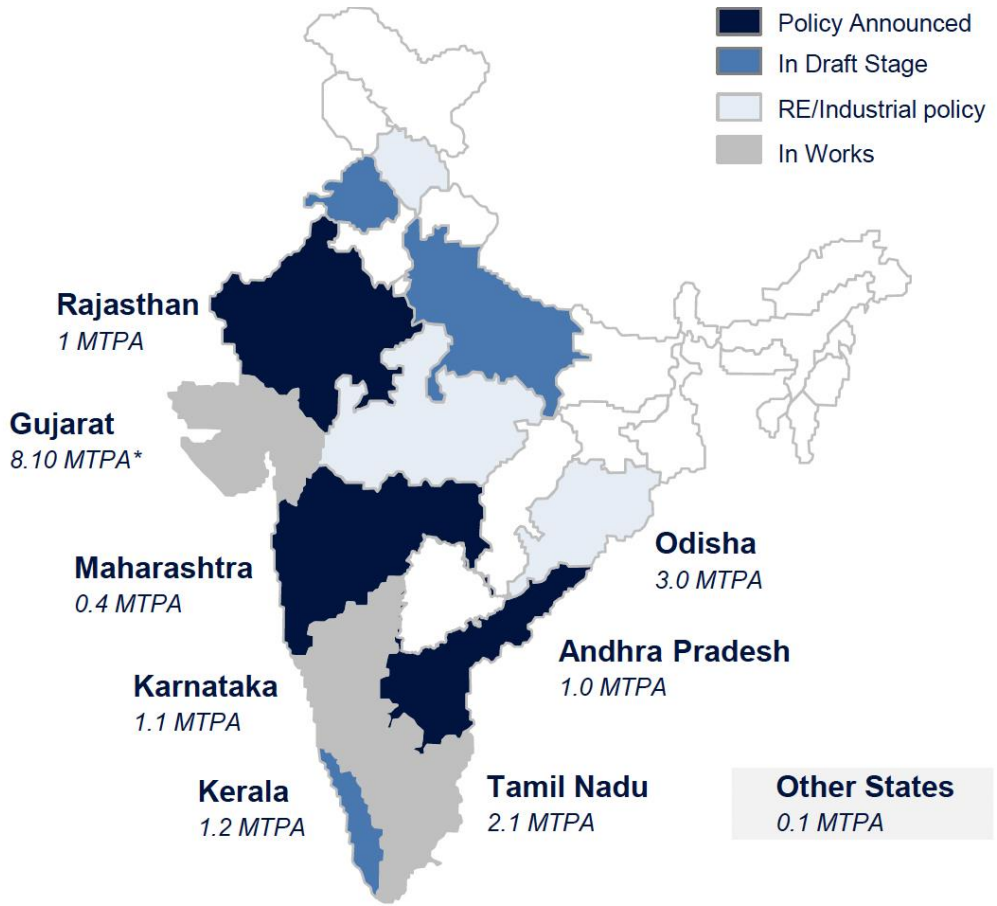
Pillar 3: Enhancing climate financing for low-carbon energy investments

- Notify the Carbon Credit Trading Scheme
- Issue regulatory framework for Environment, Social and Governance Disclosures, Ratings, and Investing

