

## Renewable Energy in India

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## Outline

- Energizing India for Sustainable Development
  - **Smart Cities- Eco City Project**
  - **Make in India- Scope for SMEs**
  - **Food Production- Drying and Thermal**
- Approach and technologies
- TERI's work
- Case study
- Conclusions

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## Need for access to energy



- Development and energy needs are interdependent
- Access to modern energy brings economic development, opportunities for better education, better health and overall better living conditions

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## Renewable energy resources



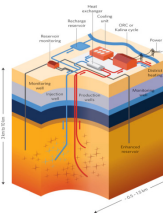
**Solar**



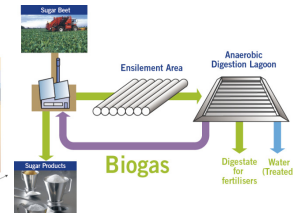
**Wind**



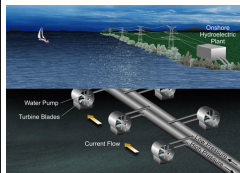
**Geothermal**



**Bioenergy**



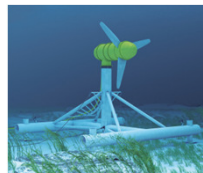
**Hydro energy**



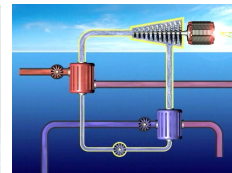
**Wave and Tidal**



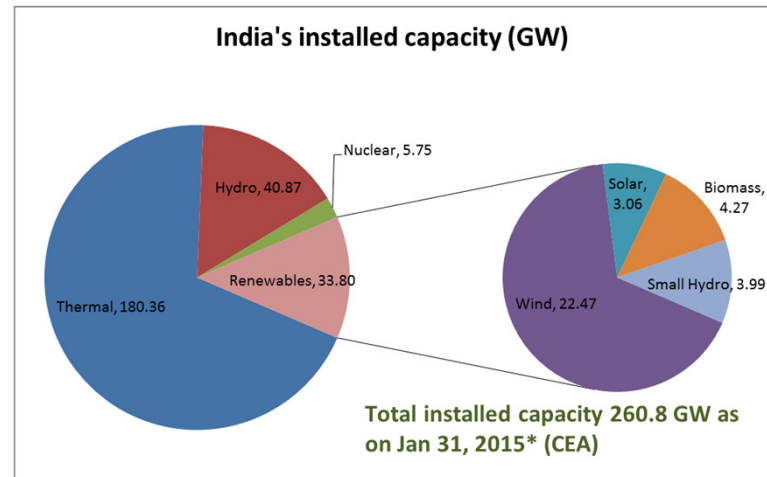
**Ocean Current**



**OTEC**



## Installed capacity (GW)



## Proposed RE targets by 2022



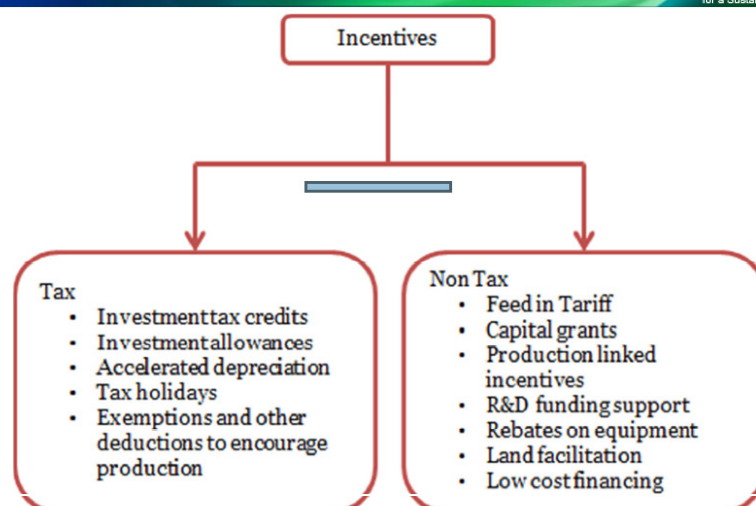
- Solar – 100 GW
- Wind – 65 GW
- Biomass 10 GW
- Small Hydro 05 GW
- Expected investment – US\$200 bn

