

MAJOR SMART GRIDS ACTIVITIES INITIATED BY DST, INDIA AT GLOBAL LEVEL

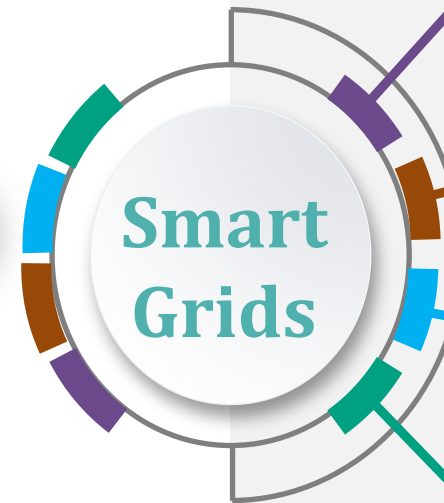
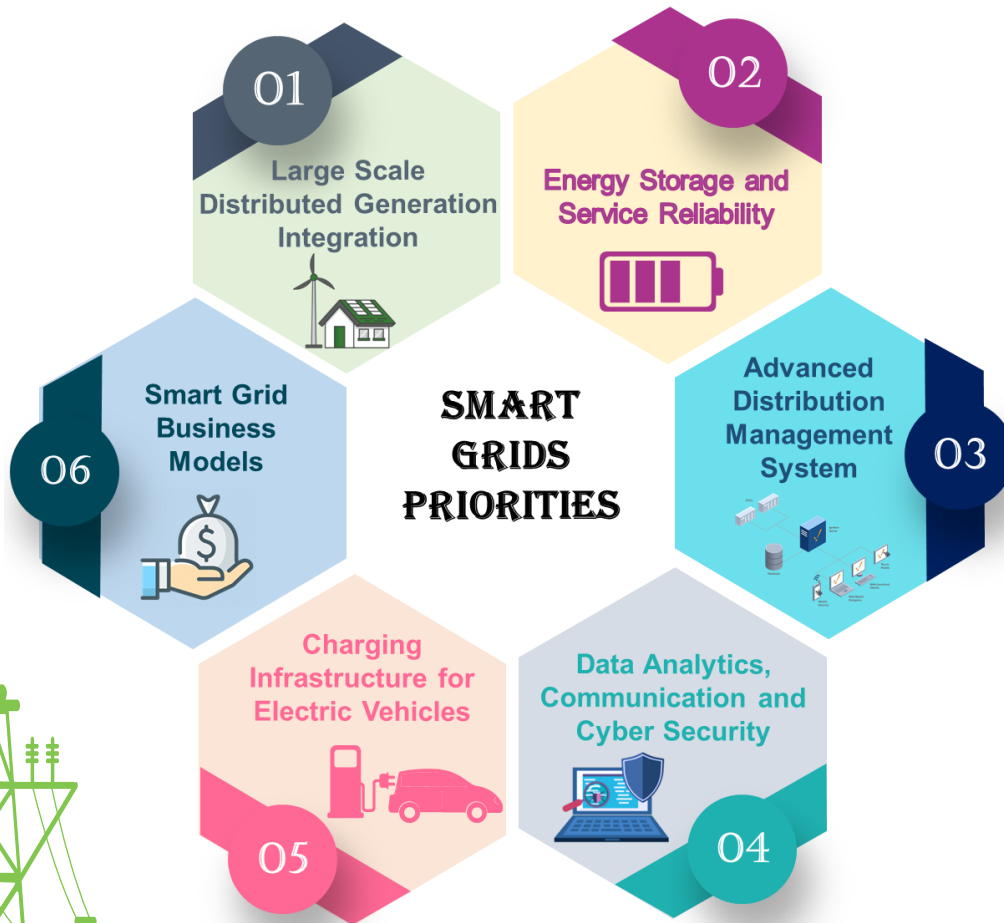
Presented by -

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Government of India





India-UK

- 5 projects and 2 Centers
- Rs.81.16 crores (£ 8.59 Million)
- Patents: 29
- Publications: 414
- Manpower Trained: 321



India-US

- 1 project
- Rs.54.85 crores (\$ 7.33 Million)
- Patents: 3
- Publications: 206
- Manpower Trained: 218



- 9 projects (Australia, Canada, France, Germany, Italy, Norway, UK and USA)
- Rs.28.33 crores (\$ 3.79 Million)
- Patents: 4
- Publications: 83
- Manpower Trained: 70

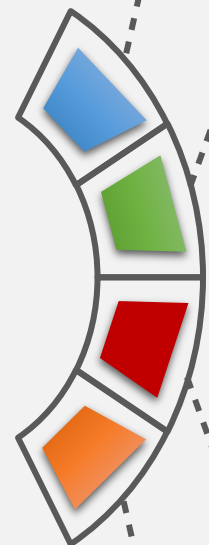


India-EU

- 2 projects
- Rs.24.19 crores (€ 2.87 Million)
- Eco-tools: 10 (Applied)
- Publications: 26



SMART GRID



● India-UK

● India-US

● Mission Innovation (Smart Grids)

● India-EU

● R & D facilities

● Pilots

High Energy and Power Density (HEAPD) solutions for large energy deficits
IIT Roorkee

Advance Communication and Control for the Prevention of Blackout (ACCEPT)
IIT Delhi

Hybrid Micro-Grid demo at Brahmakumari's Ashram
Mount Abu

MNIT Jaipur

Intelligent Micro-Grids with Appropriate Storage for Energy (IMASE)
IIT Bombay

IIT Hyderabad

IISc Bangalore

Hybrid Microgrid for housing complex (Hot & humid)
Lakshadweep

CDAC Thiruvananthapuram

Hybrid Microgrid North Eastern Hill University (NEHU) Campus,
Shillong

IIT Kanpur

Tezpur University

IEST Shibpur

Reconfigurable Distribution Networks (RDN)
IIT Kharagpur

Reliable and Efficient System for Community Energy Solutions (RESCUES)
IIT Kharagpur

IIT Bhubaneswar

IIT Madras



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Integration of Intermittent Renewable Energy With Energy Storage for Grid Connected and Isolated Communities In India And UK

Smart Energy Grids and Energy Storage (SEGES)
[2012 – 2017]
Five Projects, (INR 48 Crores)



Joint Virtual Clean Energy Centers (JVCEC)
[2017 – 2022]
Two Centres, (INR 48 Crores)

Developed Technologies

- Smart grid technologies to support novel integrated protection and control tools for **prevention of blackout** situations that occur in 2012
- Development of efficient DC microgrids and their coordinated operation for reliable power supply during **islanded conditions, in remote locations,**
- Adaptable robust energy storage solutions for different **microgrid architectures**



