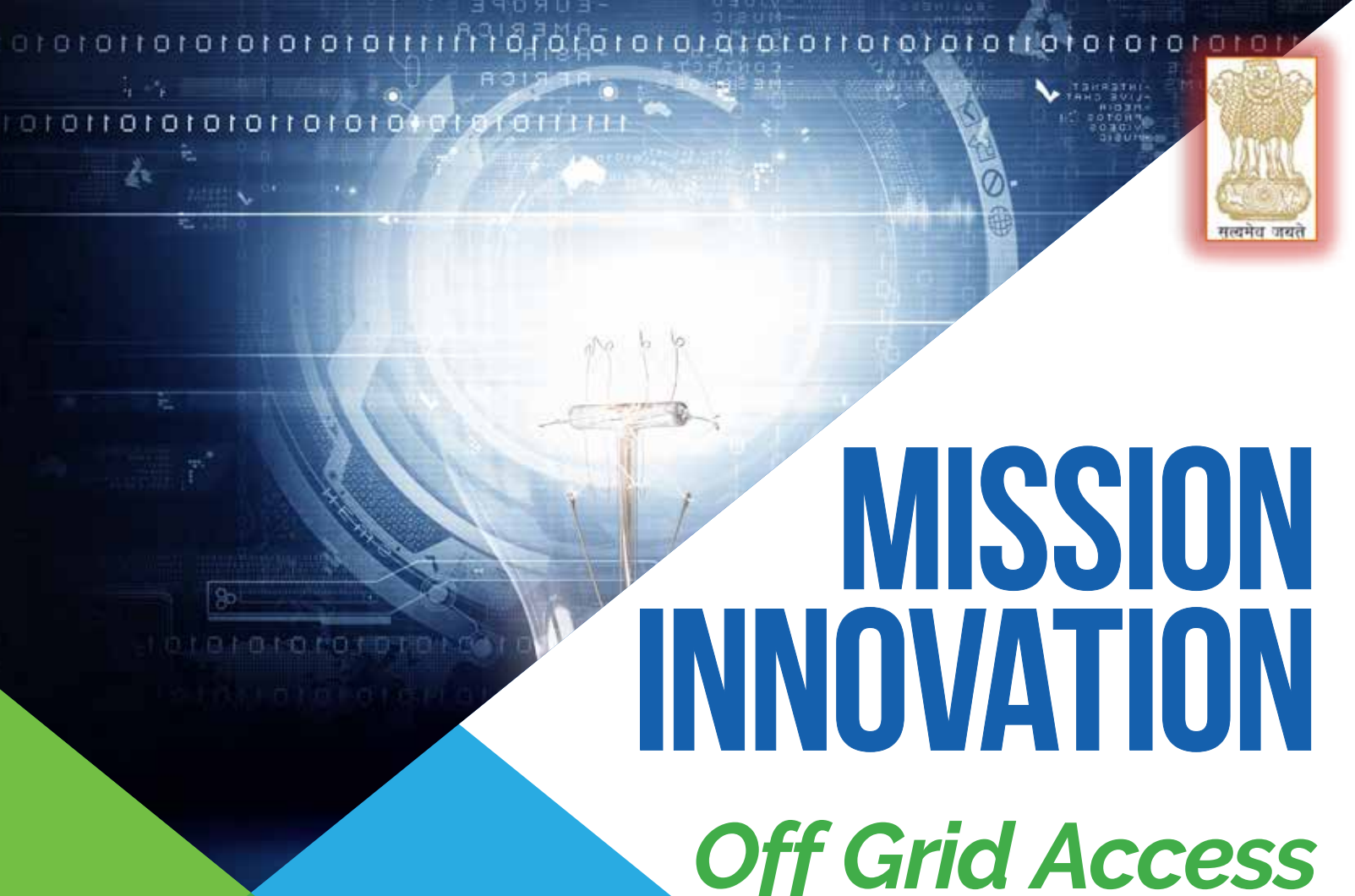
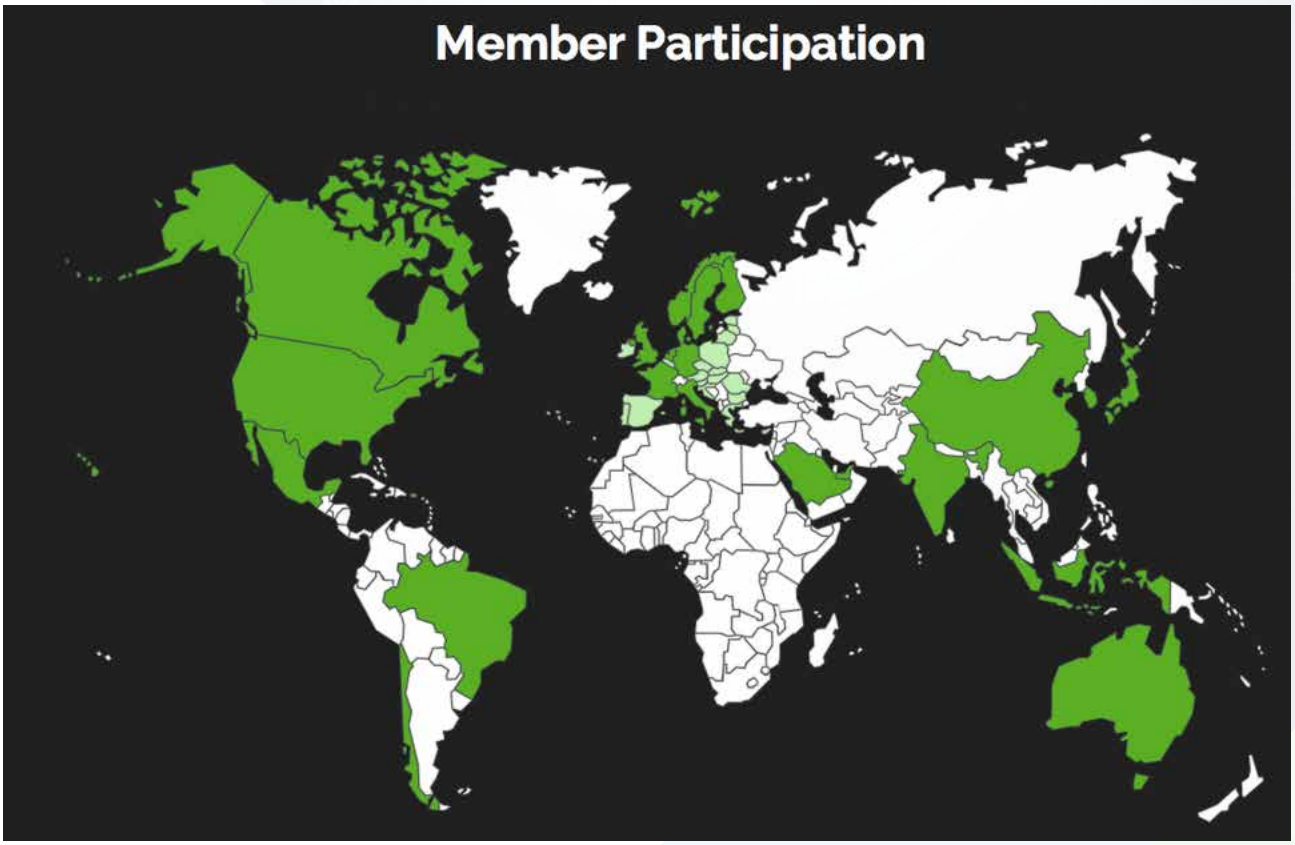