## Key Challenges for Rural electrification



- Remote locations
- Low revenue
- High cost of grid extension
- Lack of infrastructure
- Lack of economic activities
- Lack of affordability
- Integrating philosophy of sustainable development

## RE Incentives



## Major initiatives



- Renewable purchase obligations
- Renewable Energy Certificates
- Income tax incentives (Accelerated depreciation)
- Duty and tax exemptions
- Tax holidays
- Interest subvention ( low interest loans)
- Capital subsidies
- Feed- in tariff

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## Achievements (as on March 31, 2015)



### Grid connected RE

- Wind – 23444 MW
- Solar Power 3743.97 MW  
(PV + thermal)
- Small Hydro 4055.36 MW
- Biomass power 1410.20 MW
- Bagasse Cogeneration 30008.25 MW
- Waste to power 115.08 MW

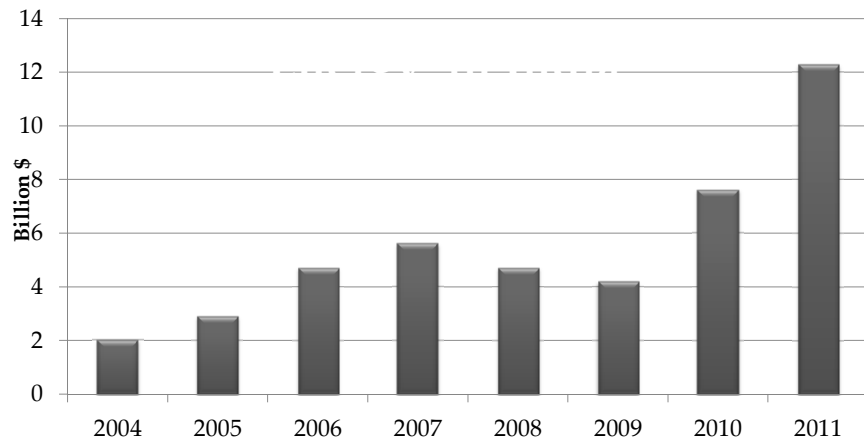
### Off-grid renewables

- Family Biogas plants 4.81 millions
- Solar water heaters 8.82 million m<sup>2</sup>
- Off-grid captive power 1174.5 MW<sub>eq</sub>

**TOTAL = 35776.96 MW**

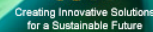
Source- MNRE

## Investments in RE in India



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## Approach towards off-grid lighting



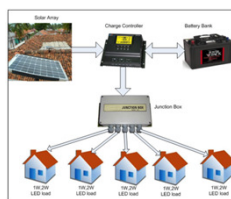
### Basic lighting and phone charging

- Solar lanterns
- Home lighting system



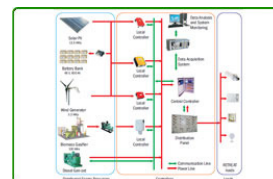
### Village level electrification

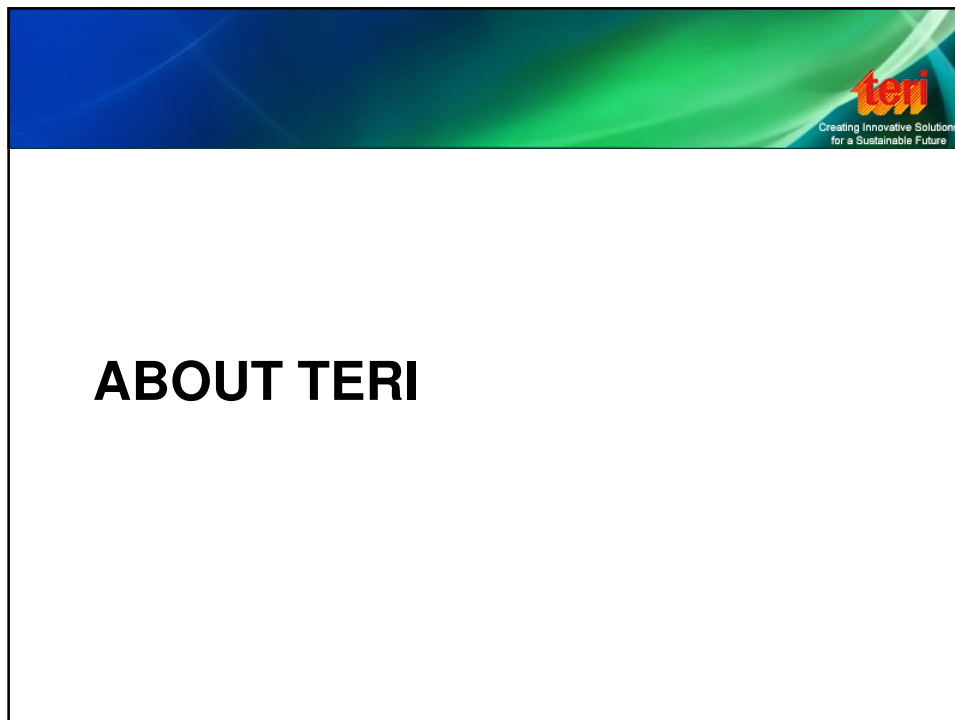
- Lighting
- Community activities
- Income generation



