WEBINAR

CLEANHORIZON
The Energy Storage Experts

Energy Storage NEWS

DATE: | 22nd June 2022

Learn about India's current and future business models for energy storage

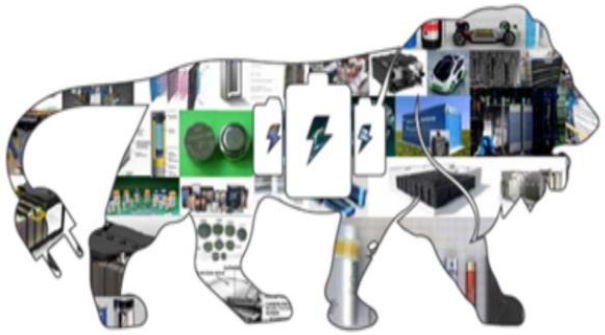
Dr. Bharath Reddy
Additional general manager
Solar Energy Corporation of India

Dr. Rahul Walawalkar
Founder and President
India Energy Storage Alliance

Rachel Locquet
Energy storage and Hydrogen Analyst
Clean Horizon

Moderated by
Andy Colthorpe
Editor
Energy-Storage.news

Role of Advanced Energy Storage for Low Carbon Transition for India



Presented by

Dr. Rahul Walawalkar
President, India Energy Storage Alliance
President & MD, Customized Energy Solutions (India)

CUSTOMIZED ENERGY SOLUTIONS

PROVIDING ENERGY MANAGEMENT SOLUTIONS SINCE 1998

Our consulting services enables competitive suppliers, technology providers, marketers, utilities and customers to prosper through change, by turning knowledge into value

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1998

ESTABLISHMENT

500+

CLIENTS WORLDWIDE

15,000+ MW

ASSET MANAGEMENT

1500+ MWh

STORAGE ASSET MANAGEMENT

Inc. 5000

11 TIMES HONOREE

Over 200+ Associates across United States, Canada, India, Japan & Mexico.

Making India a Global Hub for R&D, Manufacturing, and adoption of advanced Energy Storage and EV technologies.

IESA 10 YEARS — India Energy Storage Alliance

June 2022

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Genus — energizing lives
HERO FUTURE ENERGIES
SunSource ENERGY
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TATA — TATA AUTOCOMP

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Pixii
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STRATEGIC PARTNERS

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AMERICAN ENERGY SOCIETY
Administrative Staff College of India — Leadership through Learning
ASSOCHAM
CESA
CNESA — China Energy Storage Alliance
ESA — Energy Storage Association
ENERGY STORAGE CANADA
EASE — European Association for Storage of Energy
btc — Business & Technology Centre
BVES — GERMAN ENERGY STORAGE ASSOCIATION
GREENSTART
ieema — your link to electricity
IESA
ISGF — India Smart Grid Forum
iggf
IESA
MEITY STARTUP HUB
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NAATBatt — INTERNATIONAL
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NY BEST
SEEINDIA — SOUTHERN SECTION
TiE ANGELS
USINDIA — BUSINESS COUNCIL
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India's evolving EV & Energy Storage Policies

IESA was launched in 2012

2013

- MOP & CEA taskforce on Integration of Large-Scale renewables
- National Electric Mobility Mission Plan
- IESA host's 1st Energy Storage India conference

2014

- Creation of Standing Committee on energy storage by MNRE
- IESA releases report on the role of energy storage for ancillary services

2015

- CERC roadmap for ancillary Services
- MNRE India Energy Storage Roadmap and DHI FAME - I

2016

- Launch of ESS pilots by MNRE
- IESA proposes manufacturing policy for energy storage technologies to NIT Aayog

2017

- Launch of MOVE initiative by IESA
- Karnataka & Telangana draft EV policy
- CERC staff paper on ESS

2018

- MNRE National Wind – Solar Hybrid policy
- National Energy Storage Mission
- State EV Policies
  - Maharashtra , UP , Andhra Pradesh , Kerala, Uttarakhand, Delhi
- NITI Aayog MOVE Summit

2019

- NITI Aayog's National Mission for Transformative Mobility and Advanced Battery Manufacturing
- PMP - Phased Manufacturing Plan for EVs
- FAME-II scheme

2020

- Peak power & RTC Hybrid RFPs from SECI
- Energy Storage recognized as Champion Sector
- ACC battery Manufacturing selected as a key sector for PLI with 50 GWh target

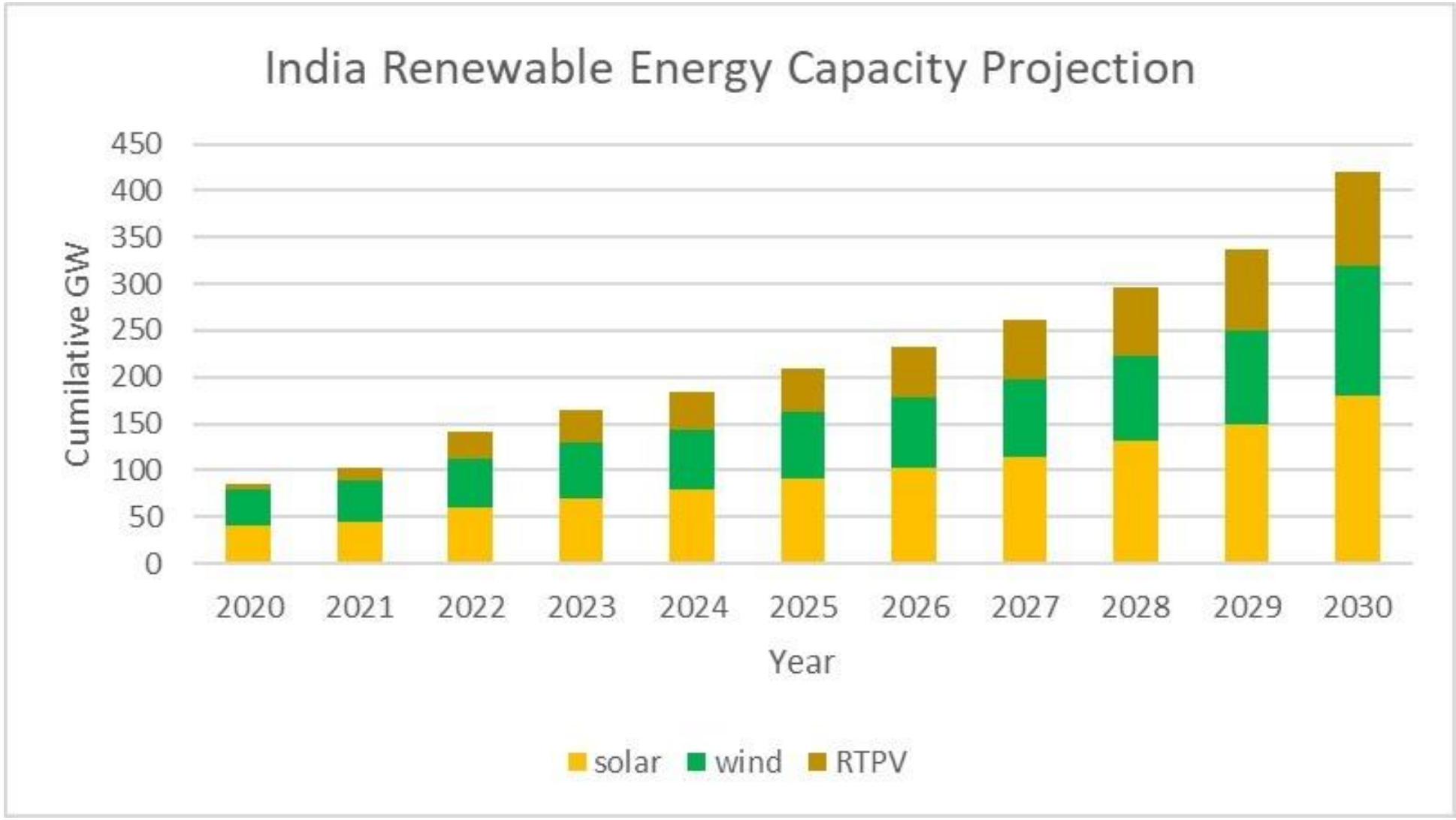
2021

- National Hydrogen Mission announced
- RFP for 50 GWh ACC Battery Manufacturing*
- 5 GWh – Niche ACC Framework Creation

2022

- ACC Battery Manufacturing Production Linked Incentive Program winners announced
- CERC Ancillary Service regulations introduced

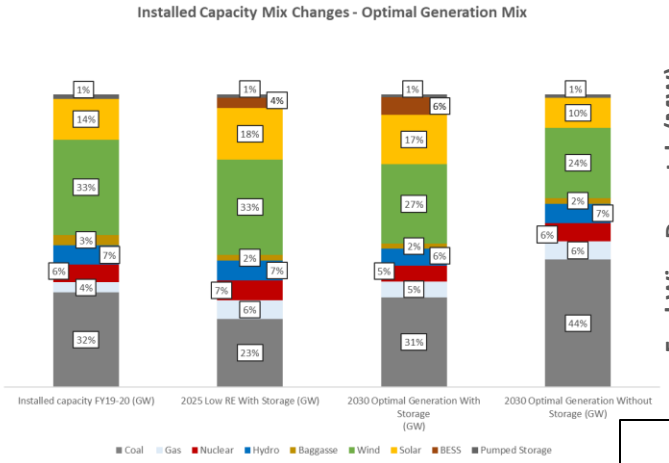
India's Renewable Energy Capacity projected to cross 400 GW by 2030