# MISSION INNOVATION

## *Off Grid Access to Electricity*

# INNOVATION CHALLENGE

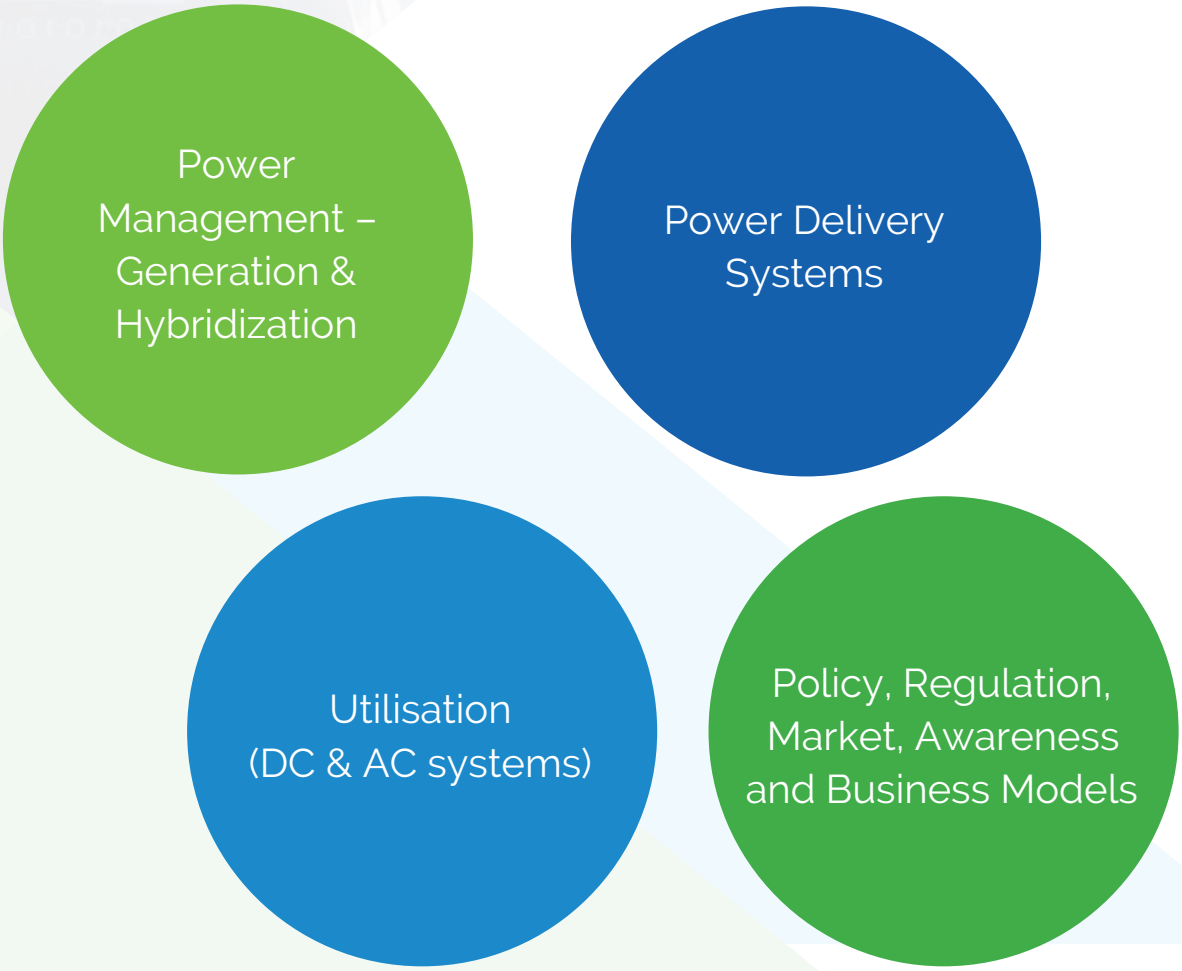



Mission Innovation (MI) is a global initiative of 22 countries and the European Union to dramatically accelerate global clean energy innovation. As part of the initiative, participating countries have committed to double their governments clean energy research and development (R&D) investments over five years, while encouraging greater levels of private sector investment in transformative clean energy technologies.

Off Grid Innovation challenge has participation of 18 countries and European Union.

# IDENTIFIED ISSUES OF IC#2

Off Grids access to electricity is one of the top research priority areas in the energy sector. There is a definite need to initiate joint research & development projects, exposure to advance research facilities, virtual centres for research to meet the growing requirements of research expertise in the country. The R&D areas identified for mounting research offered are as below:



# OBJECTIVES OF IC#2:

The objective for the Off-Grid Access to Electricity Innovation Challenge is to develop renewable systems that are cheaper than fossil fuel for affordable access to electricity by off grid.

For individual homes, the objective is to support the significant reduction in price and increase performance of renewable power systems by 2020 and for remote communities, by 2020 to demonstrate in diverse geographic and climate conditions, the robust, reliable, autonomous operation of renewable power systems up to around 100 kW at a significant lower cost than present cost.

