



सत्यमेव जयते

Department of Science & Technology  
Govt. of India



# **India's Energy Transition Efforts Initiatives in Carbon Capture Utilization/Conversion and Storage (CCUS)**

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# India's 5 Climate Goals

1. Achieving **net-zero emission by 2070**
2. Reducing total **projected carbon emissions by one billion tonnes** starting now till 2030
3. Increasing **renewable energy component to 50%** of our total energy requirements **by 2030**
4. Reducing **carbon intensity by 45% by 2030**
5. Increasing **non-fossil energy capacity to reach 500 GW by 2030**

# India's Initiatives in Renewable Energy

- ❖ In line with Prime Minister's announcement at COP26, Ministry of New and Renewable Energy is working towards achieving 500 GW of installed electricity capacity from non-fossil sources by 2030.
- ❖ So far, a total of **172.72 GW of capacity** from non-fossil fuel sources has been installed in the country as on 31.10.2022. This includes 119.09 GW RE, 46.85 GW Large Hydro and 6.78 GW Nuclear Power capacity.
- ❖ The **total share of renewable energy comes to 42.26% of total installed generation capacity** in the country i.e. 408.71 GW as on 31.10.2022.
- ❖ India stands **4th globally in Renewable Energy Installed Capacity** (including Large Hydro), **4th in Wind Power capacity & 4th in Solar Power capacity** (as per REN21 Renewables 2022 Global Status Report).

# Major Government Initiatives

## ❖ **Clean cooking initiatives**

- ❑ Pradhan Mantri Ujjwala Yojana (PMUY)

## ❖ **Production-linked incentive (PLI) scheme**

- ❑ Domestic manufacturing of high-efficiency solar modules and advanced storage batteries

## ❖ **Kusum scheme**

- ❑ Solar PV pumps to replace existing diesel pumps

## ❖ **National Solar Mission and development of Solar Parks**

- ❑ Mega Solar Power Projects
- ❑ Grid-connected solar rooftop program

## ❖ **Green energy corridors**

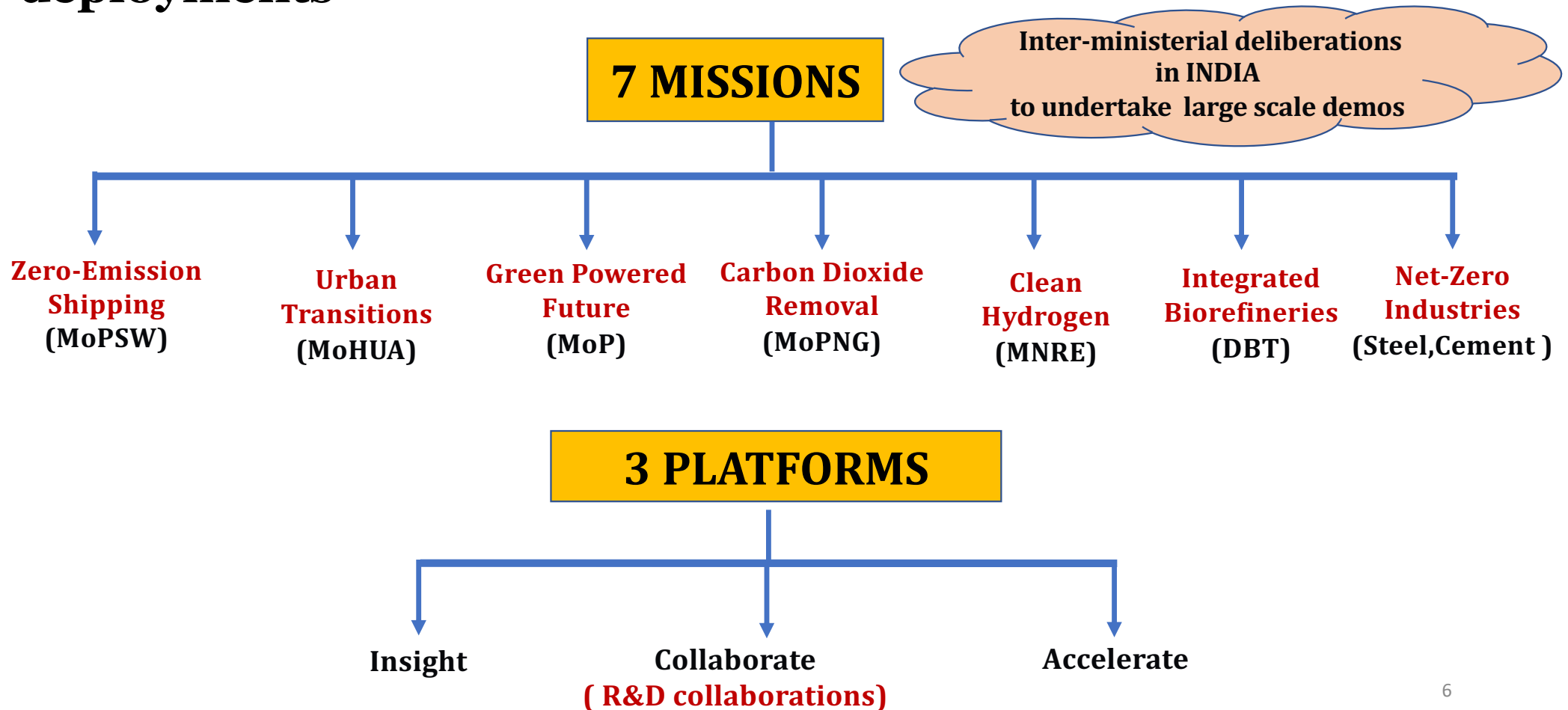
- ❑ Evacuation and integration of RE from renewable rich states

