

# INTEGRATED APPLICATIONS FOR MICROGRIDS IN DEVELOPING ECONOMIES: Webinar



22/08/2017

Rita Rinaldo, Davide Coppola (ESA)  
Dr. Rahul Walawalkar (IESA), Harsh Thacker (MICRO)

# Purpose of ESA



“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in space research and technology and their space applications.”

Article 2 of ESA Convention



# ESA facts and figures



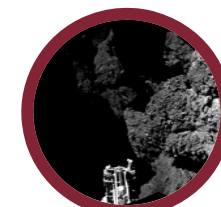
- Over 50 years of experience
- 22 Member States
- Eight facilities in Europe, about 2300 staff
- 5.75 billion Euro budget (2017)
- Over 80 satellites designed, tested and operated in flight



# Activities

ESA is one of the few space agencies in the world to combine responsibility in nearly all areas of space activity.

\* Space science is a Mandatory programme, all Member States contribute to it according to GNP. All other programmes are Optional, funded 'a la carte' by Participating States.



space science



human spaceflight



exploration



earth observation



launchers



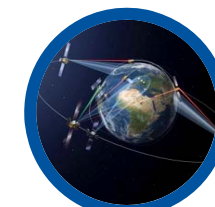
navigation



operations



technology



**Telecommunications  
& Integrated  
Applications**



## Our goal with Applications

A graphic of a globe where the continents are formed by a dense word cloud. The words are in various colors (blue, green, yellow, orange) and sizes, creating a textured effect. The background is a dark blue space with white stars.

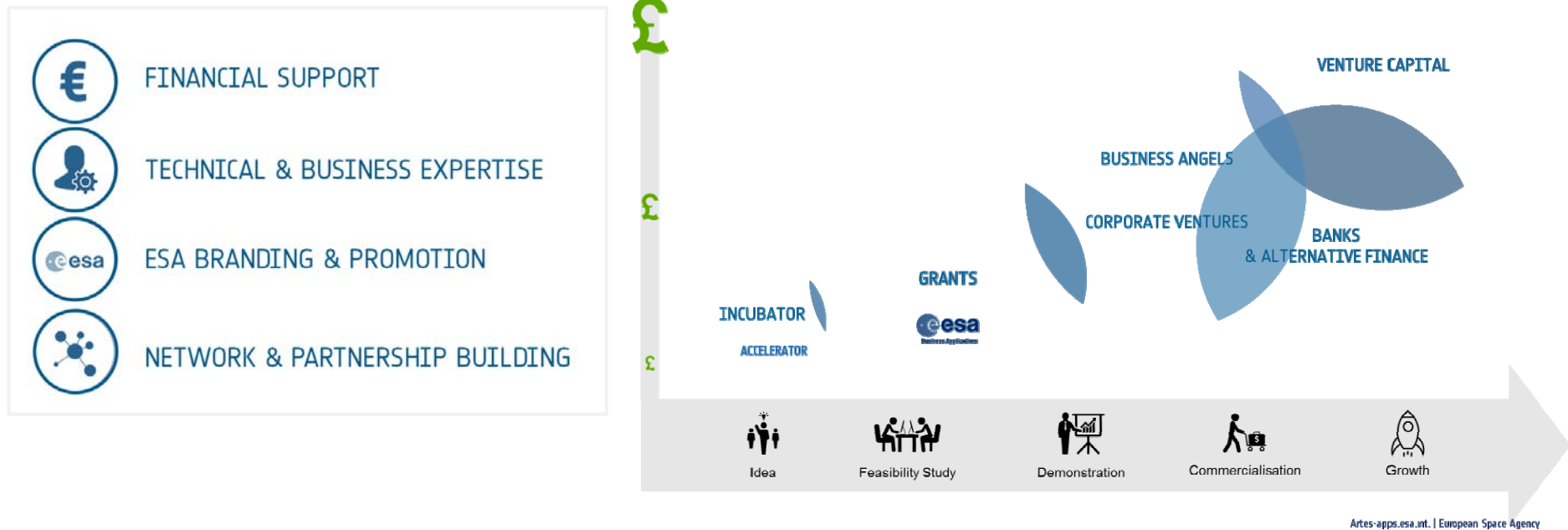
→ **SPACE FOR DAILY LIFE**

"We want space to be part of the set of technologies used in everyday business"



# What we offer

## ARTES Applications



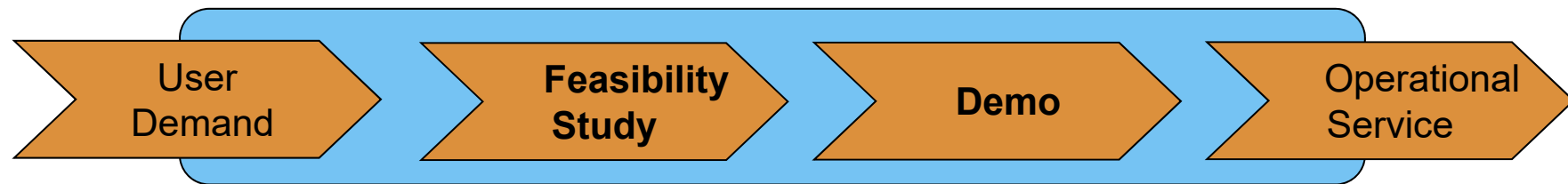
We enable and support the development of  
**business applications**  
 that uses any space assets for services on Earth



# How is this implemented?



## ESA IAP Involvement



User with demand but no contact to industry

Contact with ESA:

- iap.esa.int
- conferences
- ambassadors
- call for user ideas

Funding by ESA:

- 100% - ESA initiated activities in close collaboration with users / customers
- 50% <sup>1/2</sup> - Partner / industry initiated activities in close collaboration with users / customers
- 75% Kick-Start Activities: 60 k€ per activity theme calls by ESA

Funding by ESA:

- 50% <sup>1</sup> – Partner / industry initiated activities in close collaboration with users / customers

Support etc.