India made Funding Opportunity Announcement (FOA) to accelerate its ongoing efforts in domain of off grid access to electricity. The highlights are as under

## Objective of Off Grid FOA:

**The objective of this Call is to promote affordable and accessible access to clean energy derived from off grid electricity as set forth in the MI-Innovation challenge document. Specifically, the overarching objectives are:**

- **For individual homes, the objective is to support significant reduction in price and increase performance of renewable power systems by 2020.**
- **For remote communities, the objective is to demonstrate in diverse geographic and climate conditions, the robust, reliable, autonomous operation of renewable power systems less than at a significant lower cost than today by 2020.**

## Scope of the Off Grid FoA:

**The funding opportunity will financially support activities towards development, studies, research, standards, capacity building and technical assistance, provided that these activities have strong linkage and potential to improve energy access at affordable cost for individuals and communities with no or limited access to grid connected power.**

## India announced a US$5 million call.

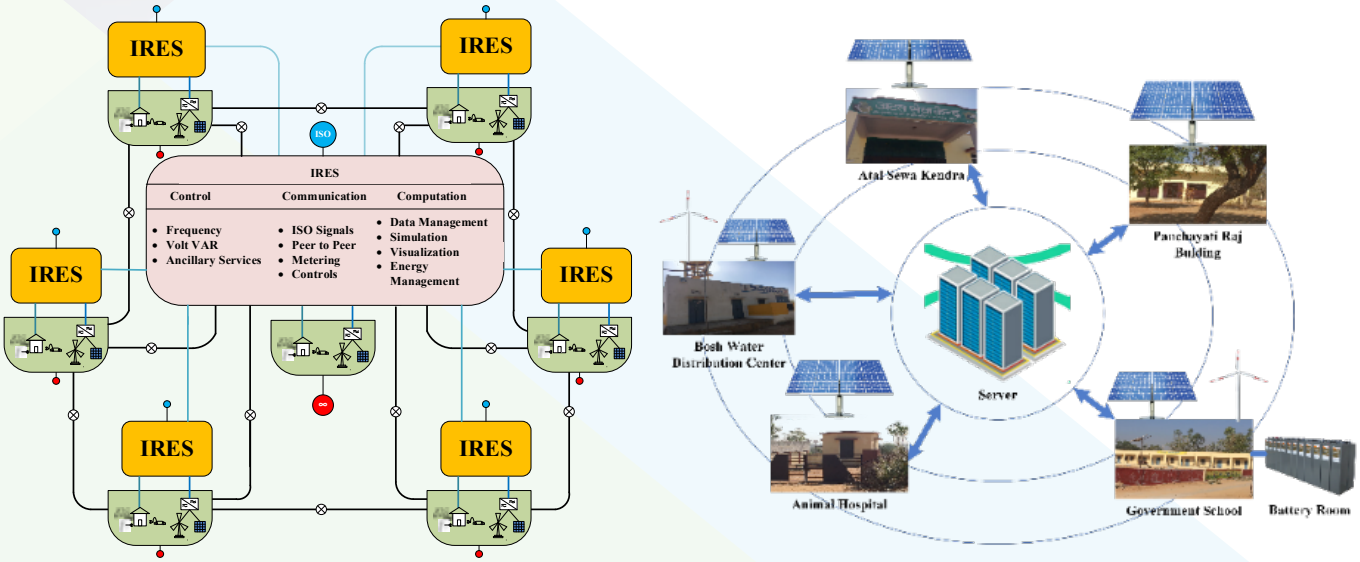
- **Funding will support researchers and private sector to work collaboratively on 2 year projects.**
- **Focus will be to accelerate innovation around the focus of innovation challenge IC#2 and collaborative work is encouraged.**
- **9 projects have been selected awarded with participation of 9 MI countries.**

# COOPERATIVE ISOLATED RENEWABLE ENERGY SYSTEMS (IRES) FOR ENHANCING RELIABILITY OF POWER IN RURAL AREAS

## Objectives

- To develop a prototype Isolated Renewable Energy Systems IRES to demonstrate the exchange of power among different IRES.
- To develop an integrated communication, control, and computing system for the exchange of power among an interconnection of IRES.
- To develop algorithm for maintaining microgrid power quality.
- To develop a local energy management system with demand response and electricity market pricing features.
- To develop a cyber-security system for secure communication of data and signals.

## Model




Schematic configuration of Renewable Energy System

### Expected Outcomes

- Rural electricity infrastructure with renewable energy resource micro grids.
- Providing connectivity to off-grid households.
- Adequate supply with desired power quality.
- Electricity supply at affordable rates & power synchronization without using base generation.

### Location

Boorthal, a Village in Bassi Tehsil in Jaipur District of Rajasthan State, India. It is situated 16.7 km (approximate) away from MNIT Jaipur.

## CONSORTIUM

### India

Prof. Uday Kumar R Yaragatti, Malviya National Institute of Technology, Malviya Nagar, Jaipur
Dr. Arun Kumar Verma, MNIT Jaipur: Prof. Bhim Singh, IIT Delhi: Prof. B K Panigrahi, IIT Delhi
Dr. Abhinav Kumar, IIT Hyderabad, Dr. Ankit Dubey, NIT Goa