## ❖ **Green Hydrogen Mission**

Ref: Talk Energy Conclave ,Chandigarh, 2022

# MISSION INNOVATION 2.0 (2021-2030)

Action Oriented Sprints to reach tipping points for accelerate deployments





# DST's Carbon Capture Utilization & Storage (CCUS) - Initiatives



## ACT4 Call Participation

(Funding Participation: 1 Million Euro)

- Participation with 5 countries
- To address the technological, environmental, social, and economic challenges required to accelerate CCUS Technologies
- 2 multilateral consortia approved.

## ACT3 Call Participation

(Funding Participation: 1 Million Euro)

- Participation with 14 countries
- To address the technological, environmental, social, and economic challenges required to accelerate CCUS Technologies
- 2 multilateral consortia approved and supported

## MI Proposal Supported

- 96 EOIs from premier research and academic institutions
- 19 R&D multilateral projects supported with 11 MI member countries.
- Participation of MI Team India in 2019 MI#3 Workshop on CCUS organized in Norway.

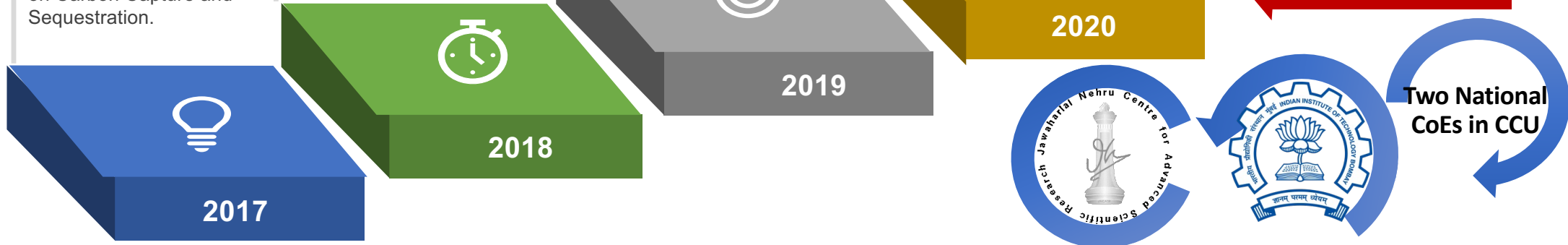
## DST Call on IC#3

(Funding: 3 Million USD)