- 1) Funding for SMEs up to 75%, decision of funding level by national delegations
- 2) For Feasibility Studies only: Work carried out by universities and research institutes and justifying no further commercial interest in the final solution may be funded 100% by the Agency





# Our portfolio



ESA UNCLASSIFIED - For Official Use

22/08/2017 | ESA-TIAA-HO-2017-1150 | Slide 9

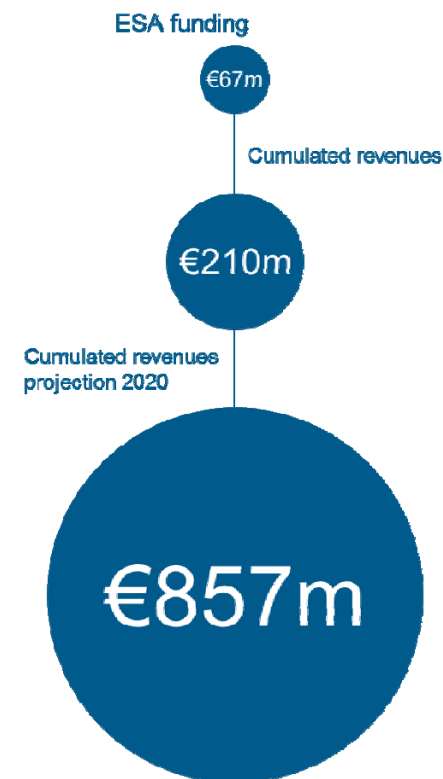
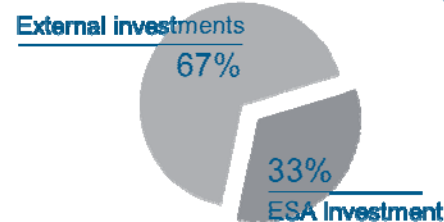


# Returns and investments

**68%**  
of revenues goes to export

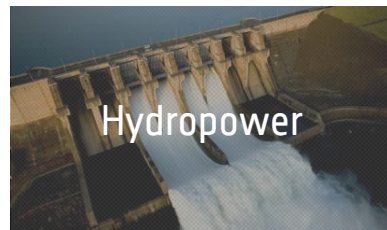
**€29b+**  
Space Applications & Services Market

**59**  
Export countries



\*Socio-economic assessment of 60 out of 320 projects (September 2016)

# ESA Business Applications: Energy Portfolio



More than **20** Projects

Over **10MEur** ESA Investment

**15MEur** Additional Investment



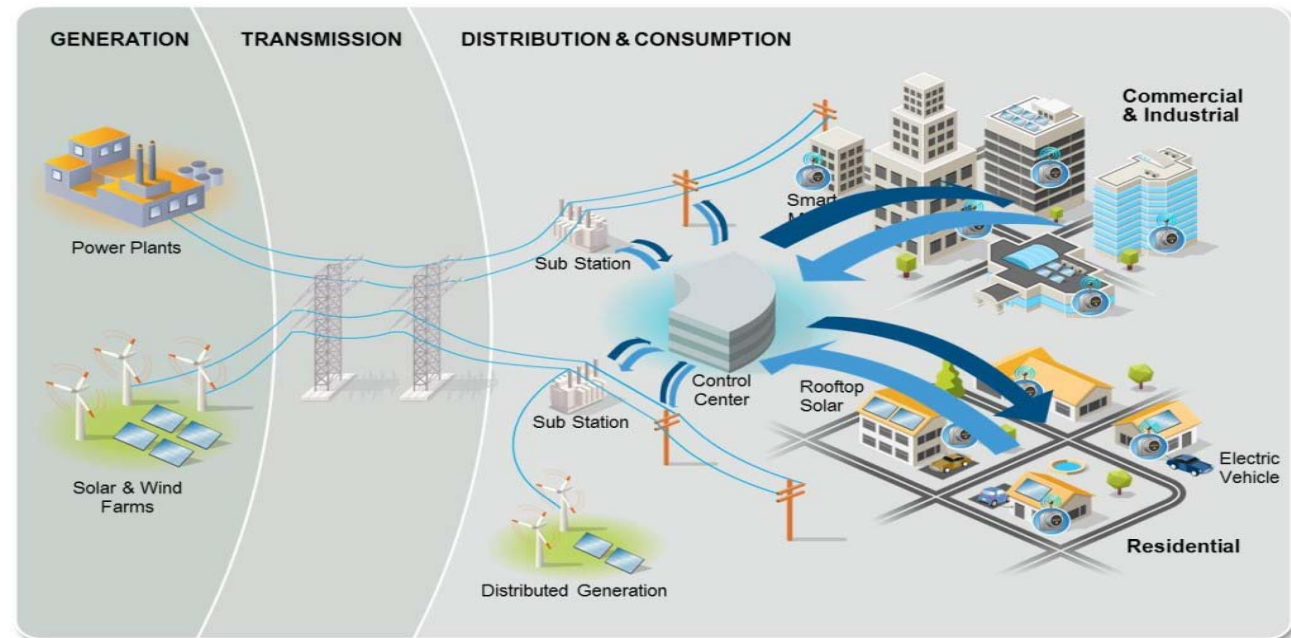
# Future Opportunities for Space Applications in The Energy Sector



# Space for Smart Electricity Grids



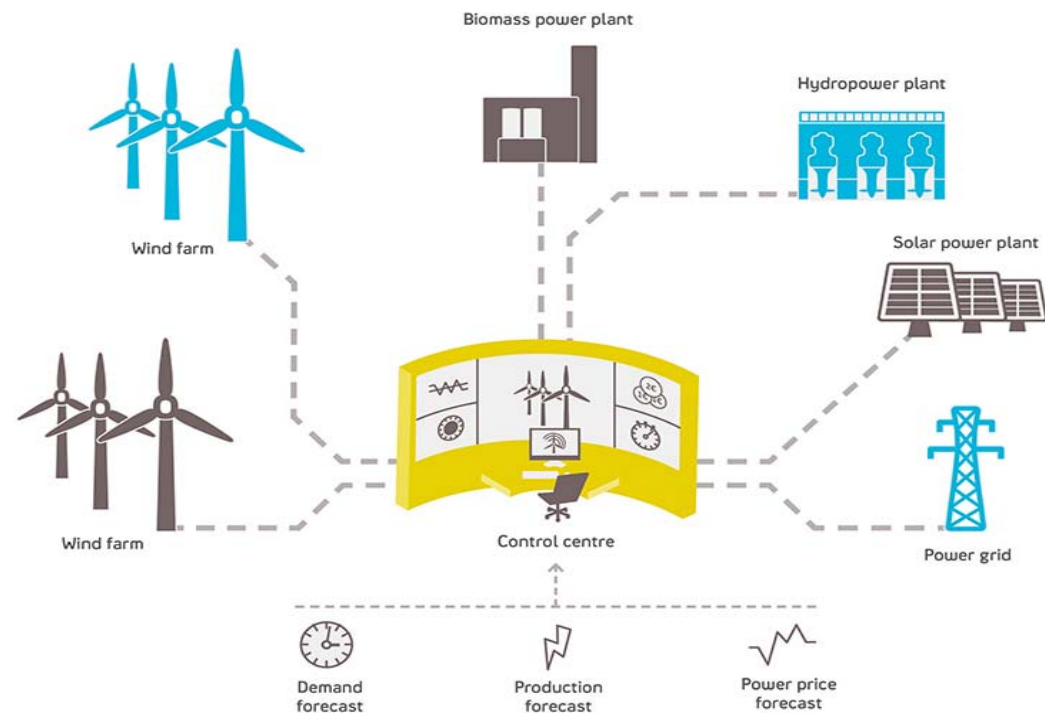
- The smartgrid: need for bi-directional information and energy flows
- Potential role of Space
  - Provide bi-directional info flow
  - Forecast energy production and consumption





