

DST Plans

for

Mission Innovation in Clean Energy

Introduction:

The 'Mission Innovation' was launched during Hon'ble PM's visit to Paris for COP 21 in November 2015. The first Preparatory Meeting of Mission Innovation was held on 18th March 2016, in Beijing China with a focus to develop framework documents for Mission Innovation.

The inaugural Mission Innovation Ministerial was held on 1-2 June, at San Francisco. Dr. Harsh Vardhan, Hon'ble Minister, Science & Technology and Earth Sciences led the Indian delegation. The Ministerial comprising of 20 founding Members and European Commission on behalf of the European Union as the 21st partner pledged to double Government funded clean energy research and development over 5 years and enhance international engagement in programmes on clean energy R&D. This would enhance the government investment of these 21 entities in clean energy research and development to US\$ 30 billion per year from the current level of US\$15 billion per year. Currently, there are 23 members of Mission Innovation (Sweden and Finland are the new additions) including European Commission. They are Australia, Brazil, Canada, Chile, China, Denmark, European Union, Finland, France, Germany, India, Indonesia, Italy, Japan, Mexico, Netherland, Norway, South Korea, Saudi Arabia, Sweden, United Arab Emirates, United Kingdom and United States of America.

During the meeting, Hon'ble Minister also announced that India's current investment of US\$72 million would be doubled to US\$145 million by 2019. He also highlighted the collaborative research programmes in solar energy, energy efficiency, advanced bio-fuels, electrical transmission and storage with US, UK, Australia, Norway and South Korea. The Minister also announced setting up of Joint Virtual Clean Energy Centre in collaboration with UK with a contribution of £ 5 million from each side and launching of a new research track on smart energy grids and energy storage under Indo US Partnership for Advanced Clean Energy Research (PACE-R) at an investment of US\$ 7.5 million from each side with matching contribution of consortia for totalling US\$ 30 million over 5 years. The doubling plan of the country also outlined strategy for doubling of the investment which includes setting up of Joint Virtual Centres, demand oriented mission mode programmes, oriented fundamental research etc. in the priority clean energy technologies such as renewable energy, energy efficiency, clean fossil technologies, electric grid technologies and advanced transportation systems and fuels and other cross cutting technologies.

The second MI Ministerial and Eight Clean Energy Ministerial (CEM-8) is being held on 6-8th June, 2017 at Beijing, China. About one year into its launch, at the United Nations Climate Change Conference 2016 (COP22) in Morocco, MI countries have established seven Innovation Challenges as the foundation for accelerating clean energy innovation while also providing opportunities for new collaboration that build on multi-lateral research and development efforts. A Preparatory Meeting for the Second Mission Innovation Ministerial (MI-2) took place in Brussels on Thursday, 2 March 2017.

DST Doubling Plan as Committed in Mission Innovation:

Table-I: Investment Doubling Plan and Progress

(Rs in Crores)

1. Baseline Amount	Rs. 60 Crore (US \$ 9 million)
2. Baseline Year(s)	2014- 2015
3. Doubling Target	Rs. 120 Crore (US \$ 18 million)
4. Doubling Year:	2017-18
5. First-Year Amount (2015-16)	Rs 80 Crore (2015-16)
6. First-Year Percent Increase (2015-16)	33 %.
7. Second Year Amount (2016-17)	147.00 Crore (US \$ 22.1 million)
8. Second Year Percentage Increase (2016-17)	145%

Table II DST: Mission Innovation Budget Elements Plan and Progress

Table II DST-India: Mission Innovation Budget Elements

	FY 2014-15	FY 2016-17	FY 2017-18	FY2014-15 VS 2016-17		FY2014-15 VS 2017-18	
				\$ Change	% Change	\$ Change	%Change
Energy efficiency: Residential and Commercial Buildings	\$ 0.71 m (4.73 Cr)	\$ 1.2 m (8.00 Cr)	\$ 1.5 m (10.00 Cr)	+ \$ 0.5 m (3.27 Cr)	69%	+ \$ 0.8 m (5.7 Cr)	120%
Renewable Energy: Solar	\$ 5.8 m (38.00 Cr)	\$ 13.20 m (87.76 Cr)	\$ 16.27 m (75.00 Cr)	+ \$7.50 m 49.76 Cr	130 %	+ \$ 5.6 m 37 Cr	97%
Electric Delivery & Energy Reliability: Smart Grids and Energy Storage	\$ 1.9 m (12.48 Cr)	\$ 5.75 m 38.25 Cr	\$ 7.2 m 48.00 Cr	+\$ 3.9 m 25.77 Cr	206%	+ \$ 5.33 m 35.52 Cr	284%
Basic Science	\$0.3 m (2.5 Cr)	\$0.45 m (3.00 Cr)	\$ 0.7 m (5.00 Cr)	+ \$ 0.07 m (0.50 Cr)	20%	+ \$ 0.37 m (2.5 Cr)	100%
Cleaner Fossil Energy Research and Development: Clean Coal, Alternate Fuel, Carbon Capture	---	\$ 1.4 m 9.42 Cr	\$ 9.31 m 62.00 Cr	\$ 1.4 m 9.42 Cr	100%	\$ 9.31 m 62.00 Cr	658%