Smart Converters

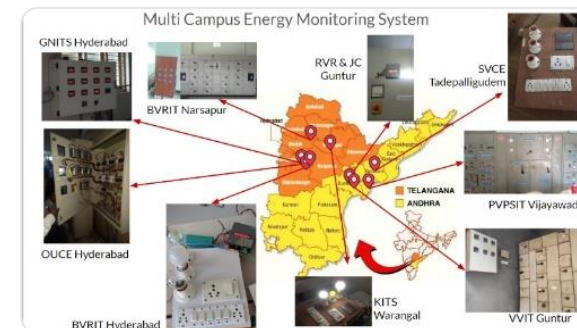


Hybrid microgrid control center

Technology Readiness Level (TRL) - 4

Developed Technologies

- **Testing facility for 100 kW** solar power converters in the laboratory has been established.
- System integration and demonstration of **hybrid microgrids (10-30 kW) in different Indian scenario** (climatic and current grid isolated community).
- Development of AC/DC hybrid micro-grid capable of operating in grid connected and isolated mode with **seamless mode transition for both rural and urban electrical demands**



Multi-Campus energy monitoring system (UKICERI)

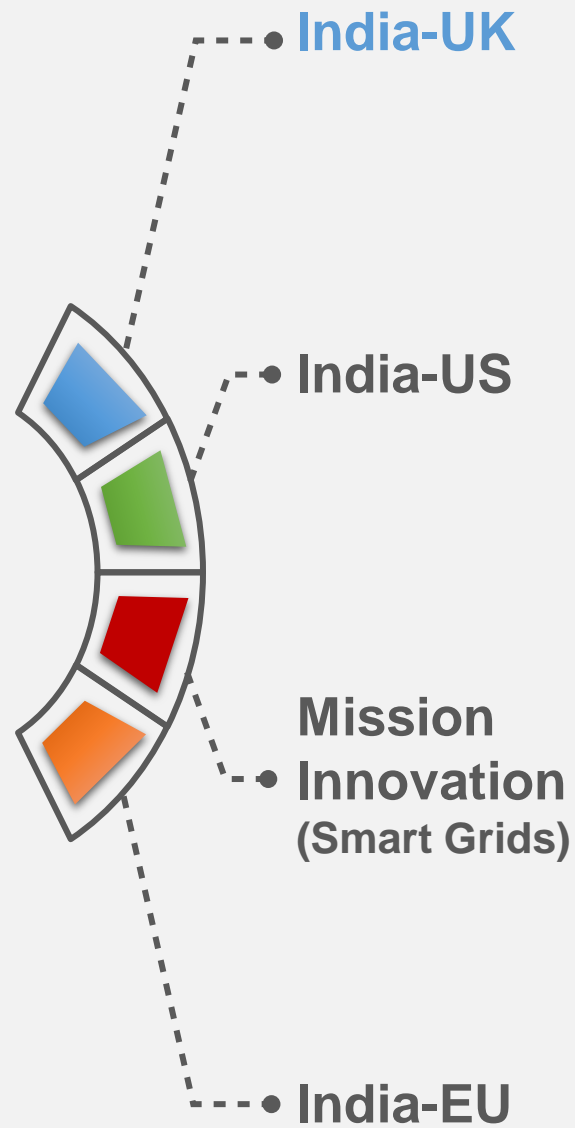


Frequency regulation algorithm testing

Technology Readiness Level (TRL) – up to 8

Utilization of developed technologies and best practice for the deployment

SMART GRID



Program **Outcomes**



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07 Projects/
Centres



321 Manpower
Trained



₹81.16 Cr.
Investment



27 Institutions



28 Industries



29 Patents

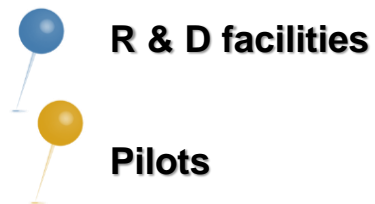
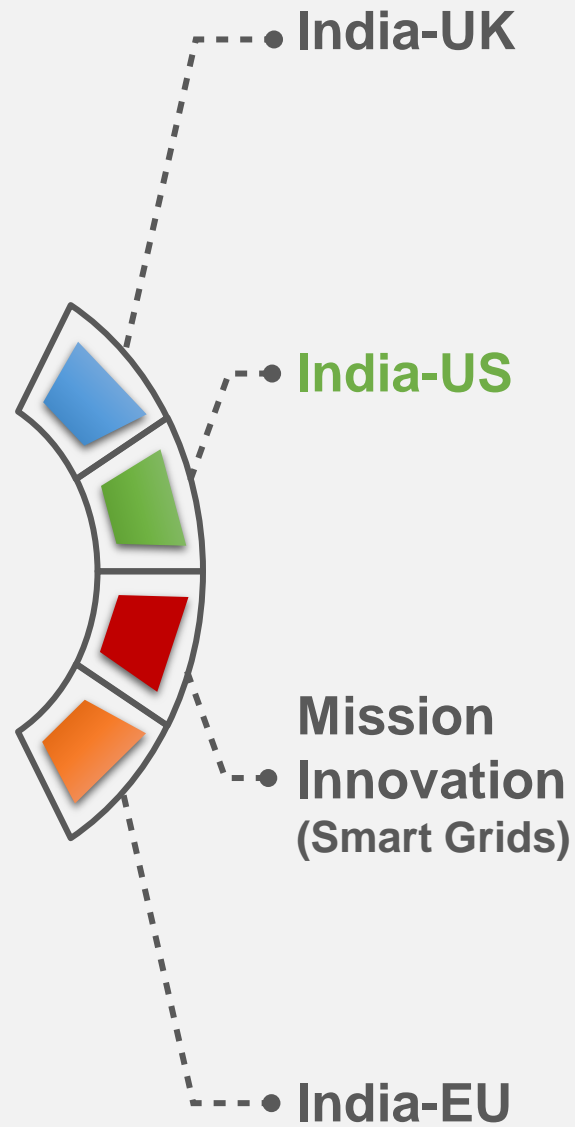