### Minigrid

- Few villages connected to isolated grid
- Providing grid quality electricity
- Mini grid can interact with central grid whenever it reaches
- Multiple resources
- Intelligent management



A presentation slide with a blue and green abstract background at the top. The TERI logo is in the top right corner, with the tagline "Creating Innovative Solutions for a Sustainable Future" below it. The title "What is TERI?" is in yellow text on the left. The main content is a bulleted list in blue text, with the mission statement in green text. The number "14" is in the bottom right corner.

## What is TERI?

- **TERI** is best described as an independent, not-for-profit research institute focused on energy, environment, and sustainable development and devoted to efficient and sustainable use of natural resources
- **TERI's vision:** Creating innovative solutions for a sustainable future.
- **TERI's mission:**
  - Tackle issues of global and local concern through innovative and cost effective solutions.
  - Enhance global network for effective integration of concepts
  - To be a global think tank.
  - Inspire and reach out to diverse stakeholders for realizing a shared vision of global
  - Sustainable development that could be translated into action

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## The Energy and Resources Institute (TERI)



- Vision:  
"To work towards global sustainable development, creating innovative solutions for a better tomorrow"
- Focus on:
  - **Energy including renewables, Environment, bio-technology, Climate modeling, sustainable development**

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## TERI's international presence



