MISSION INNOVATION
Accelerating the Clean Energy Revolution

सत्यमेव जयते
Ministry of Science & Technology
Government of India

MISSION INNOVATION
Accelerating the Clean Energy Revolution
INDIA

Funding Opportunity Announcement (FOA) in Carbon Capture Innovation Challenge (IC#3)

jointly by

Department of Biotechnology & Department of Science and Technology

1. PREAMBLE

Mission Innovation (MI) is a global initiative of 23 countries and the European Union to accelerate the global clean energy innovation. As a part of this initiative, the participating countries have committed to double their governmentôs clean energy research and development (R&D) investments over five years while encouraging greater level of private sector investments in clean energy technologies. These additional resources will dramatically accelerate the availability of the advanced technologies that will define a future global energy mix that is clean, affordable, and reliable. Mission Innovation was announced on November 30, 2015, as world leaders came together in Paris to undertake ambitious efforts to combat climate change.

MI countries have agreed to double their R&D investments from base year of 2015 in five years i.e. by 2020. Government of India has given the responsibility to Department of Biotechnology (DBT), Ministry of Science & Technology through Department of Biotechnology [with strong participation from Department of Science and Technology (DST)], to coordinate the Indian MI activities with Department of Science and Technology (DST) and other concerned Ministries engaged in clean energy R&D activities. (Please see details at www.mission-innovation-india.net).

India along with 23 other countries is a member of all Mission Innovation (MI) challenges for clean energy development and is co-lead in three challenges. India has taken lead in MI activities by arranging country workshops in all seven innovation challenges and has also organized MI International workshops/conferences on Smart Grids and Sustainable Biofuels. MI India Team in consultation with experts has identified priority areas in seven challenges where international cooperation and mutually beneficial engagements can be established. Carbon Capture Utilisation and Storage is one of the key Mission Innovation Challenge.

Carbon Capture, Utilization and Storage (CCUS) can achieve significant CO_2 reductions from power plants (fueled by coal, natural gas, and biomass) and industrial applications; which account for around 50% of all greenhouse gas (GHG) emissions. Industrial applications of CCU include upstream oil and gas production, cement production, iron and steel production, and fertilizer manufacturing. These large (>100,000 t CO_2/yrs.) point sources of CO_2 emissions have few alternative options for

significant reductions. Efforts to integrate bioenergy with CCUS also represent a pathway to negative emission technologies, which models suggest will become increasingly important in achieving deep decarbonisation. Coordinated decarbonisation efforts must include the development of additional technologies that prevent and curtail emissions of CO_2, result in carbon negative solutions, and lead to safe and secure carbon storage. If climate targets are to be achieved, development and deployment of technologies that dramatically reduce the output of CO_2, have an important contribution to make.

A key challenge for the power and industrial sectors have been the overall costs necessary for CCU technology to be adopted at a sufficient scale to meet the challenges of climate change. The science and technologies supporting CCUS have experienced great advances over the last decade, yet opportunities remain for reducing costs, improving performance, creating better business and regulatory models, and discovering new uses for CO_2.

There is a strong need to continue R&D in areas of Carbon Capture and Utilization and effective cooperation between researchers of MI countries is one of the best way to speedup these developments.

Considering the fact that the research areas under this initiative may fall in domain of both DBT and DST, this call for funding is on behalf of both DBT and DST to derive synergies and avoid any potential overlap.

2. OBJECTIVES:

The objective of the Carbon Capture Innovation Challenge is to advance CCUS technology development with the goal of reduced costs and improved performance. This Challenge will seek to identify and prioritize breakthrough technologies, and recommend R&D pathways and collaboration mechanisms.

The objective of this Call is to undertake **joint Research & Development with member MI countries** to identify and prioritize breakthrough technologies in the field of CO_2 capture, separation, storage and CO_2 value addition. CCUS is one of the only technologies able to achieve significant decarbonisation of our fossil fuel based economies, particularly in carbon-intensive industries such as cement, iron and steel production. Carbon Capture and Utilization offer important insight into the technical capabilities, policy and financing mechanisms, and permitting frameworks that could enable the successful deployment of CCU (For more details, please refer to description of this innovation challenge available at *www.mission-innovation-india.net*).