414 Publications



03 Pilots

SMART GRID



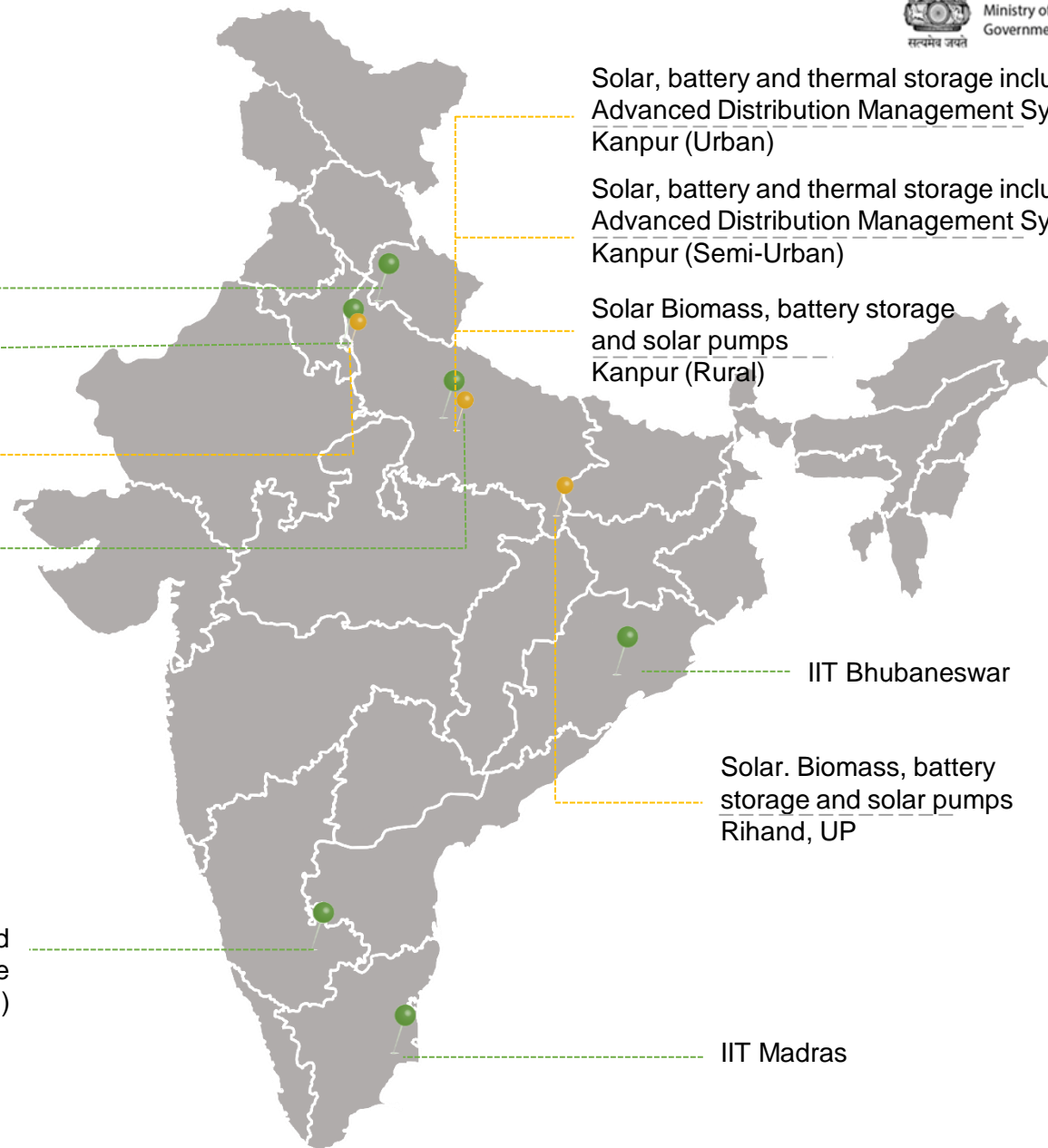
IIT Roorkee

IIT Delhi

Solar, Battery and Thermal Storage
New Delhi

IIT Kanpur

The Energy and Resources Institute (TERI)



Real World Deployment at 3 Uncommon Geographical Locations

US-India Collaborative for Smart Distribution System with Storage (UI-ASSIST)
[2017 – 2022]
One Project, (INR 111 Crores)

Developed Technologies

- **Indigenous development of ADMS** by Synergy Systems (Industry partner) and IIT Kanpur for Monitoring and Operation of emerging Smart Distribution Grids
- A **2-kW power amplifier** hardware developed and interfaced with a Real-time simulator at IIT Kanpur
- **Optimal charging/discharging scheme** for the battery in order to maximize the economic benefit to the customer
- Demonstrating **role model for future distribution grids** embedded with microgrid and storage in Indian rural, semi-urban and urban context