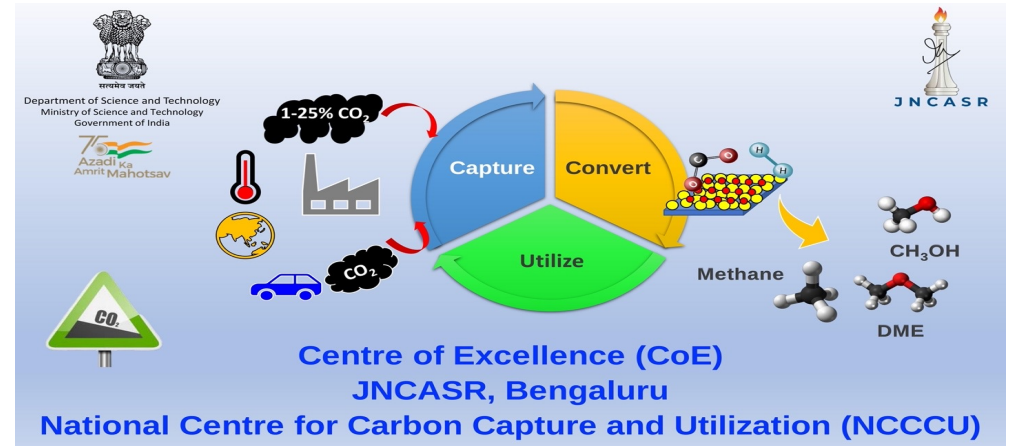
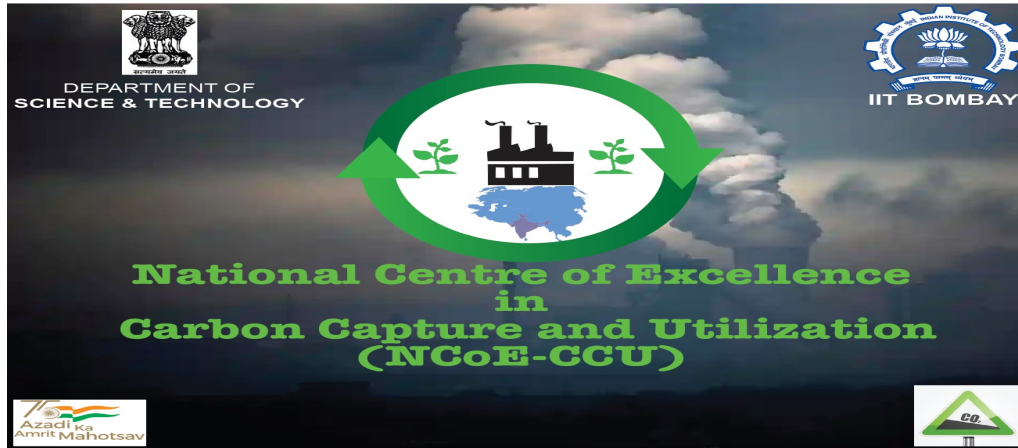
- Call launch by DST-DBT
- IC#3 on CCUS in July 2018
- Joint R&D with member MI countries
- identify and prioritize breakthrough technologies in the field of CO2 capture, separation, storage, and CO2 value addition.

## National Workshop

On 13th September 2017: A National workshop for consultation with experts and stakeholders was organized in New Delhi on Carbon Capture and Sequestration.



# India's first Two Centres of Excellence in CCUS



R&D efforts in methods of carbon capture and utilization to chemicals, CO2 transport, compression and utilization in enhanced hydrocarbon recovery as co-benefit pathways.

Cost-economic capturing of CO2 under 30\$/tonne.

Develop and demonstration of efficient CO2 capture at least 1kg/hour from effluents of Power Plant and biogas plant.

Materials and methodologies development and demonstrations for Carbon Capture and Conversion.

Scaling up to pilot scale mode to produce hydrocarbons, olefines and other value-added chemicals and fuels to reach the TRL on par with the commercial requirement at the industry level.