### MI Partners

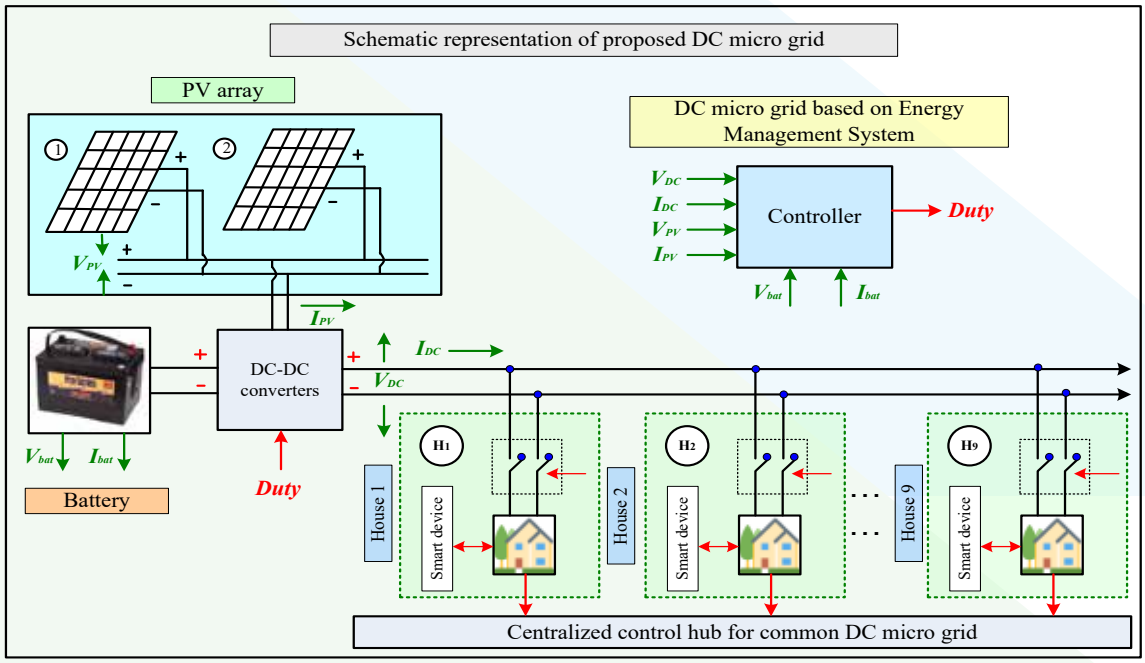
Prof. Ambrish Chandra, École de Technologie Supérieure, Montreal, QC, Canada
Prof. Hemanshu Pota, University of New South Wales (UNSW), Canberra, Australia
Prof Rajit Gadh, UCLA, USA
Dr. Pawan Sharma, UIT, Norway

# INTELLIGENT OFF GRID SYSTEM FOR ENERGY SUSTAINABLE VILLAGE

## Objectives

- To design, install, commission, monitor and control two different off grid energy models which utilizes renewable energy resources as a primary source to electrify areas that have limited or no access to electricity within India.
- To Design Energy Management System that supports the centralized power generation, storage and monitoring
- To Design and implement suitable microgrid with IOT for the automation of microgrid operation including demand-side management.
- To develop an 'intelligent' data analysis algorithms for operator interface (i.e. EMS dashboard)
- To Establish cloud-based server and hub/controller architecture to transmit data to a centralized location for visualization and processing.
- To Conduct a socio-economic market assessment/analysis of business models for operation of Panchayath owned microgrids.

## Model



### Expected Outcome

- Scalable, smart self-sustainable DC micro grid model which utilizes renewable energy resources as a primary source to electrify areas that have no access to electricity within India.
- Secure and reliable power for the rural with Energy Management system (EMS) and IOT based solution.
- A unique cluster based approach to reduce micro grid development and operating costs.
- Enable productive uses of renewable energy resources that can vastly improve the socio-economic development of local communities and employment rates for youths.
- Improve quality of life and wellbeing of the residents by providing energy access for Panchayath amenities, i.e. schools, healthcare facilities, sanitation facilities, etc.
- Generate employment opportunities by way for local youth in establishing entrepreneurial ventures using the uninterrupted power supply
- Improve the prospects for the elevation of consumers up to the multi-tier framework that measures electricity access in terms of improved capacity, Availability, Reliability, Quality, Affordability, Legality and Health and Safety

### Location

1. Nellikatri village is located at a distance of 60kms from Kollegala located in deep interior forest.
2. Belkotta village is a medium size located in Gulbarga Taluka of Gulbarga district, Karnataka

# CONSORTIUM

### India

Dr. N. Rajasekar, Professor, School of Electrical Engineering, VIT, Vellore.
Dr. Shobha Ananda Reddy, Environmental Scientist (Sr), TREND, Bengaluru.
Dr. Muralidhar K, Deputy Director and HOD-Solar Energy, MGIRED-Bengaluru.
Dr. Sivashankar, Professor, Sri Venkateswara College of Engineering, Bengaluru.

### MI Partners

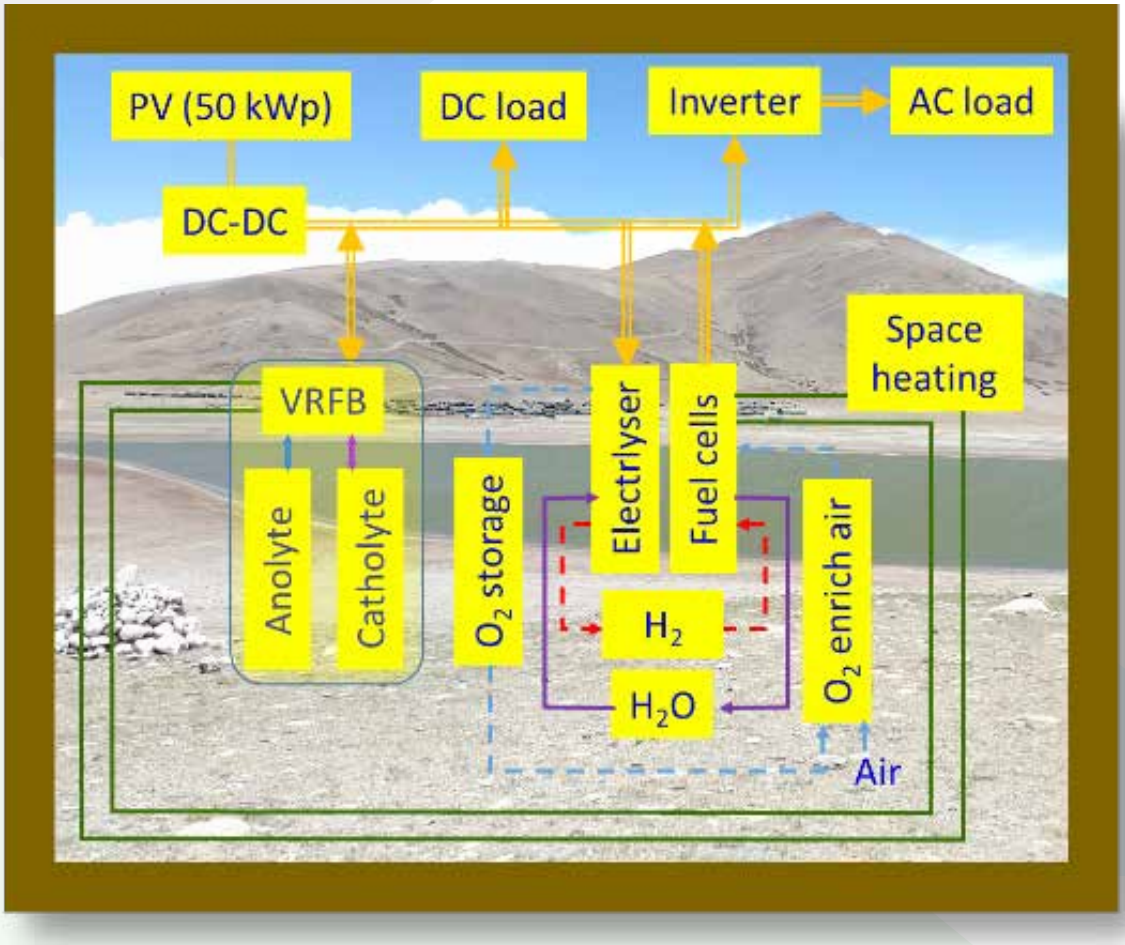
Dr. Scott Strachan, Teaching Fellow, University of Strathclyde, Glasgow.
Dr. Antonino Laudani, Assistant Professor, Roma Tre University, Italy

