



# *India's National Energy Storage Mission: Drivers and Vision*

Session: The international perspective

**Dr. Rahul Walawalkar**

Executive Director, India Energy Storage Alliance  
President & MD, Customized Energy Solutions (India)

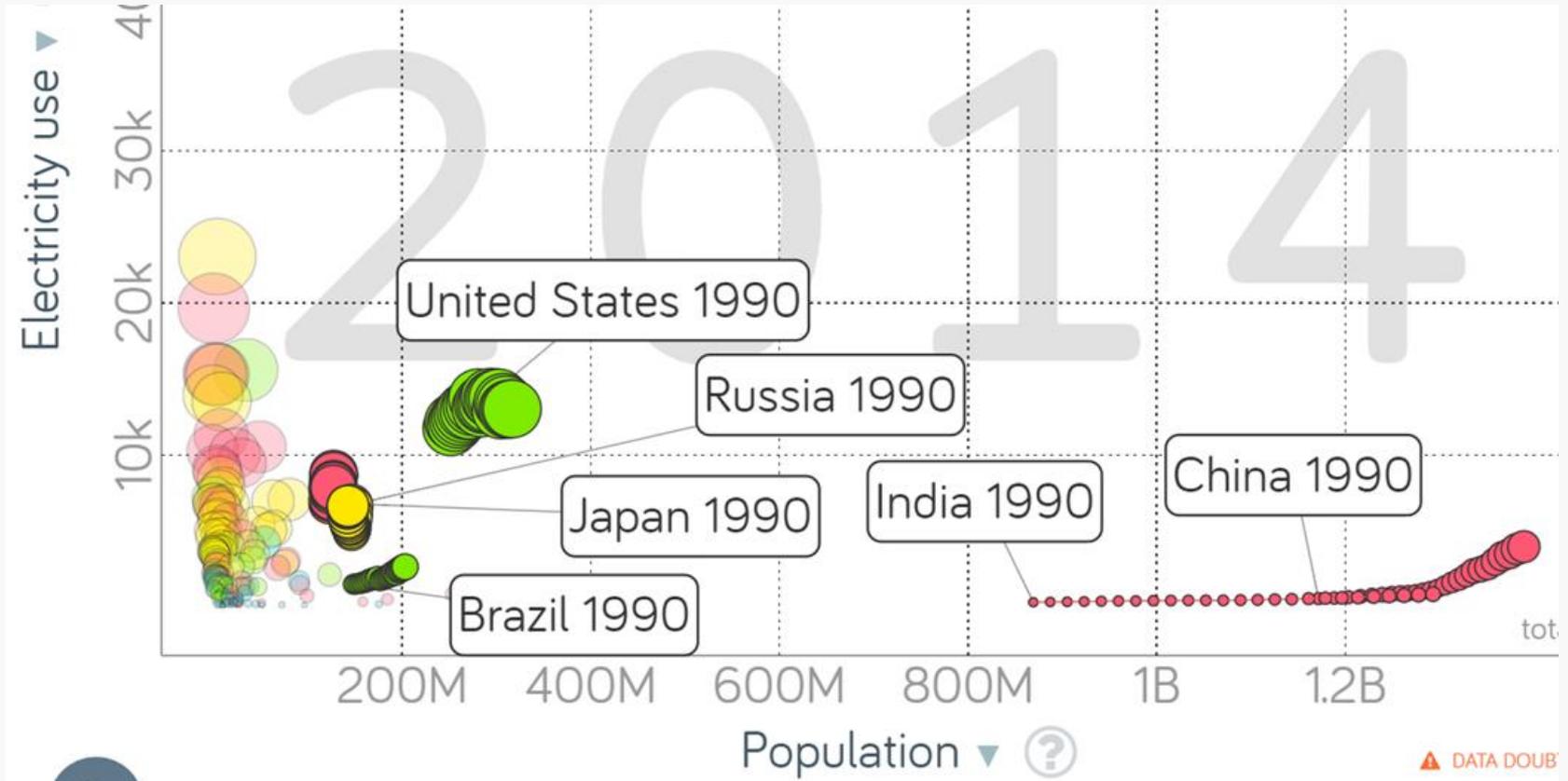
# Energy Scenario in India



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India has ~343 GW installed generation capacity with a population of 132 Crores, while China has 1,650 GW capacity and US has 1,065 GW capacity for ~32.5 Crores population



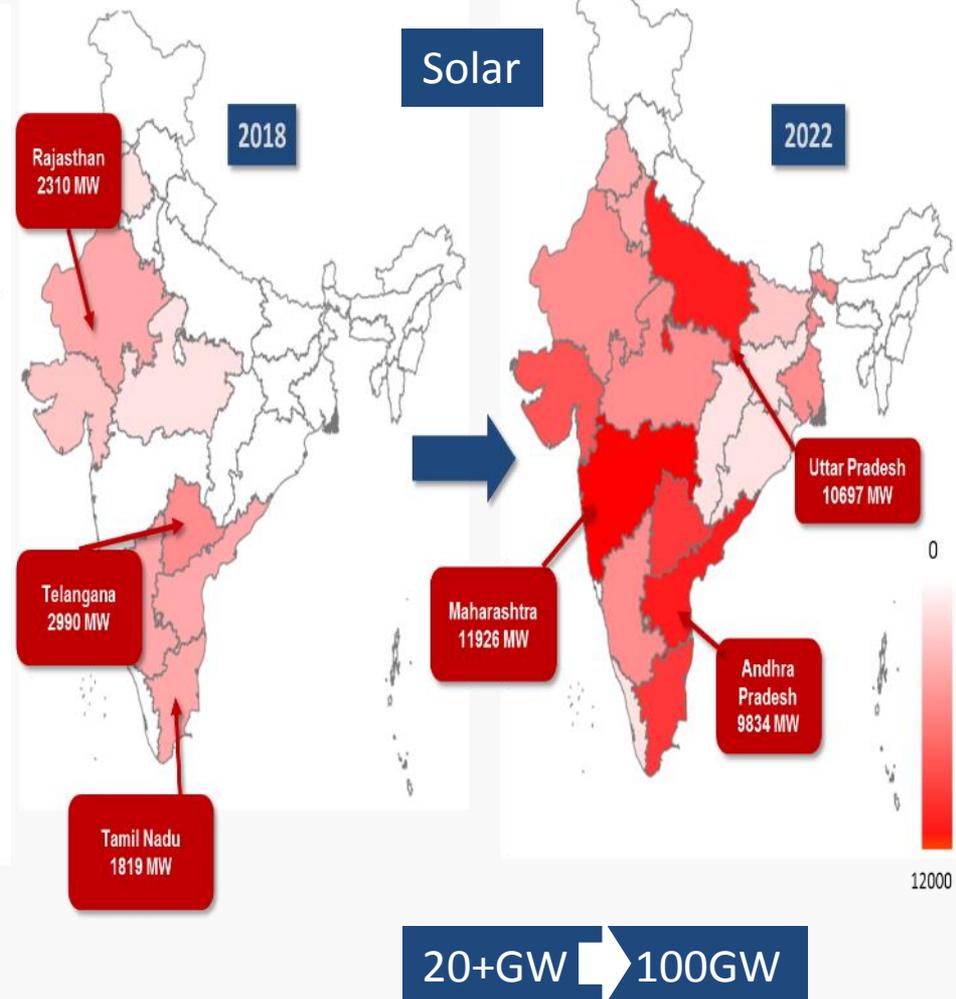
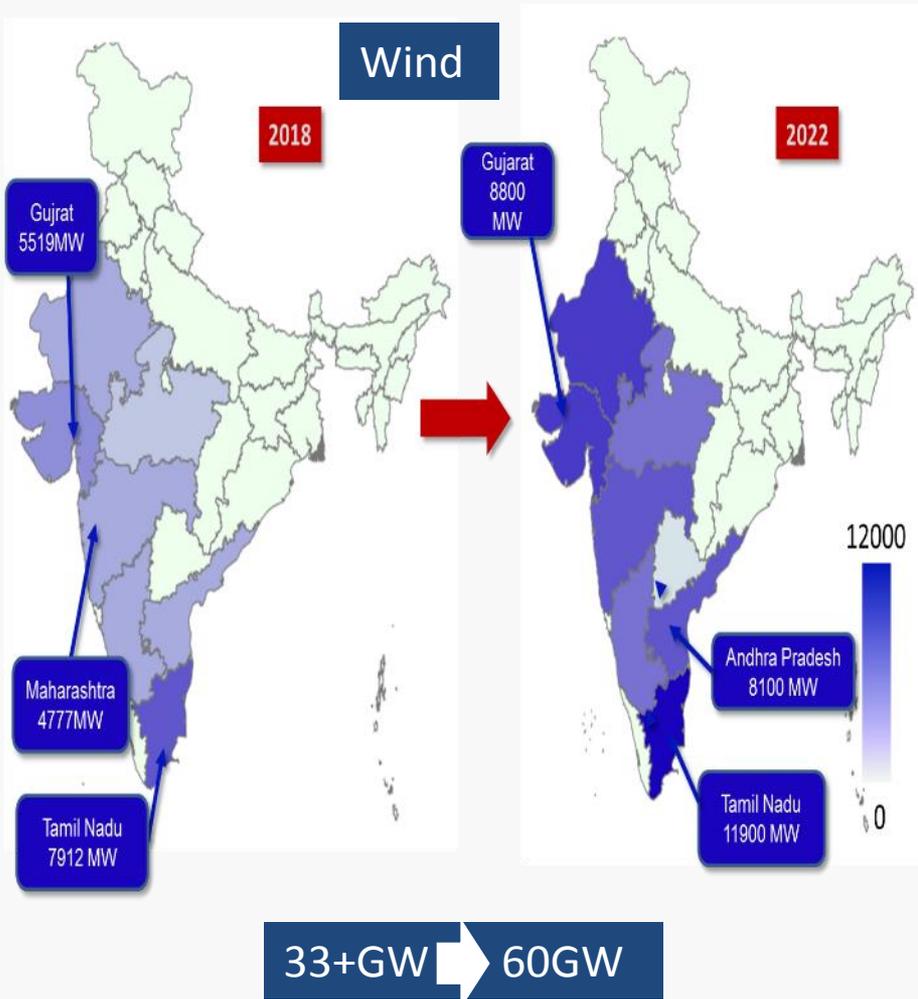
**Per Capita Annual Energy Consumption in 2014** (Source: Gapminder.org)