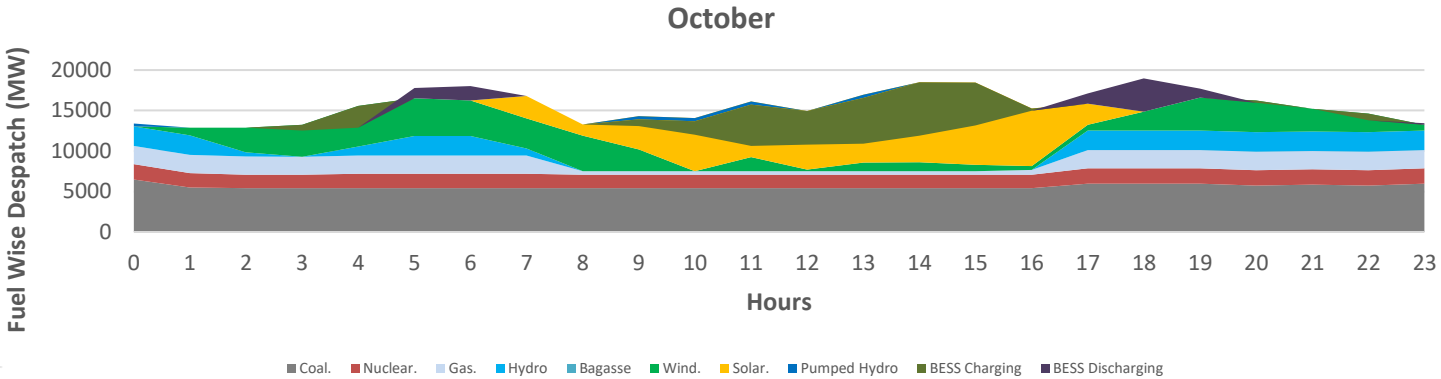
Case Study: Optimal RE Integration in TN Grid by 2025 and 2030

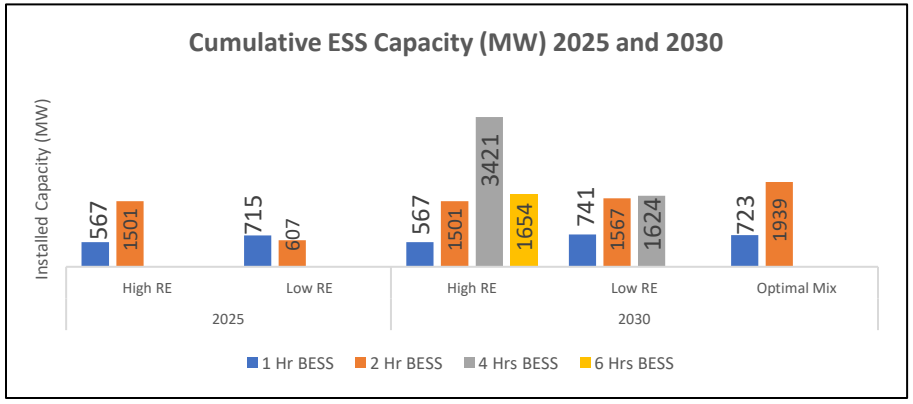
Optimal Generation Mix 2030

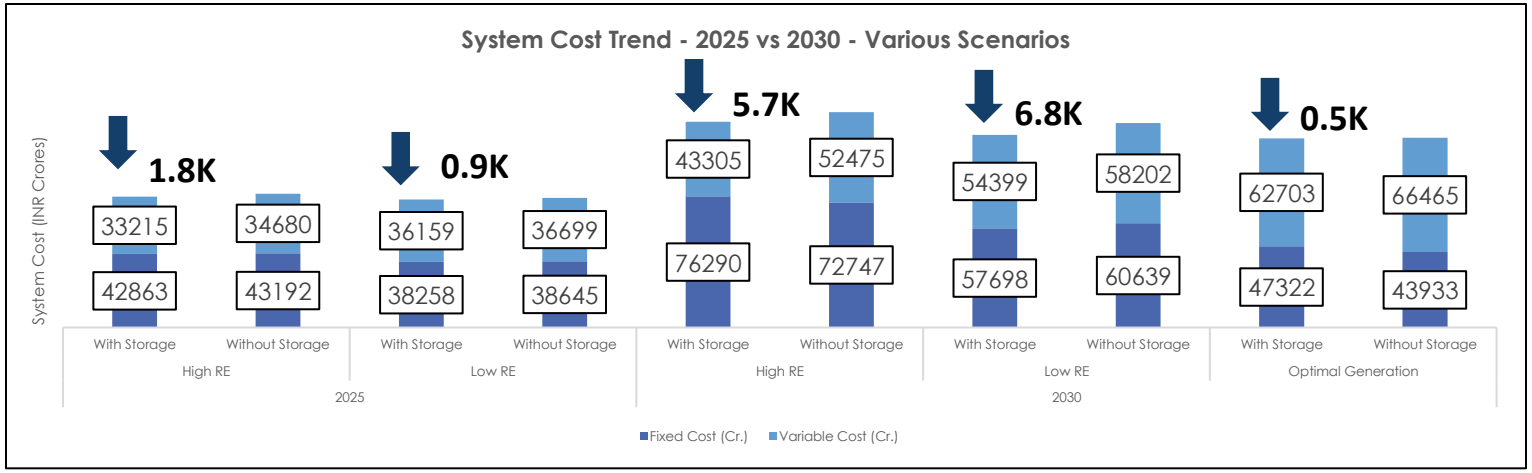
- In the Optimal Generation Mix simulation, the Model takes the least cost of generation as a criteria to decide on generation Mix while keeping the RE spillage minimal.
- We see that with small addition of storage 4% of total capacity in 2025 and 6% in 2030 the level of RE integration increases from 34% to 44% in 2030.
- Also, decreases the coal share in capacity by 13%



Model based example of economic dispatch showing the shifting and smoothing application of storage



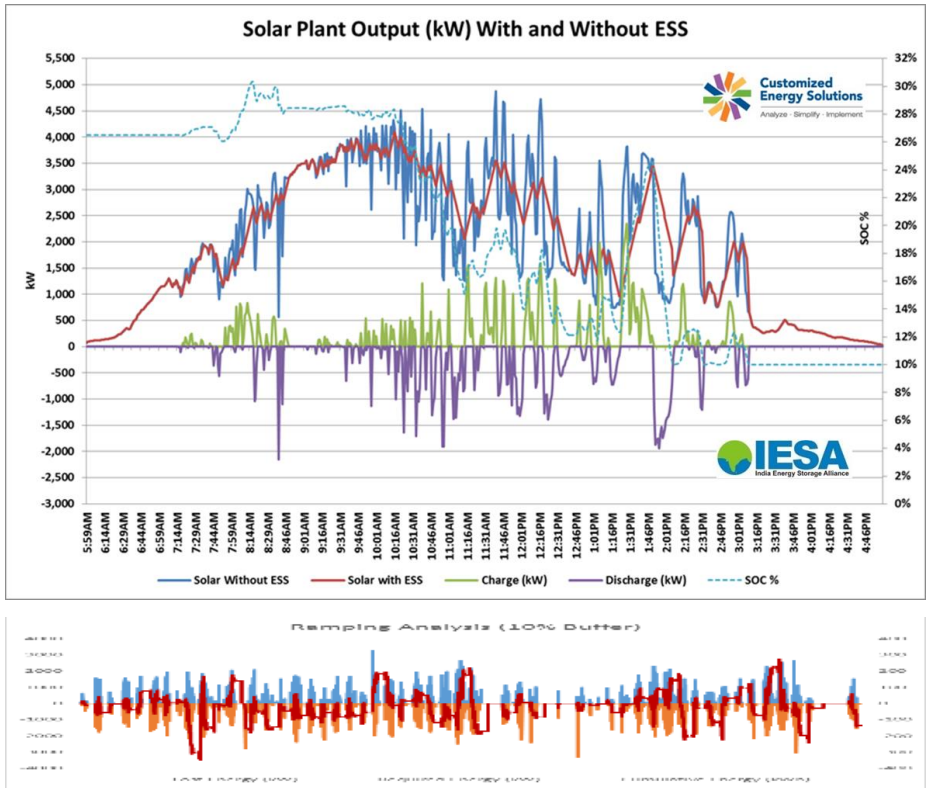




Recommendations

- Storage penetration in the Grid is prescribed to be Gradual
- The storage duration during the initial years are of 1 to 2 hours and the same increases to 6 hours for High RE case and 4 Hours for Low RE Case by 2030
- As per cost benefit analysis it is observed that BESS at Grid level brings maximum benefits in the 4 to 6 hours duration
- By 2030, with decrease in battery costs and improvement in technological performance, BESS will be highly competitive with new coal or gas additions

Solar + Storage Case Study: Port Blair, Andaman Island



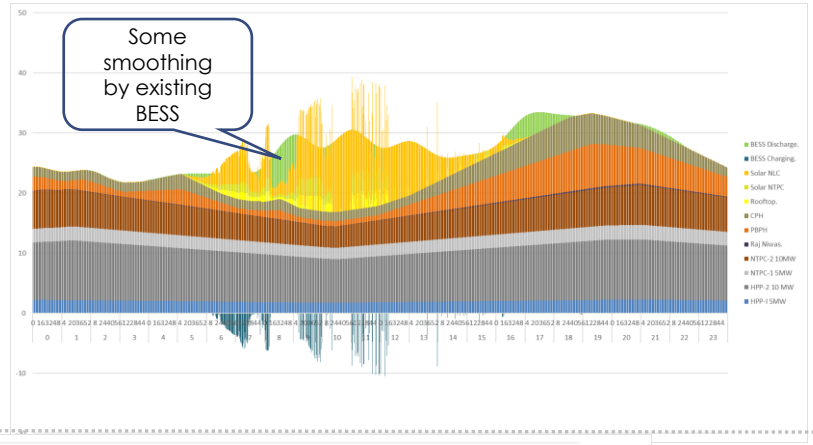
- Solar generation is inherently intermittent and supply may create very large instantaneous ramps.
- The problem will be accentuated in islands like Andaman and Nicobar, where currently diesel generators are used for providing base load as well as balancing service
- MNRE under Greening the Islands program is exploring deployment of 50+ MWh of energy storage with solar PV
- Unfortunately 3 large tenders from NTPC and NLC were cancelled last year despite strong industry response, and are currently being re-tendered.