# SUSTAINABLE ENERGY STORAGE SUITABLE FOR MICROGRID

## Objectives

- Development of AC-DC hybrid microgrid supported by a 50 kWp PV system and DG system
- Development of hybrid storage systems suitable of operating at an extreme temperature conditions.
- Integration of the RE system and storage in North Sikkim to cater the partial energy requirements of an Indian army base.

## Model



- AC-DC Microgrid based on 50 kWp PV system.
- Flow battery system of capacity 20 kW and 200 kWh
- Hydrogen storage system 40 kWh with a fuel cell of 5 kW
- Space heating system using the waste heat from the fuel cell
- An integrated system consists of hybrid storage (hydrogen storage and flow battery) and PV system.

### Location

Bunker, Forward area in North Sikkim

# CONSORTIUM

### India

Dr. Prakash C Ghosh, Department of Energy Science and Engineering IIT Bombay Adi Shankaracharya Marg Powai Mumbai-400076 India
Dr. Rangan Banerjee, Department of Energy Science and Engineering IIT Bombay Adi Shankaracharya Marg Powai Mumbai-400076
Dr. Vishal Mittal, Delectrik Systems Private Limited
Tata Motors & Indian Army

### MI Partners

Dr. Peter Fischer, Fraunhofer ICT, Joseph-von-Fraunhoffer-Strasse 7, 76327 Pfinztal, Germany
Dr. Gavin Walker, University of Nottingham, Nottingham, NG7 2TU, UK.

# EFFICIENT PORTABLE STAND-ALONE VACCINE REFRIGERATOR FOR RURAL APPLICATION

## Objectives

The research on portable stand-alone vaccine refrigerator, a transformative agent for lives of individuals and communities through providing quality of life and prosperity

## Model

## Expected Outcomes

- One number of 1.5 litre and 3 litre portable refrigerator
- Technology transfer package

## Location

Demonstration at a suitable remote location in Kerala

# CONSORTIUM

## India

Er. Subhash Joshi T. G. Centre for Development of Advanced Computing (C-DAC), PB No. 6520, Vellayambalam, Thiruvananthapuram, Kerala

Dr. Vinod John, Department of Electrical Engineering Indian Institute of Science (IISc), Bangalore – 560 012

Dr. Biju Soman, Trivandrum Medical College, Kerala

## MI Partners

Dr. T. S. Sudarshan, The University of South Carolina (USC) ,Columbia

# UNEVEN SPAN GREENHOUSE INTEGRATED SEMITRANSPARENT PHOTOVOLTAIC THERMAL (GISPVT) SYSTEM FOR AGRICULTURAL APPLICATIONS

## Objectives

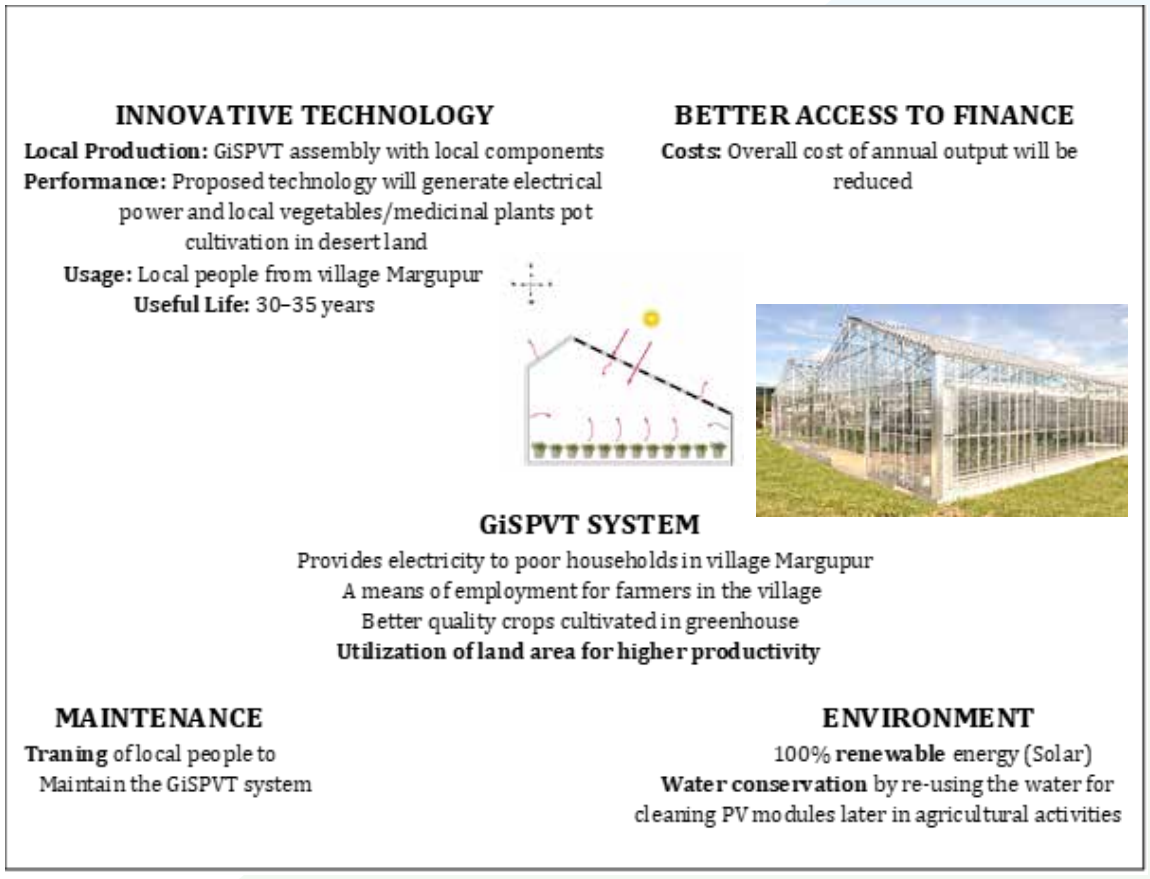
Optimizing the packing factor of glass-glass PV module in GiSPVT system for better pot crop production preferably vegetables in winter and summer conditions.