**US: 13,000 Japan: 7820, Russia: 6600, China: 3930, Brazil: 2600, India: 800 kWh/Yr**

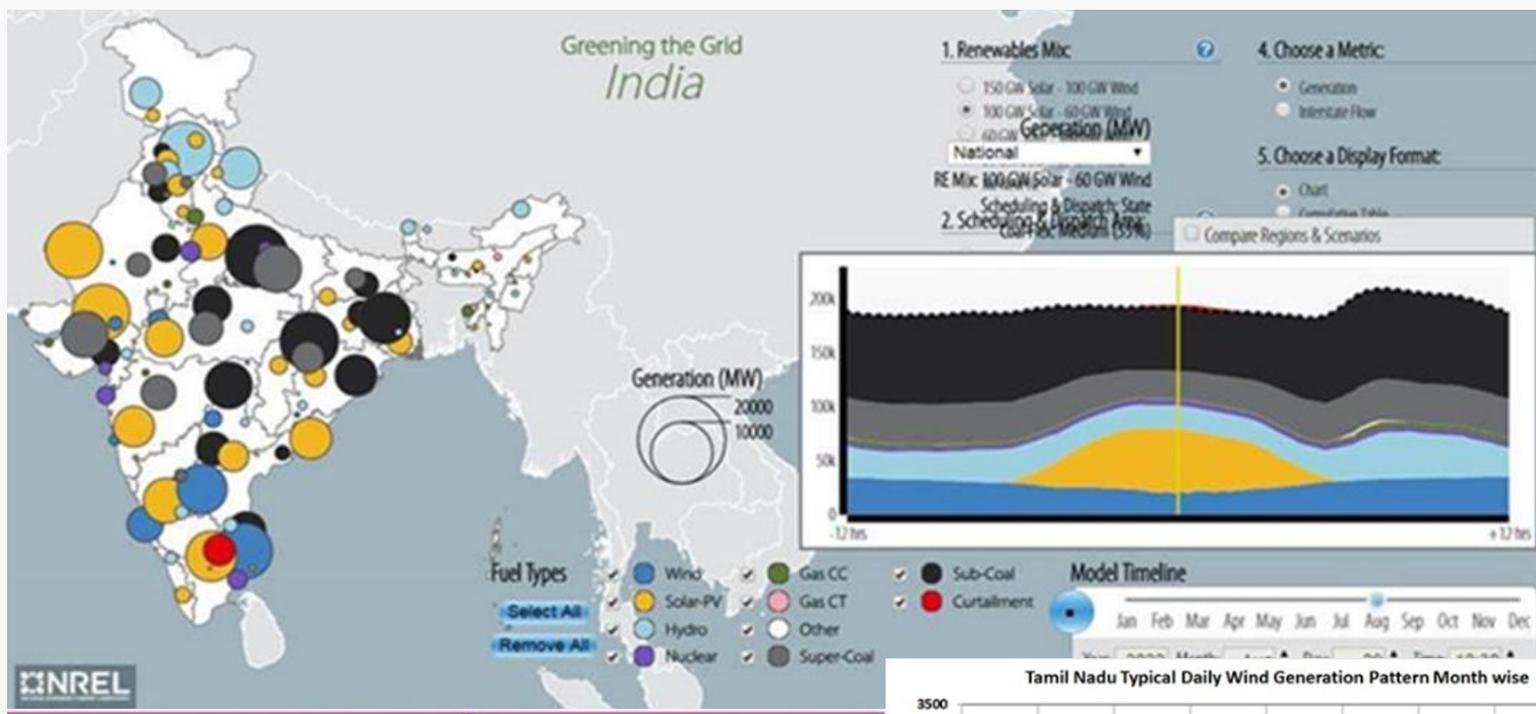
In 2017, India's per capita energy consumption was ~1200 kWh/yr and MOP expects India's per capita energy consumption to double in the next 6 to 7 years, and then double again after 5 years.



# India's RE installations and targets

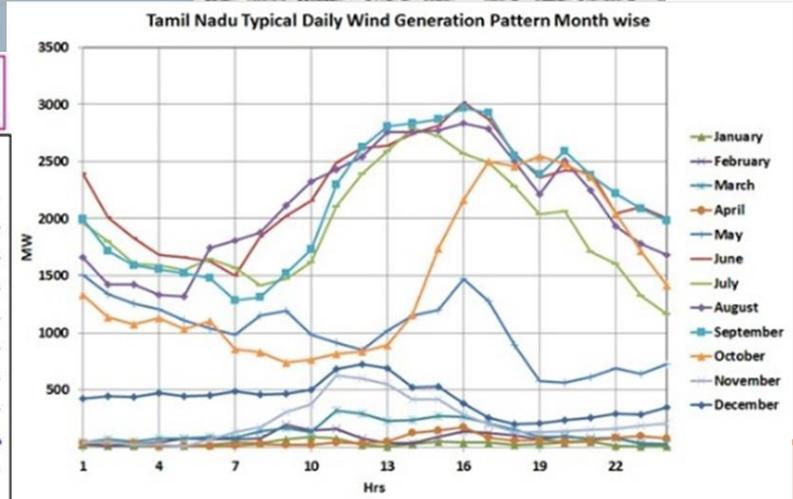
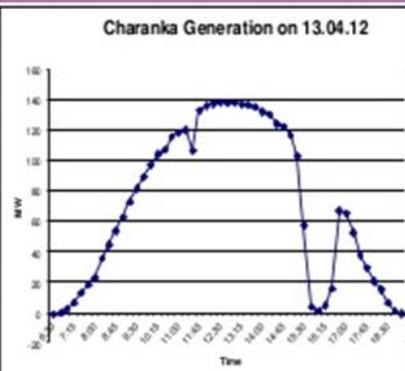
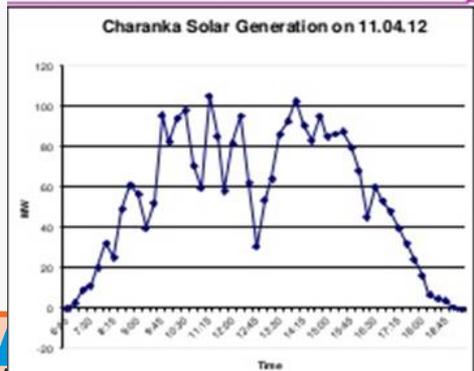