3. PURPOSE:

The purpose of this joint call on ***Carbon Capture*** is to discover scalable methods for carbon capture, storage and utilization for value addition. Also the purpose is to conduct research, development and demonstration to foster technology innovations that are technically feasible, robust and cost-effective for CCU. It is expected to evolve technologies and develop methodologies that address issues related to high capital costs, safety, logistics, high auxiliary power consumption and non-existence of commercial scale CCS projects.

4. SCOPE:

This funding opportunity will financially support activities towards design, Research & Development and Demonstrations (RD&D) that can address the issue of development of widely affordable, ways that address carbon capture, and utilization for value addition.

The project is to be led by academies/ scientist from Indian scientific / R&D institution with the participation of at least one MI country.

5. IDENTIFIED RESEARCH PRIORITIES:

Indicative list of R&D priority areas identified for this call are listed below. However, this list is not exhaustive and proposals aimed at addressing any other major research challenge in the area could be submitted. In all proposals need and relevance of proposal to address research challenge must be established and overreaching goal of the proposal need to be highlighted.

- Research and improve upon CO_2 capture as absorption, adsorption, membrane based.
- Hybrid model of two technologies which increase the efficiency of absorption.
- Development of efficient absorbants for solvent based CO_2 absorption, with improved regeneration, capacity and energy efficiency. Production of low cost absorbant material.
- Designing tailor-made sorbent materials.
- Enzyme (biomimetic) assisted solvent mediated CO_2 capture.
- New material development for membrane based CO_2 capture, with improved selectivity, high temperature operation and lower costing. Technologies exploring membrane separation of CO_2 and water vapor.
- Sequestration by enhanced oil recovery.
- Cost economics evaluation and industry evaluation for CO_2 capture as absorption, adsorption, membrane based technologies and others.
- Carbonates synthesis and dry reforming of CO_2
- CO_2 value addition to chemicals and value-added products in areas of research related to fuel additives, CO_2 dry reforming, CO_2 to methanol, polymer, biological and photochemical processes.
- Valorizing CO_2 by breakthrough catalytic transformations into fuels and chemicals
- Electrochemical and Photochemical transformation of CO_2.
- Hybridizing electrochemical and biological processes for CO_2 conversion to Fuels, Chemicals, and Nutrients.
- Research to develop and establish Oxy-combustion for utilization in coal-fired boilers.

6. ELIGIBILITY:

The proposals have to be led by qualified researchers/ professionals from Science, Technology and Engineering disciplines working in regular position at Indian institutions drawn from academia and public funded R&D Laboratories.

The institutions/industries of Mission Innovation (MI) member countries are welcome to join the partnership with the lead Indian institute/ organization to carry out collaborative work. While there is no restriction on upper number of participating MI countries (which includes Australia, Austria, Canada, China, Denmark, European Union, Finland, France, Germany, Indonesia, Italy, Japan, Mexico, Netherlands, Norway, Republic of Korea, Saudi Arabia, Sweden, United Arab Emirates, United Kingdom and United States), participation of at least one organization (institution/industry/utility) from MI country is mandatory.

The funding under this call will be provided to successful Indian researchers / Institutes who are expected to draw common R&D programs in the listed areas with researchers/ institutes of MI member countries. The MI member countries are encouraged to take part in this call by providing financial support to their researchers / institutes. The participating MI organization has to be a legal entity as per statute of the host country.

7. FUNDING:

This is a joint call of DBT and DST which will share the funding in equal proportions i.e. US$ 3 Million each

Total Funding Size:	**US $ 6 million** or equivalent in local currency of participating MI country
Floor limit:	**US $ 0.2 million**
Ceiling limit:	**US $ 1 million**
Expected Number of Awards:	**12**

8. COMPONENTS OF FUNDING

- Additional research manpower especially hired for the project in India (existing research manpower will not be eligible for funding).
- Travel (domestic and international) for researcher mobility.
- Dissemination activities and stakeholder workshops.
- Contingent expenditure such as stationery, incidentals etc.
- Permanent Equipment (not exceeding 20 % of project cost) Where possible, researchers are advised to make use of existing facilities and equipment, including those hosted at MI countries. If equipment is needed as part of the research proposal, applicants must follow DST/DBT norm

for requesting equipment which will be made available only on the basis of strong dedicated requirement for the project.