### Focus on:

**Energy including renewables,  
Environment, Biotechnology, Climate modeling,  
Sustainable development**

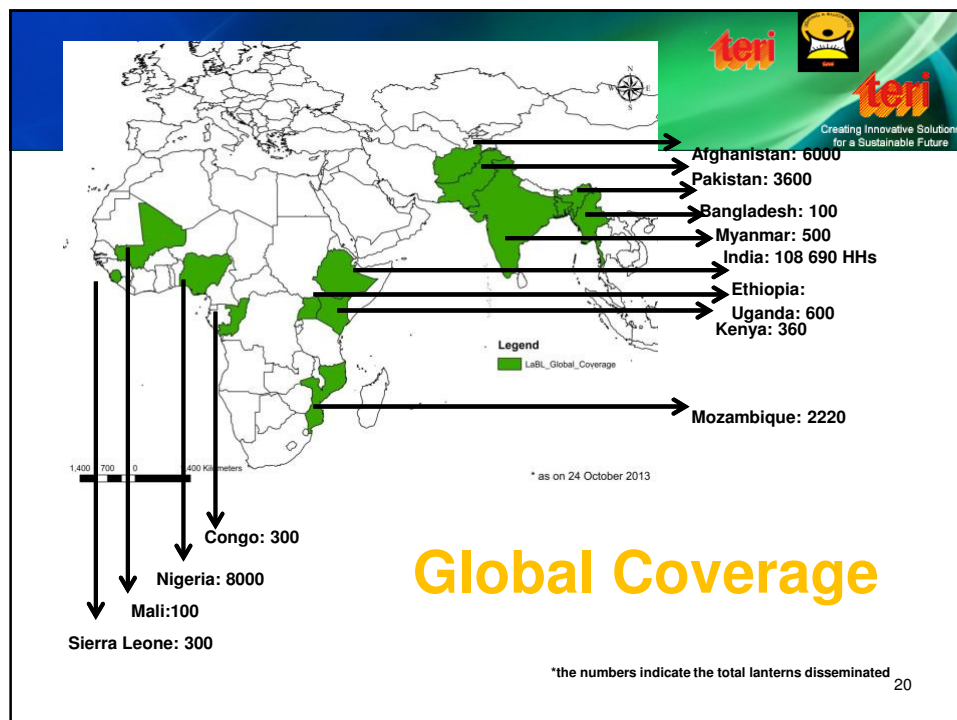
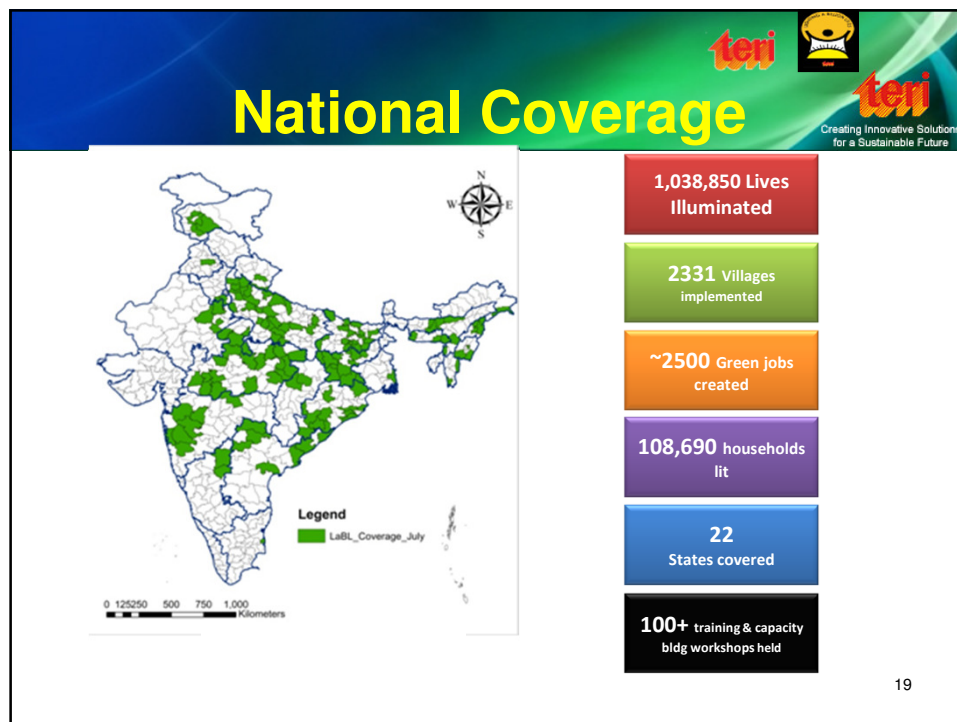
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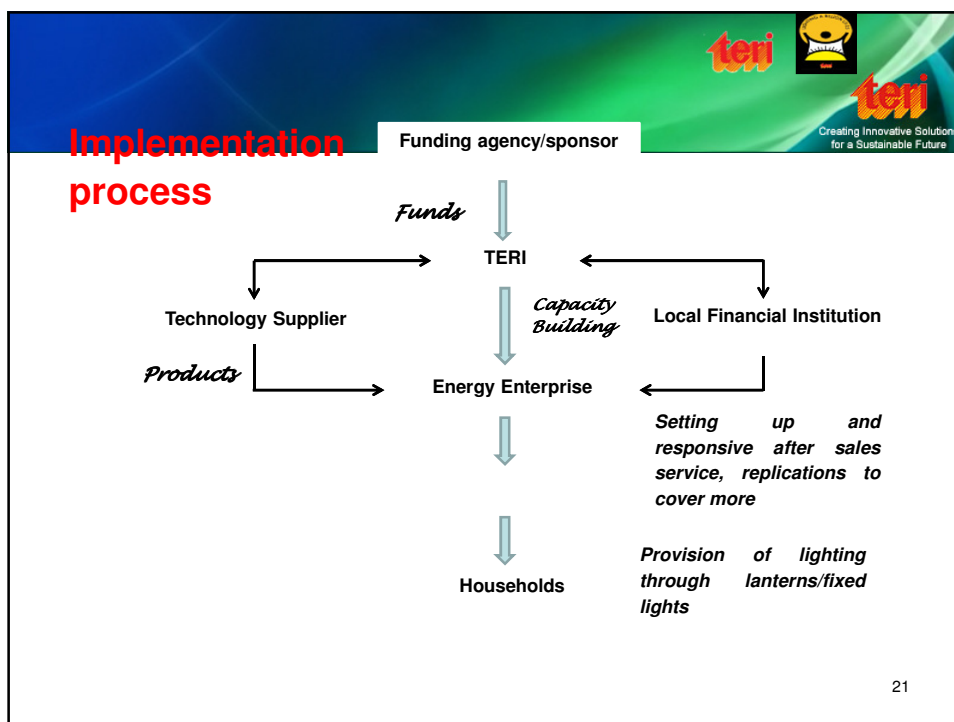





