SMART MINI-GRID

A TERI INITIATIVE

The Energy and Resources Institute

What are Smart Mini-Grids?

A Smart Mini-Grid (SMG), or Micro-Grid, is an intelligent electricity distribution network, operating at or below 11 KV, in order to provide electricity to a community. Smart Mini-Grids use advanced sensing, communication, and control technologies to generate, manage, distribute, and utilize electricity more intelligently and effectively. The electricity is supplied by a diverse range of Distributed Energy Resources (DERs), which typically include small conventional generators such as diesel gensets, and a range of renewable generators such as solar PV, micro-hydro power plants, wind turbines, biomass, and so on, in combination with each other. Smart Mini-Grids can either be connected to the conventional utility grid or be isolated, providing electricity for localized loads only.

Essential Features of Smart Mini-Grids

- Intelligent load and energy resource management through smart controllers and advanced control techniques
- Accommodation of multiple DERs and energy storage into the common grid
- Self healing (ability of the grid to rapidly detect, analyse, respond, and restore itself in case of any disturbances), self configuring, plug and play

Benefits of Smart Mini-Grids

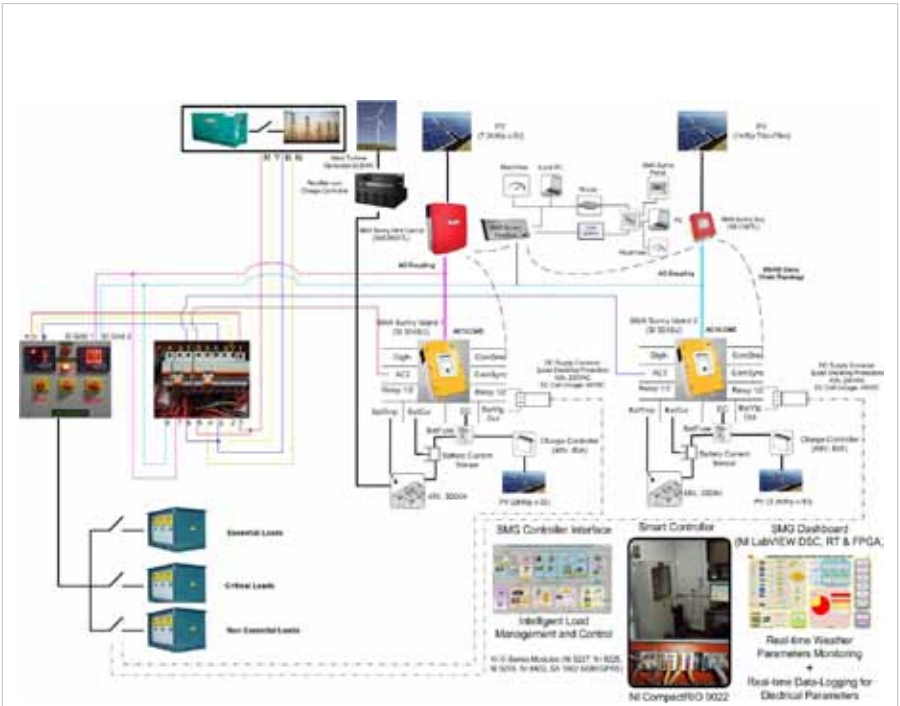
- Foster demand side management and demand side response
- Reduce power outages, increasing reliability, efficiency, and safety of the grid
- Reduce carbon footprint and minimize fossil fuel consumption
- Provide better autonomy to customers to manage their electricity needs

Applications of Smart Mini-Grids

- Industrial complexes
- Commercial complexes, shopping malls, hotels, hospitals
- Residential complexes, apartments
- Educational institutions
- Rural and peri-urban locations
- Telecom base stations

Smart Mini-Grid at TERI Gram: pioneering SMGs in India

RETREAT, the residential complex of TERI Gram, Gual Pahari, hosts the first-of-its-kind Smart Mini-Grid in India. The varying load of RETREAT is intelligently and effectively managed through various distributed energy resources.



Complete Single Line Diagram (SLD) of Smart Mini Grid System developed by TERI

The SMG facility at TERI Gram has been developed in collaboration with SEC, India and CSIRO, Australia.