- Field/Pilot demonstration in India (upto 50 % of project cost, if proposed).

9. EVALUATION CRITERIA

Integrated proposals which can address one or more research challenges right from the R&D to development and demonstration at laboratory/ field level, wherever feasible as well as standalone proposal focusing on pressing challenges/issues with clear path to bring about out affordability, robustness and accessibility are welcome. It is mandatory that the research consortium is engaged in cutting edge R&D and has proven research and technical competence to execute the project. Besides, fulfillment of minimum eligibility and this requirement, the following criteria will be used in grant making decisions:

- Relevance to objectives MI Innovation Challenge IC#3.
- Potential for catalyzing R&D led breakthroughs for CCU.
- Technical Innovation on improving the ways to capture carbon towards value addition.
- Addressing critical R&D issues requiring early stage grant funding that will allow the development and testing of innovative technological solutions.
- Potential for accelerating the commercialization integrated carbon capture, separation and storage.
- Contribution of proposed work to enhance cost effectiveness and sustainability of carbon capture.

10. PROCESS

The evaluation process will be conducted in **two stages**:

- **Stage-I:** All interested applicants are invited to submit a Letter of Intent (LoI) in Consortium mode with agreement of MI member country researchers/ institutes.
- **Stage-II**: From these initial submissions, Evaluation Committee (EC) will shortlist the eligible applicants through peer review process ***separately both in India and in participating member MI country.*** The EC will be constituted jointly by DBT and DST.

Applicants found eligible at **Stage-I** evaluation will be requested to submit detailed proposals for participation in **Stage-II** and these will be critically evaluated by constituted expert committees in India and in participating MI member country.

11. TIMELINES

Call for Letter of Intent (LoI)	1st July 2018
Last date of submission of LoI Form	31st Aug 2018
Invitation for submission of detailed proposals	8th Oct 2018
Receipt of detailed proposals	11th Feb 2019
Evaluation of proposals and due diligence	2nd April 2019
Announcement of Awards	25th May 2019

12. GENERAL GUIDANCE ON PROPOSAL FORMULATION

The below guidance is not exhaustive, but is designed to help interested organizations to develop proposals.

- Proposed projects should necessary be based on clean energy and should be truly innovative and transformational. Proposals should make clear how they are adding value and not duplicating an existing solution; multiple forms of innovation are eligible and will be considered. Proposals should also clearly illustrate how the work proposes to overcome technical barriers of the current issues in carbon capture, storage and utilization for value addition.
- Proposed projects should be for oriented fundamental research and applied research, establish proof-of-concept in the early stages of development, defined broadly as the critical transition phase of idea/ concept to development thus making support from this grant would be most impactful.
- The maximum duration of the project **should not be more than 36 months**. Each project is subject to review at key milestones to continue funding.
- The project administrative costs should be kept to a minimum. The permanent equipment maximum upto 20% of the cost of project may be provided to the organization to develop the solution.
- In case, the partner is an institute/organization in MI member countries, a supporting **document from them is needed regarding their support to the project**. The participating MI researchers/ institutes need to provide supporting document from relevant authority in the MI country.
- The grant places strong emphasis on evidence-based results. Proposals must clearly define the indicators of success in the application form to show quantified tangible gain during the project lifecycle.

The grant also places a strong emphasis on sharing the results more widely. Project implementing organizations will be required to maintain an Open Access Policy.

13. SUBMISSION GUIDELINES

- A Soft copy (MS Word) should be e-mailed to **IC3@mission-innovation-india.net**
  Please mention **MI-India-IC#3: Name of Principal Investigator/ Name of Institute** in the subject line of the email. The mail should also be copied to:
  i. Dr. Sangita Kasture, Department of Biotechnology, MOS&T, GOI at **sangita.kasture@nic.in** and
  ii. Dr. Neelima Alam, Department of Science and Technology, MOS&T, GOI at **neelima.alam@nic.in**