# Greening the Grid: Modelling vs Reality

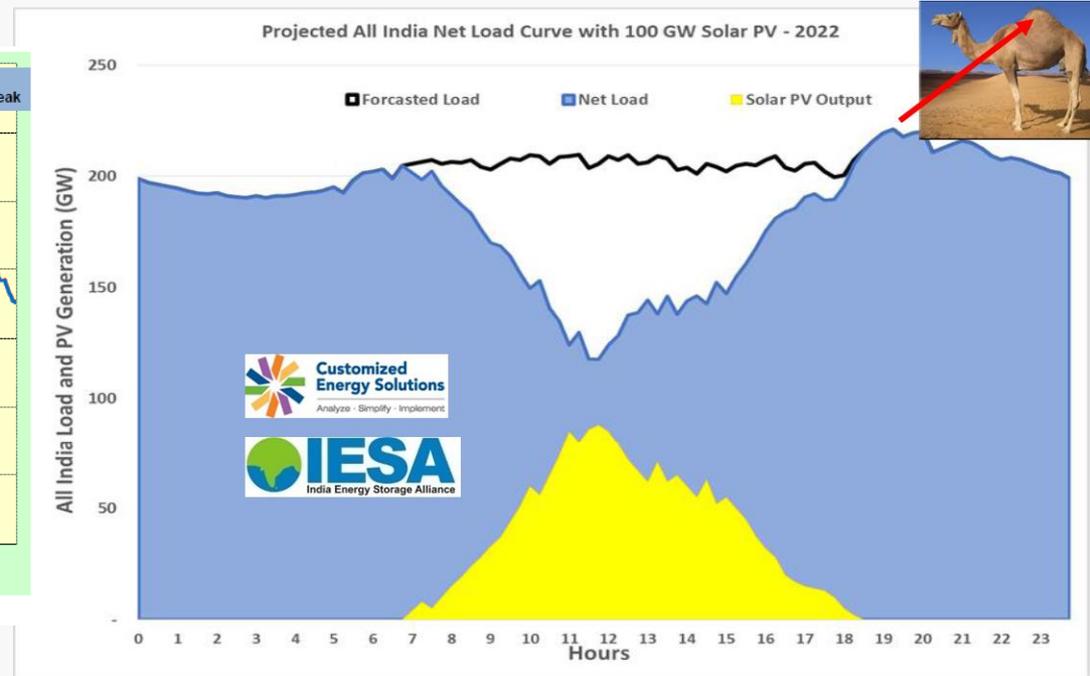
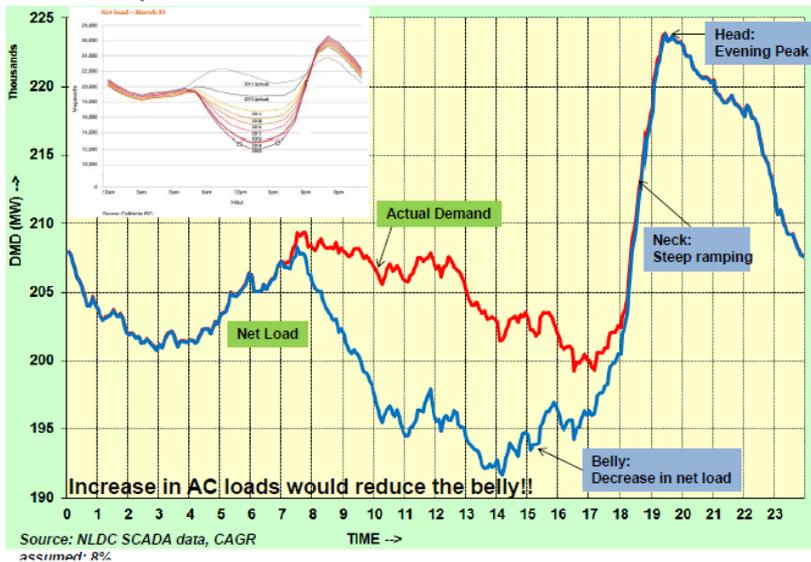


Varying Output:

Sudden Variation in Generation:



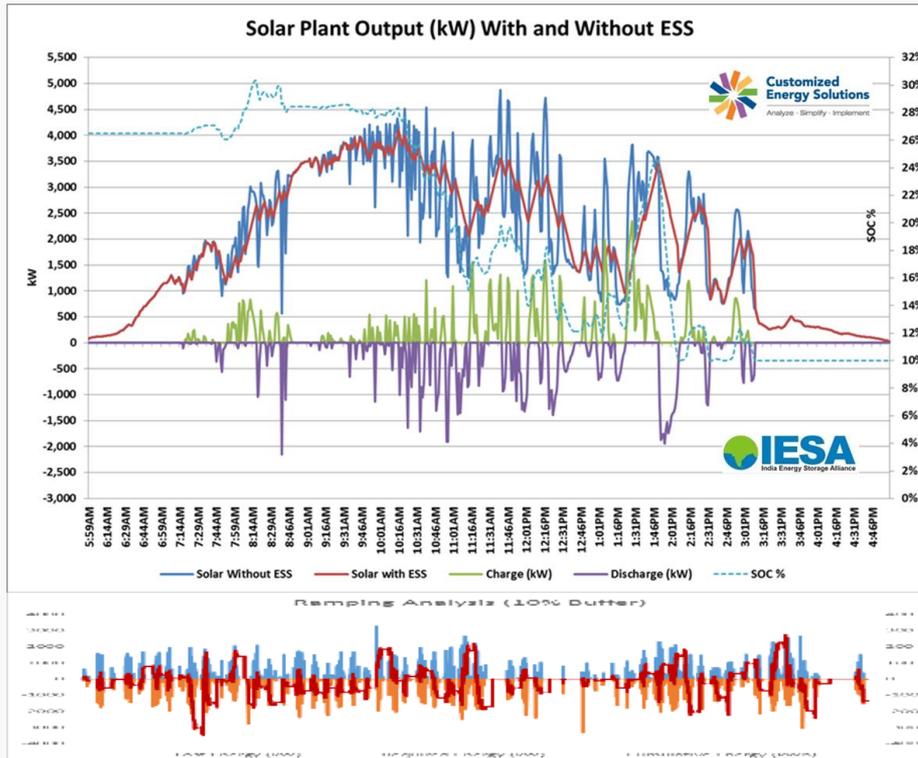
# Expected India Net Load Curve 2022 (with 100 GW of solar generation)



POSOOCO's projections for India net load curve with 20 GW solar PV

IESA projections for India net load curve with 100 GW solar PV

# Solar + Storage Case Study on Port Blair, Andaman & Nicobar Island



- Solar generation is inherently intermittent and supply may create very large instantaneous ramps.
- The problem will be accentuated in islands like Andaman and Nicobar, where currently diesel generators are used for providing base load as well as balancing service
- MNRE under Greening the Islands program is exploring deployment of 50+ MWh of energy storage with solar PV
- 1<sup>st</sup> project in this for 20 MW solar + 8 MWh storage is being implemented by NLC.
- There are 5-6 RFPs for additional projects with combined solar + storage capacity of 20 MWh being developed by NTPC and Indian Army

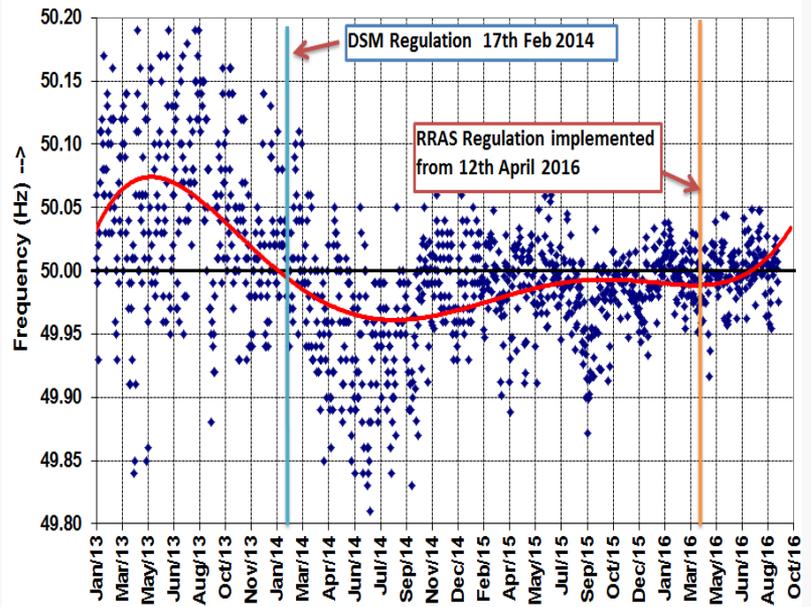
Island is dependent on diesel generators as primary source of electricity and balancing power, where solar variability is a major issue and opportunity for energy storage integration.