## Lighting a Billion Lives (LaBL)

### Extending Clean Lighting Services to Rural Communities across India and Africa

**teri** Lighting a Billion Lives  
Finding Innovative Solutions for a Sustainable Future







**“Now I am able to see the ingredients a lot more clearly while cooking”, says Gudiya Baiga, Rakhi, Madhya Pradesh**



## Smart Eco City

- Transport
- Street Lights
- Domestic/ Residential
- Solar Lighting
- Industry Processes



**TERI in collaboration with  
NMMC and Department of Urban  
Development (UD) , GoM is implementing**

**“A unique program-based approach for  
integrating environment friendly  
concepts for making Navi Mumbai an  
Eco City of India.”**

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## Phases of the project

**Phase I Completed**

- Baseline carbon footprint estimation
- Comprehensive action plan

July 2012 → July 2016

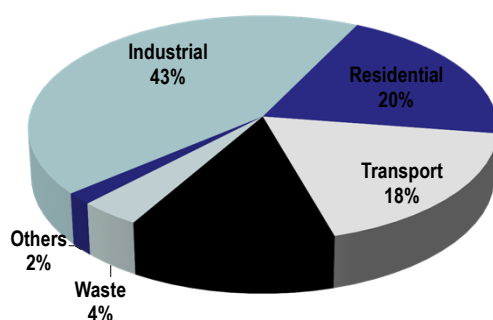
**Phase II- Ongoing**

- Implementing the action plan as a collaborative effort between NMMC, TERI and other partner organizations.

## ACHIEVEMENTS SO FAR

### 1. CARBON FOOTPRINT ESTIMATED AT CITY LEVEL

#### Emissions in Navi Mumbai City (2011-12)



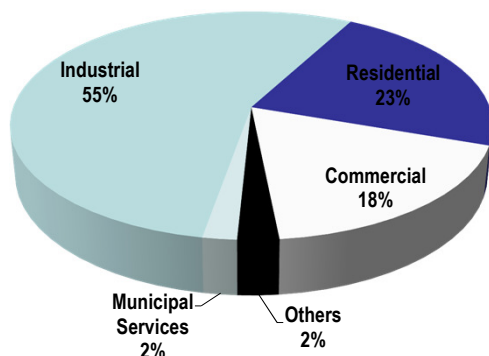
Total emissions from City  
**2.8 Million tCO<sub>2</sub>e**

Per capita emissions  
**2.51 Metric tCO<sub>2</sub>e**

## Interventions for Industrial sector



Sectoral break up of emissions from electricity usage in 2011-12

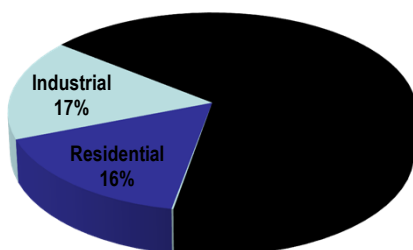


- Energy Audits
- Retrofitting
- Carbon foot-print estimation

## Interventions for Transport sector



Sector wise share of emissions from fuel combustion in Navi Mumbai 2011-12



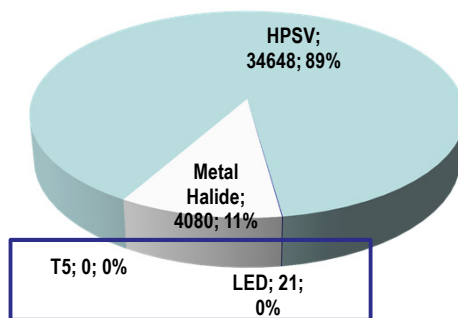
- Promoting CNG usage for vehicles
- Concession/rebates by NMMC for erecting CNG fueling stations
- Battery operated transport vehicles providing point to point service
- Promoting electric public transport
- Introducing Hybrid buses in NMMT's fleet of