Overall energy and energy analysis of GiSPVT system.

Evaluation of energy matrices such as energy payback time (EPBT), energy production factor (EPF) and life cycle conversion efficiency (LCCE) for GiSPVT system.

Performing techno-economic analysis of GiSPVT system

## Model



### Expected Outcomes

- Increased access to energy services for under – served population in Village Margupur.
- Renewable energy capacity addition and Increased energy savings
- Increased number of innovative clean energy tools, product, technologies, and methodologies adopted.
- Increased number of beneficiaries with relevant skills in clean energy technologies.

### Location

Mauza Village Margupur (Rasra), district Ballia, Uttar Pradesh, India.

## CONSORTIUM

### India

Prof. Mohammad Emran Khan, Department of Mechanical Engineering, Faculty of Engineering & Technology, Jamia Millia Islamia, Jamia Nagar, New Delhi
Prof. G. N. Tiwari, Bag Energy Research Society, Delhi
Prof. M.K. Ghosal, Department of Farm Machinery and Power, Orissa University of Agriculture and Technology, Odisha

### MI Partner

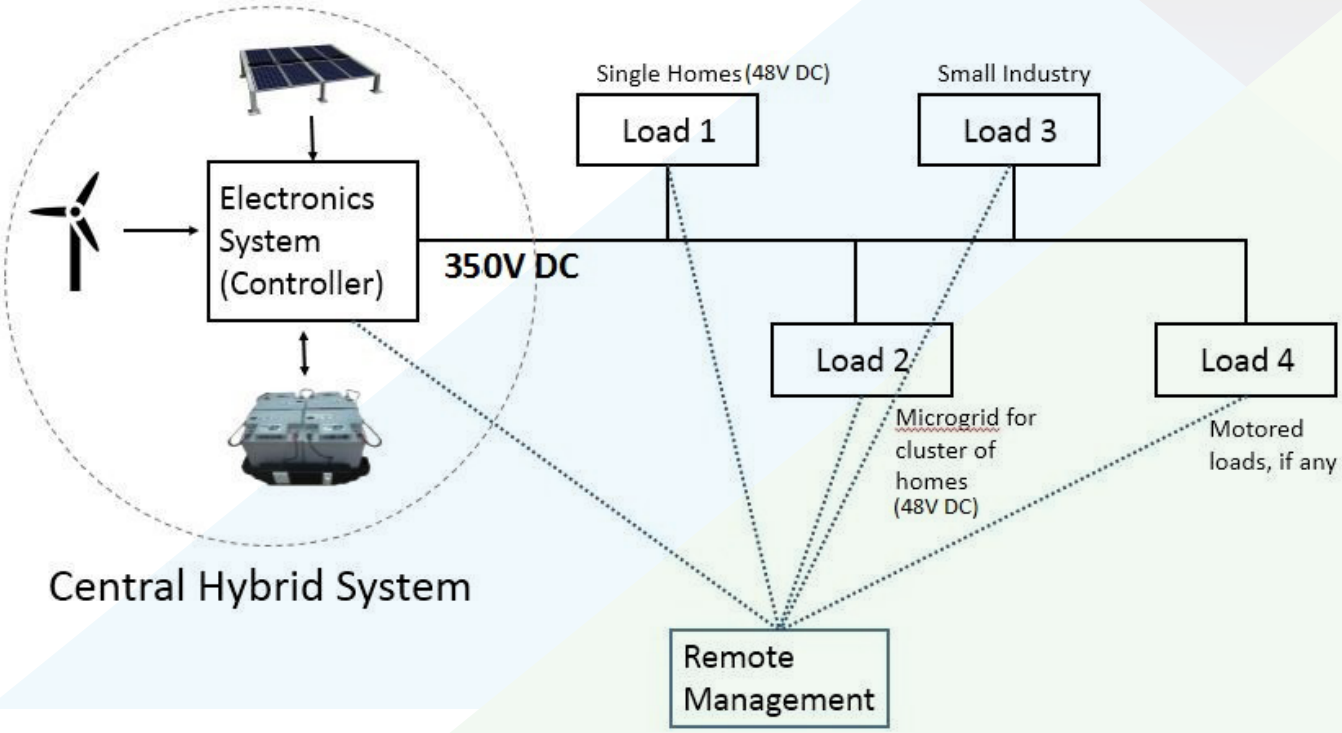
Prof. Tariq Muneer, School of Engineering and the Built Environment, Edinburgh Napier University, Edinburgh, U.K

# A LOCALIZED MICROGRID TO POWER AN OFF-GRID LOCALITY

## Objectives

- Introduce a new innovative electricity off-grid system with transmission of ±350VDC together with a distribution of 48VDC.
- Electrify about 150 households in a completely (or near) off-grid area connected through a small DC Microgrid
- Create a self-sustaining DC-based clean energy system
- Develop local eco-system to manage and monitor the project
- Collect data from each system for analysis and optimization studies
- Develop an ecosystem in the region of intervention

## Model



### Expected Outcomes

- Development of a new hybrid power control system which allows for optimum usage and management of variety of clean power sources
- Increase in energy efficiency and decrease in capex in comparison with equivalent decentralized power systems
- Optimizing power distribution and load management in the village using data analysis
- Data analytics to support power and demand management
- Increasing number of clean energy enterprises with improved business operations