Develop and Demonstration of Conversion of CO2 + H2:

- To mixture of CO and Hydrogen (syngas),
- To mixture of C2 to C18 Hydrocarbons
- To mixture of C2 to C4 olefinic Hydrocarbons



# Carbon Capture Utilization & Storage (CCUS) – Outcomes from 19 MI projects

## CO<sub>2</sub> Emission



## CO<sub>2</sub> Capture



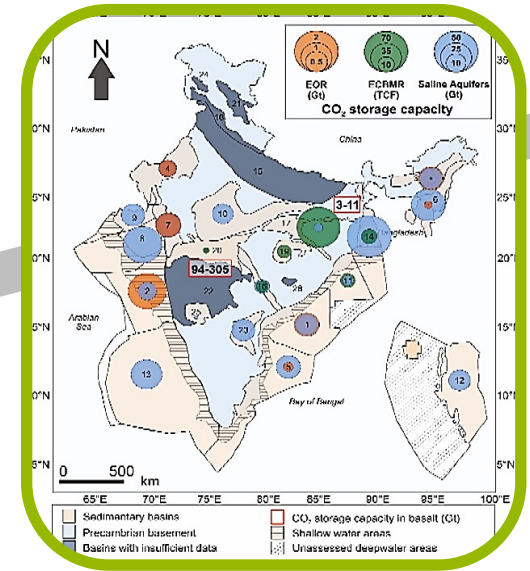
Pilot scale plant of 30 kg CO<sub>2</sub>/day capacity to methanol at JNCASR

## CO<sub>2</sub> Utilization



One pot conversion of CO<sub>2</sub> rich syngas to Dimethyl Ether by IIT Delhi

## CO<sub>2</sub> Storage



County-wide assessment for potential of CO<sub>2</sub> enhanced oil and gas recovery by IIT Bombay



Publications



Patents filed/granted



Technologies developed



Manpower supported



Project supported



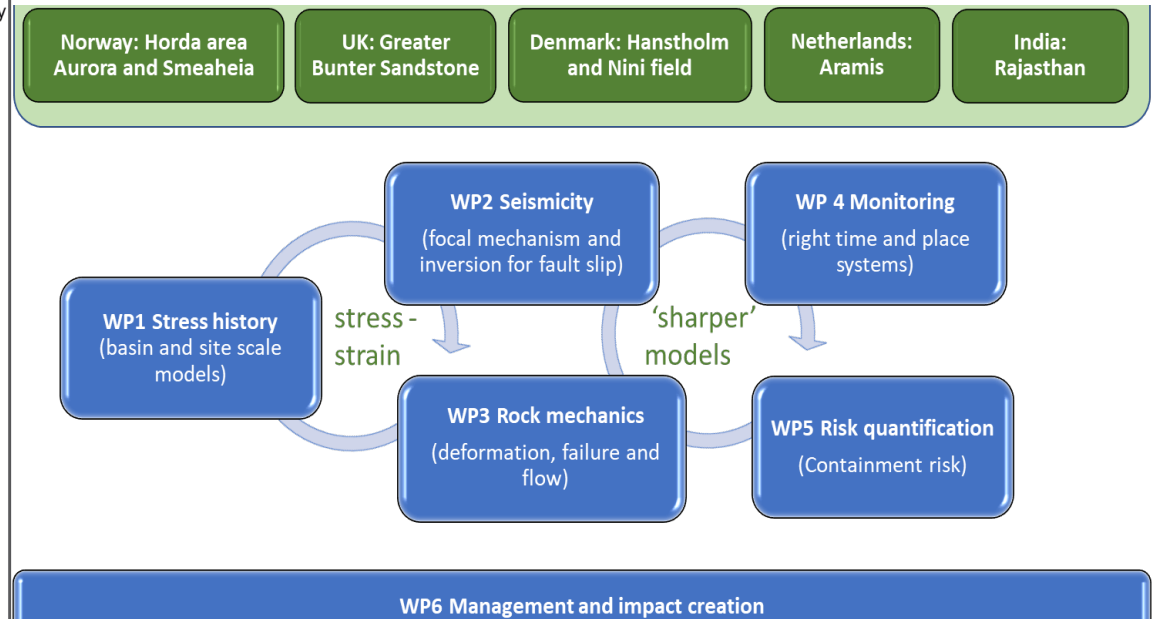
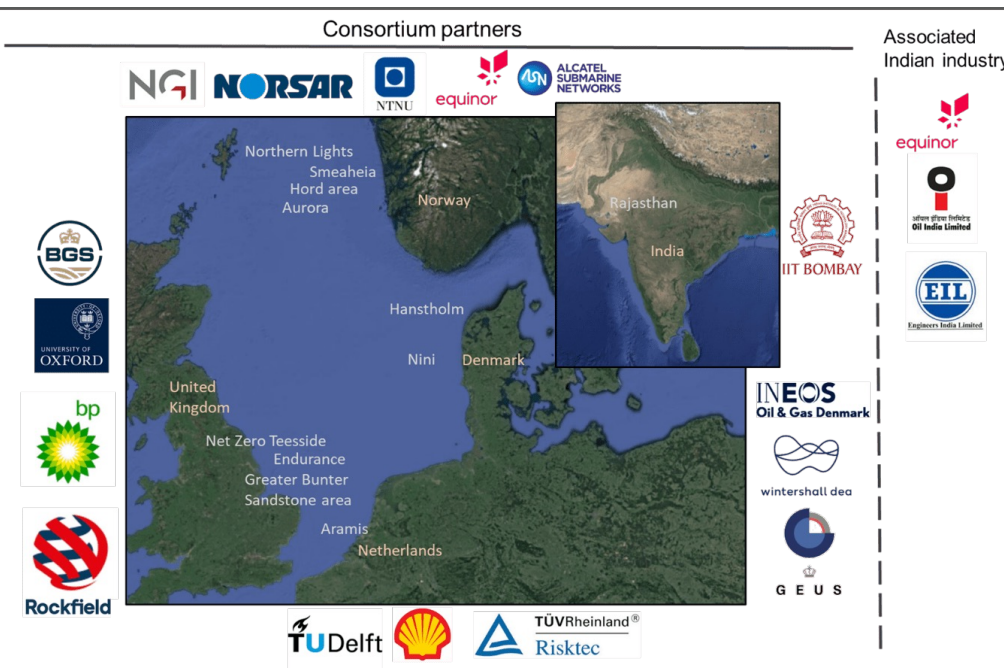
# Projects funded by DST under Multilateral ACT# 3