## Interventions for Government sector



Type of streetlight share in Navi Mumbai  
(Numbers, %)



### Streetlights

- Installing more LED based streetlights
- Converting HPSV to energy Efficient LED
- Installing Solar PV based street lights

## Interventions for Construction sector

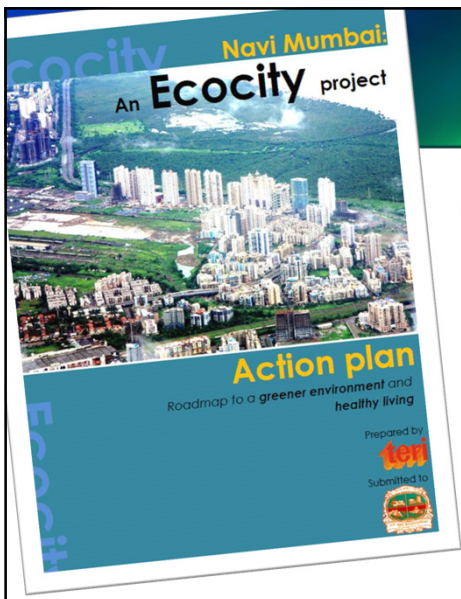


Permission Granted to New Constructions



### New constructions

- Promoting Green buildings
- Amendments in bye-Laws
- Training of builders and architects



## 2. COMPREHENSIVE ACTION PLAN PREPARED

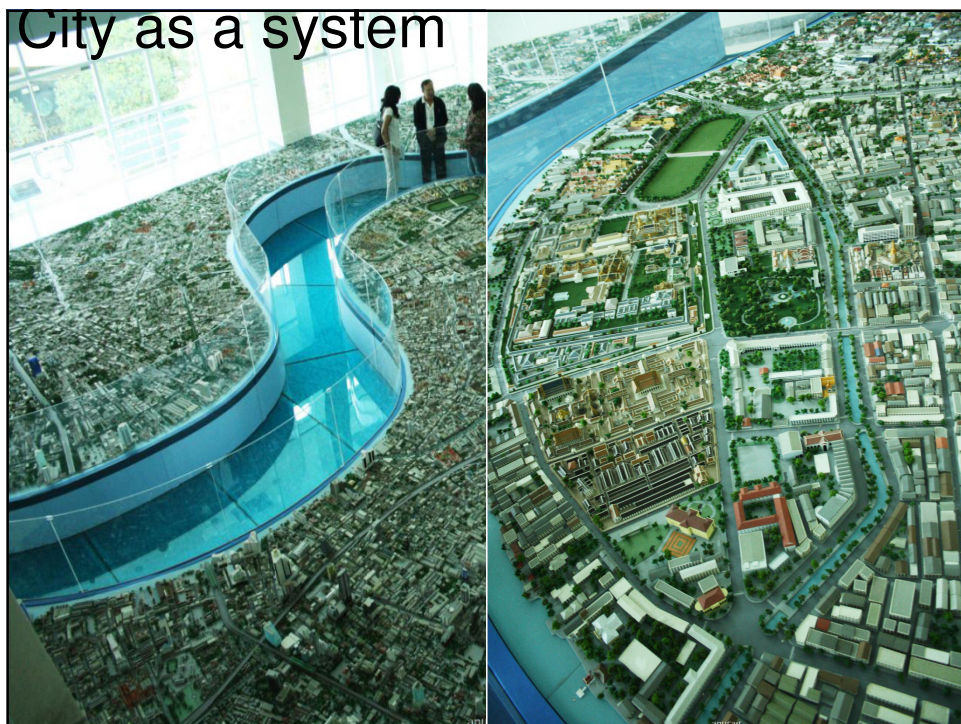
ACHIEVEMENTS SO FAR....