### Location

Andaman Island

## CONSORTIUM

### India

Dr. Ashok Jhunjhunwala & Dr. Prabhjot Kaur, IIT Madras

### MI Partners

Mr. Sten Stenbeck, Research Institute of Sweden

# DESIGN AND DEMONSTRATION OF OFF-GRID SELF-HEALING & SUSTAINABLE DC COMMUNITY ENERGY SOLUTIONS

## Objectives

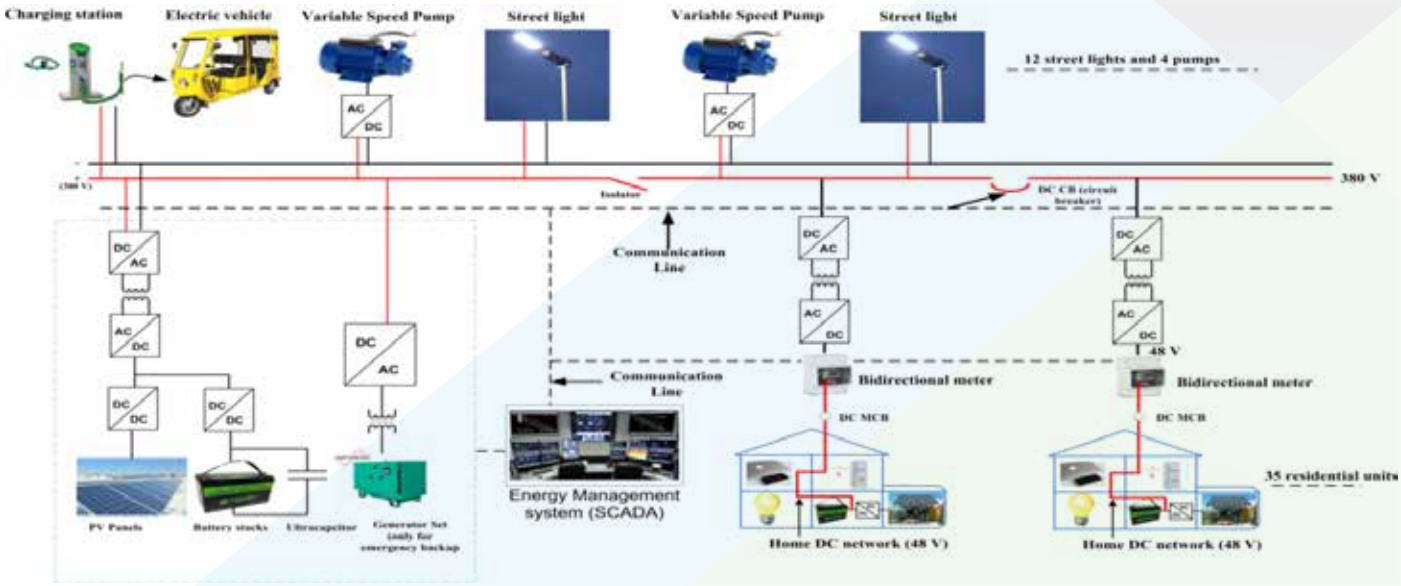
Designing of resilient, configurable, self healing, scalable architecture for community energy solution

Energy Efficiency: Generation/ Delivery/ Utilization

Demonstration of PV – DC – µG and support eco–tourism near Sharda river adjoining tiger reserve

Social and economic impact study, development of sustainable and scalable model for PV – DC microgrid

## Model



### Expected Outcomes

1. PV-DC-µG aligns with the requirement of off-grid access to electricity for rural communities
2. E-mobility: Installation of charging infrastructure facilitate shift from conventional fuels to clean energy for mobility.

### Location

Village Musepur, District Pilibhit (UP)

# CONSORTIUM

### India

Dr. Vishal Verma, Professor & Dean, Delhi Technological University
Dr. Amritesh Kumar, Delhi Technological University, Bawana Road, Delhi
Mr. Subhashis Mukherjee, M2M Cybernetics Private Limited, Global Business Park, MG Rd Gurgaon, Haryana

### MI Partners

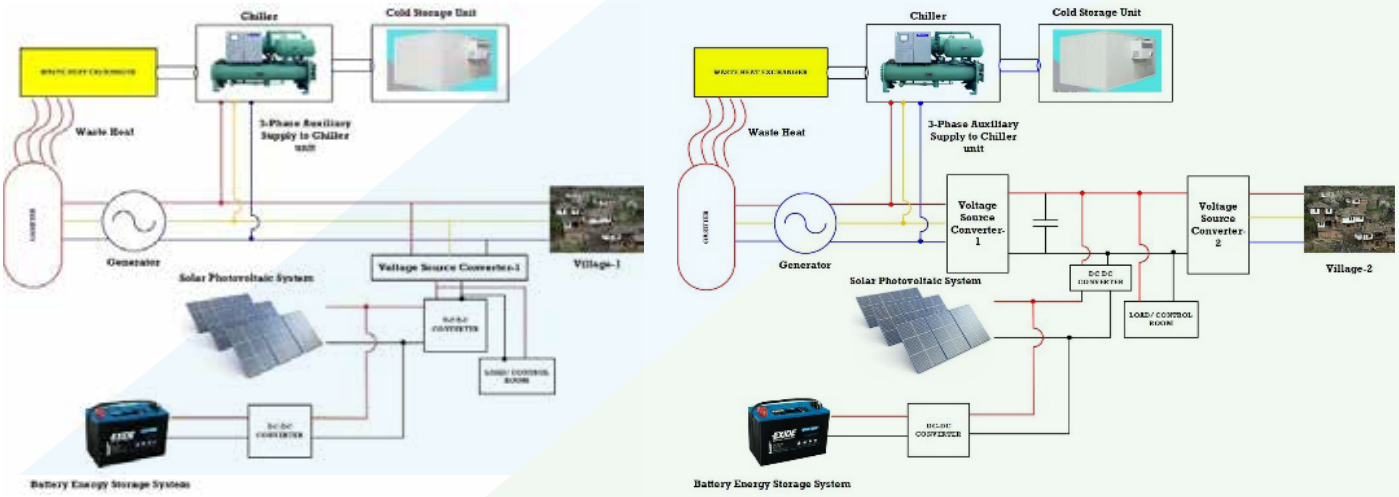
Dr. Vikram M. Rao, RTI International; 3040 E. Cornwallis Road, PO Box 12194Research Triangle Park, NC 27709-2194,USA