# Space for Smart Electricity Grids

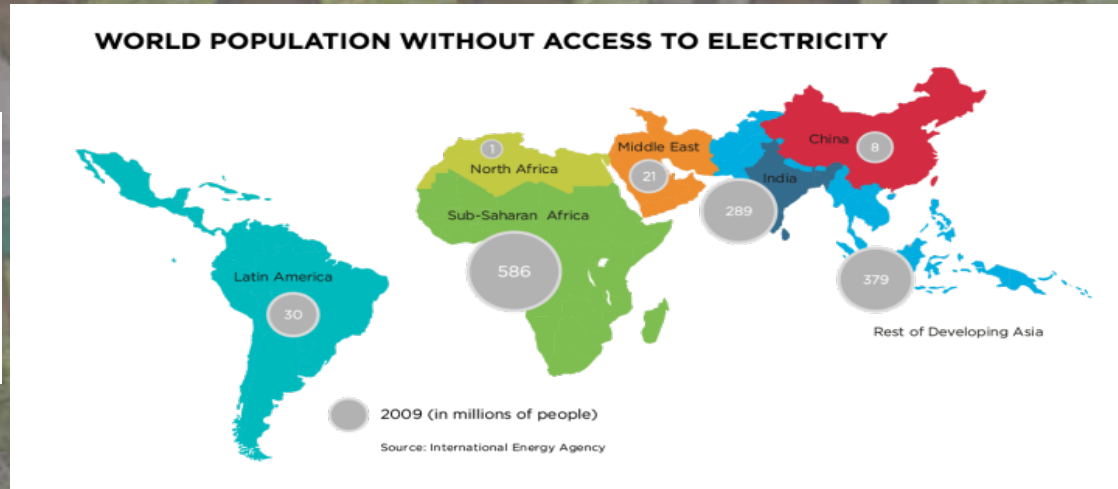
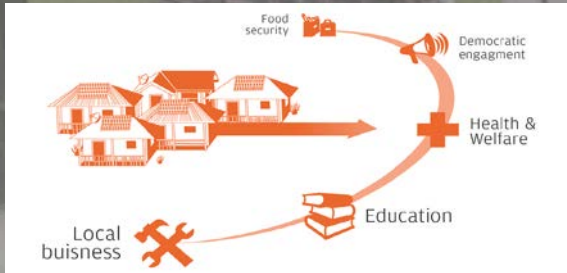
- Energy management services at the commercial and residential level
- Energy services for utilities
  - Monitoring, early warning of outages and self-healing of the grid
- Virtual Power Plant services
  - Energy forecasting to optimize use of energy assets and stabilize the grid
- Microgrids
  - Intended Tender



## Integrated applications for microgrids in developing economies

Global access to electricity still far from achieved

- 1.2 billion have no access to electricity
  - 95% in Sub-Saharan Africa and Asia
  - 80% in rural areas
- An additional 1 billion people lack access to *reliable* electricity supply



Global access to electricity still far from achieved

- 1.2 billion have no access to electricity
  - 95% in Sub-Saharan Africa and Asia
  - 80% in rural areas
- An additional 1 billion people lack access to *reliable* electricity supply

Microgrids offer an attractive solution to achieve energy access in rural and developing areas

Challenges remain that are restraining microgrid development

- Data acquisition/monitoring
- Lack of accurate energy forecasts hinders financial analysis and investment

ESA's IAP "Integrated applications for microgrids in developing economies" invitation to tender.



# Feasibility study overview

## Objectives



Assess if and how space technology can support the setting-up and operation of microgrids in developing countries

Assess the technical and commercial viability of proposed services

Propose roadmap for service implementation and demonstration

## Targeted Application domains



Assessment of energy demand and potential energy supply

Remote monitoring and maintenance (including disaster recovery)

Spin-off services to boost socio-economic growth

100% funding, up to €200k

Duration: 9 months





# Space tech and services potential contribution



- **Earth observation:** socio-economic information energy load forecasting and planning, environmental information / landscape and land use to optimise the selection of microgrid sites and assessment of their power potential.



- **Satellite Communication (SatCom):**
  - to provide seamlessly connectivity to (typically) remote microgrid sites (monitoring and maintenance).
  - Enabler of spin-off services (e.g.: tele-education)



## Indian Stakeholders involvement



- India Energy Storage Alliance (IESA) has agreed to support the ESA by liaising with Indian governmental and private stakeholders throughout the study and (potentially) during the follow-up demo project
- IESA has recently launched the “Microgrid Initiative for Campus & Rural Opportunities (MICRO)” whose main goal is the reduction of electricity cost from microgrids by 20-30% within next 3 years in India





Presented by

**Dr. Rahul Walawalkar**

Executive Director, India Energy Storage Alliance &  
President & MD,  
Customized Energy Solutions India Pvt. Ltd

&

**Harsh Thacker**

Program Manager, MICRO  
Sr. Consultant  
Customized Energy Solutions India Pvt. Ltd



## Energy Scenario in India

- India has ~350 GW installed generation capacity with a population of 1.2+ Billion

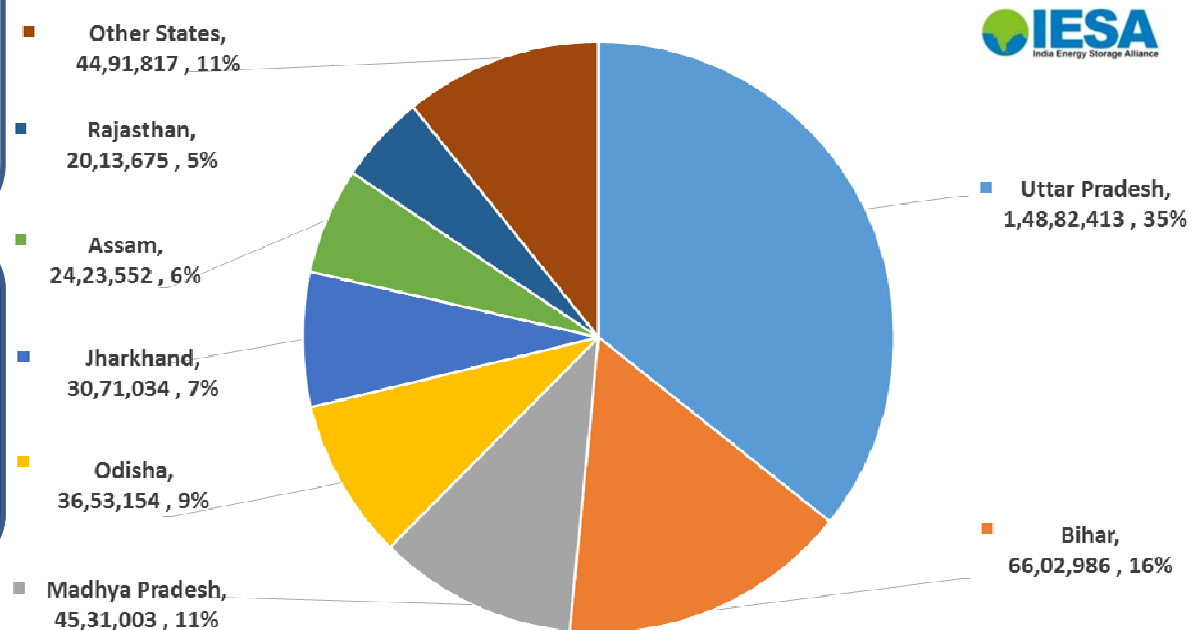
- Over 300 million people without access to electricity
- Highly populated states such as Bihar and UP will require significant increase in generation capacity (MW)
- Number of states experience regular planned power outages of 4 hrs or more