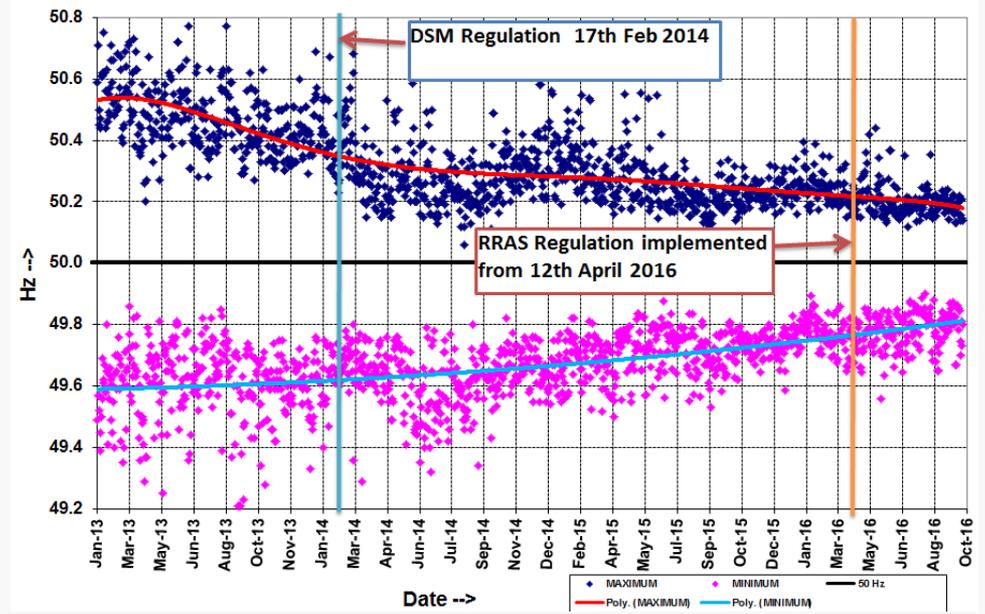
# Frequency profile of Indian Grid

Improving, but significant scope for improvement remains

Pattern of Average Frequency

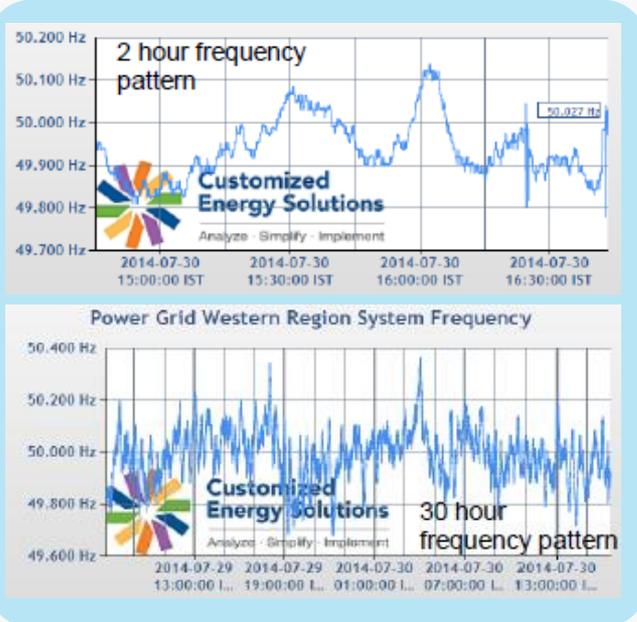


MAXIMUM AND MINIMUM FREQUENCY PATTERNS

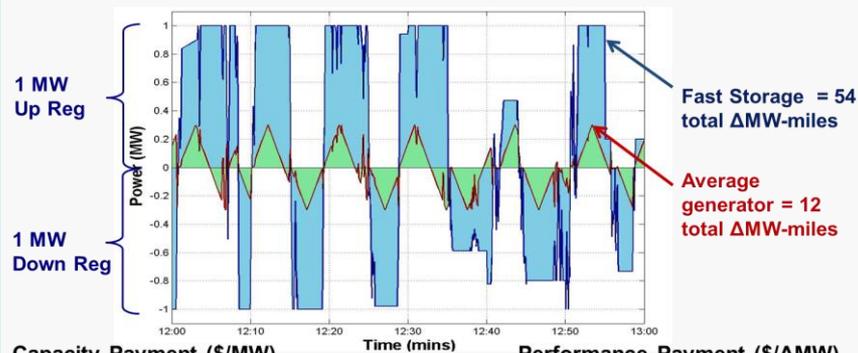


The frequency has remained within the operating band for over 75% of the time  
i.e. **over 20% of the time frequency is outside the band.**

# Grid Balancing Services: for improving grid power quality for the 21st century smarter grid



## FERC Order 755: Pay-for-Performance

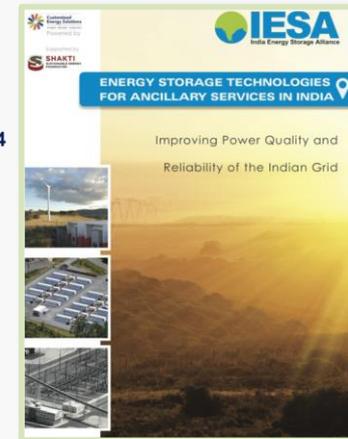


### Capacity Payment (\$/MW)

- Amount set-aside (MW)
- Includes Opportunity Cost
- *May be adjusted based on state-of-charge*

### Performance Payment (\$/ΔMW)

- Sum of up and down movement "mileage" (ΔMW)
- Adjusted by accuracy



- Consumers have no ability to resolve the grid frequency on their own. In a synchronized grid this has to be managed by grid operators.
- India can address a significant part of the frequency issues by allocation of flexible resources hydro, gas based generation and EES.

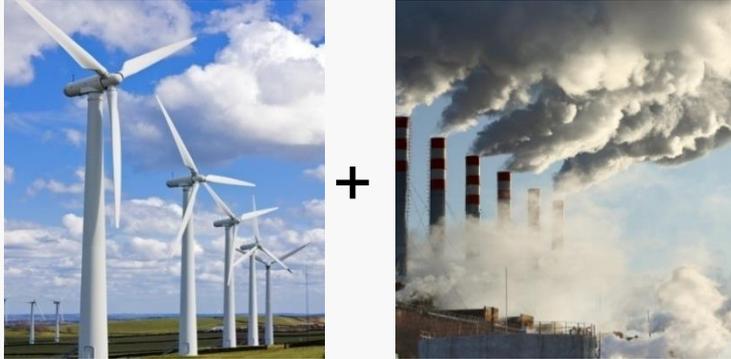
IESA is leading efforts for promotion of the ancillary services by actively engaging policy makers, central electricity authority and other key stakeholders. Last year IESA released a report outlining the roadmap for adoption of EES for grid frequency regulation.



# Ancillary Services

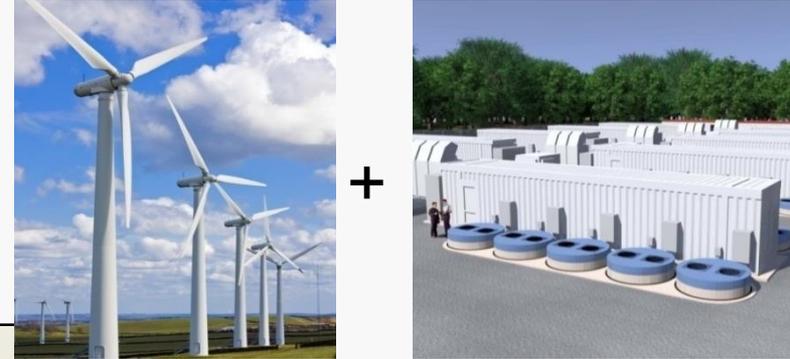
## Technology choice: Environmental Impact

### Conventional Grid



- Manage renewable variation by fossil generators varying output
  - Decreases efficiency
  - Increases fuel consumption
  - Requires more maintenance
  - Increases emissions

### Smarter Solution: Storage



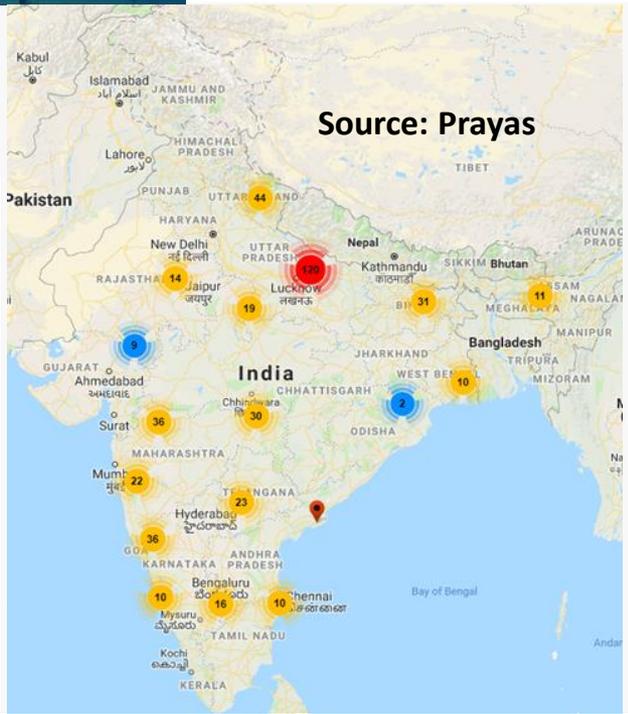
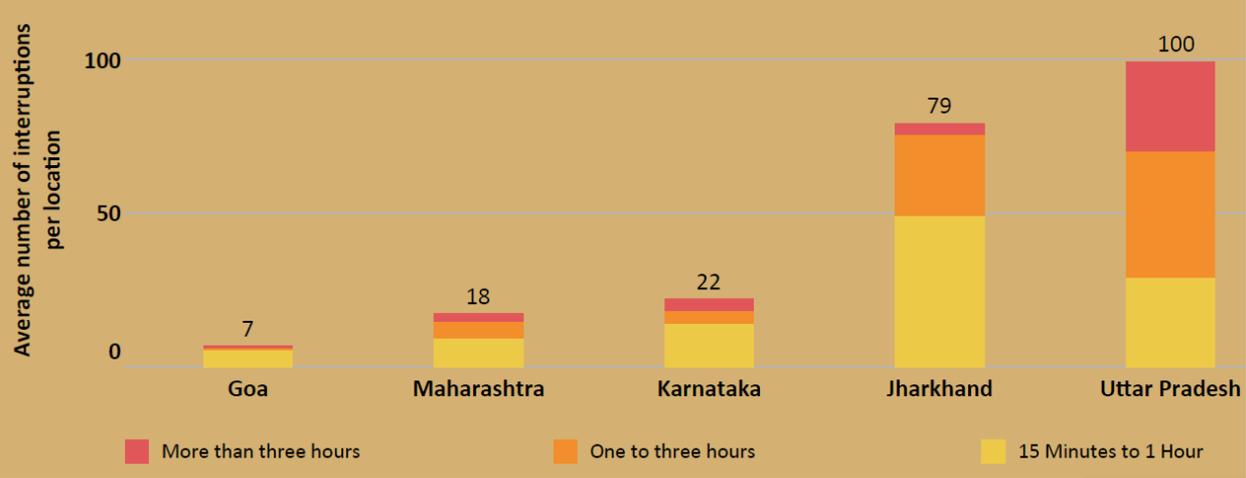
- Store energy when supply exceeds load; inject energy when load exceeds supply
  - High round trip efficiency
  - Low operating cost
  - Near instantaneous response
  - Zero direct emissions
  - Frees up generation capacity

**20% of the CO2 emission reduction and up 100% of the NOX emission reduction expected from wind and solar power may be lost because of ramping fossil plants**

\* Katzenstein, W., and Jay Apt. Air Emissions Due To Wind And Solar Power. *Environmental Science & Technology*. 2009, 253-258.