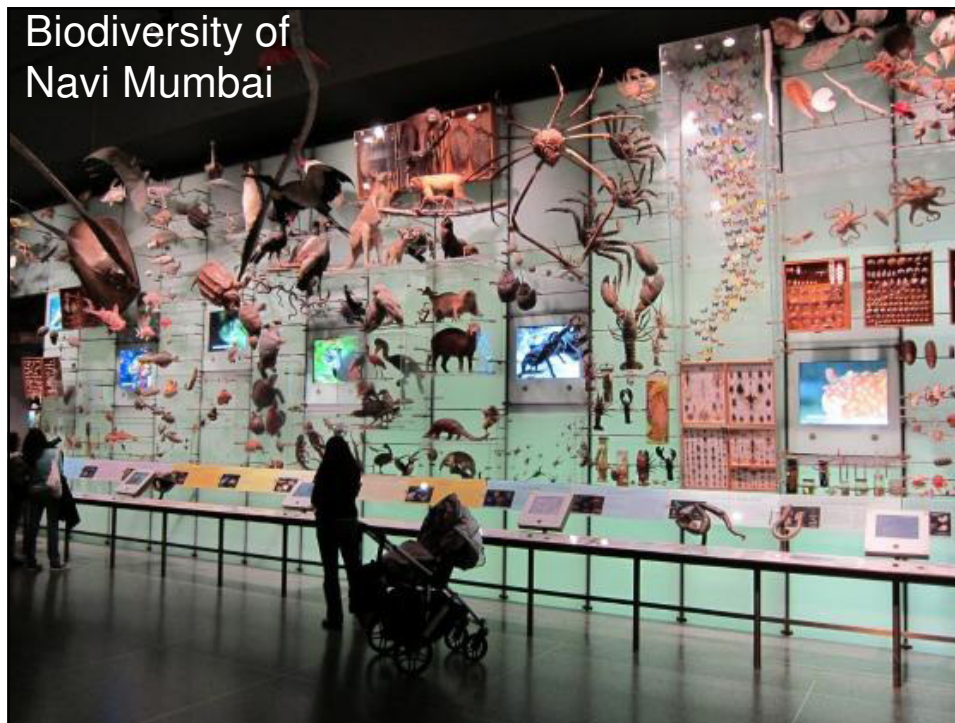


IN PROGRESS

**Demonstration of technology-**  
*Walk through model of a green home  
to be installed at a prominent location  
in the city.*







## Some of the expected outcomes of the project



- **Demonstration of technologies**
  - **Green buildings-** *Minimum registration of 175 projects for green certification*
  - **Waste to Energy-** *installation of one plant at each node.*
- **Energy efficient industries-** *500 energy audits*
- **Air monitoring stations-** *5 nos.*
- **Conservation of biodiversity and wetlands**
- **Sensitized citizens and professionals**

# ON FIELD REQUIREMENTS

## Field installations- TEAM

50 kg/day plant at  
TERI Gram, Gurgaon

100 kg/day plant  
SKSS Ltd Gurgaon

250 kg/day plant at  
CIDCO, Mumbai

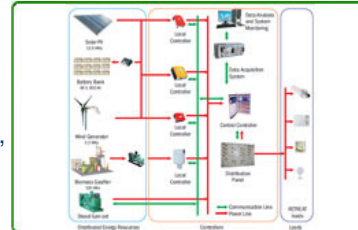
100 kg/day plant at  
ONGC Township, Noida

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## Solar mini grid project



- **Sponsor(s):** Ministry of New and Renewable Energy
- **Duration of the project:** 18 months
- **Key Stakeholders:** Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia; Solar Energy Centre (SEC), India
- **Beneficiaries:** Utilities, regulators, energy service providers, technology and automation experts, and all consumers of electric power



Power plant



Intelligent Dispatch Controller

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## Field installations- Gasifiers



Gasifier system installed at Sittway Hospital, Myanmar. This is one among the 20 Biomass gasifier systems installed at the cyclone affected areas there



Biomass gasifier system installed and commissioned at the Central Institute of Agriculture Engineering, Bhopal

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## Field installations: Mini grids



- Innovative Smart and Sustainable Off-Grid Solutions for Rural Electrification (Three-Phase Solar PV Power Plants in MP) under TERI Norwegian Framework Agreement (NFA: <http://www.teriin.org/projects/nfa/index.php>)
- Solar-Hybrid EVs Charging Station @ TERI GRAM.