# DESIGN AND DEVELOPMENT OF BIOMASS –SOLAR ELECTRICITY AND COOLING SOLUTIONS FOR RURAL INDIA

## Objectives

- Control algorithms for seamless control of voltage source converters from voltage control to current control modes.
- Demonstration of Green chill cold storage system using waste heat from two stage gasifier power plant.
- Demonstration of optimal PV-biomass Gasifier operation.
- Incorporation of the DSM practices to control the integrated operation and provide reliable electricity.
- Demonstration of AC-DC system concepts for reduction in losses of the overall system.
- Implementation of the PV-Biomass hybrid system for two villages. In Village 1, AC side Integration will be demonstrated while in Village 2 DC side Integration will be demonstrated (avoiding synchronization problems). The performance comparison between the two configurations will be carried out.

## Model




AC Side Synchnization DC Side Synchnization

### Expected Outcomes

- Optimal sizing of the hybrid solar-PV biomass, battery systems with DSM enabled inverter support and direct DC load feed options.
- Energy Management Algorithms for optimal utilization of resources.
- Controllers for EMS, Biomass gasifier, solar PV/MPPT, Battery Charging etc.
- Protection schemes and design for the two systems.
- Technology development for integration of green chiller with the biomass gasifier based waste streams
- Tribal Woman Empowerment, Livelihood improvement, Human Resource Development

### Location

Distt. Koraput, Odhisa

Village 1: Bilatpur, Bilatput G.P., Nandpur

Village 2: Khajuripadar, Ramgiri, Baipariguda

## CONSORTIUM

### India

Prof. Sukumar Mishra, Indian Institute of Technology (IIT) Delhi, HauzKhas, 110016
Dr. Ashu Verma, Indian Institute of Technology (IIT) Delhi, HauzKhas, 110016.
Prof. Vishal Verma, Delhi Technological University, Delhi
Mr. Sunil Dhingra, The Energy and Resources Institute, Delhi

### MI Partners

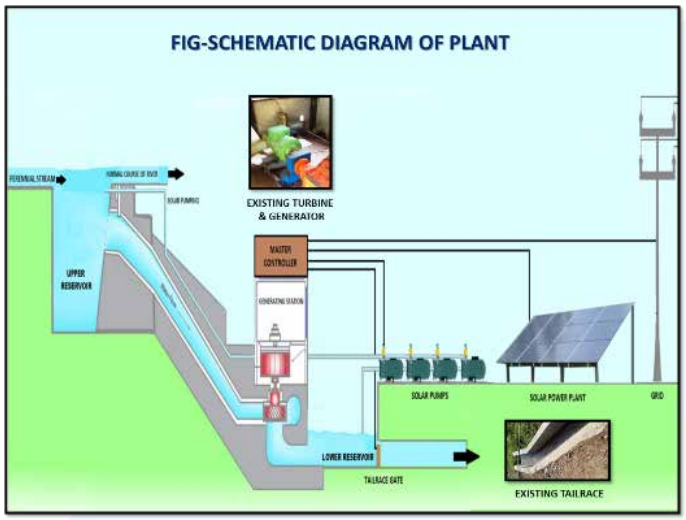
Anis Jouini, National Institute of Solar Energy (INES R&D) CEATECH/LITEN – Department of Solar Technology, France
Ing. Giacobbe BRACCIO, BRACCIO Trisaia Centre, Italy
Mr Erik Hoble, Røykenviklinna 617 N-2760 Brandbu, Norway

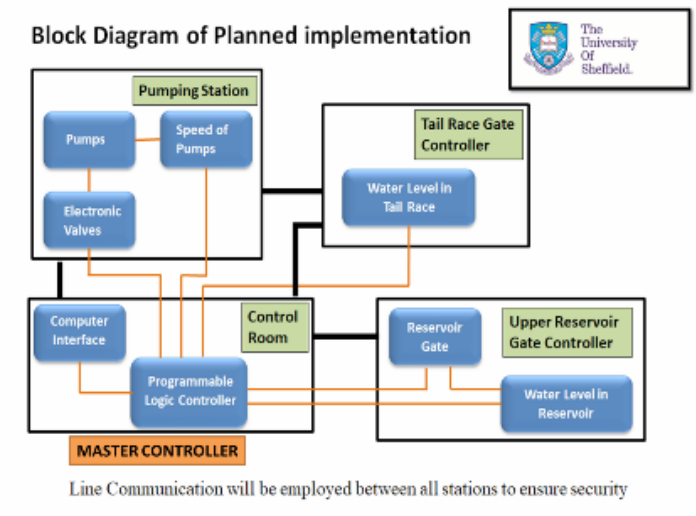
# DEVELOPMENT, RESEARCH AND PILOT SCALE INSTALLATION OF SOLAR-HYDRO PUMPED STORAGE SCHEME IN A REMOTE VILLAGE OF ASSAM TO ENSURE 24X7 ELECTRICITY.

## Objectives

- Interconnecting and interfacing a mini or micro hydel project with Solar
- Functional intelligent controller to operate pumping of tailrace water to upper reservoir water by using Solar pumps.
- Enhancing Capacity Utilization Factor of Mini/Micro Hydel plant along with stabilizing intermittent solar power to firm dispatch-able power.
- Training of the selected people from the local community
- Different social activities like Women empowerment and socio-economic activity for banana stem fiber, broom making, Supari leaf plate making, preparation of orange jelly, jam and squash, bamboo handicraft etc.

## Model



### Expected Outcomes

- Improving reliability of power generation
- Overcome limitations of Hydro plants in the dry season
- Continuous water supply
- Intelligent controller for Water and Power management
- Socio-economic and health status

### Location

Upper Killing Village (Khetri, East Kamrup District of Assam)

## CONSORTIUM

### India

Dr. Shibani Chaudhury, Department of Environmental Studies, Institute of Science, Visva – Bharati University, Santiniketan 731235, West Bengal.
Dr. S. P Gon Chaudhuri, NB Institute for Rural Technology, 220 Madurdaha, Kolkata 700107

### MI Partners

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