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

### Supply Quality in Rural Areas - December 2017



### ESMI Locations Receiving Entire Six Hours of evening supply



### In May 2017



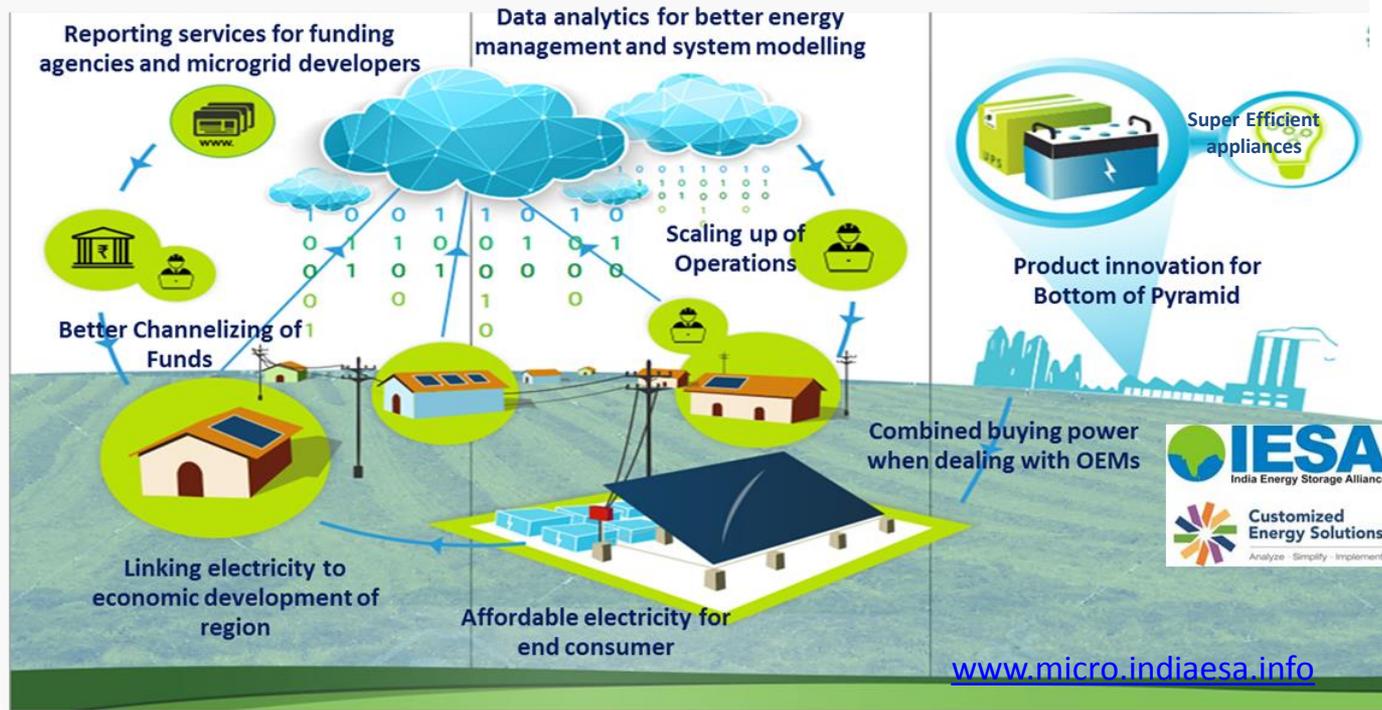
### In December 2017



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



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

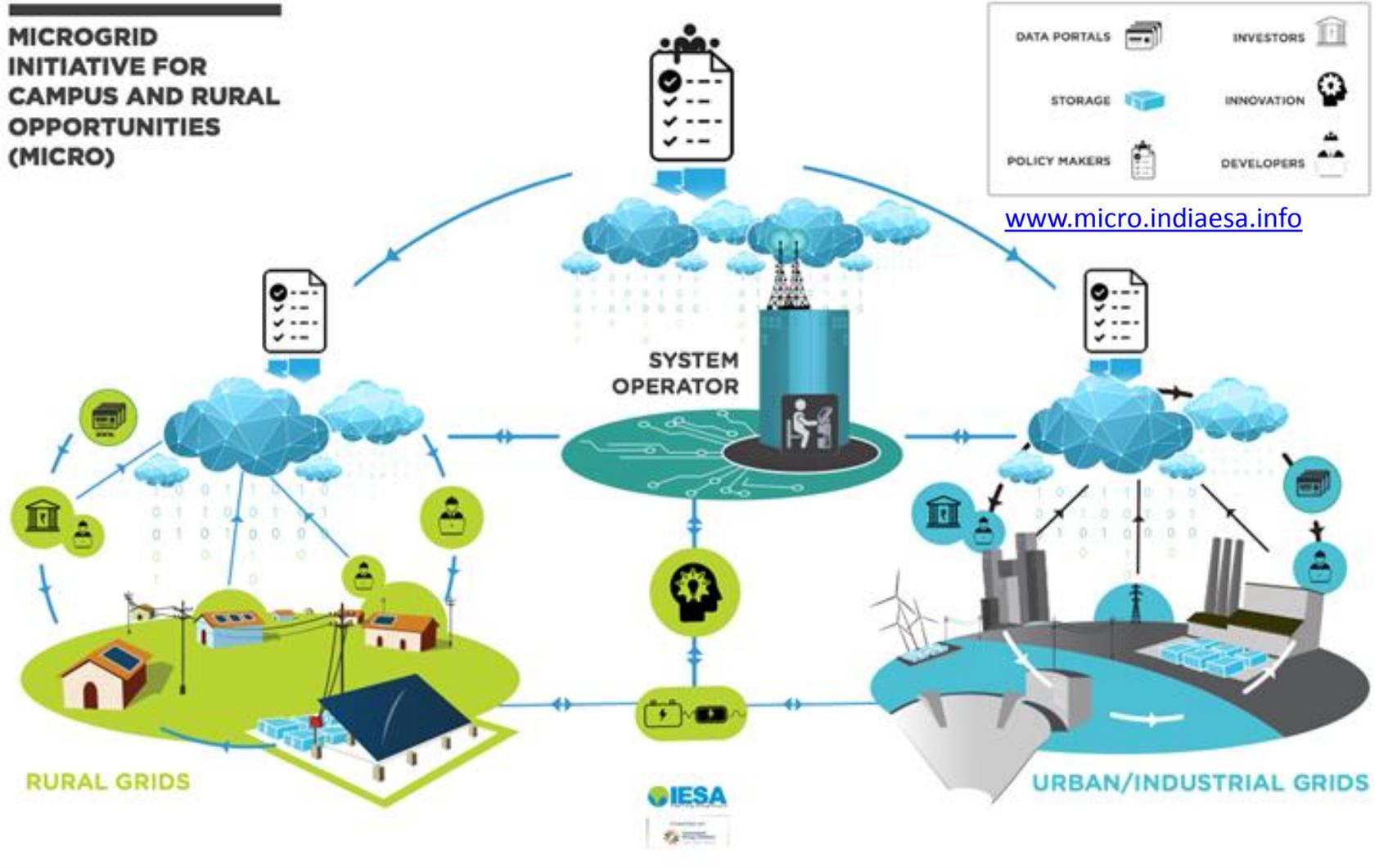


# Microgrid Initiative for

# Campus & Rural Opportunities (MICRO)



## MICROGRID INITIATIVE FOR CAMPUS AND RURAL OPPORTUNITIES (MICRO)

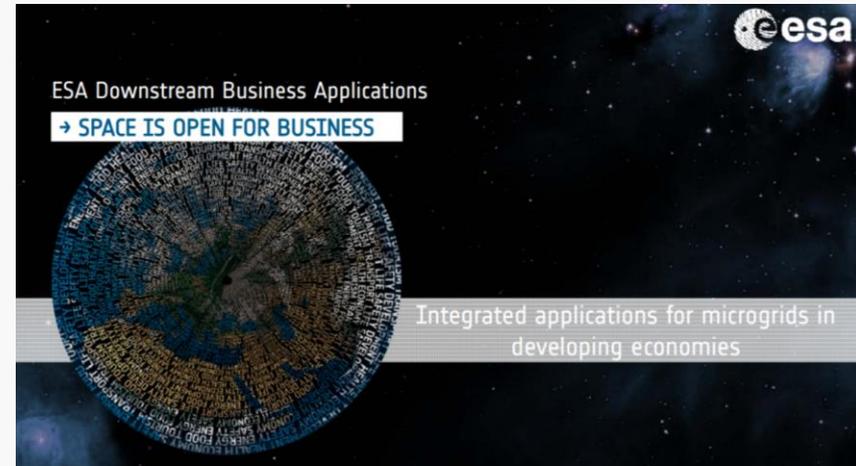


# IESA is working with European Space Agency

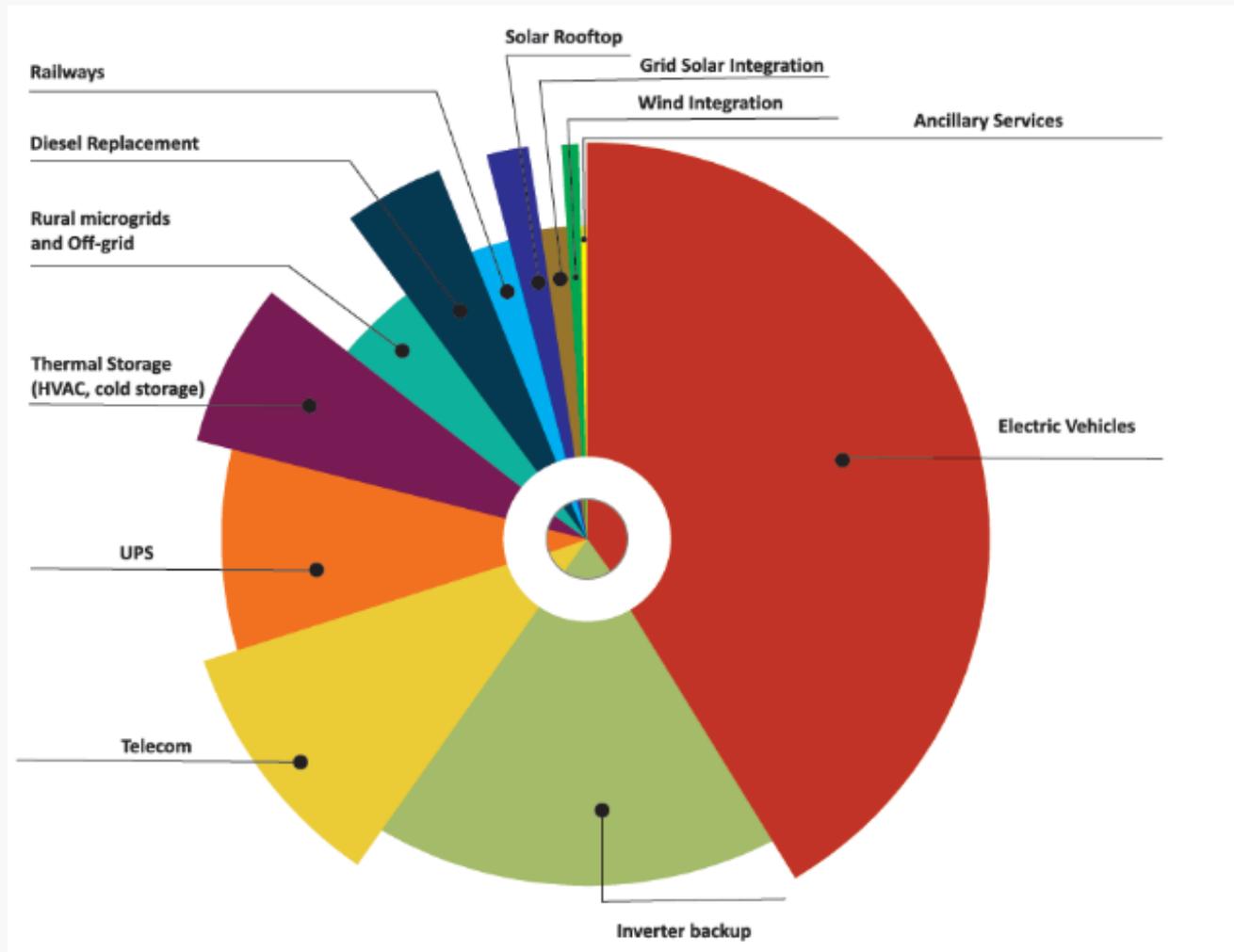


## for feasibility of use of satellite around energy access

- Identification of clusters / habitats with potential need for microgrids using satellite data.
- Providing resource assessment to help in optimal sizing of microgrids
- Facilitate socio-economic growth of the local communities through
  - Telemedicine
  - Tele-education
  - Ensuring communication between different local communities
  - Creating better economic development opportunities through access to better data and tools
- Support the assessment of the socio economic impact of microgrid projects
- Support disaster recovery and damage assessment

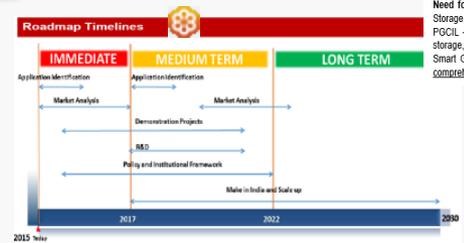
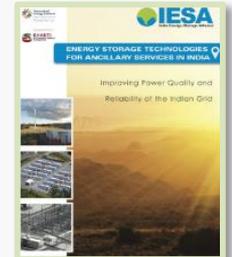
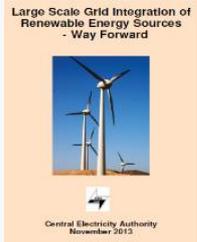


# India Energy Storage Potential (2018-25)



As per the latest Energy Storage India market overview report by IESA, the energy storage potential between now and 2025 will be around 300GWh.