## 1. SHARP: STRESS HISTORY AND RESERVOIR PRESSURE FOR IMPROVED QUANTIFICATION OF CO<sub>2</sub> STORAGE CONTAINMENT RISKS

Norway, UK, Denmark,  
Netherlands, India

Co-ordinated by: *Prof. D N Singh, IIT Bombay*

### Objectives and Scope: Capacity Building in India



# **SCOPE - Sustainable OPERATION of post-combustion Capture plants**



Co-ordinating Institutes : *IIT Kharagpur, IP University New Delhi, MIPL*

International consortium: *Norway, United Kingdom, Netherlands, Germany, India and the United States.*

**Overall Goal: Development of technology for emission control and enable harmonization of regulations for amine-based CO<sub>2</sub> capture facilities.**

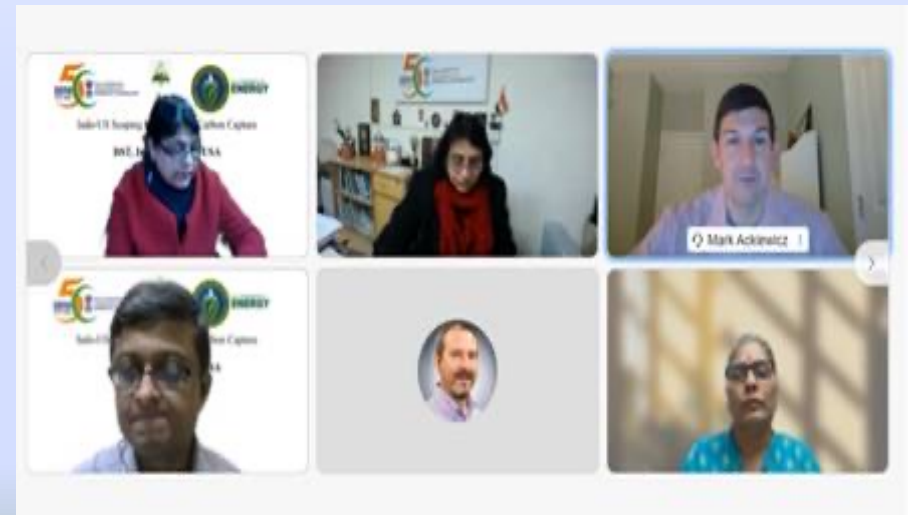
**Objectives & Work-packages:**

- **Development of *effective online monitoring systems* and *emission control guidelines*;**
- **Validation of predicted amine emissions from solvents against data generated in the project through test campaigns at *6 different pilot plants*;**
- **Effective *utilization of knowledge* about environmental hazards in risk assessment of amine-based CO<sub>2</sub> capture plants; and**
- **Identification of *societal concerns, policies and practices* that may affect the credibility of *industrial decarbonisation* using amine-based CO<sub>2</sub> capture in different countries.**

