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)
- Capacity building, applied research, proof of concept, technology development, demonstrations (www.dst.gov.in, www.dsttara.in)

**DST Funding for Clean Energy**

- DST’s Expenditure in Clean Energy
- Increase due to Mission Innovation

**DST’s Clean Energy Portfolio**

- Energy efficiency
- Renewable Energy
- Electric Delivery & Energy Reliability
- Basic Science
- Cleaner Fossil Energy

- 2014-15 Baseline Year
- 2016-17 Doubling Year
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

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
Commercialisation of Innovations


• **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

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<tr>
<th>Laser diagnostics</th>
<th>National Centre for Combustion Research and Development at Chennai and Bangalore</th>
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<td>3”X3” c- Si Solar Cells</td>
<td>Solar Energy Research Hub at Kolkata</td>
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<tr>
<td>Lab-scale thermal energy storage prototype</td>
<td>Solar Thermal Research Centre at Pathshala, Chennai</td>
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#### 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)**
**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)**

![Image of co2 brayton cycle test loop](image1)

**Supercritical CO\textsubscript{2} 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)

![Image of co2 brayton cycle test loop](image2)
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