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.

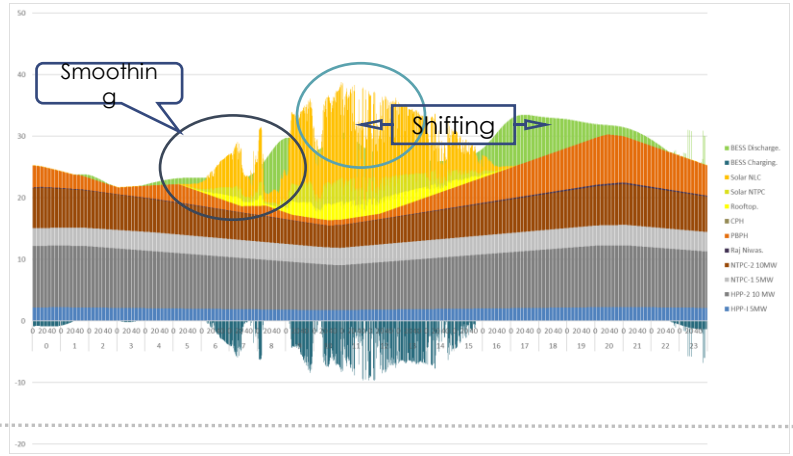
Analysis of BESS Integration for South Andaman Electricity Grid

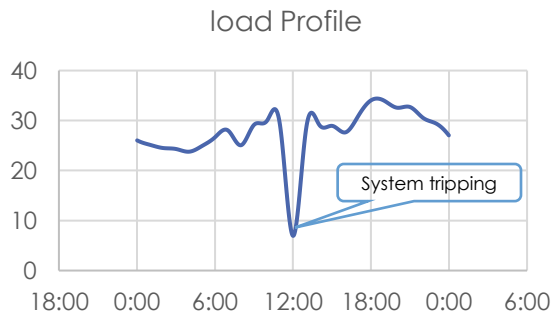
Solar Availability

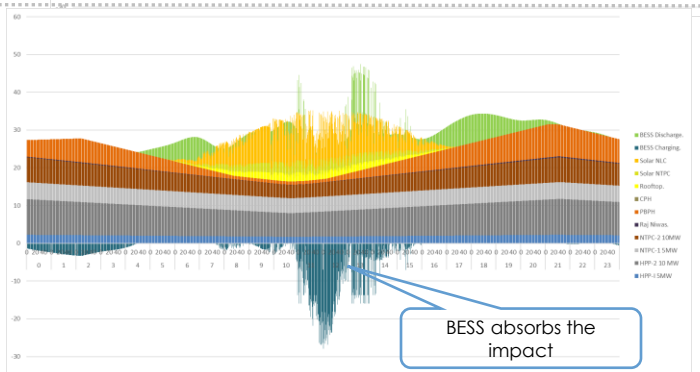
Dispatch WITHOUT storage addition



Dispatch WITH storage addition







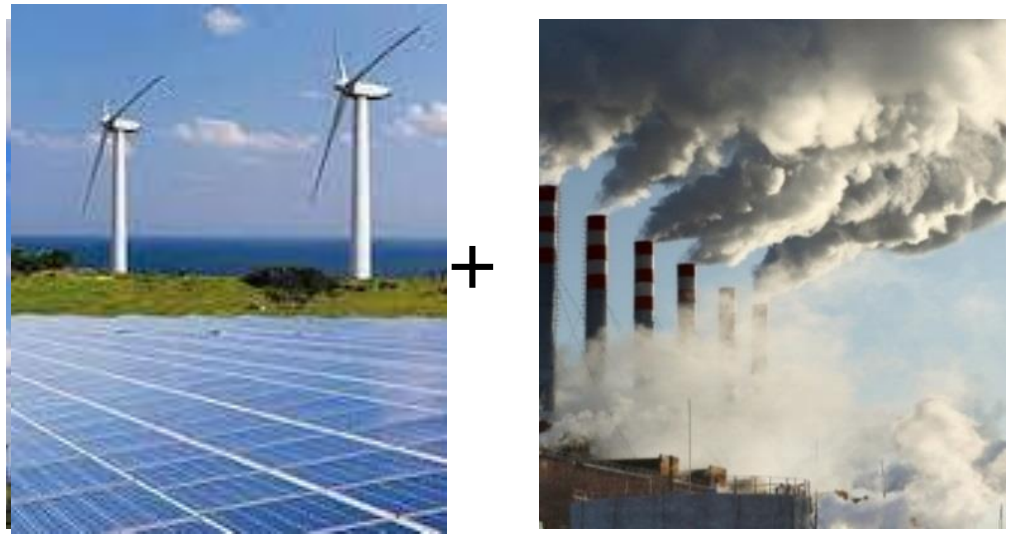
Multiple denominations of storage type size and rating which can provide the best economics, limited curtailment and diesel savings was estimated so that it can be considered as the optimal solution for South Andaman's present power system

Recommendations

- Power and Energy rating of storage along with type (1-hour, 4-hour etc)
- System level benefits obtained from, with and without storage scenario comparison
- Diesel saving was reported both as liters and INR; Avoided curtailment was also reported in MWh and INR
- For the recommended sizes of storage the possible pricing, payback period, IRR, DSCR and 10-year Net Benefits were reported
- Inputs regarding Placement and Operation of BESS were provided
- Detailed report regarding risk, safety and standards of BESS

Balancing Variable Renewable Resources Technology choice: Environmental Impact

Conventional Grid



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

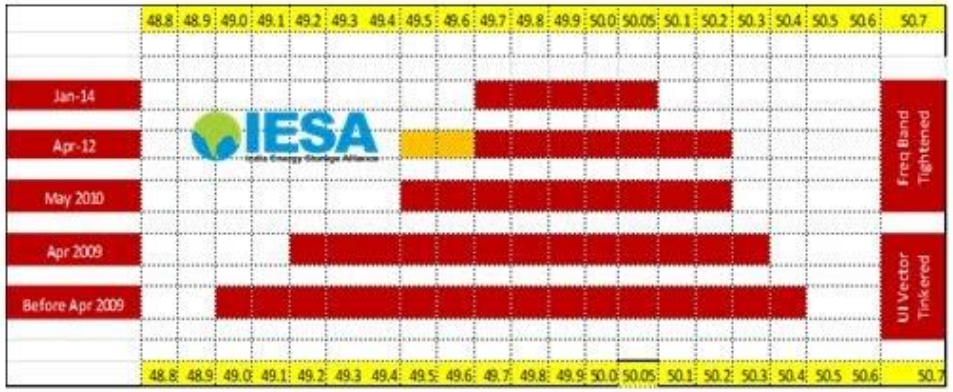
Smarter Solution: Storage

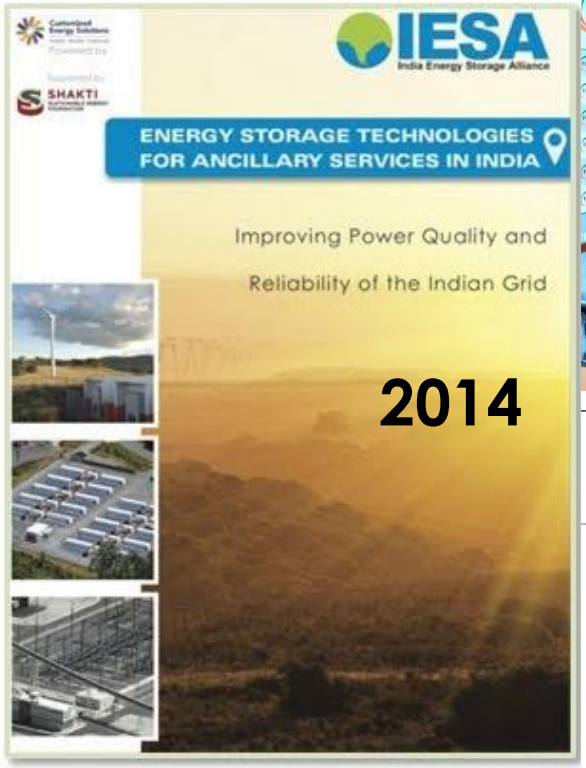
- Store energy when supply exceeds load; inject energy when load exceeds supply
  - High round trip efficiency
  - Low operating cost
  - Near instantaneous response
  - Zero direct emissions
  - Frees up generation capacity

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

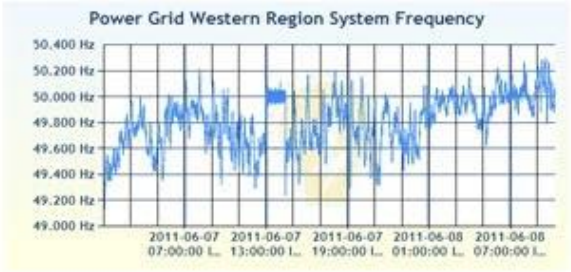
* Katzenstein, W., and Jay Apt. Air Emissions Due To Wind And Solar Power. *Environmental Science & Technology*. 2009, 253-258.