Thermal storage IIT Kanpur Urban pilot



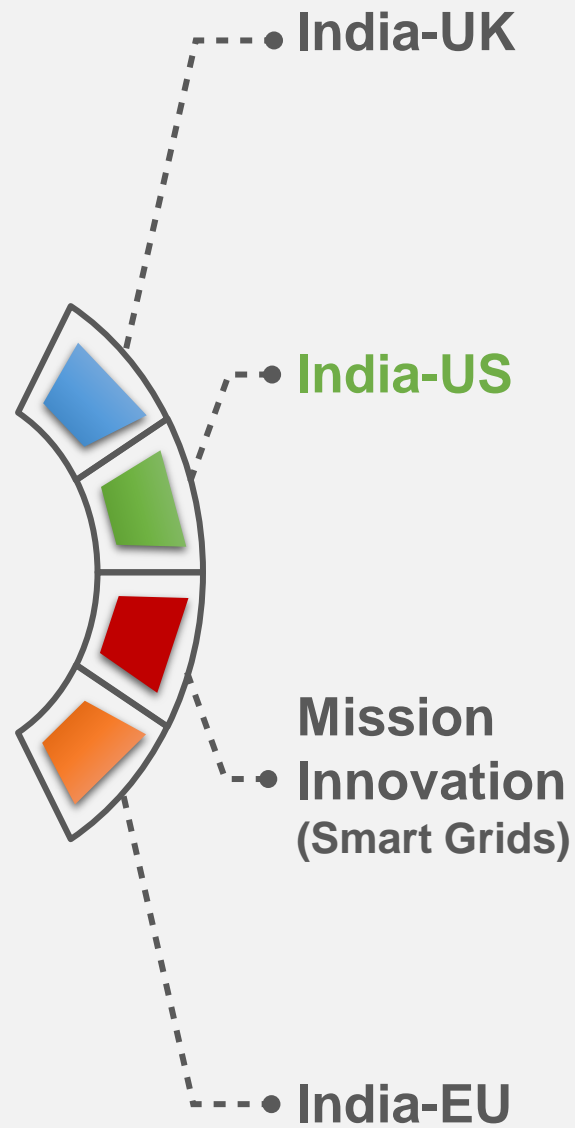
Lab test beds



Concept White Paper – Distribution System Operator (DSO) for Indian Context

Technology Readiness Leve (TRL) - 8

SMART GRID



Program **Outcomes**



01 Projects



218 Manpower
Trained



₹54.85 Cr.
Investment



11 Institutions



9 Industries



03 Patents

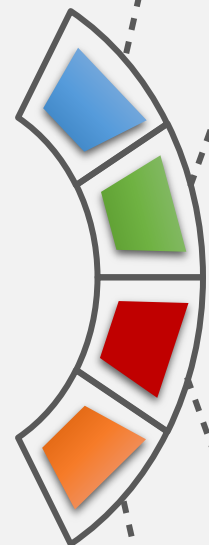


206 Publications



05 Pilots

SMART GRID





India-UK

India-US

**Mission
Innovation
(Smart Grids)**

India-EU

-  **R & D facilities**
-  **Pilots**

Field- Deployable Energy
Storage Solution for
weak distribution grid
IIT Roorkee

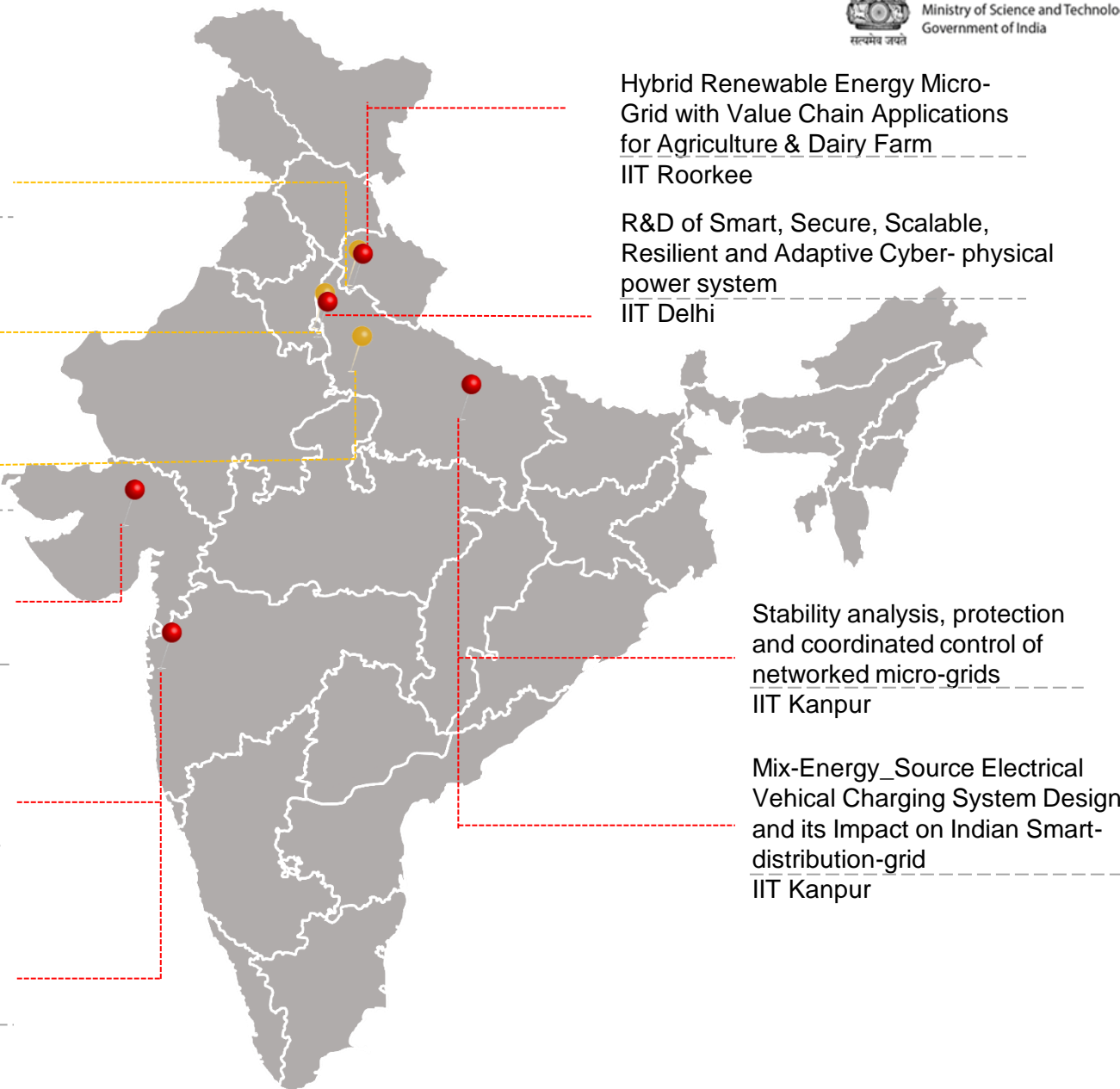
Demonstration of 20 kW
Smart Electric Vehicle
Charger IIT Delhi

Renewable energy-based
Agriculture farm - 200 kWp
Solar Power Plant DEC
Agra

Developing a Prosumer
driven Integrated smart
grid
IIM Ahmedabad

AlGaIn/GaN Power
Transistor Based Platform
Technology and Modules
for Smart Grid Applications
IIT Bombay

SMART Planning and
Operations of Grids with
Renewable and Storage
(SPOReS)
IIT Bombay



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Focusing on R&D Areas: Large Scale Renewable Energy Generation and Integration to Conventional Grid, EV Infrastructure, Prosumer Driven Electricity Market, Cyber-physical System for Security Concerns

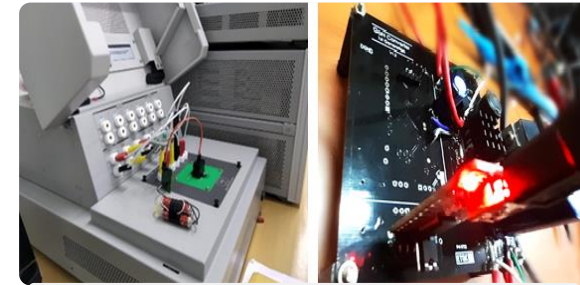
Smart and Resilient Networks

[2017 – 2022]

Nine Projects, (INR 37 Crores)

Developed Technologies

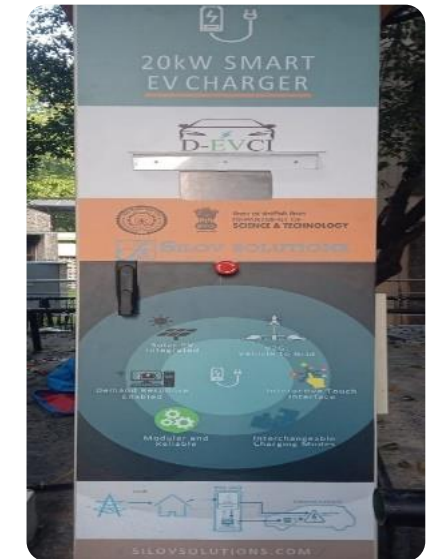
- Development of **Utility grid supportive smart EV charger**
- Development of **Solar Agricultural farm** with possible applications in other sectors viz. highways, railways, industries, Hospitality, education etc.
- Demonstration of **MW scale solar energy integration in weak grid** using distributed energy storage architecture to reduce the frequency and voltage fluctuations
- Developing a **prosumer driven integrated Smart Grid** for decentralized peer to peer power trading mechanism to authorize consumers to the prosumer level.