# The evolving policy framework for adoption of energy storage in India



## IESA recommendations for encouraging advanced Energy Storage Technology manufacturing in India

**Context:** With comprehensive power sector reforms, electrification of villages, generation and transmission capacity addition, reduction in energy deficit, opening up of ancillary services market and installation of large scale renewable power generation, the Energy sector in India is in its inflexion point for transformational growth. With ambitious targets of installing 100 GW of solar and 60 GW of wind by 2022, and becoming 100% electric vehicle nation by 2030, Energy Storage technologies has strategic importance for India's energy security and clean energy future.

**Market Size:** The total energy storage market between 2015 and 2022, in India is estimated by India Energy Storage Alliance (IESA) is close to 70 GW and 200 GWh. Out of 70 GW, over 35 GW of demand is expected from newer applications like wind and solar integration, frequency regulation, peak management, T&D deferral, diesel replacement and electric vehicles.

**Applications:** Energy Storage applications include Electric Vehicles, e-rickshaws, Backup Power, Telecom Towers, Renewable Integration, Frequency regulations, Ancillary Services, RE shifting or RE Firming, Forecasting & Scheduling, RE Smoothing, Ramp Rate Control, Optimizing Transmission Utilization, Captive RE Optimization & Demand Charge management, Distributed RE & Micro grids, Micro grids & Off grids, Peak Management, T & D Deferral, Agricultural applications etc.,

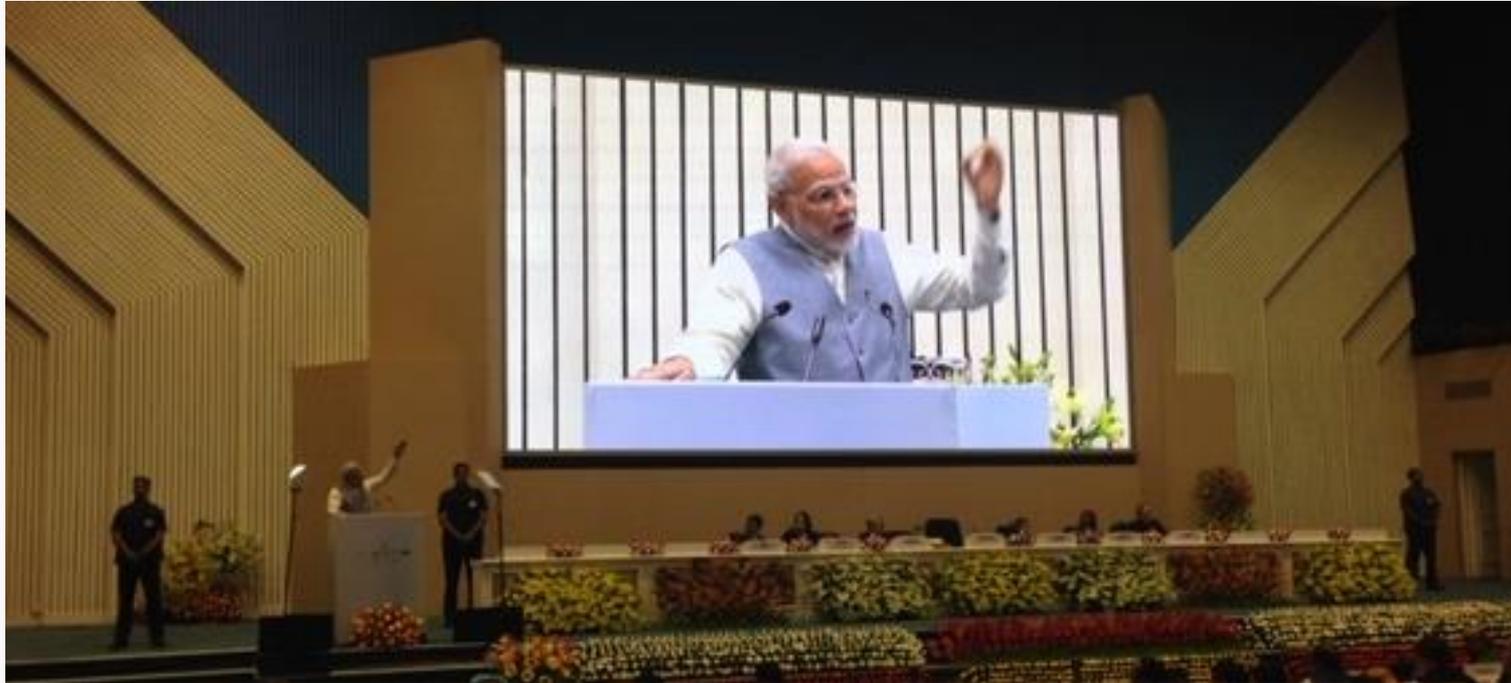
**Need for Comprehensive Policy:** With various ministries / PSUs piloting and announcing Energy Storage demonstration projects and roadmaps such as MNRE Energy Storage Demonstration EOI, POCIL - Pilot Project in Puducherry (3 projects of 250 kWh - 500 kWh), Gujarat GIFT RFP 40 MW storage, NTPC 20 MW solar - storage project in Andaman, SECI's 1MWh Project in HP and National Smart Grid Mission, MNRE Energy Storage Mission Plan etc., the need for a holistic review and comprehensive policy on Energy storage is imminent.