Features of Smart Mini-Grid at RETREAT

- Integration of multiple DERs, ensuring maximum utilization of renewable energy sources
- Resource and load profiling, controlling, and forecasting
- Centralized control (Smart Hybrid Controller/Intelligent Dispatch Controller) for resource optimization and demand management
- Load prioritization
- Integrated, high-speed, FPGA-based digital communication on LabVIEW platform
- Real-time data acquisition and monitoring of thousands of electrical and physical signals
- Minimized outages and fast response to network disturbances through automatic connect/disconnect of system components

Snapshots of Smart Mini-Grid at RETREAT

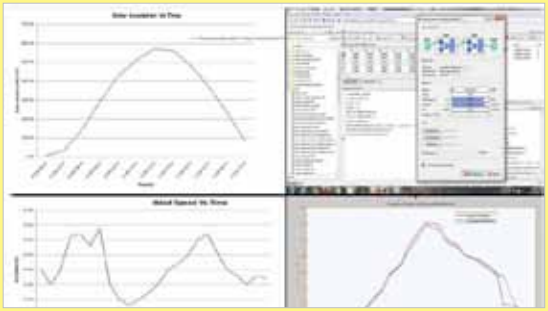






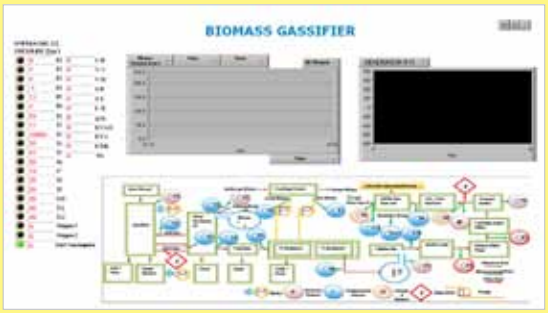

TERI's Smart Mini-Grid at work

Line Diagram of Smart Mini-Grid at TERI



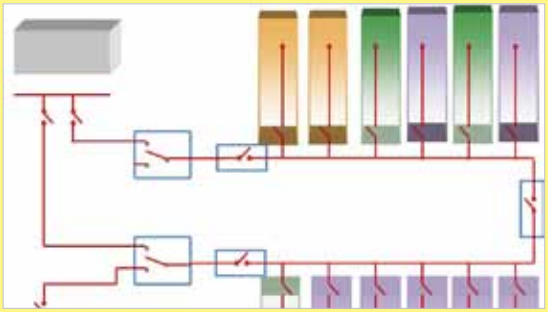
Load and Resource Profiling and Forecasting

System load is analysed and priority levels set to enable intelligent load dispatch.
Solar resource forecasting model has been developed to manage resources intelligently.



Local Smart Controllers for each Resource

Unique controllers for each load ensure power quality and reliability.



Intelligent Central Controller for Resource Prioritization and Load Control

Custom algorithms enable the central controller to dynamically add or remove energy resources and automate load dispatch based on set priority levels.

TERI's experience and expertise on Smart Mini-Grids

- Planning, design, simulation, and optimization of a SMG system
- Development of load and resource forecasting models
- Research on utilization of different types of energy storage systems
- Research and development of advanced control techniques and controllers for SMGs
- Monitoring and assessment of performance of SMGs
- Research and development of smart energy solutions for electric vehicles and their integration with SMGs
- Study of policy, regulatory, and financial aspects of SMGs

About RETREAT

The modern facilities at the RETREAT include conference halls, official and residential premises, laboratories, and sports grounds. The electricity demand of the complex varies quite widely depending upon the season, occupancy level of the residential premises, the number of conferences being held, and several other factors.

About TERI

The Energy and Resources Institute (TERI) is today a strong, dynamic, and flexible organization with a global vision and a local focus. TERI is committed to every aspect of sustainable development—providing environment-friendly solutions to rural energy problems; finding solutions to growing issues of urban transport and air pollution; promoting energy efficiency in Indian industries; and much more. The emphasis has always been on finding innovative solutions for making the world a better place to live. All activities in TERI revolve around formulating local- and national-level strategies and suggesting global solutions to critical energy- and environment-related issues.

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