AlGaIn / GaN based semiconductor devices



150 kWh (75 kW) Li-ion BESS has been successfully installed



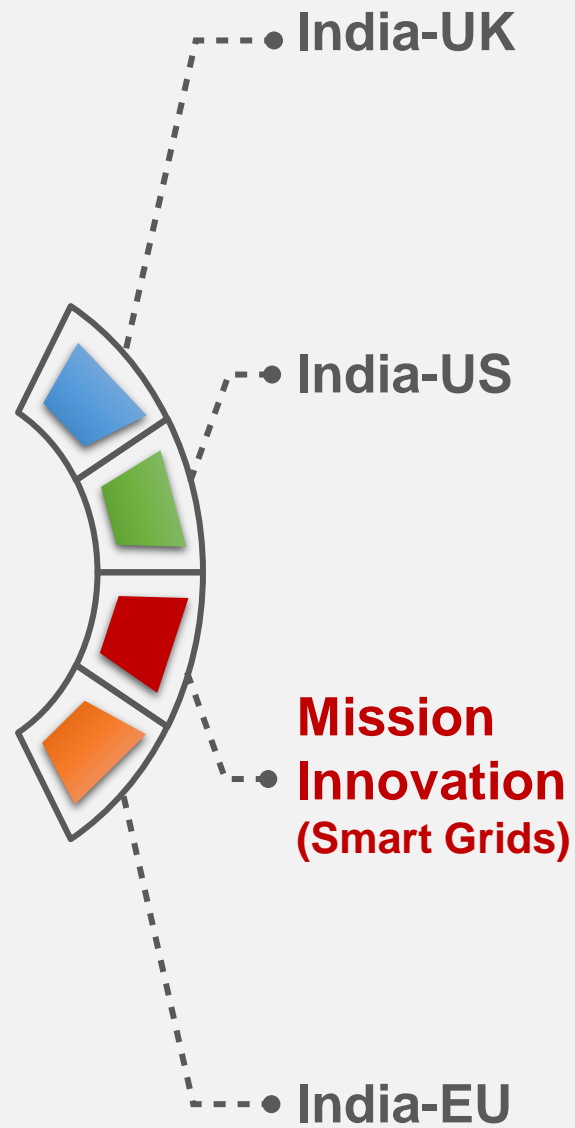
20 kW EV Charging Infrastructure at IIT Delhi



Solar-Agriculture Farm at DEI, Agra

Technology Readiness Leve (TRL) - 8

SMART GRID



Program **Outcomes**



09 Projects



70 Manpower
Trained



₹28.33 Cr.
Investment



17 Institutions



16 Industries

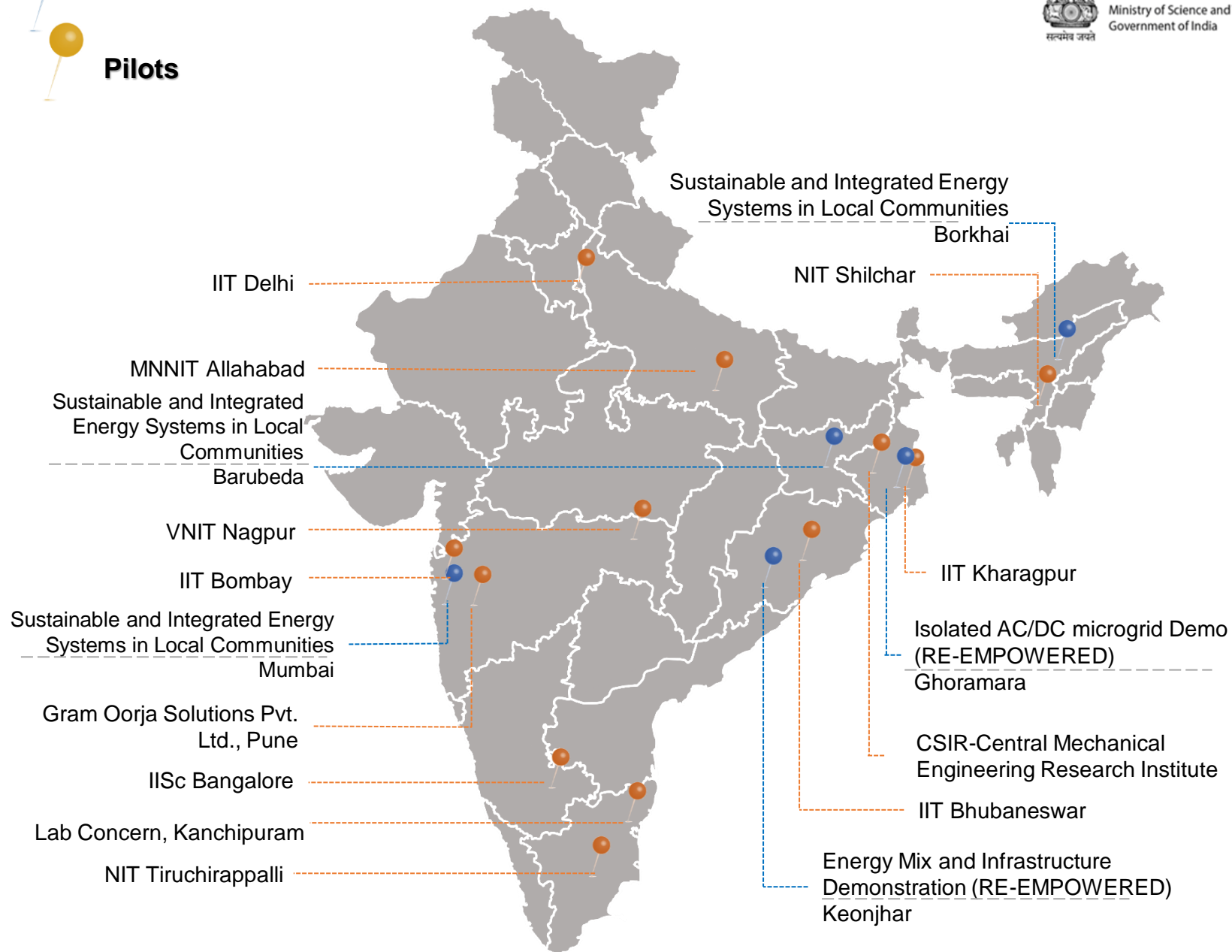
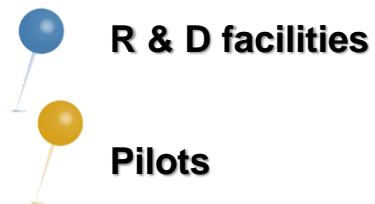
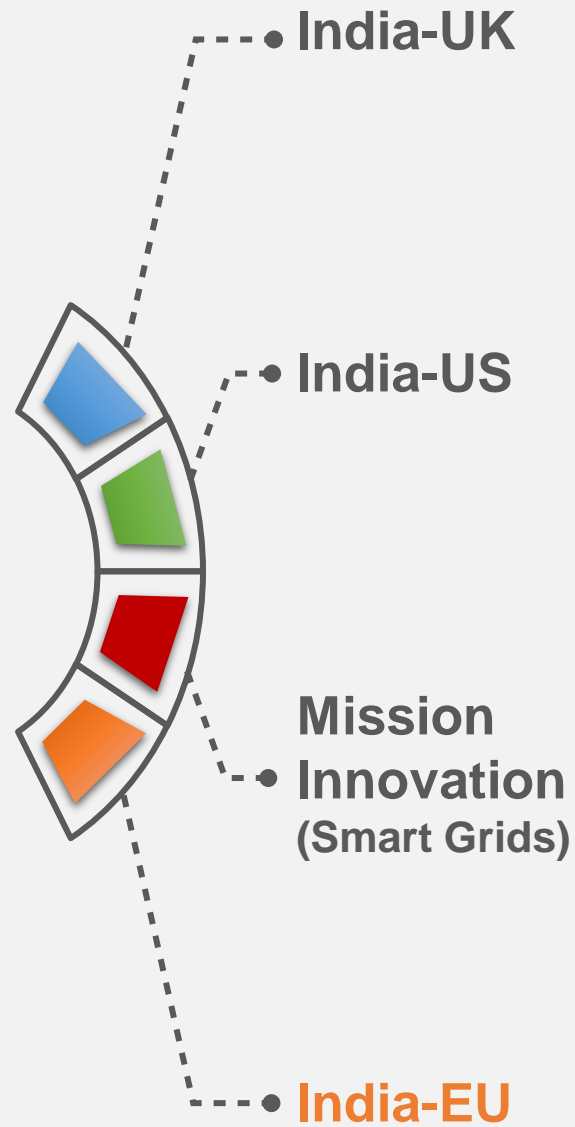