- CEA report on large scale RE integration Nov, 2013
- Taskforce for RE integration by CEA and MOP created with participation of IESA 2013-14
- IESA hosts IRENA workshop for Electricity Storage: Technologies, supporting RE Dec 2014
- IESA releases report on the role of energy storage for providing ancillary services in India Dec 2014
- MNRE & USAID release Roadmap for Launch of a National Energy Storage Mission May 2015
- CERC issues Roadmap to operationalise Reserves in the country Oct 2015
- IESA submits recommendations to NITI Aayog for encouraging advanced EST manufacturing in India May 2016
- POSOCO's half year implementation report of Reserve Regulation Ancillary Services Apr-Nov 2016
- Worked with DIPP, NITI Aayog and IEEMA on Make in India Opportunity for Energy Storage

# Energy storage need of the hour: Hon. Prime Minister Modi



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Inaugurating the first assembly of International Solar Alliance, Prime Minister Narendra Modi said **“Under the National Energy Storage Mission, the government is focusing on demand creation, indigenous manufacturing, innovation and energy storage,”**



# National Energy Storage Mission

## NESM



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MNRE Expert committee was formed in February 2018 to draft National Energy Storage Mission

3. The composition of the Committee is as under:-

Secretary, MNRE	Chairman
Additional Secretary, MNRE	Member
Member, ( Planning), Central Electricity Authority	Member
Joint Secretary (Smart Grid), Ministry of Power	Member
Adviser (Energy) , NITI Aayog	Member
Representative from Department of Heavy Industry	Member
Representative from Ministry of Environment, Forests and Climate Change	Member
Representative of Council of Scientific and Industrial Research	Member
Representative from ISRO	Member
Representative from CERC	Member
Representative from CII and FICCI	Member
Representatives from the C-WET/ NISE	Member
President – India Smart Grid Forum	Member
Representative from Indian Wind /Solar Association	Member
Executive Director, Indian Energy Storage Alliance	Member
Adviser (Energy Storage), MNRE	Member-Secretary

### Key focus areas

- Energy storage for large scale RE at transmission level
- On-site energy storage integration at distribution level
- Rural micro-grids
- Storage component in EV plans

NESM is currently under review by various ministries. MNRE is anticipating comments by end of this month, and expect to submit it for approval to PMO by end of the year.



# NESM Objectives



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- To strive towards leadership in the energy storage sector by creating an enabling policy and regulatory framework that encourages deployment, innovation and further cost reduction through multiple strategies.
- To clearly signal the Government Of India's strong and long-term commitment to the importance and need for energy storage in India;
- To facilitate market led technology deployment at scale across multiple applications and multiple geographies, while gaining valuable technology, policy and regulatory experience;
- To facilitate setting up of large scale integrated electric storage and electric vehicle manufacturing clusters that can also cover manufacturing of components and associated power electronics.
- To provide for job creation in manufacturing, project deployment value chain and associated skill development/training; and
- To set up a national portal of storage projects including regular monitoring of performance, costs, manufacturing etc., aspects that are crucial for knowledge sharing and dissemination.



# NESM - First phase (2018-2022)



- The proposed first phase will focus on applications, wherein energy storage can immediately play a cost effective role, like in the case of integrating storage with
  - diesel generators to minimize diesel consumption
  - providing ancillary services to the grid
  - demand creation in various sectors / applications through mechanism for providing appropriate incentives for various large scale / aggregated storage projects.
- It is also vital to build confidence among stakeholders by deploying market based projects at scale and gain valuable technology, regulatory and policy experience in the coming 2-3 years in preparation for a potential large-scale proliferation of storage systems as they become even more cost-competitive.



# India Energy Storage Alliance



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- IESA was launched in 2012 by CES to help technology and system integration companies involved in energy storage and microgrids to understand and capture opportunities in thro growing market
- In 2013 launched IESA-Knowledge Partner Network with a goal of addressing energy storage applications in over 10 key sectors
- In 2016 created IESA leadership Council to help companies to play strategic leadership in developing IESA roadmap
- For more details, visit [www.indiaesa.info](http://www.indiaesa.info)

## IESA Members



# IESA Initiatives

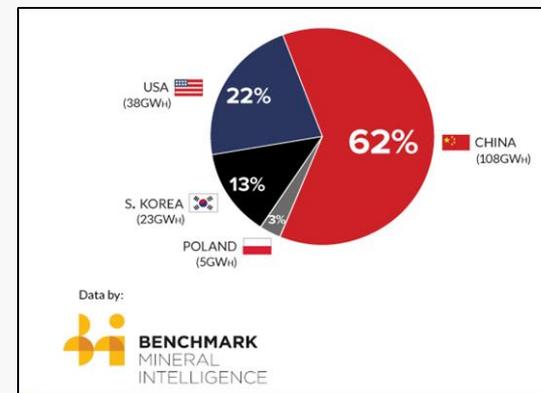
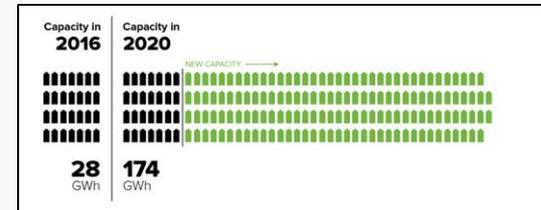
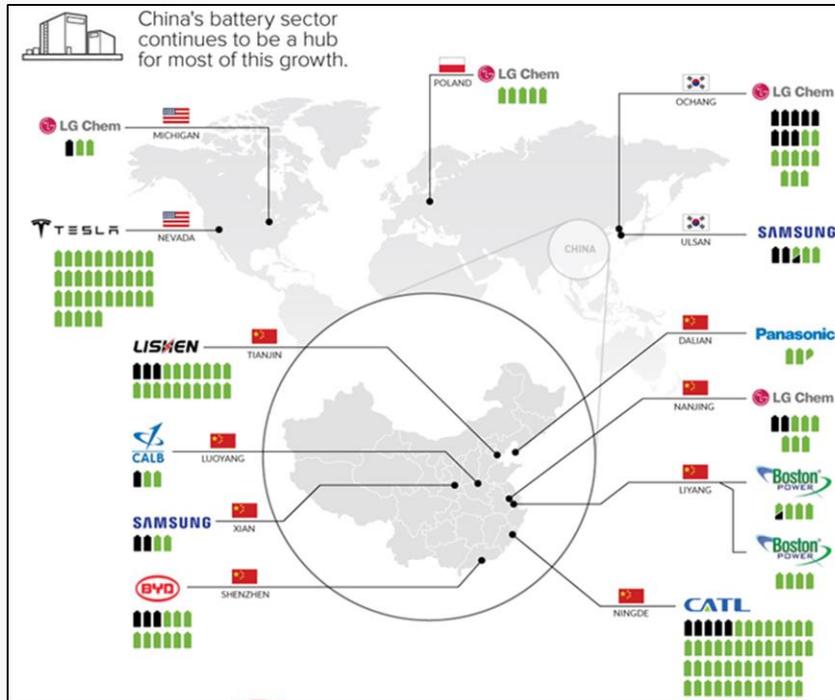


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- Inputs for NITI Ayog for energy storage manufacturing policy:
- Inputs to CERC, CEA, MNRE and MOP for energy storage policy
- Energy Storage Standards Roadmap:
- MICRO - Microgrid Initiative for Campus and Rural Opportunities:
- MOVE - Electric Vehicles initiative & annual EV conference with ICAT
- Utility working group:
- CES-Global Energy Storage Index: <http://gesi.indiaesa.info/>
- India Energy Storage Database: <http://iesdb.indiaesa.info/>
- IESA Energy Storage Hotline (1-800-123-3519):
- IESA Skill development initiative
- Energy Storage and Microgrid focused incubator at VJTI, Mumbai



# IESA has set a vision to make India a global hub for R&D and Manufacturing of energy storage and EV



According to CES research estimates, by 2020 there will be at least 3 companies globally with 50 GWh + annual production capacity and another 5-10 companies with 10+ GWh annual production capacity for Li-Ion batteries. India is targeting 5-10 GWh of manufacturing by 2020 and 50 GWH by 2025.