INDIA'S GREEN HYDROGEN ECOSYSTEM
EMBRACING THE FEDERAL STRUCTURE AS WELL

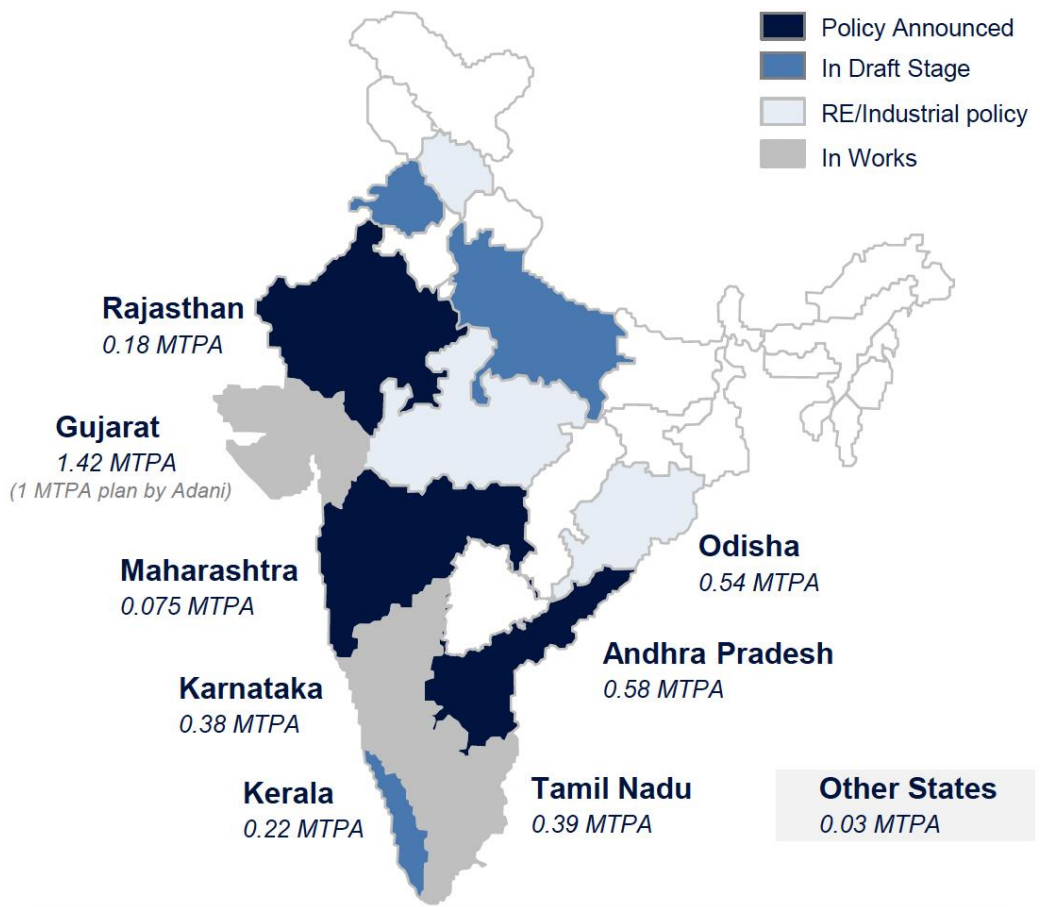
Announced capacities and Policy status

- Capacity for Green Hydrogen



Announced capacities and Policy status

- Capacity for Green Ammonia



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Source: MEC+ Analysis

SEVEN SIGNPOSTS OF SCALE-UP
TOWARDS GH2: INDIA

Standards governing hydrogen use are harmonized and regulatory barriers removed

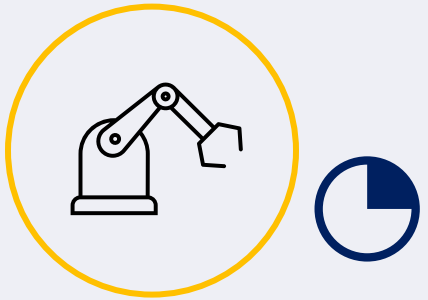
Stringent heavy transport emissions are set

Industrial decarbonization policies and incentives are put in place

Net-zero targets are legislated

Targets with investment mechanisms are introduced

Mandates and markets for low-emission products are formed



Hydrogen ready equipment becomes commonplace

LESSONS LEARNED

- **Focus on both supply side** to reduce GH costs and **demand side** to increase domestic market uptake for GH
- Strong and effective **inter-ministerial coordination** for GH
- Provide **certainty to the market**
- Issue the **GH standards** and **safety standards** together with the **GH incentive scheme**
- Large programmatic DPO is an effective way to support clean energy financing with **scale and speed**
- **Early engagement** and **analytical work** are critical and paid off

Thank you