Evolution of India Grid Frequency Control

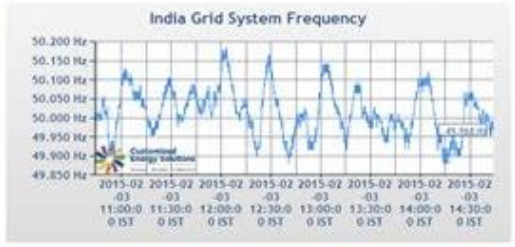


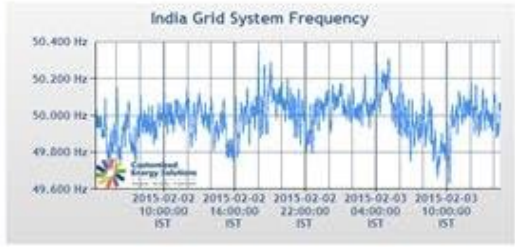


India Grid Frequency 2011

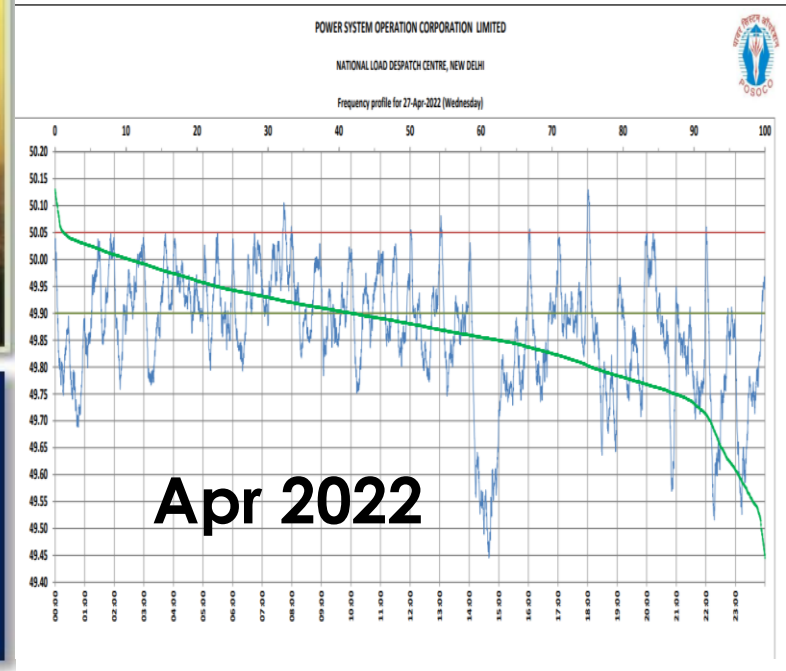


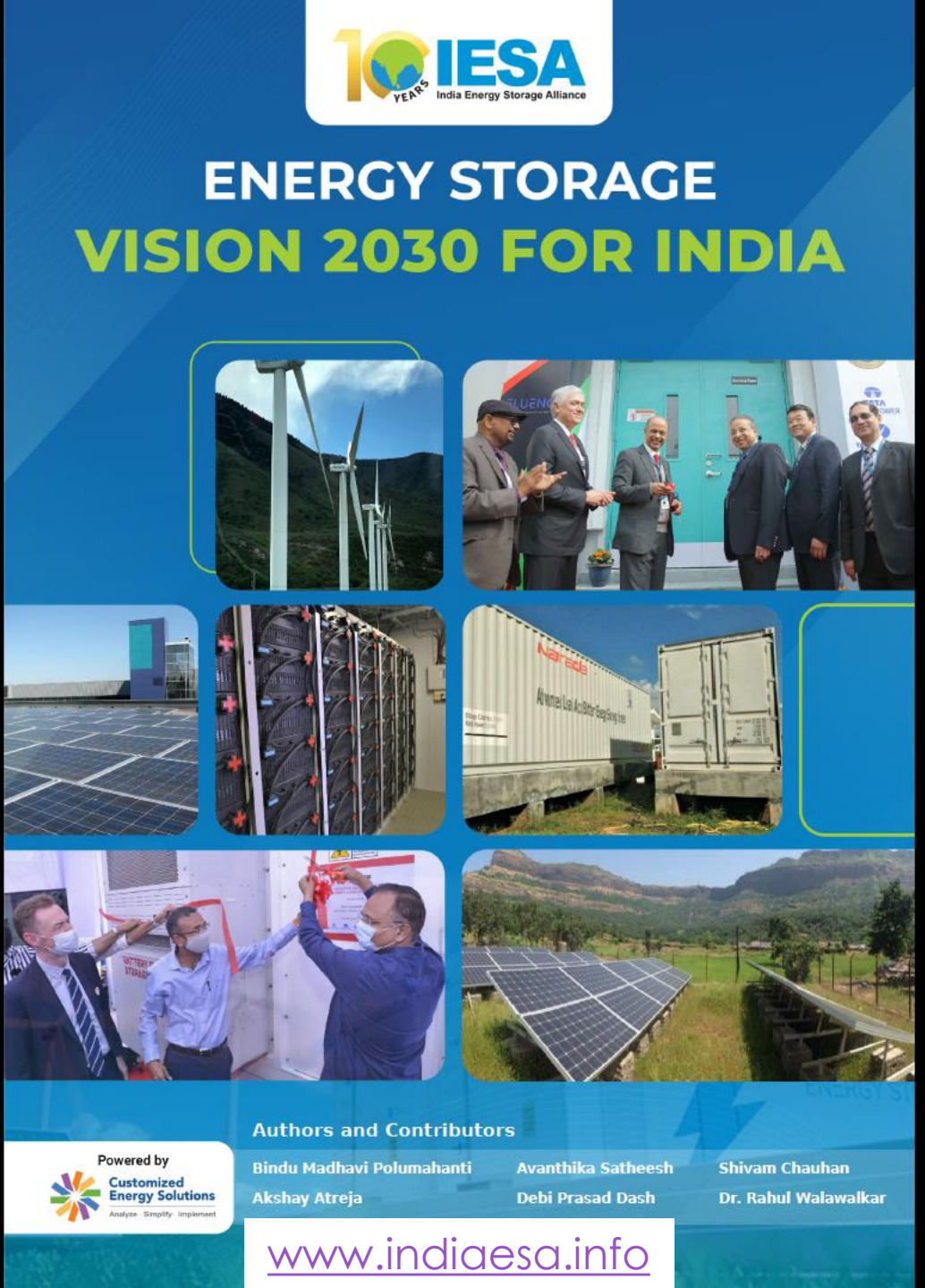
India Grid Frequency 2015





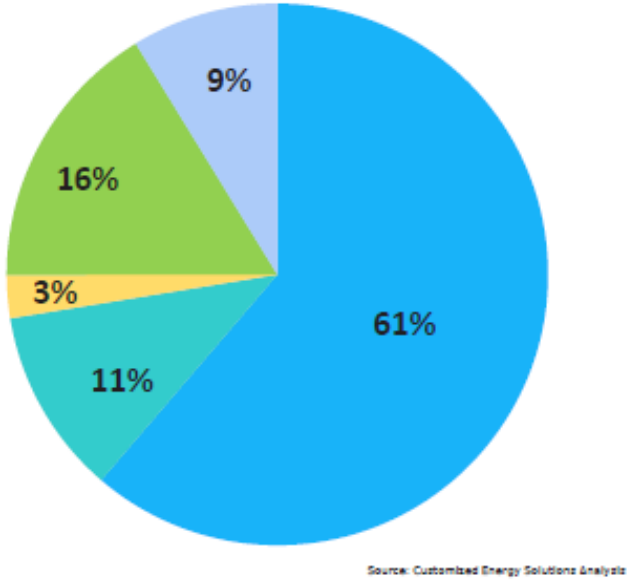
IESA is leading efforts for promotion of the ancillary services market by actively engaging policy makers. The ancillary service market for storage is expected to be cross 1 GW by 2022.





Energy Storage Target for 2030:

Customized Energy Solutions
Analyze · Simplify · Implement



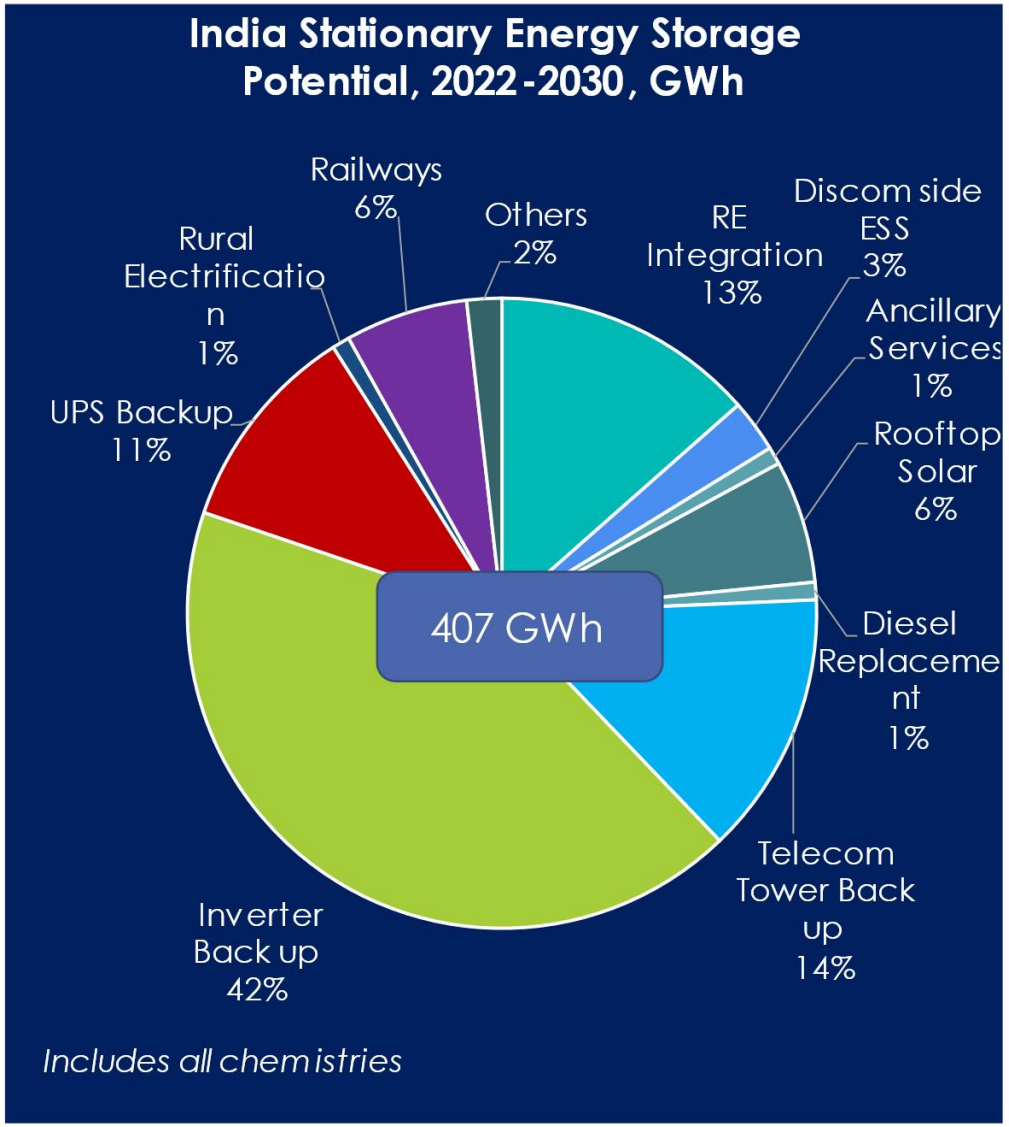
160+ GWh by 2030

*** BTM & C&I Applications do not include UPS & Inverter requirements**

Total India stationary Market Potential through 2030

Stationary Storage Pack
(5 Annual reports and 12 Monthly Reports)

