



# Research, development, demonstrations and commercialisation endeavours for accelerating Clean Energy Innovations

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# Science, Technology and Innovation Framework for Clean Energy Innovation

## National Policy

Accelerate the pace of discovery and delivery of science led solutions for High priority sector including Energy through enhanced global cooperation and Public-Private Partnership (PPP)

## DST Mandate

Build human, institutional and technology capacity forging alliances, partnership and R&D Missions for larger benefit of society through S&T.

## Mission for Clean Energy

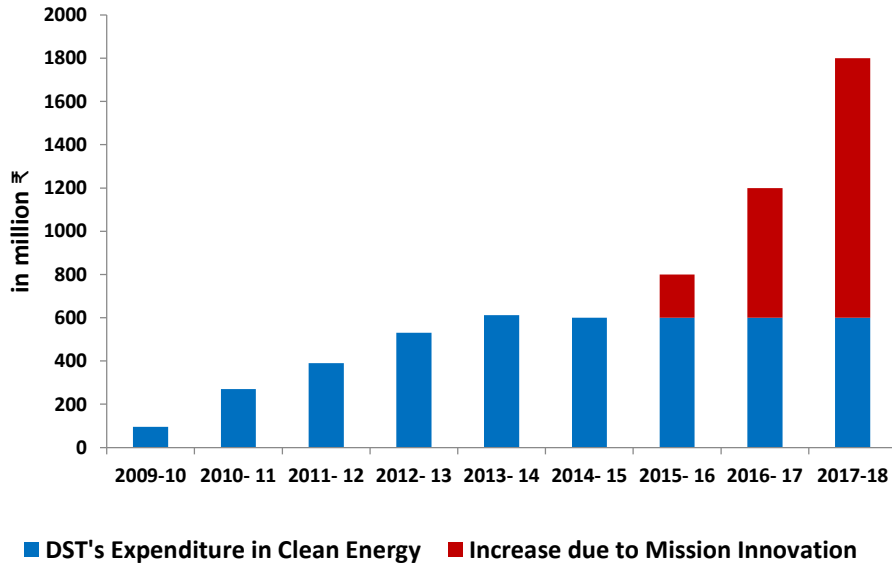
- Promote novel ideas & cutting edge research to foster innovations
- Foster Translational Research to develop competitive technologies
- Nurture start ups and partner with industry for accelerated diffusion through start ups and industries.



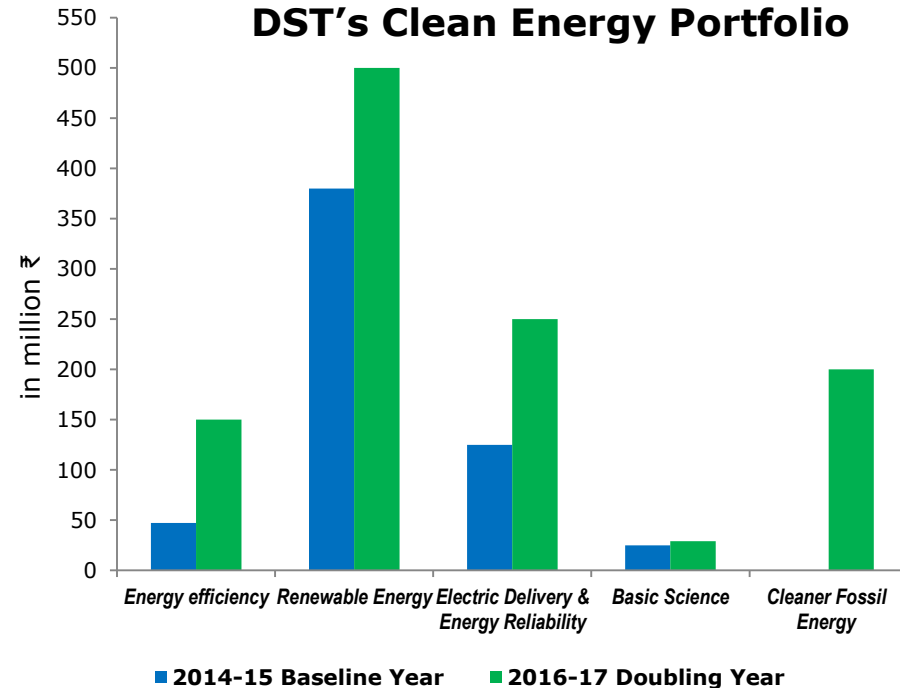
# Advancing technology readiness levels through Clean Energy Research, Development and Demonstration