# Join us for Energy Storage India 2018-19



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**ENERGY STORAGE INDIA**

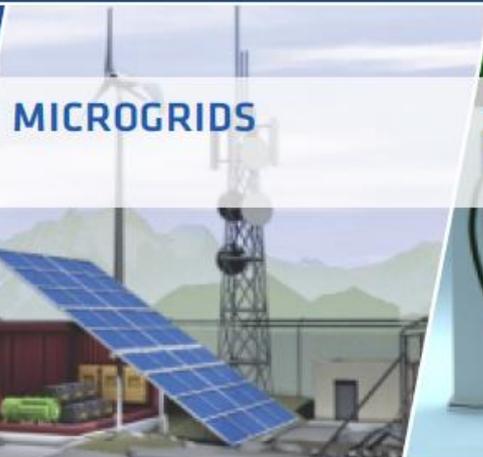
6th INTERNATIONAL CONFERENCE & EXHIBITION ON ENERGY STORAGE, EV & MICROGRIDS IN INDIA

[www.esiexpo.in](http://www.esiexpo.in)

**PRE-CONFERENCE WORKSHOP**  
**January 09, 2019**

**EXPO & CONFERENCE**  
**January 10 - 11, 2019**

**The Ashok, New Delhi, India**



*For more information, please contact:*

**Ms. Amruta Dhumal**  
Project Manager  
Messe Düsseldorf India Pvt. Ltd.  
Mob.: +91 99599446348  
Email [DhumalA@md-india.com](mailto:DhumalA@md-india.com)

**Mr. Debi Prasad Dash**  
Director - Membership & Operations,  
India Energy Storage Alliance (IESA)  
Mob.: +91-9699719818  
Email: [contact@indiaesa.info](mailto:contact@indiaesa.info)

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# Stay informed about India opportunities



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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 RFPs / Tenders in members only section

**IESA - KPN Information Bulletin**  
July 2016

Dear Debi Prasad Dash,  
Welcome to the IESA Members Community!

The year 2016 is the year for energy storage implementations in India. The much-awaited Energy Storage project by SECI has been released. Through this bid, SECI invites proposals for 30 MW of energy storage systems with solar for 6 projects in India. PGCIL, CEL, NLC, SECI (for Himachal Pradesh) have already invited tenders for energy storage systems in the earlier part of 2016. IESA anticipates 50-100 MW of projects to be announced in 2016 for advanced energy storage technologies in India. We expect you to apply for this project. A number of private players are planning energy storage projects in the calendar year of 2016. If you have any upcoming projects or plans, kindly share with IESA. The alliance will make sure the projects get high visibility through to network.

**Spotlight**  
IESA MEMBERS BENEFITS  
Avail 50% discounts, only for IESA Members  
Login Details (EmailID Password) for IESA-KPN membership is already sent to the email of contact person. For queries, feel free to mail us at [contact@indiaesa.info](mailto:contact@indiaesa.info)

**FUNDING OPPORTUNITY**  
ANNOUNCEMENT BY DST, Govt of India and DoE, US under JUSST for Smart Grid and Grid Storage Technology  
Department of Science & Technology (DST), Govt. of India and US Department of Energy are funding partners for IESA's collaboration in the priority area of Smart Grid and Grid Storage Technology.

Energy Storage India 2017 - Call for Abstracts  
4<sup>th</sup> INTERNATIONAL CONFERENCE & EXHIBITION ON ENERGY STORAGE & MICROGRIDS IN INDIA  
January 12 - 13, 2017  
Nehru Centre, Mumbai  
CALL FOR ABSTRACTS OPEN!

**IESA Newsletter**  
India Energy Storage News

Dear Reader,  
Greetings from India Energy Storage Alliance (IESA)

Join IESA: Be a part of India's Energy Storage Ecosystem

[Download IESA Leader Circle Membership Form](#)  
[Download IESA KPN Membership Form](#)

To join IESA email us at [contact@indiaesa.info](mailto:contact@indiaesa.info)

India's SECI adding Energy Storage to 300MW of solar tenders in Andhra Pradesh and Karnataka

Solar Energy Corporation of India (SECI) will soon tender for utility-scale solar-plus-storage projects in the states of Andhra Pradesh and Karnataka.

India's first ever large-scale solar-plus-storage tender plans for Andhra Pradesh were revealed back in February, marking a major step into new territory for the country's utility-scale solar sector, but details were lacking until now.

Consultancy firm BridgE to India revealed that the procurements will now be for 100MW in Andhra Pradesh and 200MW in Karnataka, with each 50MW project connected to 50MW/2.5MWh of storage capacity.

In May, Canada-based renewables firm SkyPower said it will join China-based battery developer BYD in

**IESA Tender Alert (Exclusive for Members)**

**NLC India Ltd. : Deadline to apply for Expression of Interest (EOI) for Battery Storage and Solar PV 20 MW Power Project at Andaman & Nicobar**

NLC India Ltd. (Formerly NEVELI LIGNITE CORPORATION LTD) issued a notice inviting Expression of Interest (EOI) for Qualifying Requirements (QR) for 20 MW PV Solar Power Project at Andaman & Nicobar Islands, India.

The deadline for the same is: **14:30 on 3rd October 2016.**  
Please send in your bids prior to this date.

The complete EOI document can be found [here](#)

Customized Energy Solutions (CES) have 10+ years of experience in the global energy storage sector and also helped many global clients in bidding and providing solutions for energy storage industry. In India Energy Storage Market, Customized Energy Solutions also helped its clients in bidding and tender application process for **PGCIL RFP, MNRE EDI and SECI.**

Customized Team will be happy to assist solar and energy storage companies to apply for this project. Feel free to reach us at [contact@indiaesa.info](mailto:contact@indiaesa.info)

**IESA India Policy Update**

Dear Debi Prasad Dash,  
Greeting from India Energy Storage Alliance (IESA)!

Renewable Energy technologies are widely established as the prime solution to energy problems in India and around the world. With a strong push from the state and central government, 2016 proves to favor immense development in the Indian Renewable Energy sector. Mentioned below are policy and regulatory updates from the Indian Electricity market.

**Draft National Lab Policy for Renewable Energy Sector for Testing, Standardization and Certification has been issued under MNRE.**

**Draft National Lab Policy for Renewable Energy Sector : MNRE**  
**Microgrid Renewable Energy Generation and Supply (MPERC) Regulations, 2016**  
**JERC Issued Final Net Metering Policy for Rooftop and Microgen**  
**Andhra Pradesh Electricity regulation commission issued draft Regulations for Renewable Power Purchase Obligation**

IESA-KPN Information Bulletin

IESA - Newsletter

IESA - Project/Tender Alert

IESA - Policy Update

**Emerging Technology News**  
Issue 2 Volume 2 Apr-Jun 2015

**Emerging Technology News**  
Volume 3 Issue 1 Jan-Mar 2016

4<sup>th</sup> INTERNATIONAL CONFERENCE & EXHIBITION ON ENERGY STORAGE & MICROGRIDS IN INDIA  
EXPO AND CONFERENCE  
11 - 13 January, 2017  
Mumbai, India

## IESA - Resource Section

## IESA - Industry News

▼ 2016

▼ October

- Hero MotoCorp To Invest Up To ₹ 205 Crore In Ather Energy
- Mahindra launches new electric car 'e2oPlus'
- NTPC plans 50MW solar with battery storage on Indian islands
- Changing mobility: Ashok Leyland and DHL bet on electric vehicles

Opportunity Name	Company/Organization	Logo	Sector	Technology	Last Date to apply	Contact Value (INR)	View Details
SECI 100 MW Solar Power Reserve for Energy Storage (MCC 2016)	Solar Energy Corporation of India		Government	Lead Acid Battery	2016-09-21	Rs. 30,00,00,00,000	<a href="#">View Details</a>
Purchase of 10 MW UPS with Battery Bank	LEI POWER SYSTEMS (PVT) LTD		Government	Lead Acid Battery	2016-06-28	Rs. 15,11,71,00,000	<a href="#">View Details</a>
Procurement of 40 MW and uncharged lead acid battery	Department of Fisheries (Andhra Pradesh) Fisheries Limited		Government	Lead Acid Battery	2016-06-20	Rs. 1,00,00,00,000	<a href="#">View Details</a>
Supply of Station 12 Volt 100AH Wind Battery in Ministry of Health	Ministry of Health (Andhra Pradesh) Government of India		Central Government	Lead Acid Battery	2016-06-20	Rs. 1,00,00,00,000	<a href="#">View Details</a>
Supply and installation of Inverter and Battery	Municipal Corporation Bhubaneswar		State Government	Lead Acid Battery	2016-06-13	Rs. 1,80,00,00,000	<a href="#">View Details</a>
SECI Tender for 1 MWh Energy Storage System	SECI		Solar Wind Hybrid	Solid State Battery	2016-06-10	Rs. 1,00,00,00,000	<a href="#">View Details</a>
12 VOLT 180 AH LEAD-ACID BATTERIES	Paradip Port Trust		Government	Lead Acid Battery	2016-05-10	Rs. 28,20,00,000	<a href="#">View Details</a>
Supply Installation Testing And Commissioning Of Battery Storage Unit	Sahyadri Rail Corporation Limited		Government	Lead Acid Battery	2016-04-25	Rs. 28,20,00,000	<a href="#">View Details</a>
ESTIMATION OF COST PROJECT ON MANJESLA ARAKANA FLOW TYPE BATTERY ENERGY STORAGE SYSTEM	PGCIL		Government	Na/NaCl /Inhaler/ New Battery	2016-03-21	Rs. 1,00,00,00,000	<a href="#">View Details</a>
BSF Academy	BSF Academy		Defence	Lead Acid	2016-02-04	Rs. 127,00,00,000	<a href="#">View Details</a>

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rahul@ces-ltd.com

**Customized Energy Solutions India Pvt. Ltd.**  
A 501, GO Square, Aundh - Hinjewadi Link Rd, Wakad,  
Pune, 411057 India  
[www.ces-ltd.in](http://www.ces-ltd.in)