- India Stationary Storage Market Reports
- Technology Review Reports- Stationary Application
- Monthly Policy and Tender Updates



INDIA ENERGY STORAGE DATABASE (IESDB)

https://www.indiaesa.info/initiatives/iesdb

This 10 MW project is located at Tata Power Delhi Distribution Ltd's sub-station at Rohini.

NLC India Commissioned 20 MW Solar Project with 8 MWh Battery Energy Storage in Andaman, develop by L&T

EXICOM & Narada installed at Puducherry with Li-Ion & Adv Lead Acid Battery

1 ARCI Chennai
IIT-M Research Park, P...
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2 ARCI Chennai
IIT-M Research Park, P...
More details ›

3 IISc Bangalore
CV Raman Rd, Bengal...
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4 IISER Pune
Dr Homi Bhabha Rd, ...
More details ›

5 IISER Tirupati
Karakambadi Rd, Opp ...
More details ›

ESS Projects
Manufacturing Plants
Recycling Plants
EV Charging Stations
R&D Institutions
Microgrids

CHARGING STATIONS

Enter city, state, country or zip code | Charging Station

1 Anand Vihar Railway ...
Gate No. 2, Anand Vih...
More details ›

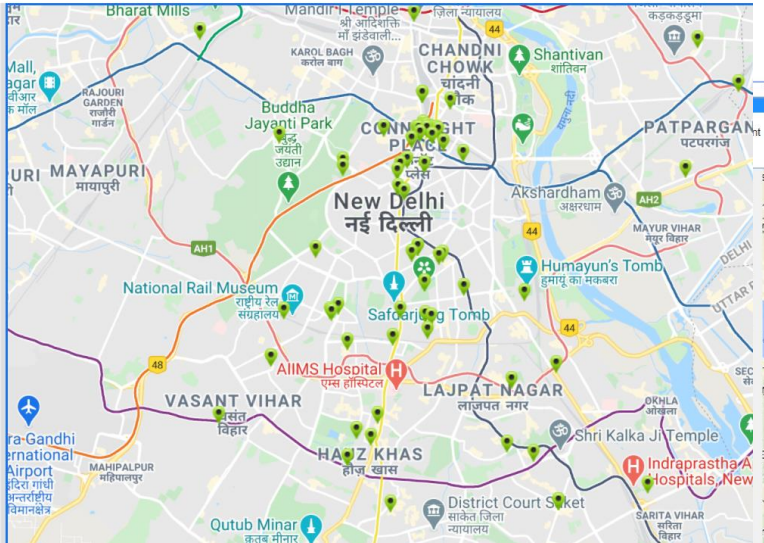
2 Autovikas sales & serv...
Block B RAMA ROAD, ...
More details ›

3 EESL Akashwani Bha...
Akashvani Bhawan, S...
More details ›

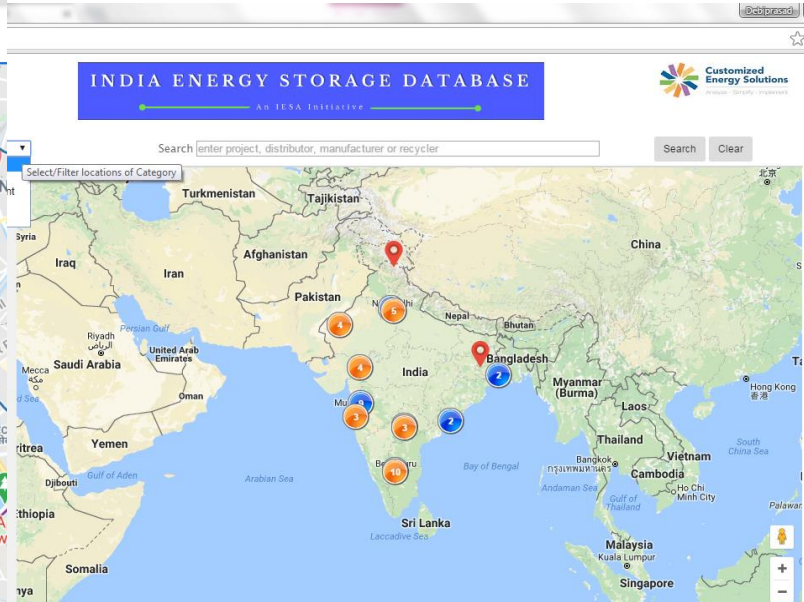
4 EESL Aurbindo Market...
SDMC Parking, Aurbin...
More details ›

5 EESL Barakhamba
Near NDMC Office, Fir...
More details ›

6 EESL Bharat Sanchar ...
Outside Bharat Sanch...
More details ›

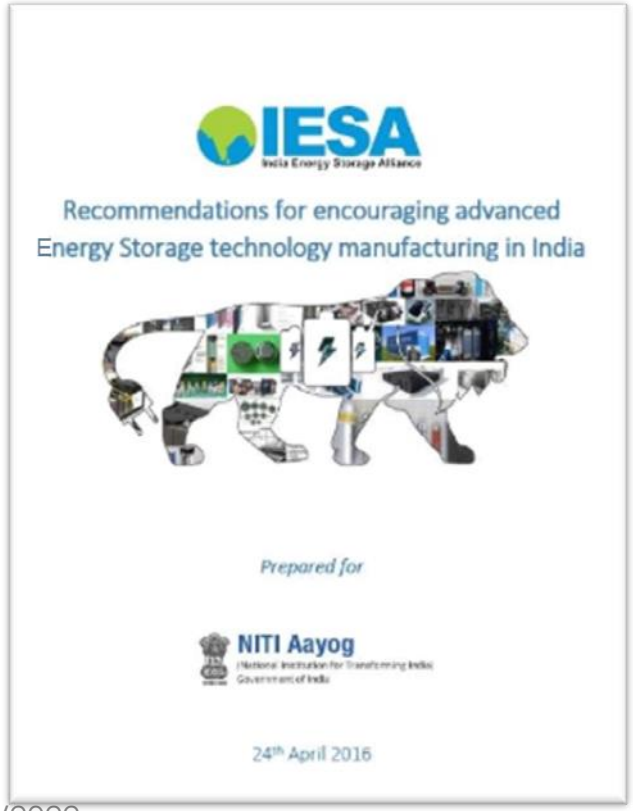


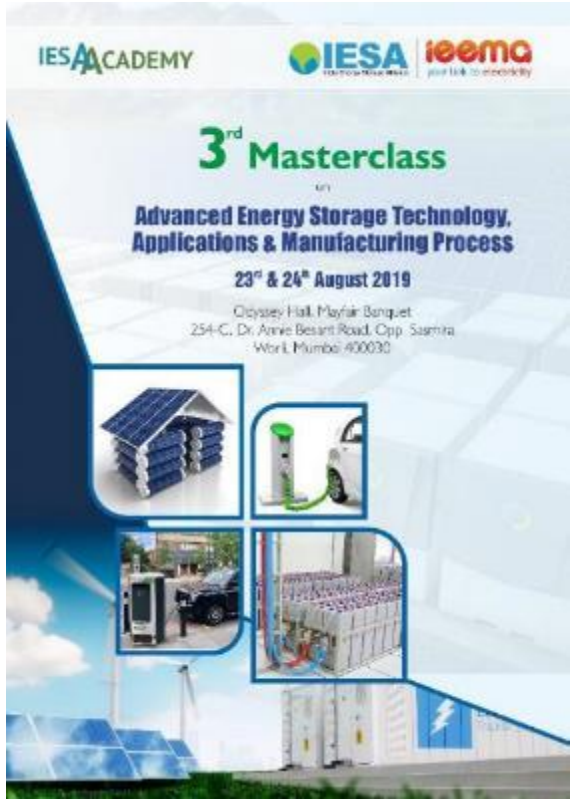
LAERGE SCALE ENERGY STORAGE PROJECT

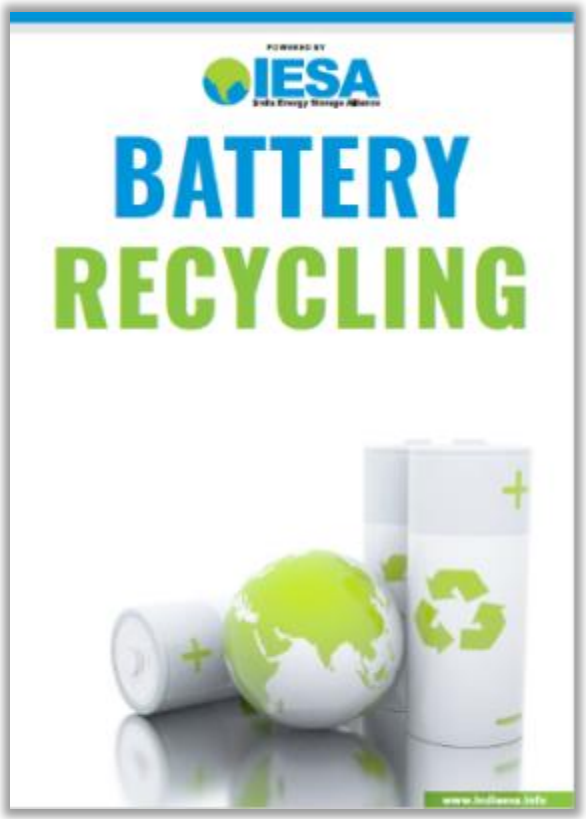


IESA : DRIVING MANUFACTURING POLICY

- We set a mission in 2016 to make India a global hub for R&D and manufacturing of advanced energy storage and EV technologies.
- We have been working closely with Key Decision Makers across various government ministries to create a sustainable manufacturing sector for Batteries in India
- IESA expects 3-4 Li-Ion Cell manufacturing will open in next 2-3 years in India.
- We are helping conglomerates to enter this space and with global companies to set up manufacturing facilities in India
- As a part of awareness creation we have been conducting various hands on training programs and masterclasses over the years