- Has over 90 GW of installed Diesel Generation used in some cases as the primary source for power for industrial and commercial customers offering a low hanging fruit for early storage adoption coupled with renewables

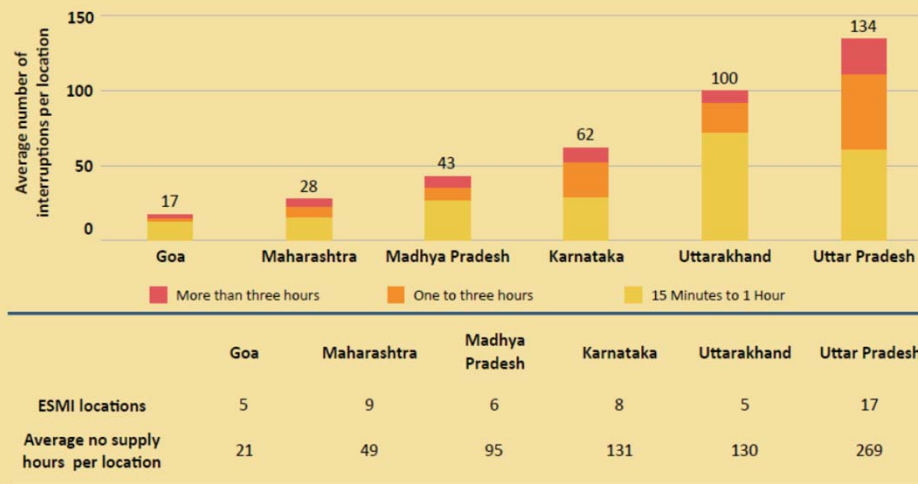


### Indian Households to be Electrified

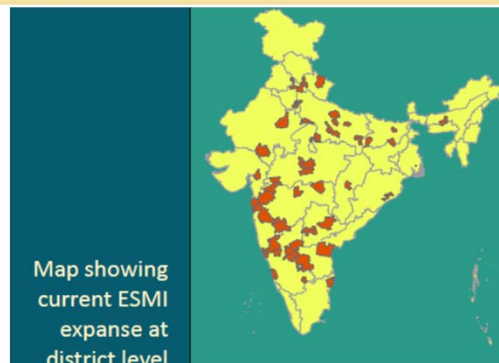
(Source: garv.gov.in as of 15th August 2017)



## Supply Quality in Rural Areas - May 2017



While significant improvements are taking place in overall generation availability and grid expansion, microgrids can help in improving the power quality and reliability.



## ESMI Locations Receiving Entire Six Hours



**55%**  
Mega Cities



**29%**  
Other Cities



**4%**  
Rural Areas

## In May 2017



ESMI locations experienced outages for more than 15 hours



ESMI locations experienced more than 30 interruptions, each greater than 15 min



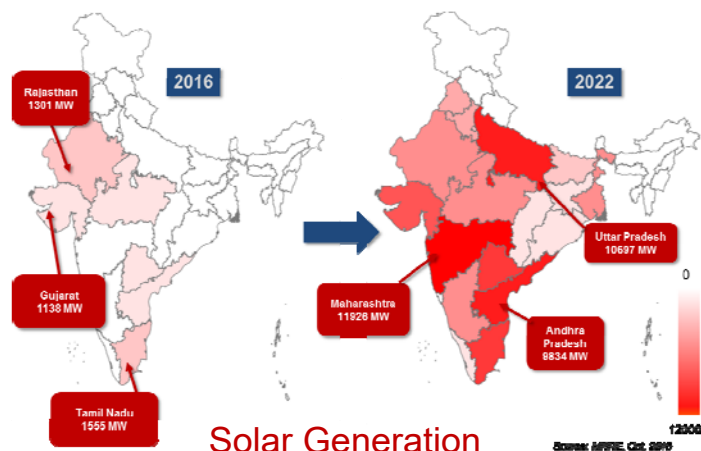
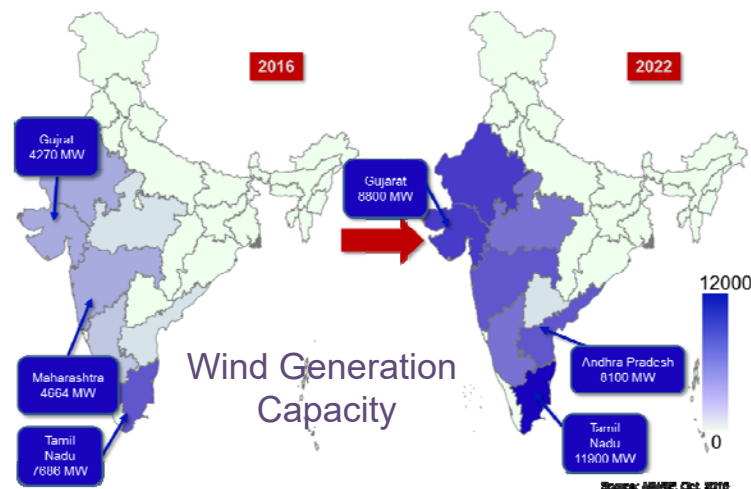
ESMI locations experienced average daily outage of 30 min or more during evening hours