# Indo-US Bilateral collaboration in CCUS



A series of Indo US Scoping 6 Workshops on Carbon Capture, Utilization/Conversion and Storage/Sequestration was jointly organized by DST, India and DOE, USA from 21<sup>st</sup> Jan 2022 to 25<sup>th</sup> Feb 2022 for exploring the complementary strengths and gaps in the area of CCUS between the two countries.



# Indo UK Scoping exercise on CCUS Technologies...

- ❖ DST and UKRI/NERC/EPSCRC jointly commissioned a scoping exercise for mapping the Technology landscape in the areas of **Carbon Capture, Utilisation and Storage (CCUS)** in India and UK.
- ❖ The CCUS report has been officially released by **Secretary DST** and **British High Commissioner in India** on **14<sup>th</sup> December 2022**.



# Other National CCUS Efforts

- ❖ NTPC commissioned 20 TPD CO<sub>2</sub> capture plant, for conversion to methanol
- ❖ Tata Steel established the 5 TPD CO<sub>2</sub> capture plant for internal consumption
- ❖ Tuticorin Alkali Limited has the facility for capture of 200 TPD CO<sub>2</sub> for manufacturing of soda ash.
- ❖ ONGC, Oil India Limited and IOCL have signed MoUs for CO<sub>2</sub> enhanced oil and gas recovery
- ❖ NITI Aayog spearheaded in developing the 'CCUS Policy frameworks and its deployment mechanism in India'
- ❖ Ministry of Petroleum and Natural Gas released the draft '2030 CCUS roadmap for upstream exploration and production companies'.



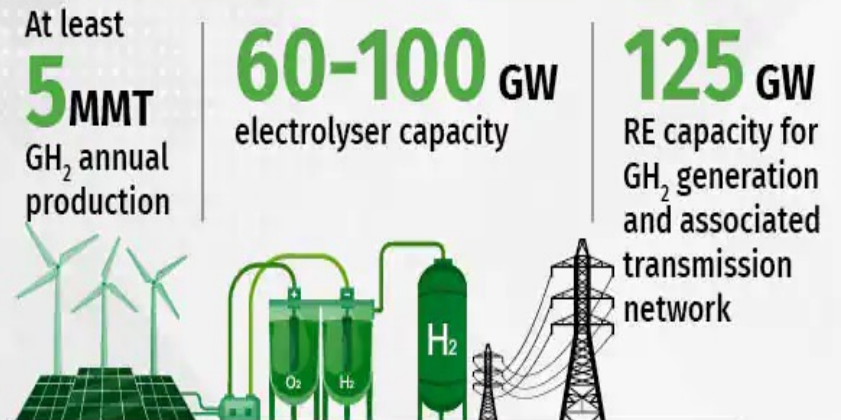
# Transition to Hydrogen Economy - (National Green Hydrogen Mission announced in Jan 2023)

## DST Intervention's

- Focus on R&D of hydrogen and fuel cell technologies for niche applications and to provide symbiotic international linkages.
- Recently launched the Hydrogen and Fuel Cell program and the Advanced Hydrogen and Fuel Cell Programme with objectives
  - Indigenous development of new and existing material in large quantities
  - Catalysts, membrane and other components for fuel cells
  - Electrolysers
  - Hydrogen storage materials, materials for Type IV cylinders and prototypes.
  - To reduce the cost of hydrogen Production, distribution & Storage
- Supported 41 projects and 2 centre of excellence on Hydrogen Storage with a total cost of Rs. 79 Cr.
- All the projects are currently under different stages of implementation.

## UNION CABINET APPROVES NATIONAL GREEN HYDROGEN MISSION

### EXPECTED DELIVERABLES BY 2030



**Total outlay approved: ₹ 19,744 crore**



Thank You !!