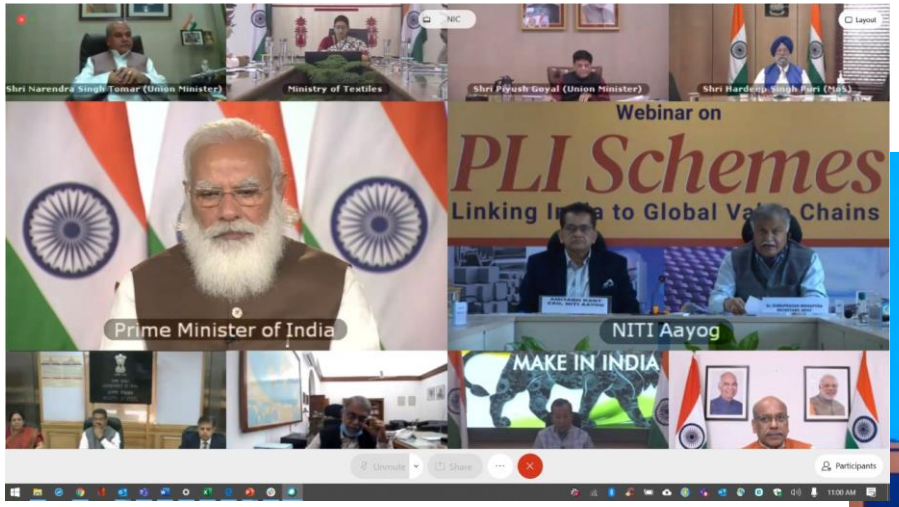


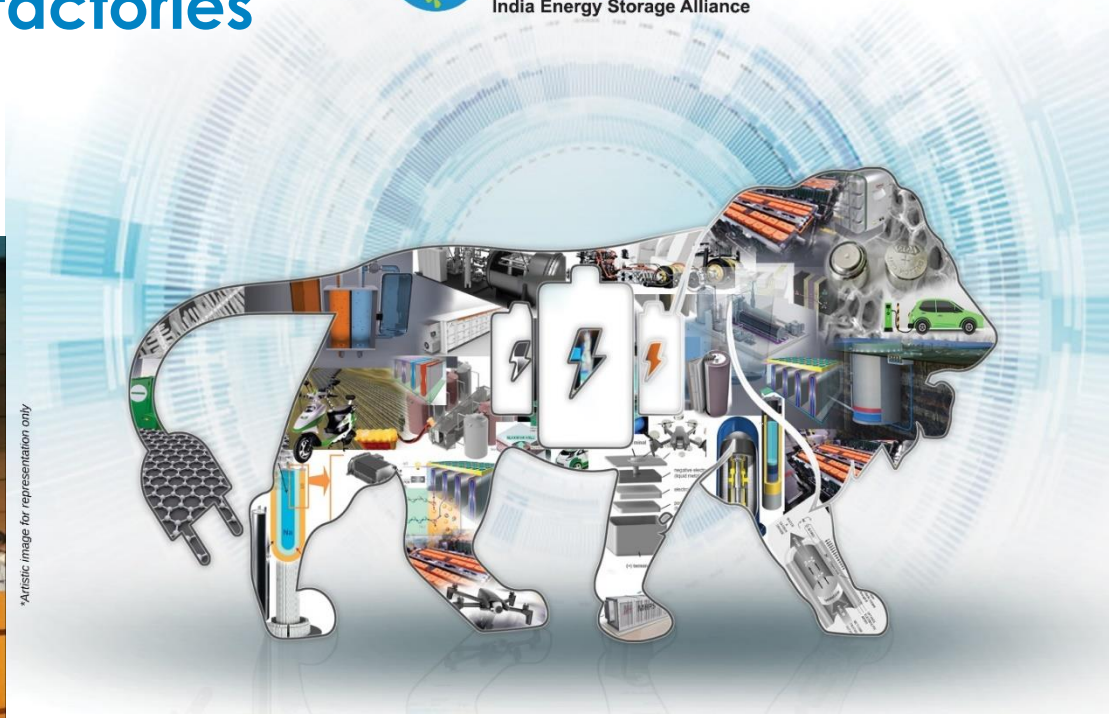




India, the Emerging Market & New Destination for Battery Giga-factories

IESA
India Energy Storage Alliance





*Artistic image for representation only

April 2016
IESA submitted 1st whitepaper to NITI Aayog for advanced energy storage manufacturing policy

2018-19
Development of National Energy Storage Mission & National Mission for Transformative Mobility

2020
Creation of ACC Battery Manufacturing PLI framework

12 May 2021
ACC Battery Manufacturing PLI Program announced by DHI, Govt. of India

June 2021
Notification with PLI details announced

Oct 2021
Global Tender announcement for 50 GWh ACC Manufacturing

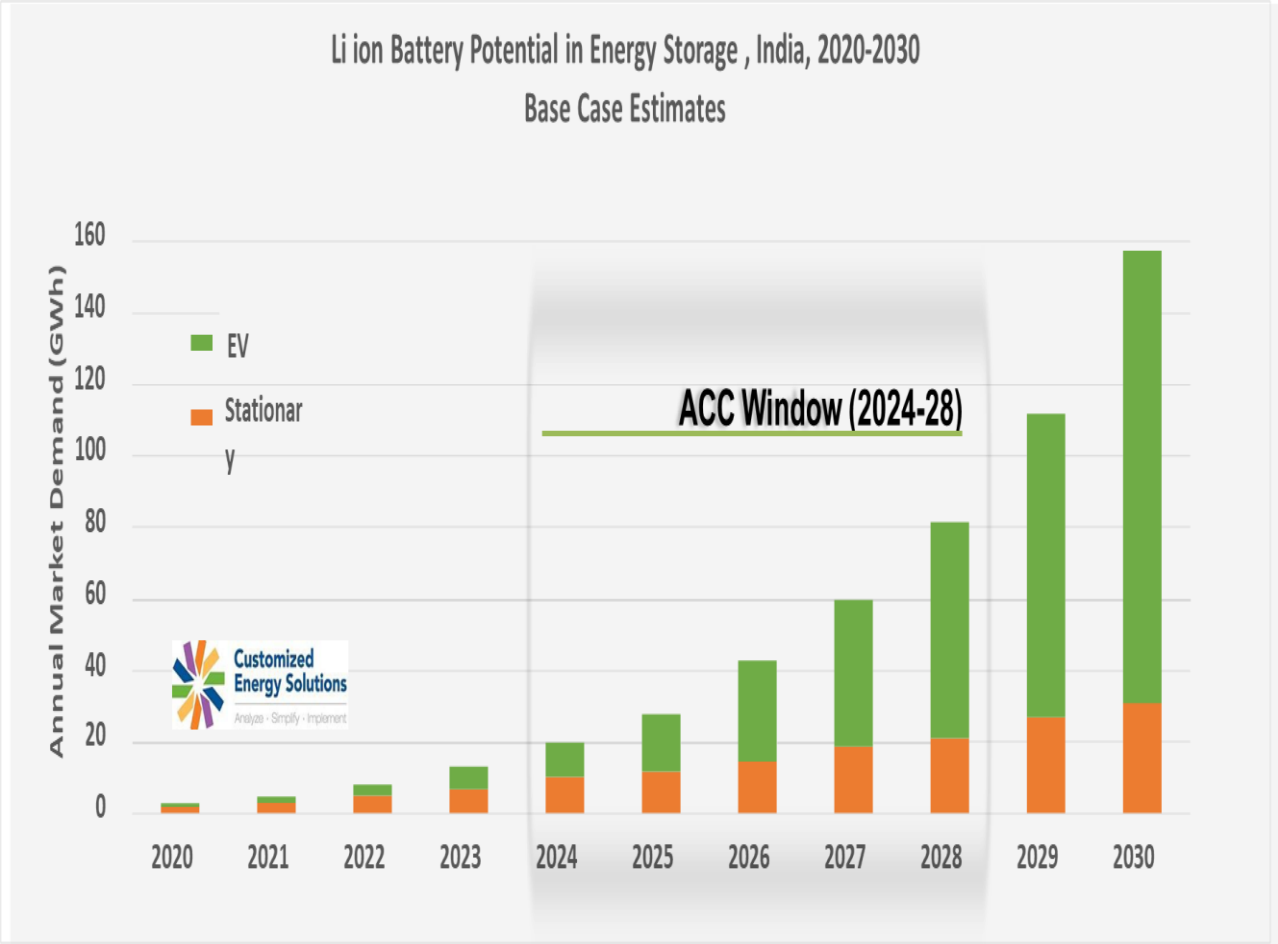
Jan-Mar 2022
50 GWh Manufacturing Application Closure