Action Plan to double the Investment:

Intensifying research efforts on:

- Promoting India centric innovation for Clean Energy Proliferation
- National, bilateral and multilateral joint virtual centres on clean energy themes
- Technology platform led by industry for select technologies
- Scaled up funding to academic/ R&D institutions as well as R&D units in the industry for research on identified topics relevant to clean energy.
- National, bilateral and multilateral capacity building programmes in clean energy.
- Setting up demand oriented mission programmes on clean coal technologies, building energy efficiency, cleaner fuels (Bio-fuels, Methanol and DME) besides consolidating and orienting present research in solar energy to national needs.
- Promoting research programme and studies relevant to water energy nexus.
- Developing models for last mile connectivity for technology leads obtained through R&D.

Country Narrative on Pledged Priorities (Research Priorities for Clean Energy Research)-

- Solar Energy-Solar Energy utilization for applications both for power as well as other than power generation with a view to provide convergent technology solutions.
- Building Energy Efficiency- to promote research and clean energy innovation in the area of energy efficiency in building, building energy modeling and simulation, monitoring and benchmarking of buildings, Advanced HVAC (heating, ventilation, and air conditioning) and lighting technologies etc.
- Smart Grids- to ensure safe, reliable and resilient grid operations for densely populated urban setting, sub-urban and rural setting, and commercial and large-industrial setting.
- Energy Storage- especially for fluctuating solar and wind energy to store the amount of power required and to supply it at times when need is greatest, which is during peak load.
- Energy Materials- To develop innovative hybrid material for energy storage and to build energy storage device with enhanced output. Synthesis of new hybrid materials for energy storage devices (electric energy or thermal), achieving efficient use of renewable energy in hybrid systems for the storage and generation of energy and addressing the continuous conversion and integration of renewable electricity and heat are the few significant areas.
- Energy Conservation- for reducing energy consumption through using less of energy. It reduces the *energy* consumption and energy demand per capita.
- Electric Mobility- to promote hybrid and electric vehicles through products, technology development and infrastructure facilities.
- Biomass- for sustainable feedstock cultivation and supply, technologies for production of biofuels with minimal environmental impact, and analysis of overall sustainability and supply chain of feedstock.

- Alternate Fuels: to promote renewable materials or substances that can be used as fuels, other than conventional fuels like fossil fuels, coal, and natural gas etc.
- Energy Efficient Building Materials- for low carbon foot print energy efficient designing, construction, operation and maintenance of the buildings.
- Innovative Research for Enhancing Efficiency of Wind Energy systems.

Collaborative R&D Endeavour of DST (Post Mission Innovation):

➤ **India-US Joint Clean Energy Research and Development Center (JCERDC)**

Areas of Focus- Three priority areas were identified mutually; Solar Energy, Energy Efficiency of Buildings and Second Generation Biofuel. Joint Funding Opportunity was drafted and announced. Proposals were evaluated prior to selection by a joint review mechanism.

Project Funding and Duration

- Solar Energy: \$ 25.00 million over five years from each side
- Energy Efficiency of Buildings: \$ 62.50 Million over five years from each side
- For Phase-II JCERDC for Smart Grids and Grid Storage: \$7.5 million for 5 years with equal sharing between India and US government.

➤ **India-UK Joint Research Activities in Clean Energy**

Areas of Focus- Solar Energy, Fuel Cells, Rural Energy Systems and Smart Grids and Energy Storage. Areas of mutual interest were identified through stakeholders consultation and joint proposal were invited and peer reviewed independently.