04 Patents



83 Publications

SMART GRID

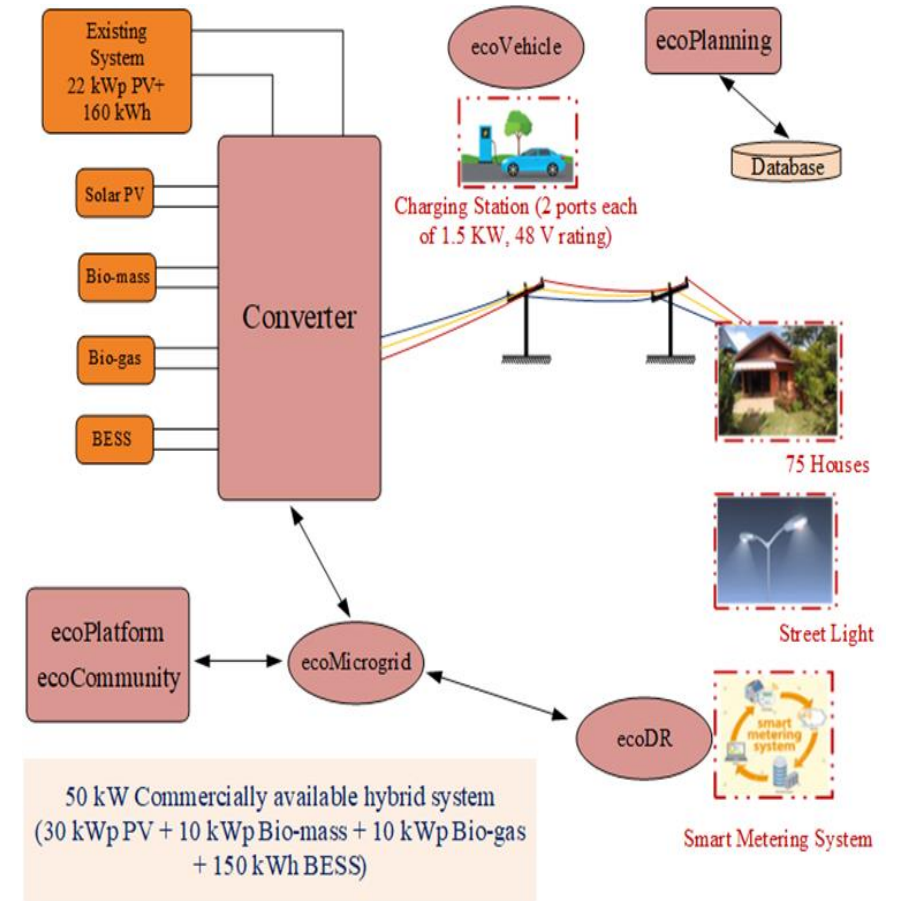


Integration of Multiple Energy Sources/ Vectors With or Without Local Grid Connectivity, The Demo Units Covering Rural, Semi-urban and Urban Environments and Varied Climatic

Integrated Local Energy Systems
[2021 – 2024]
Two Projects, (INR 24.19 Crores)