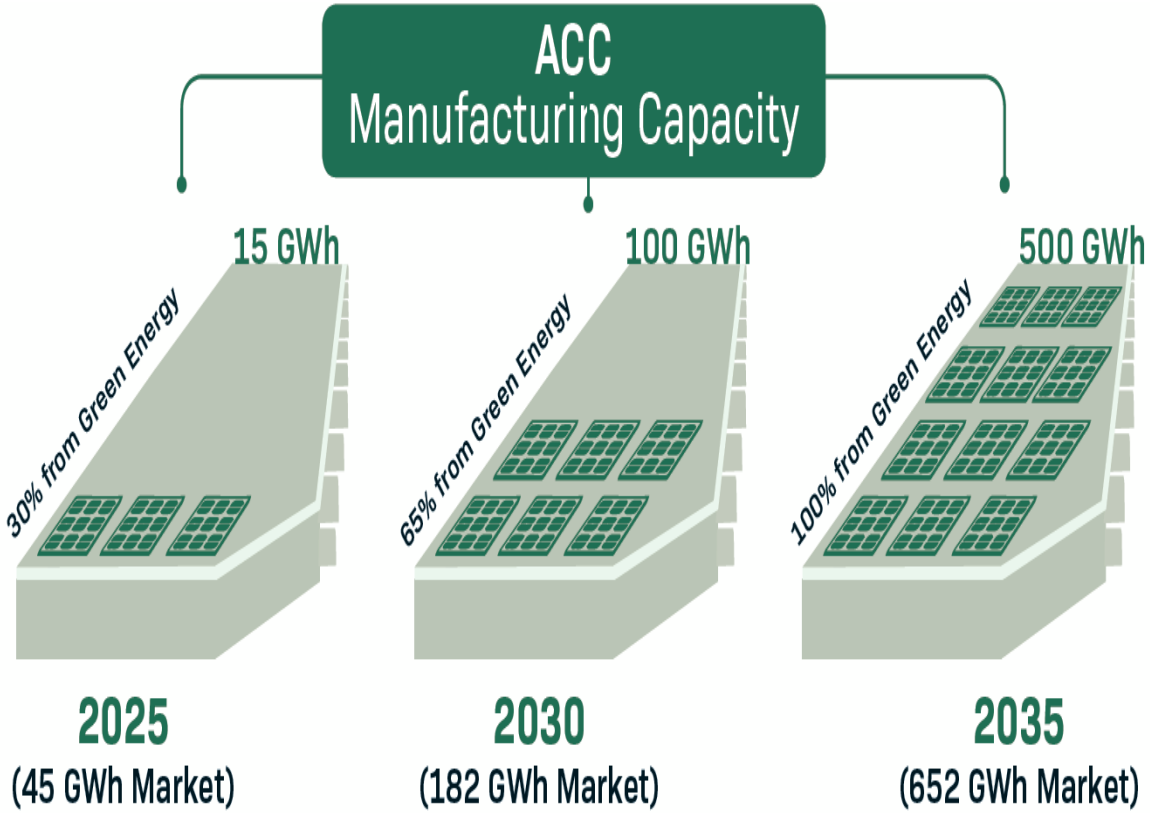
Mar-June 2022
Award for 50 GWh ACC battery Storage PLI

Sept –Oct 2022*
5 GWh Niche ACC Program notification

June –Dec 2024*
Start of Commercial Production from Indian Giga Factories

IESA has set a vision for building on ACC PLI for 50 GWh by 2027, 100 GWh by 2030 and 500 GWH by 2035.





Conclusion

- Since 2012, the Policy Framework for Energy Storage and EVs in India has evolved steadily
- Energy Storage sector is showing similar learning curve for cost reduction as exhibited by Solar Industry
- Various Energy Storage Technologies are seeing significant performance improvements and cost reduction trends over past decade and this is expected to continue over next decade
- It is important to understand the technology as well as application requirements
- Cost reduction is achieved not just by manufacturing scale up, but through learning curve and improvements such as energy density / cycle life as well as better understanding of system performance and safety aspects
- There are lots of collaboration opportunities for all nations to combine resources for accelerating R&D and manufacturing of advanced energy storage technologies for Green Energy and Clean Transportation.

WORLD ENERGY STORAGE DAY (WESD) – 22nd Sept 2022

www.energystorageday.org

सत्यमेव जयते

प्रधान मंत्री
Prime Minister

MESSAGE

I am pleased to learn that India Energy Storage Alliance and its partners are holding a digital World Energy Storage Day Global Conclave and Expo on September 22.

Energy is a key driver of growth across various sectors of development. As India is rapidly marching ahead fulfilling dreams and aspirations of the youthful nation, our energy and electricity needs are also growing. Our approach for energy planning is integrated and our energy agenda is inclusive.

When it comes to choosing between environment and development, India believes that these two are not contrary entities, but complementary to each other. Be it the endeavour to take clean fuel to every family, or efforts for eco-friendly mobility system, this idea gets reflected in our policy and strategy.

Energy security and sufficiency are pivotal for self-reliant India. We are constantly striving to ensure that electricity reaches everyone, there is sufficient electricity for everyone, and that our environment remains clean. We are also making sure that our resolve towards clean and renewable energy is taken care of in every aspect of life.

The world looks at India with hope as a reliable partner. In view of this expectation of the world from India, we are engaged in connecting the entire world. International Solar Alliance is the outcome of this thinking, that aims to bring together the whole world for common need and good.

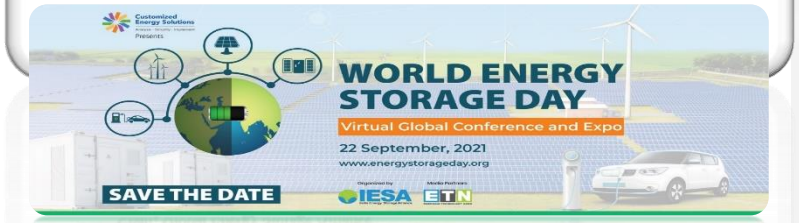
For energy access and energy sustainability, we are focussed towards building a robust storage capability in the country. Efforts like the Global Conclave and Expo strengthen this vision. The presence of policy makers, technical experts and other participants from various countries reflects mankind's commitment to sustainable development.

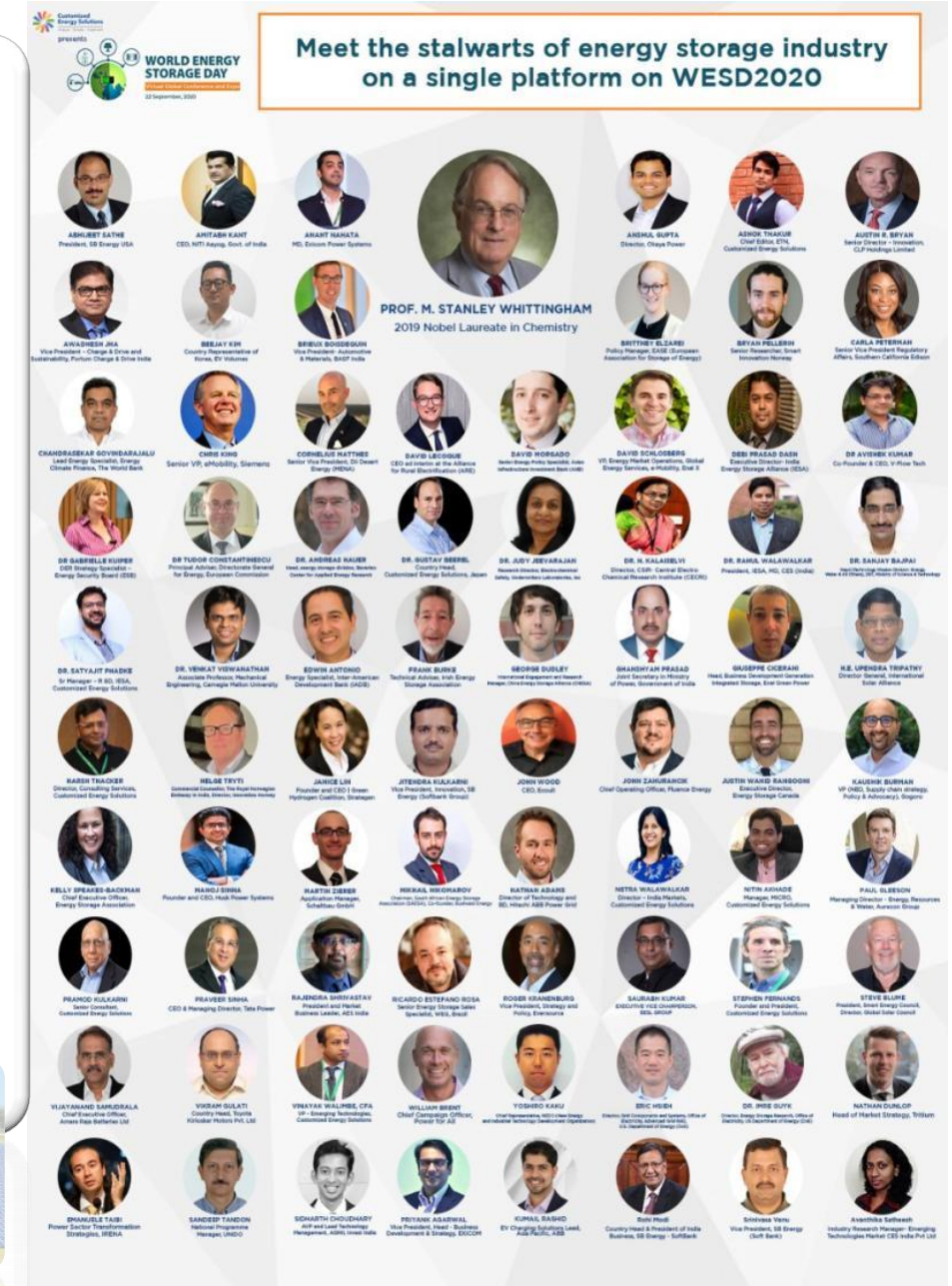
May the Global Conclave and Expo be a huge success.