- Fundamental and early stage research ( [www.serb.gov.in](http://www.serb.gov.in) )
- Capacity building, applied research, proof of concept, technology development, demonstrations ( [www.dst.gov.in](http://www.dst.gov.in), [www.dstattara.in](http://www.dstattara.in) )
- Market readiness of promising innovations and technologies ( [www.nstedb.com](http://www.nstedb.com), [www.tdb.gov.in](http://www.tdb.gov.in) )

### DST Funding for Clean Energy



### DST's Clean Energy Portfolio





# National Programmes for Clean Energy Research Development and Demonstration

- Missions on Clean Energy (175 projects at ₹ 2000 million) and Water Research ( 300 projects at ₹1500 M)
- Nationally funded research programme and fellowship with provision of international participation

Technology Platform for Electric Mobility (TPEM) - ₹ 1600 M

National Programme on CO<sub>2</sub> sequestration Research (NPCSR) - ₹ 500 M

## ***NEW INITIATIVES***

- *Initiative to Promote Habitat Energy Efficiency (I-PHEE)*
- *Energy Storage Material and Devices*
- *Power Electronics and Smart Grids Programme*
- *National Mission on Advanced Ultra Super Critical Technology for Cleaner Coal technologies ( ₹ 15600 M )*
- *National Mission on Methanol and Di-Methyl Ether as cleaner fuels*



सत्यमेव जयते

# Commercialisation of Innovations

- **National Innovation Foundation-DST** <http://nif.org.in/>

Documenting, adding value and protecting  
Intellectual Property Right



- **Technology Development Board -DST:** commercialisation of indigenous technologies and adaptation of imported technologies for wider application

Infuse ventures co-promoted by TDB-DST supports  
early stage clean tech companies



- **National Initiative for Developing and Harnessing Innovation (NIDHI)** to transform the start-up eco system with the commitment of ₹ 5000 million leveraging more than 100 Technology Business Incubators in public-public and public-private partnership.

- **Commercialisation of New Technologies:** Universal lighting access by Micro solar dome (Surya Jyoti) lighting technology has potential for 10 million households





# DST National Energy Research Centres and Networks

## Energy Research Centres at Academic Institutions



Laser diagnostics

**National Centre for Combustion Research and Development at Chennai and Bangalore**



3"X3" c- Si Solar Cells

**Solar Energy Research Hub at Kolkata**



Lab-scale thermal energy storage prototype

**Solar Thermal Research Centre at Pathshala , Chennai**

## Knowledge Networks

**Solar Thermal and Power Electronics Research for grid/off grid requirements**

**Generation, Storage and distribution of Solar Hydrogen**

## DST Laboratories with Energy Focus

**International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)**

**Indian Association for the Cultivation of Science (IACS)**

*Material Research Centres on Advanced Ultra Supercritical Technology (Upcoming)*

*Technical Research Centres on Energy and Water( Upcoming)*



# DST International Research & Development Networks

## Bilateral Networks

- **Australia:** Energy storage technologies, smart grids, cleaner fossil fuels, energy materials, bioenergy and biofuels
- **Finland:** Platform biofuels, novel photovoltaic and PV system, influence of clouds and atmospheric aerosols on solar energy
- **Germany:** Solar thermal, large area solar cells, bio-butanol smart super-capacitors
- **Norway :** Solar energy, bio-energy, smart grids
- **Singapore:** Flexible pervoskite Solar Cells and high-efficiency dye-sensitized solar cells
- **South Korea:** Biofuel utilisation, carbon dioxide to fuel, Hydrogen production, enzymatic biofuel cell, organic solar cell, energy recovery from distillery waste water
- **United Kingdom:** Organic solar cells, stability and reliability of solar modules, fuel cells, smart grid and energy storage, building energy efficiency, water and waste water