Developed Technologies

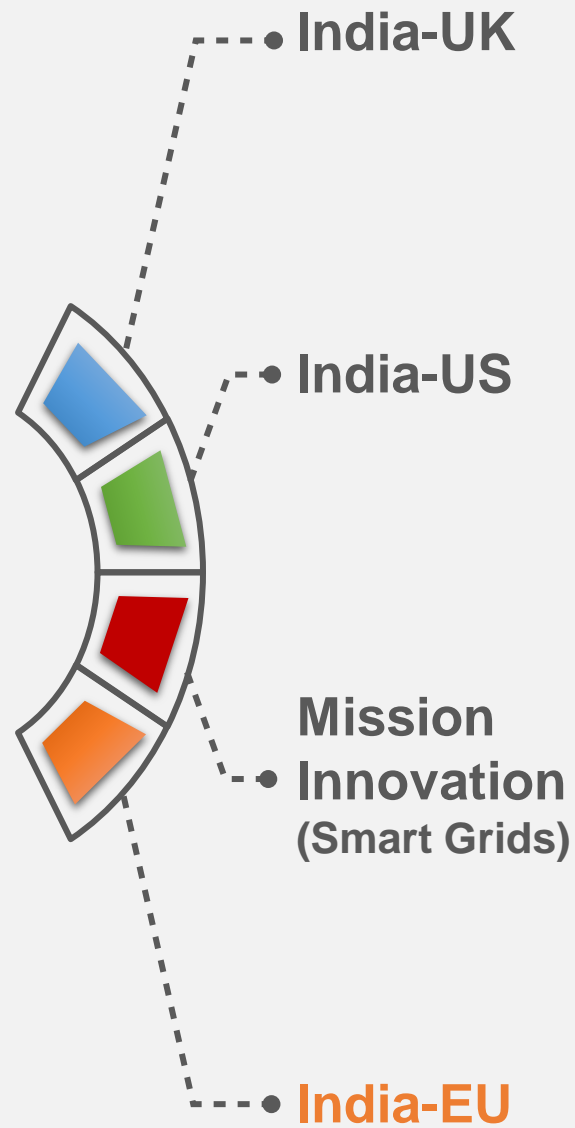
- To develop and demonstrate cost-effective, sustainable, and customer-centric solutions for effectively integrating different energy vectors
- To develop a set of hardware and software solutions (called as **ecoToolsets**) namely **ecoEMS**, **ecoMicrogrid**, **ecoPlanning**, **ecoDR**, **ecoPlatform**, **ecoConverter**, **ecoMonitor**, **ecoCommunity**, **ecoVehicle** and **ecoResilience** for efficient, decarbonized and RES-intensive multi-energy local energy systems



- A 50 kW microgrid system (30 kW PV + 10 kW Biogas + 10 kW Biomass+ 180 kWh BESS)
- **Integration with the existing Legacy System**
- A charging station with two 3.3 kW ports (two for electric three wheelers)

Technology Readiness Leve (TRL) - 8

SMART GRID



Program **Outcomes**



02 Projects



₹24.19 Cr.
Investment



16 Academic
Institutions



8 Industries/
Utilities/ NGOs



10 Eco-tools
(Applied)



260 Publications



05 Pilots

DST- Smart Grids Pilots

Mission Innovation (Smart Grids)

Roorkee | Field- Deployable Energy Storage Solution for weak distribution grid (IIT Roorkee)

New Delhi | Demonstration of 20 kW Smart Electric Vehicle Charger (IIT Delhi)

Agra | Renewable energy-based Agriculture farm - 200 kWp Solar Power Plant (DEC Agra)



India-UK

Mount Abu | Hybrid Microgrid demonstration at Brahmikumari Ashram (Hot and dry climate)

Shilong | Hybrid Microgrid at North Eastern Hill University (Humid & Rainy)

Lakshadweep | Hybrid Microgrid for housing complex (Hot & humid)

India-US



New Delhi | Urban smart distribution system with storage

Kanpur | Urban, semi-urban and rural smart distribution system with storage (IIT Kanpur)

Rihand (UP) | Rural smart distribution system with storage

India-EU



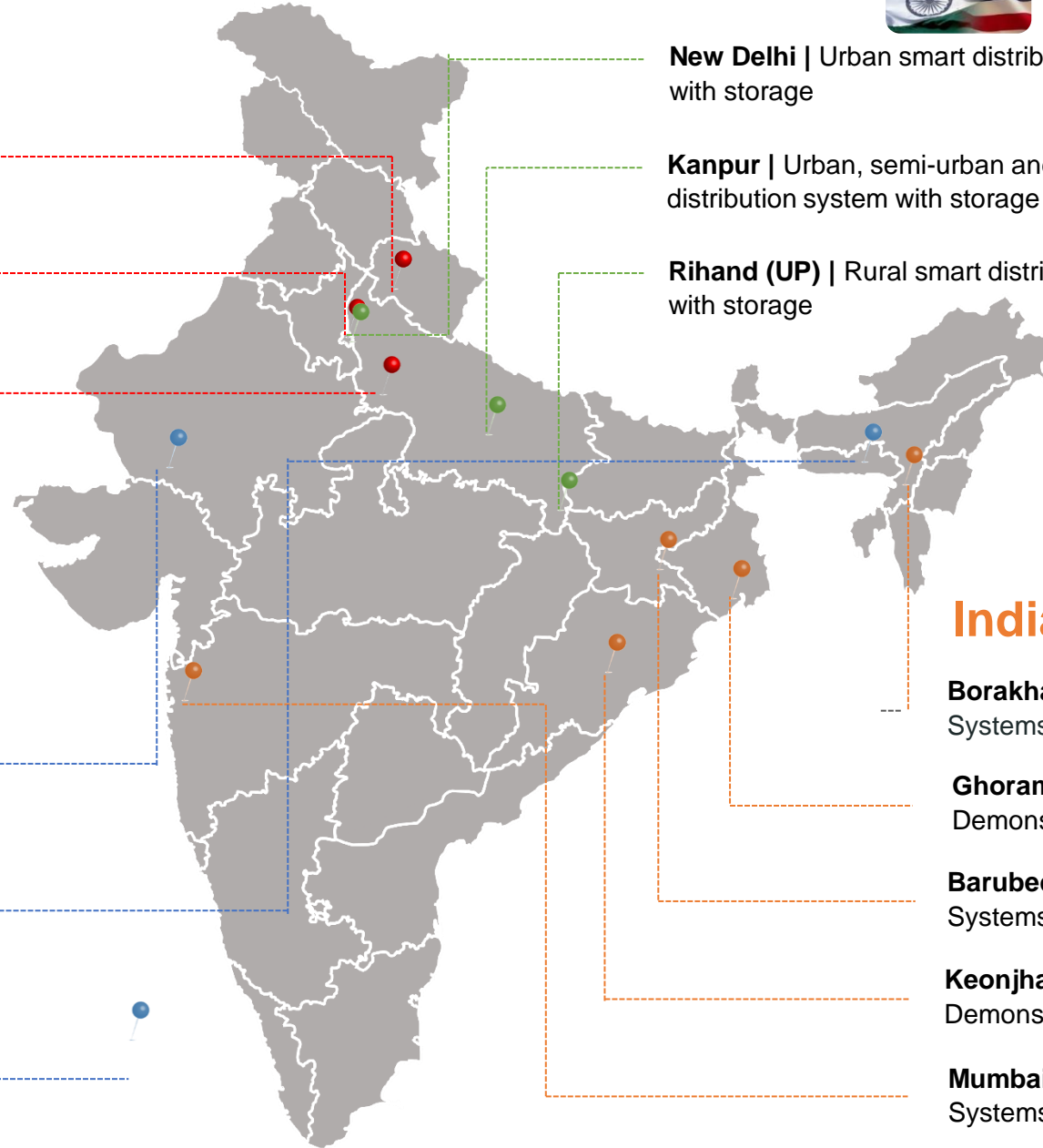
Borakhai | Sustainable and Integrated Energy Systems in Local Communities (IIT Bombay)