**Source: Prayas**



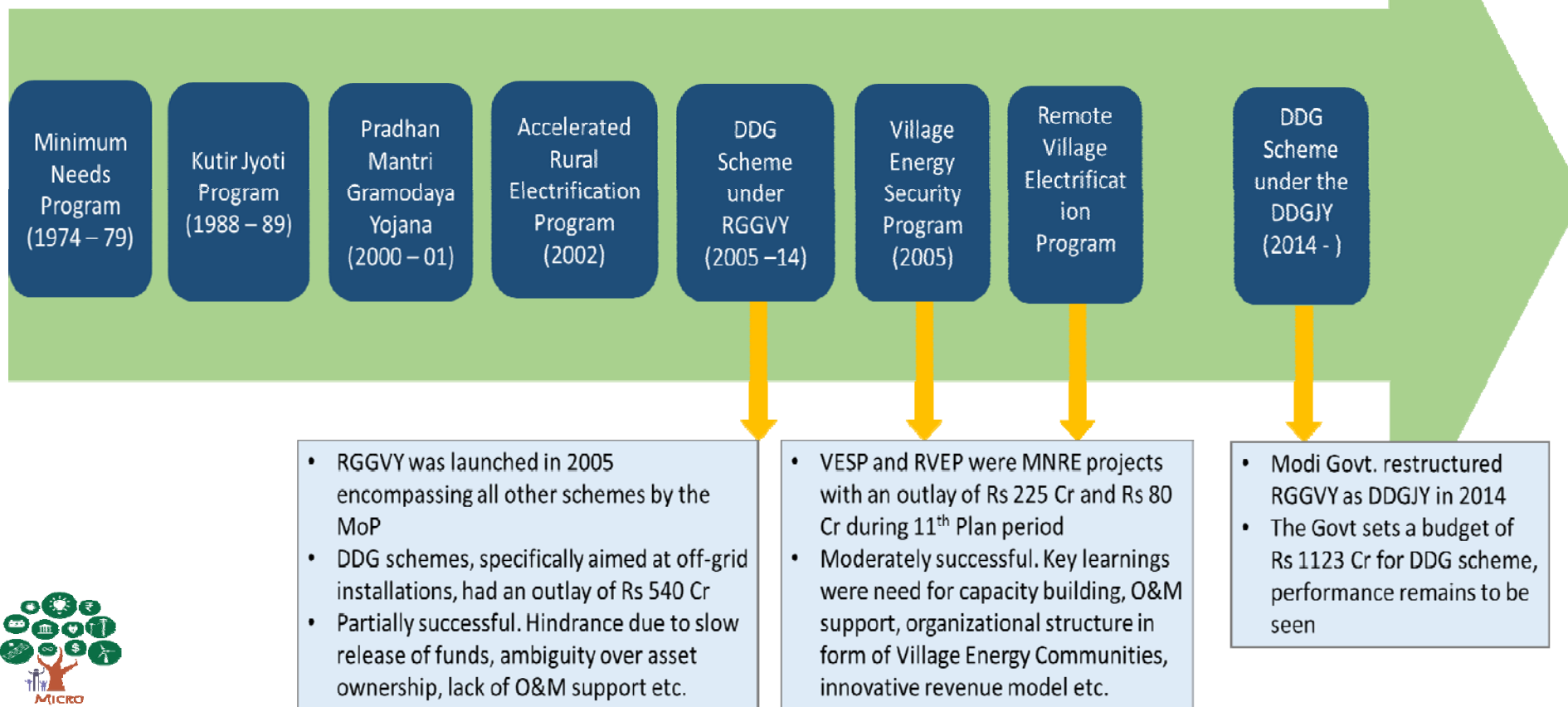
## Renewables in India: Solar and Wind

- Currently installed total wind generation capacity is ~32 GW
- Western and southern regions of India are the most favourable
- Target for 2022 is 60 GW which implies almost doubling of the current installed capacity



- Currently installed total solar PV generation capacity is ~13 GW
- Most regions of India have an abundance of source of solar energy
- Target for 2022 is 100 GW which implies almost 8X of the currently installed capacity
- Target includes 40 GW of rooftop solar, which could be part of microgrids as well

# Timeline of schemes launched by the Indian Government for rural electrification



# India has taken a lead in microgrids policy

## ❑ Revenue and financing

- ✓ Pay as you go model – metered energy tariff
- ✓ Power tariff – fixed Wattage based package
- ✓ RoE capped at 16% in case of for-profit ventures
- ✓ Allow grant/subsidy support for O&M but needs transparency

## ❑ Performance and technical standards

- ✓ Service norms – minimum 8hrs of domestic supply, atleast 30% of load should be domestic
- ✓ System component – adhering to MNRE specifications
- ✓ Distribution n/w – Safety norms as per CEA regulations
- ✓ Consumer connection – stipulates a min 200W per HH
- ✓ Interconnection to the grid - CEA regulation 2013 with proper care w.r.t. islanding/isolation

## ❑ What happens when main grid arrives

- ✓ Co-exist with grid, can draw and sell surplus to grid (PPA arrangement)

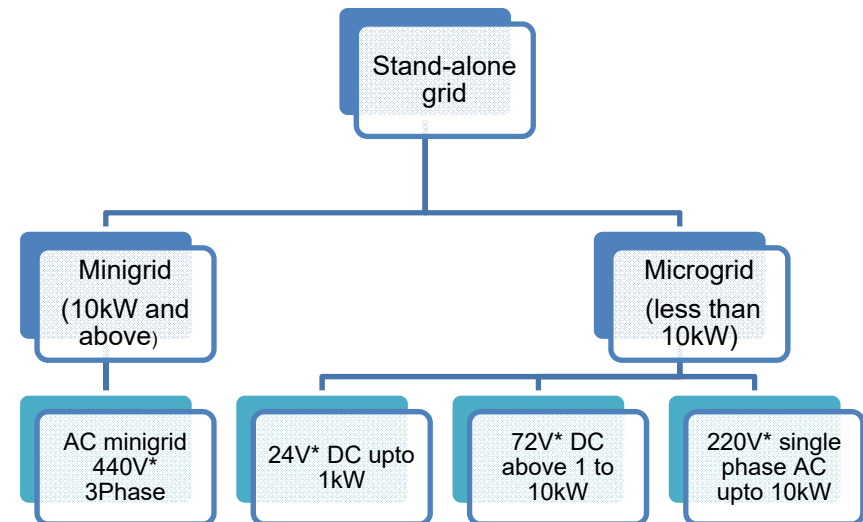


✓ If exits, mini/ micro grid will receive SERC regulated tariff for generation including wheeling charges