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## Solar DC Micro-grids installed in Uttar Pradesh



**Preferred by energy providers over diesel generators;**

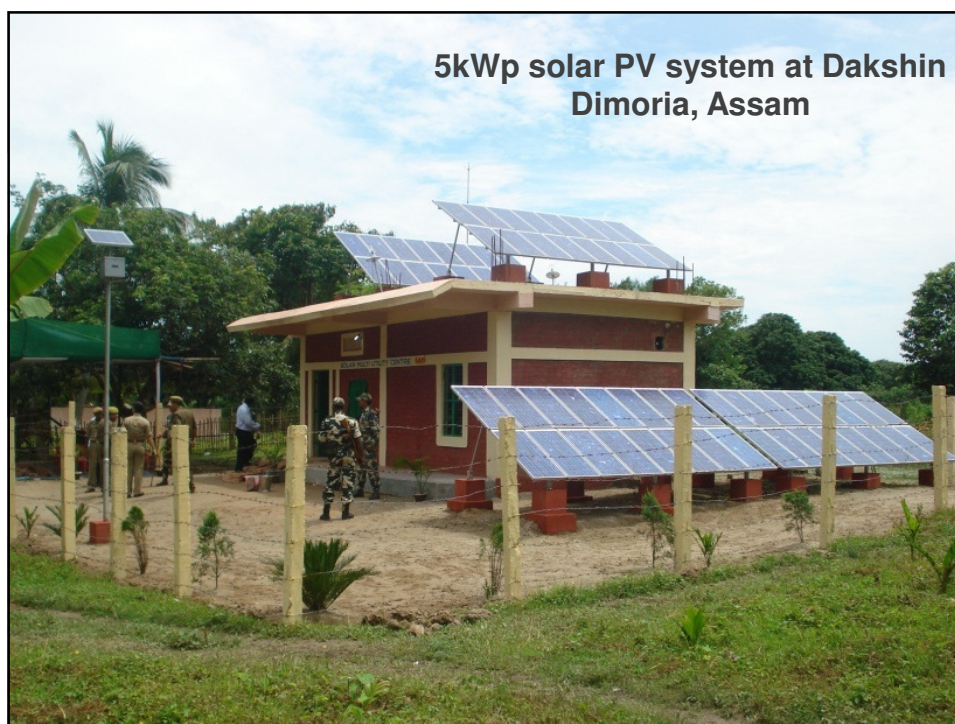
- DC based- reduced power theft
- Easy to operate
- Reduced operational cost



**Replaced diesel generators in two market places- 200 shops**



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## Turmeric grinding

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for a Sustainable Future



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## Income Generation from SMU-Assam

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Incense stick making, tie up with supplier to  
ITC Profit of USD 100/month



**Turmeric Packaging and Selling**  
Net Profit: USD 100 (INR 10/kg and selling 500  
kg/month)


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Also cost effective substitute for;


- Kerosene (Kerosene lamps)
- LPG (petromax)
- Battery operated lights



A number of small vendors, handloom/handicraft workers do not mind paying Rs 5 per day for 4-5 hours of light, considering the additional income from extra hours of operation.

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**Income enhancement:**  
Handloom workers are able to work during evening hours. The time required to weave a five meters cloth takes almost a day lesser when compared to pre-installation days.

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# FOOD PROCESSING

**SOLAR DRYING**

**THERMAL APPLICATIONS**

**STORAGE**

  
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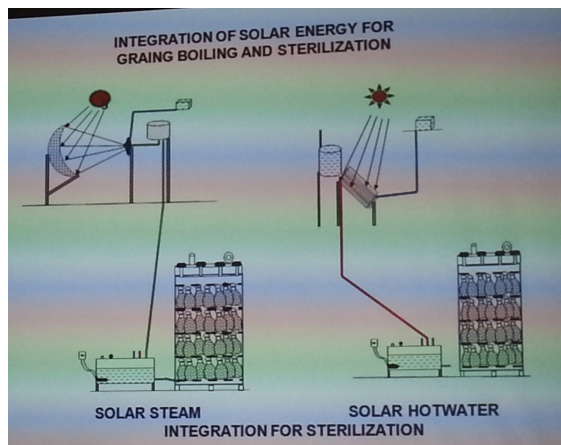
## Field installations

Cool village  
project- Cold  
storage and village  
electrification



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## RE Integration- Sterilization






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## Solar Installation for thermal energy




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# Thank you for your kind attention!



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