Ghoramara | Isolated AC/DC microgrid Demonstration (RE-EMPOWERED) | IIT KGP

Barubeda | Sustainable and Integrated Energy Systems in Local Communities (IIT Bombay)

Keonjhar | Energy Mix and Infrastructure Demonstration (RE-EMPOWERED) | (IIT BBS)

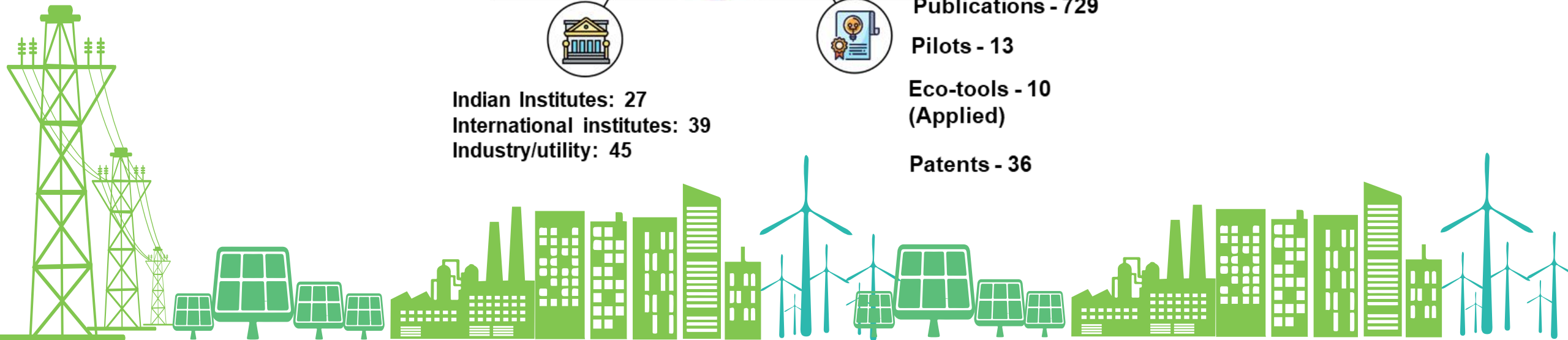
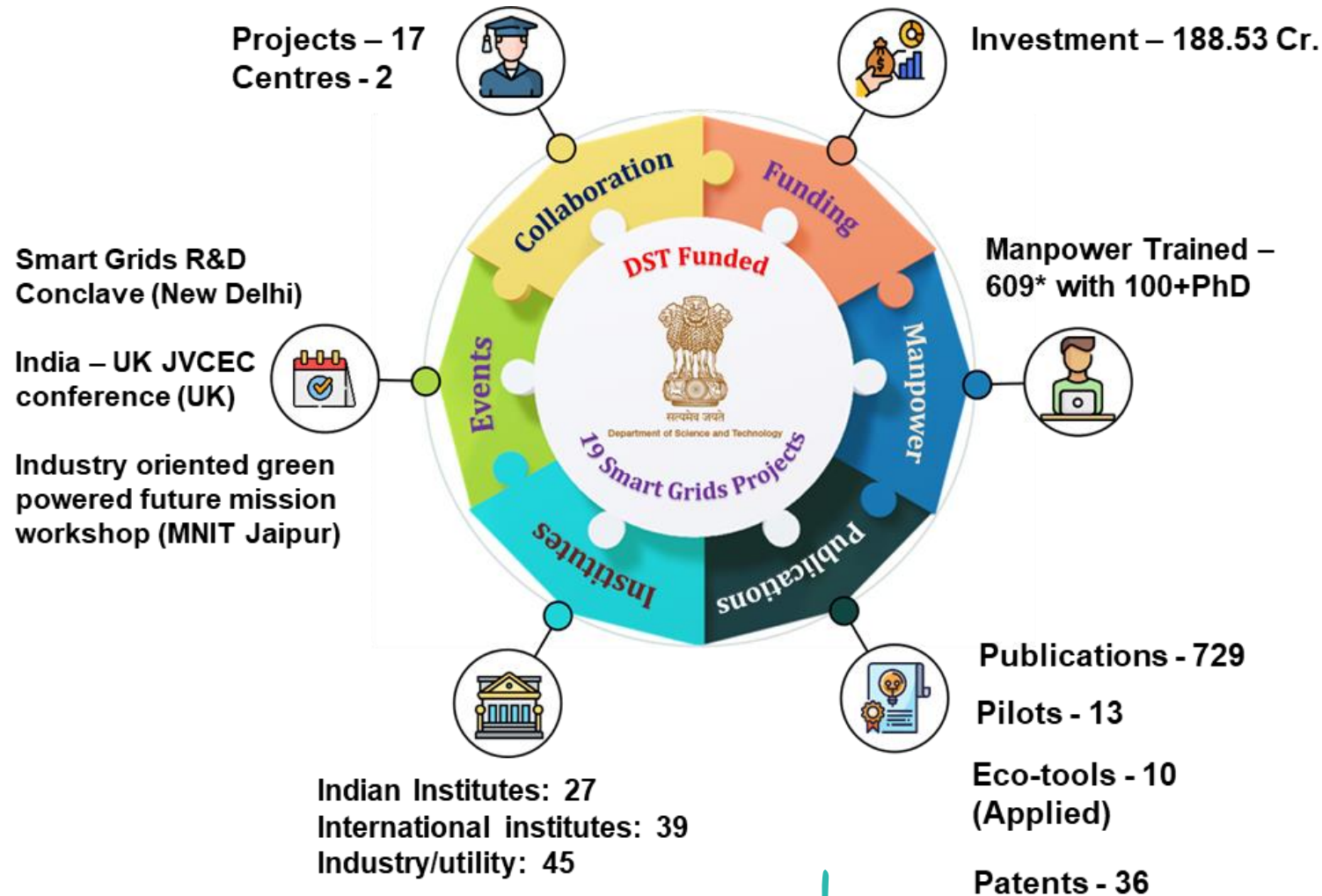
Mumbai | Sustainable and Integrated Energy Systems in Local Communities (IIT Bombay)



Program Outcomes



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Thank you

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