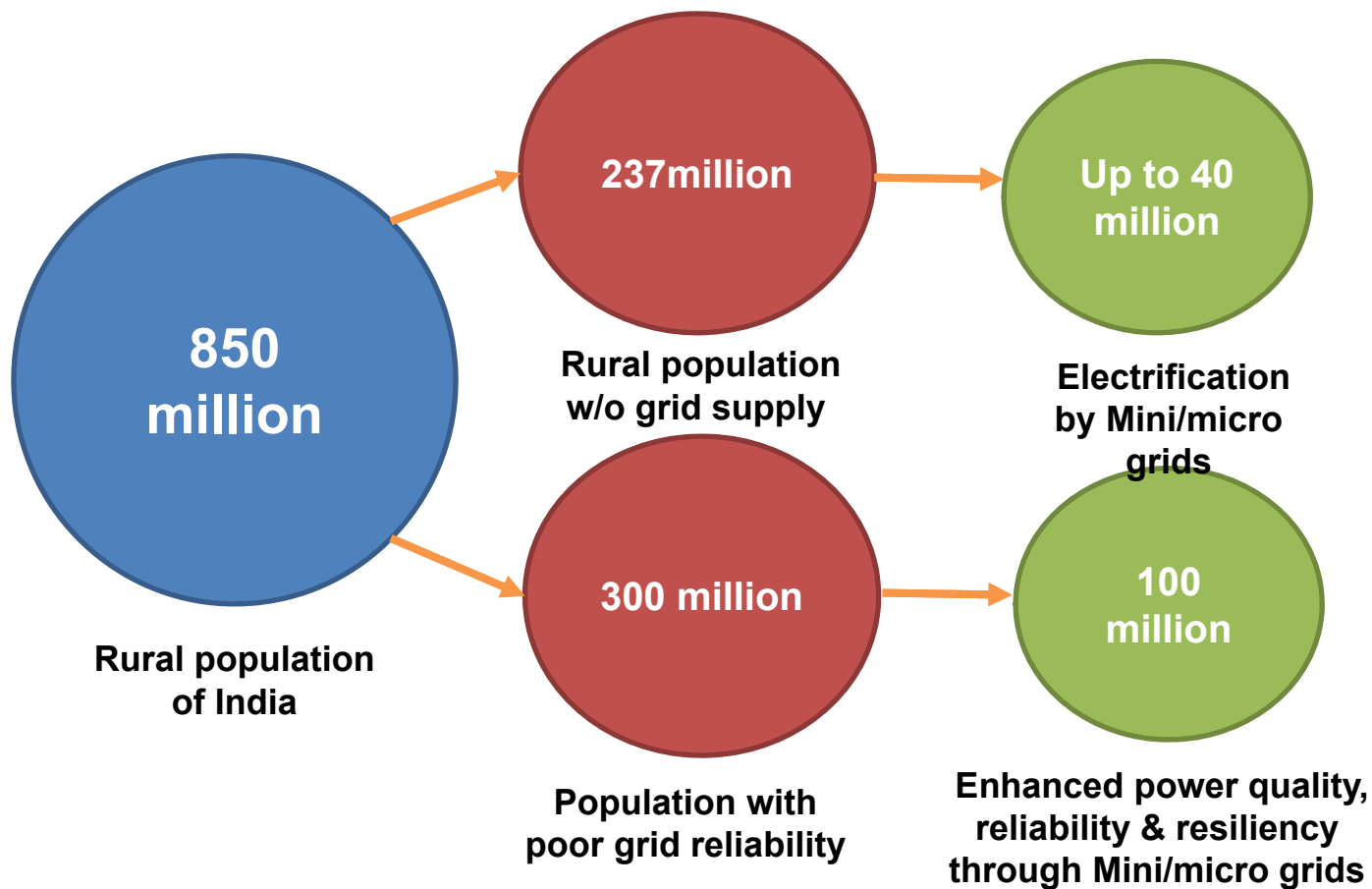
✓ Option to enter Franchisee Agreement with Discom, modalities to be developed by the SNA

The Policy targets minimum 10,000 installations or 500MW of mini/micro grids in 5 years

**National Policy in India classifies Microgrids and Minigrids as per their size. The policy also recommends voltage level for the different sized grids.**



## What can be the scale of microgrid opportunities in India?



## Funding gap need to be bridged strategically

- India would require funding in range of over \$10 billion per year to achieve energy access for all till 2030
- Private investment required in range of billions to achieve this feat.
- Villages with high economic growth potential have to be identified and should make way for private equity investments. Supply and marketing chains of FMCGs and other entities need to be tapped.
- Funding businesses around microgrids can be the key to find anchor consumers.
- CSR and low return investments should be strategically targeted towards the very last mile habitation and communities.