Project Funding and Duration-

- Fuel Cells: £3 million over three years from each side (2011-14)
- Solar Energy: £5 million over five years from each side (2011-16)
- Bridging Rural Urban Divide- Rural Energy System: £2.5 million over five years (2012-17)
- Smart Energy Grids and Energy Storage: £5 million over three years from each side (2014-17).
- Indo UK Joint Virtual Centre Clean Energy (JVCCE): £5 million from each side over four years (2016-20).
- Energy Remand Reduction in Built Environment: £3.8M for 4 years. (2017-20)
- India-UK Water Quality Research Programme: £4.2m for over three years (2017-20)

➤ **India and Norway Programme in environmental friendly energy research**

Areas of Focus- Renewable Energy (Wind, Solar, Hydropower, Bioenergy), Energy System (Grid, Off Grid, Storage), Energy Use and Planning. Areas of mutual interest were identified through stakeholders consultation. The last date of the call is 24 May, 2017.

Project Funding and Duration- The project duration is 3 years. Upto 8 million NOK is available for funding to each project.

- **BRICS STI Framework Programme (Brazil, Russia, India, China, South Africa):**
Area of Focus- Collaborative multilateral basic, applied and innovation research projects in the areas of New and renewable energy, and energy efficiency, Material science including nanotechnology etc.
Project duration – Three years

- **Science and Engineering Research Board (SERB), a Statutory body under the Department of Science and Technology, Government of India has SERB Overseas Postdoctoral fellowship (SERB-OPDF)** for a period of one year extendable to one more year. The Program admits candidates in identified areas including energy and sends them to top institutions around the globe.

National Initiatives:

- **Surya Jyoti- a Micro Solar Dome:** Surya Jyoti is a unique solar energy operated lighting device, which works during daytime in passive mode and in the night time through photovoltaic mode. The integrated PV module fitted in the dome charges a special battery during day time which in turn provides light during night.
- **Initiative to Promote Habitat Energy Efficiency (I-PHEE):** A new national programme on “Initiative to Promote Habitat Energy Efficiency (I-PHEE)” to improve energy performance of buildings and cities was launched. It would support enhancement of knowledge and practice to save energy in design, construction and operation of buildings. 105 research proposals were received under the programme, out of which 31 have been recommended for funding.
- **Materials on Energy Storage (MES):** A new programme on the Materials on Energy Storage (MES) to support R&D activities aimed at innovative materials for energy storage, and to build energy storage device with enhanced output for multifunctional applications was launched during the year. Aiming the efficient use and further increase of renewable energy, and demonstrating its value in terms of flexibility in the energy systems are the prime objective of the initiative. 130 proposals were received and 18 were approved for funding.
- **Collaboration with Ministry of Railways:** Department of Science and Technology has embarked upon a new initiative with Ministry of Railways to provide research based technological solutions in the areas of fuel efficiency, emission control technologies, alternate fuels and fuel conservation. This collaboration is also expanding under the ambit of Technology Mission for Indian Railways. DST is planning a joint investment of the order of Rs. 75 crores to further strengthen this collaboration to meet needs of Indian railways.
- **Programme on Methanol:** In order to augment energy security of the country, the work has been initiated for utilising methanol as a drop in fuel for gasoline and its derivative DME as a replacement of

diesel. Techno economic analysis in Indian context is being initiated to evolve a roadmap for methanol economy leading to energy security in the long term.

An International Seminar on 'India's Leap to Methanol Economy- Opportunities and Option for Energy Security' was held at New Delhi for knowledge sharing and aggregation for chalking out a strategy for preparing road map on Methanol & DME economy for the country. DST actively contributed in preparation of Roadmaps for Methanol DME and Di methyl ether. A survey report on Production & Utilisation issues of Methanol & DME was finalized. DST initiated research programme on methanol and DME, which evinced great interest and 94 proposals were received.

- **Clean Coal Technologies:** As significant percentage of the energy needs of the country are met from the coal and coal is going to continue as the mainstay for Indian power requirements, clean coal technologies require renewed attention. It is planned to identify possible technological solutions that can improve efficiency, emissions and water requirements for the coal plants. The concepts such as polygeneration for simultaneous production of power, heat, refrigeration, desalination etc. could also be looked into. A clean coal technology programme involving all stakeholders namely, Ministries, power generation companies, coal industry, research and academic institutions both as national and bilateral programme could be very pertinent.

DST has identified priority research areas through stakeholders consultation. DST is participating in National Mission on Advanced Ultra Super Critical Technology for Cleaner Coal technologies. Two virtual research centres on Advanced Ultra Supercritical (AUSC) have been initiated at IISC and ARCI Hyderabad.