## Multilateral Networks

- **European Union :** Dye Sensitised Solar Cells (DSSC), Water and Waste Water Treatment, **Energy Networks (upcoming)**



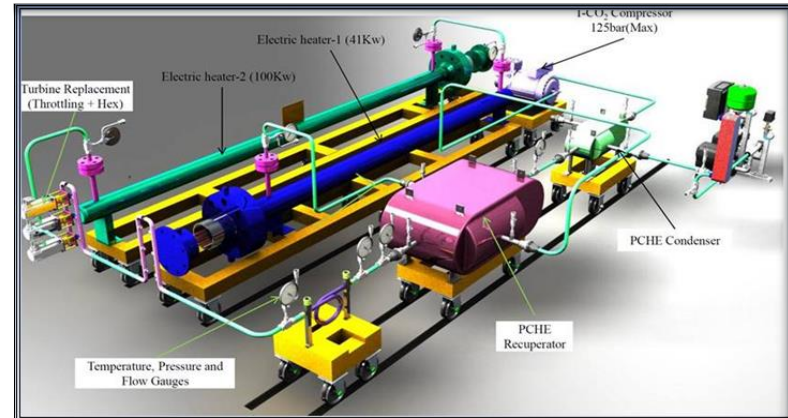
# DST International Research & Development Centres

## Bilateral Clean Energy Research and Development Centre

- Solar Energy Research Institute of India and US (SERIIUS) - (₹ 500 million. Sustainable Photovoltaics, distributed solar thermal and solar energy integration)
- Indo-US Centre for Building Energy Research and Development (Life cycle Analysis energy efficiency framework of building construction, operation and maintenance)
- *Indo- U.S. Joint Clean Energy R&D Center (JCERDC) on Smart Grid and Grid Storage Technology ( upcoming)*



Dedicated outdoor air system (DOAS) technology testing at IIT Bombay



Supercritical CO<sub>2</sub> Brayton Cycle Test Loop developed by IISc, Bangalore and NREL, USA

- Indo-UK Joint Centre on Clean Energy (₹ 500 million, Integration of intermittent renewables with suitable energy storage in on/off grid situations)





# Collaboration with Industries

- Industries with proven R&D credentials eligible for grant on cost sharing basis.
- Start-ups incubated in Technology Business Incubators (TBIs ) can avail government grants upto Rs. 10 million through TBIs.
- Funding to industries ( including start ups) through bilateral S&T forums for Germany (<http://www.igstc.org> ) and United States (<http://www.iusstf.org> ) and under bilateral programmes with Canada, Israel, Korea , Finland and Spain through Global Innovation & Technology Alliance (GITA) (<http://www.gita.org.in> )



Solar steam generator with thermal energy storage for desalination



Solar Thermal Power Demonstration at Shive Village, Pune



# DST's Industrial Partners





# Mission Innovation – DST Plans, priorities and investment opportunities

## Scaling Up

- Scaled up funding to academics, Research institutions , R&D units in industry , TBIs and Start ups
- National, bilateral and multi lateral capacity building programmes
- Demand oriented mission programmes on clean coal technologies, building energy efficiency, cleaner fuels (Bio-fuels, Methanol and DME) ,Solar Energy
- Joint Research & Capacity Building Sub-Group

## Investment Opportunities for Industries

- Technology Business Incubators in Public Private Partnership
- Partnering in upcoming research centres through benefit sharing and sharing of risks in research
- Co-investment in fellowships on industry defined problem
- Technology platforms led by industry with participation of academic/R&D institutions
- Upscaling of Universal lighting access through Micro Solar Dome.

## Research Priorities

- Clean Coal Technologies
- Solar Energy including daylighting solutions
- Building Energy Efficiency
- Smart Grids
- Energy Storage
- Energy Materials
- Energy Conservation
- Electric Mobility
- Biomass
- Cleaner Fuels
- Energy Efficient Building Materials
- Wind Energy Efficiency
- Energy-Water Nexus



**Thank You**