### Annual Funding Requirement for energy access and clean energy, Global, Till 2030

#### Clean Energy Investment Gap

**Energy Access:** USD 49 Billion / Year

USD 9 B

Gap: USD 40 B

**Renewable Energy:** USD 650 Billion / Year

USD 258 B

Gap: USD 392 B

**Energy Efficiency:** USD 560 Billion / Year

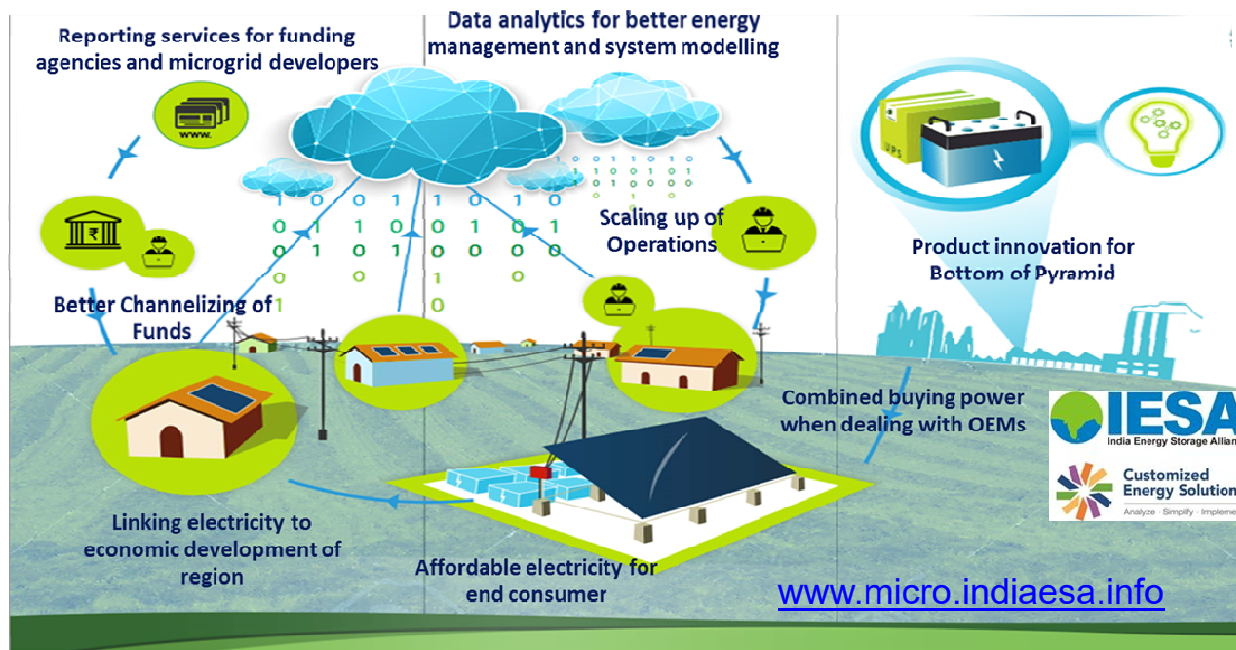
USD 130 B

Gap: USD 430 B

Source:  
ADB



# Microgrid Initiative for Campus & Rural Opportunities (MICRO) – Phase 1



European Space Agency



**MICRO has set up goal of reducing cost of electricity from microgrids by 30-50% with in next 3 years.**

## Energy Access – Four Pillars of Strength



**Enhancing Data and Knowledge** for  
Driving Policies



**Bottom of Pyramid Innovation** for  
Achieving Right Business Models



**Skill Development** of People Working  
in Highly Un-organized Sector



**Funding** needs to be co-related with  
Economic Development of Community



## Data Availability a major concern

- Data on operational microgrids is not easily available.
- Inverter OEMs need to freely share communication protocol for their equipment.
- Innovative technology and business model required for low cost data collection and analysis at microgrids level.
- Inaccessible sites makes monitoring even more crucial
- Sites surveyed by MICRO team shows lack of optimized sizing of grids and efficiencies on the lower side
- There is no feedback of operational data taken by developers while designing new sites



# Monitoring on MICRO

Battery-In KWh

**8.9 kWh**  
Aug 18 - 4:21 pm

Battery-Out KWh

**2.4 kWh**  
Aug 18 - 4:21 pm

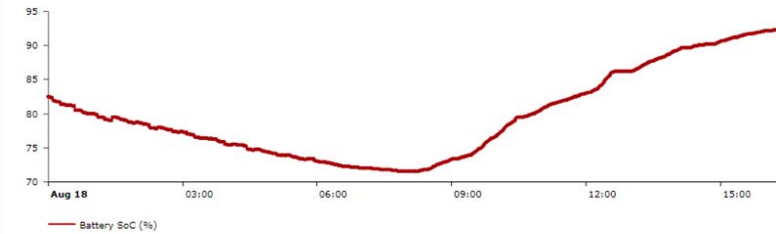
Battery Utilization

**14.58 %**  
Duration: 29 days

Battery Efficiency

**69.52%**  
Duration: 29 days

Battery SoC



Active Power

**0.58 kW**  
Aug 18 - 4:21 pm

Energy - Today

**11.12 kWh**  
Aug 18 - 4:21 pm

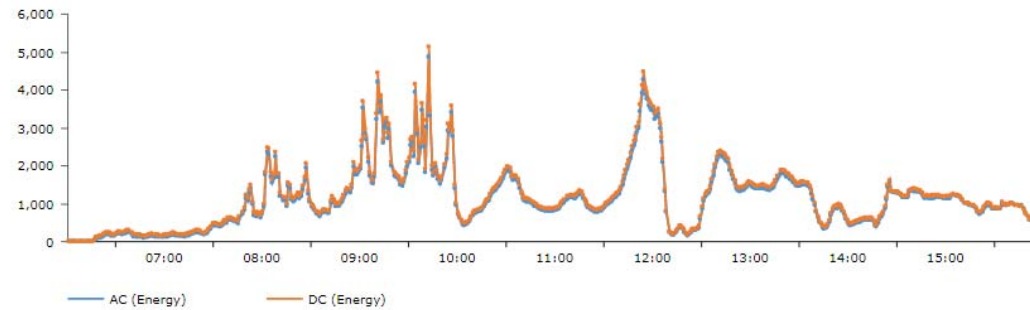
Energy - Lifetime

**333.37 kWh**  
Duration: 29 days

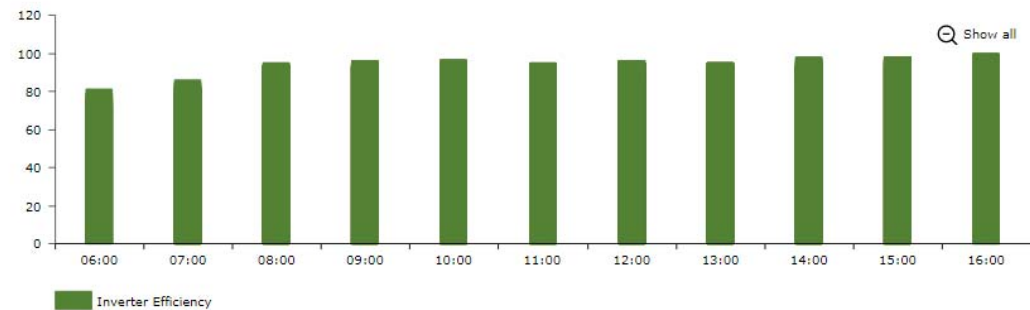
Score

**1.91**  
kWh/day/KW

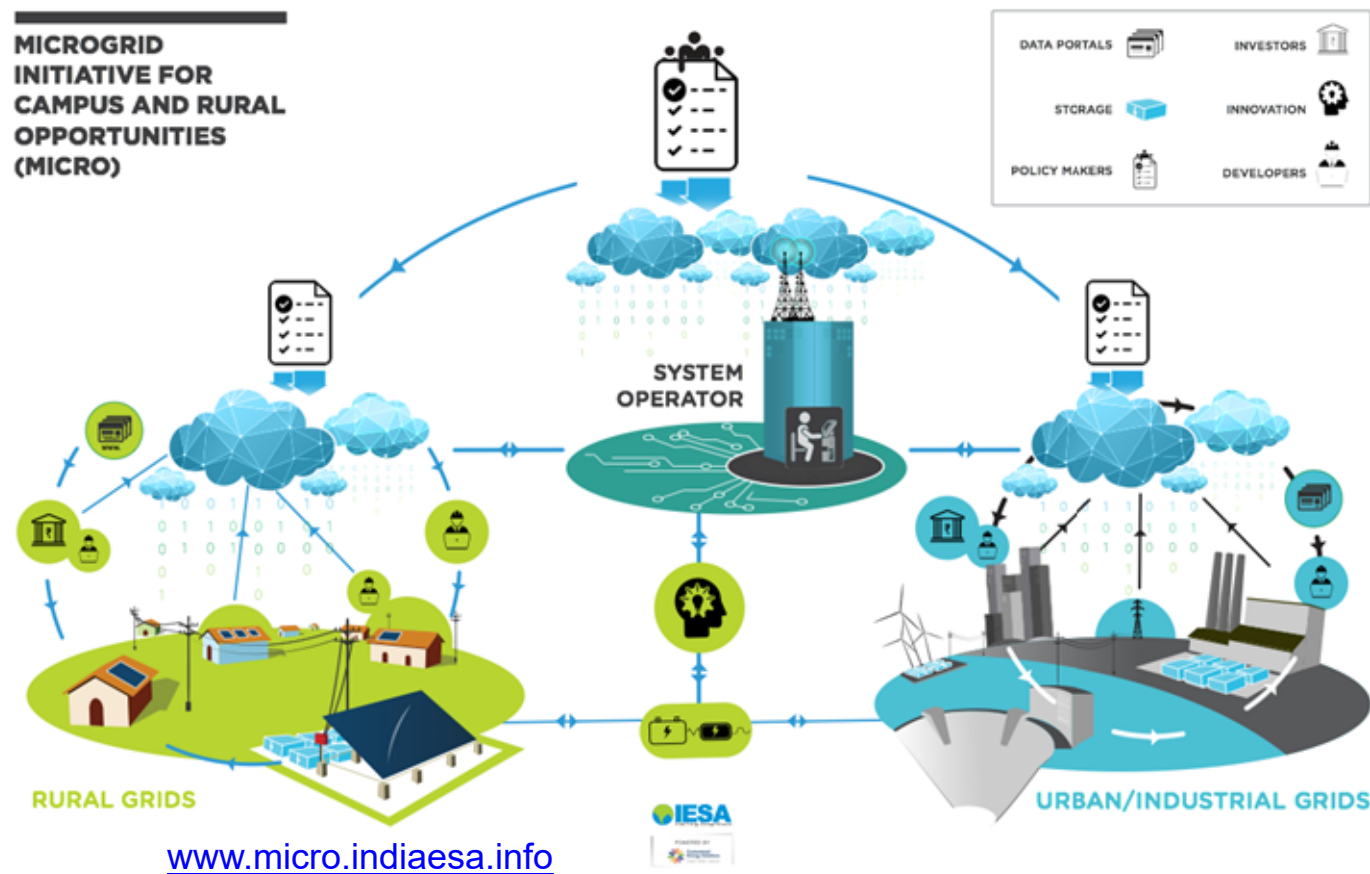
Inverter Output



Inverter Efficiency



# Microgrid Initiative for Campus & Rural Opportunities (MICRO)





## Smart Townships and Cities



- Indian Government is working on developing 100 Smart Cities.
- 20 smart cities are already identified for initial funding
- In addition over 300 Ultra Modern Townships with 5 – 50 MW of peak demand could drive need for storage in India.





## MICRO Team & Partners



A diverse team developed to achieve these initiatives.



Dr. Satish B  
Agnihotri,  
**Chief  
Advisor**



Dr. Rahul  
Walawalkar  
**Thinker-in-  
chief,  
Chairman**



Harsh  
Thacker,  
**Project &  
Stakeholder  
Manager**



Javed  
Shaikh,  
**Technical  
Manager  
and Portal  
Developer**



Rajarshi  
Sen, **Battery  
and System  
Design  
Expert**



Vinay  
Walimbe,  
**Financial  
Services**



Vipul Pagrut,  
**Hardware  
Engineer**



## India Energy Storage Alliance (IESA)

- IESA was launched by CES in 2012 to help technology and system integration companies involved in energy storage and microgrids to understand and capture opportunities in the growing market
- In 2013 launched IESA-Knowledge Partner Network with a goal of addressing energy storage applications in over 10 key sectors
- In 2013, IESA also started hosting Energy Storage India, an international conference and expo
- In 2014, we launched Emerging Technology News as quarterly magazine for spreading awareness
- In 2015, we launched IESA- Leadership Council to broaden the strategic leadership of IESA .
- In 2016, IESA launched MICRO, the Microgrid Initiative for Campus and Rural Opportunities with a goal of reducing levelized cost of energy for energy access by 50% in 3 years.
- For more details visit [www.indiaesa.info](http://www.indiaesa.info)



### IESA Members



# Driving Industry – Academic Collaboration



## LABSCALE TO COMMERCIALIZATION

- Prototyping of developed material or design innovations
- Gathering input from industry and policy makers on needs for next generation solutions

## INTERNSHIPS

- Exchange students for pursuing research projects in India
- Actively engaging with Indian partners (manufacturers, policy makers and researchers) for understanding needs and opportunities in India



## ACCELERATOR

In order to promote fast growth in the energy storage domain an accelerator has been planned.

Researchers with innovative technologies can avail the benefits of fabrication, prototyping and industrial testing of their lab-scale setups

Active engagement with key members from the industry who can act as mentors to guide young and enthusiastic researchers and also assist with commercialization.



## FUNDING OPPORTUNITIES

- Global Innovation and Technology Alliance (GITA). India collaboration with UK, Spain, Israel, Taiwan, Korea, Finland and Canada
- USAID funding for addressing Energy, Environment and Global Climate Change concerns

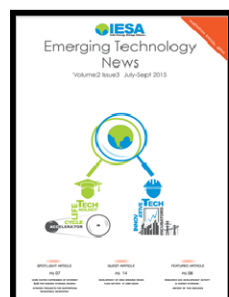
Innovation possibilities are limitless in energy storage. They could be at a materials, design, controls, packaging or system level. Some ideas for general improvement trends are presented in the next few slides. More IDEAS are always welcome!



## Stay informed about India opportunities through IESA




Subscribe to free IESA newsletter or download the quarterly magazine Emerging Technology News at [www.indiaesa.info](http://www.indiaesa.info)

Members also get access to Monthly Policy updates & RFPs / Tenders in members only section



**IESA Magazine (Emerging Technology News-ETN) has completed 2 years of publication**



Title	Company/ Organisation	Logo	Sector	Technology
BHEL Enquiry for Supply of 300 kWh /100 kW Advanced Lead Acid Battery with BMS  View Details	BHEL		Energy Storage	Advanced Lead Acid
NTPC Ltd Invites online Bids For 3.2MW Battery ESS for 8 MW Solar PV Project in Andaman & Nicobar Islands  View Details	NTPC		Solar + Storage	Neutral
BHEL Enquiry for Supply and Commissioning of 200 kWh /50 kW ESS  View Details	BHEL		Energy Storage	Flow Battery



# INTEGRATED APPLICATIONS FOR MICROGRIDS IN DEVELOPING ECONOMIES



- Follow updates in EMITS and ESA business application website <https://business.esa.int/> & subscribe to the newsletter!
- Funding eligibility: open to organisations residing in any of those states that subscribed to the IAP programme: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, The Netherlands, Norway, Poland, Portugal, Romania, Sweden, Switzerland and the United Kingdom.





## ESA Business Applications

→ SPACE IS OPEN FOR BUSINESS

Twitter: @esa\_artes

[artes-apps.esa.int](http://artes-apps.esa.int)

European Space Agency