(Narendra Modi)

New Delhi
भाद्रपद 30, शक संवत्, 1942
21st September, 2020

Dr. Rahul Walawalkar
President, India Energy Storage Alliance &
Chair, Global Energy Storage Alliance
A501, GO Square, Aundh - Hinjewadi Link Road
Wakad, Pune, Maharashtra – 411057





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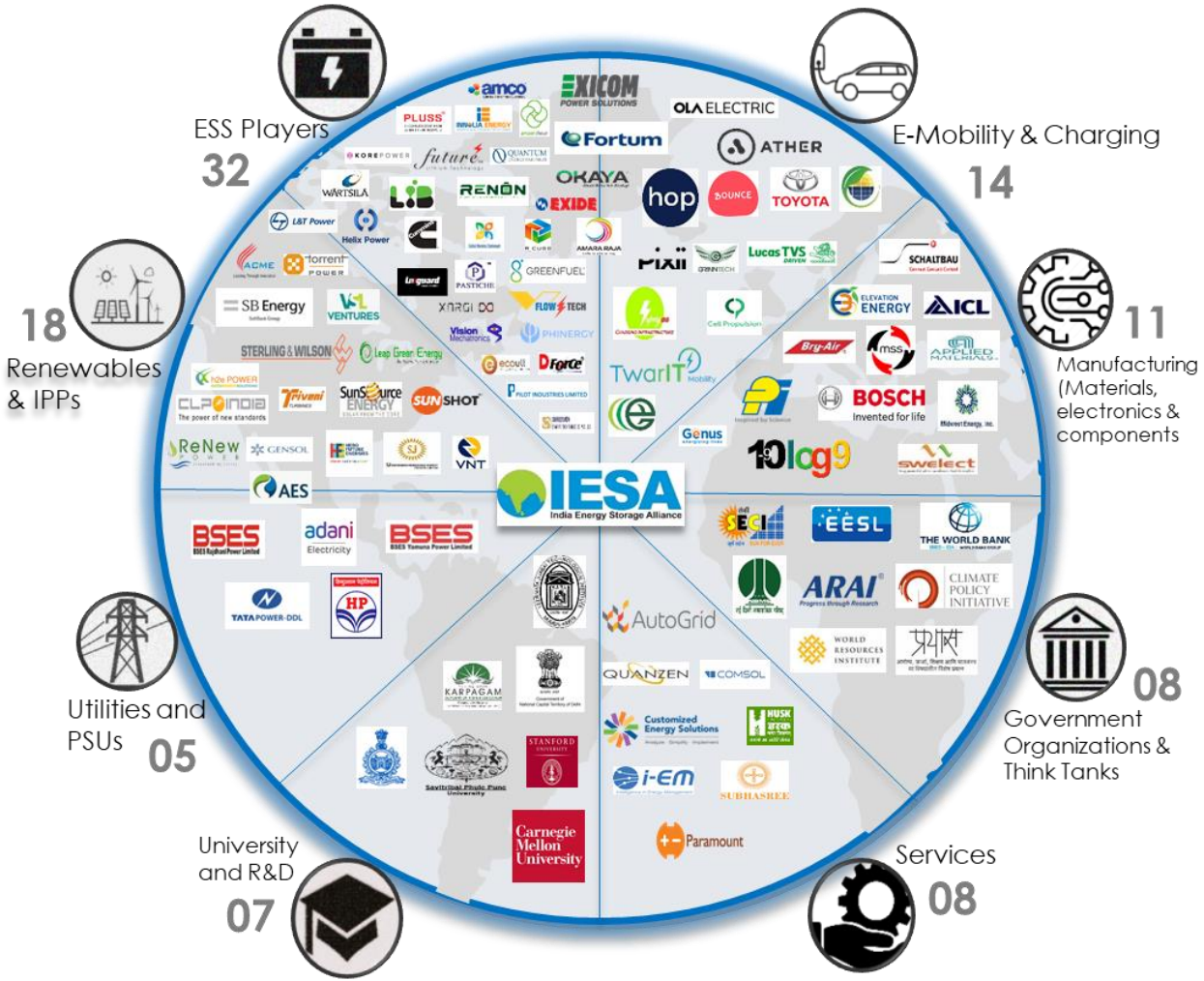
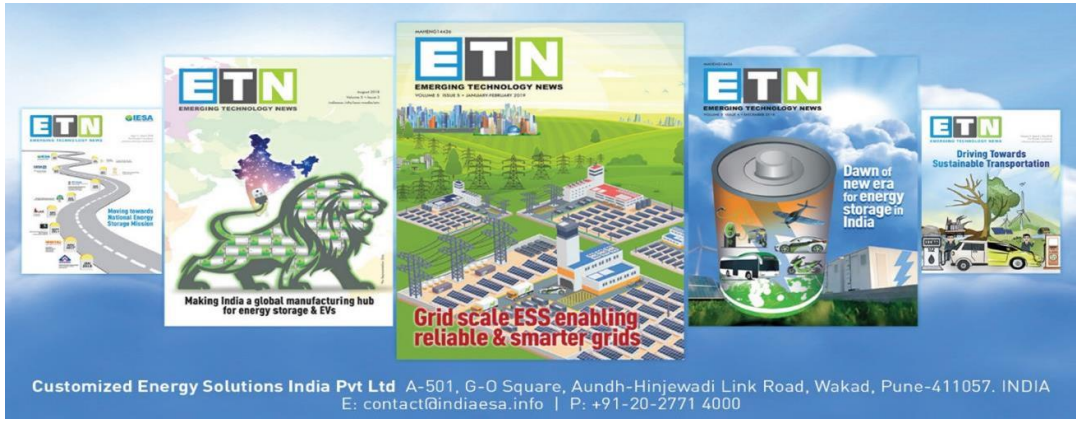
Designation: President
Mail: rahul@ces-ltd.com





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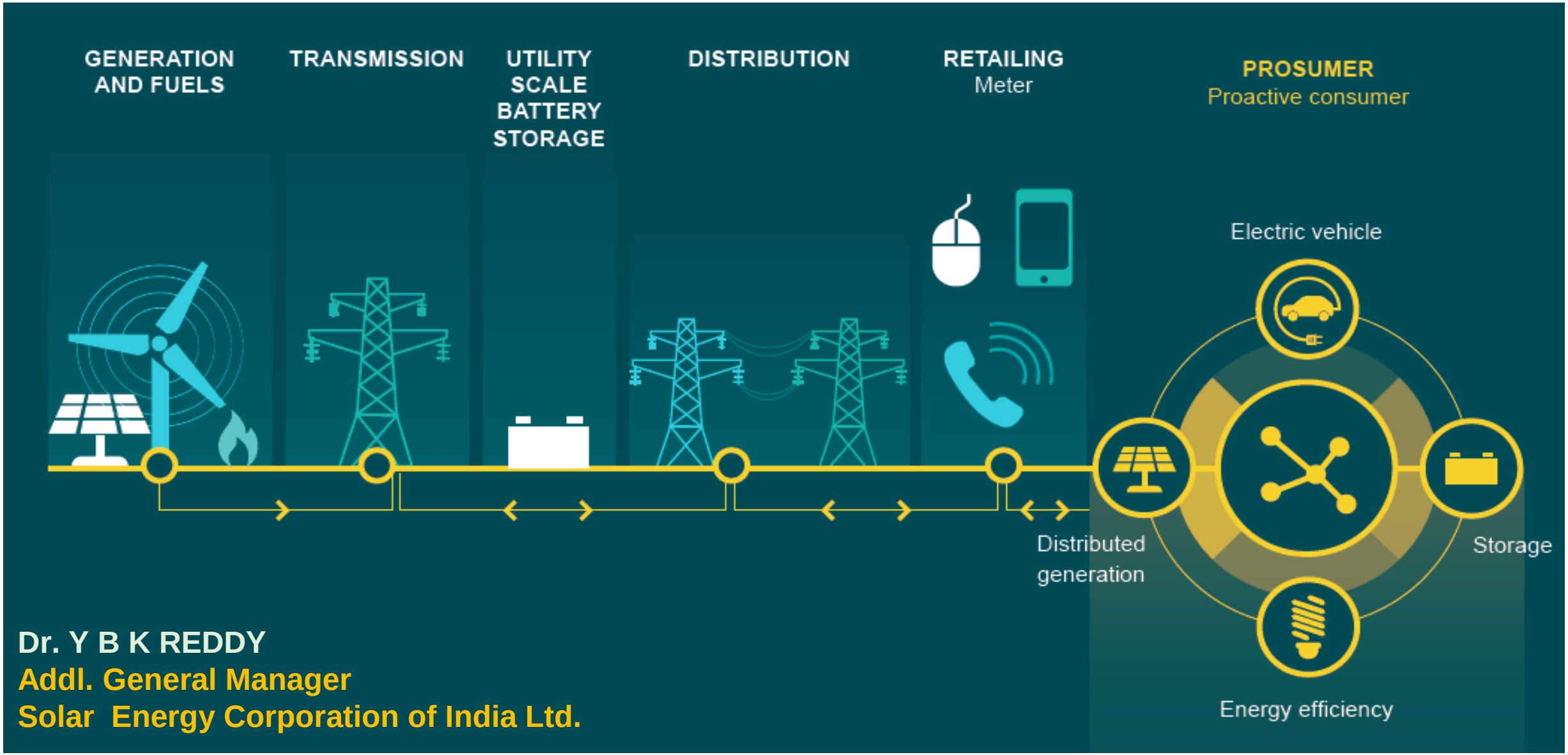
Energy Storage - the Critical Link to RE Penetration

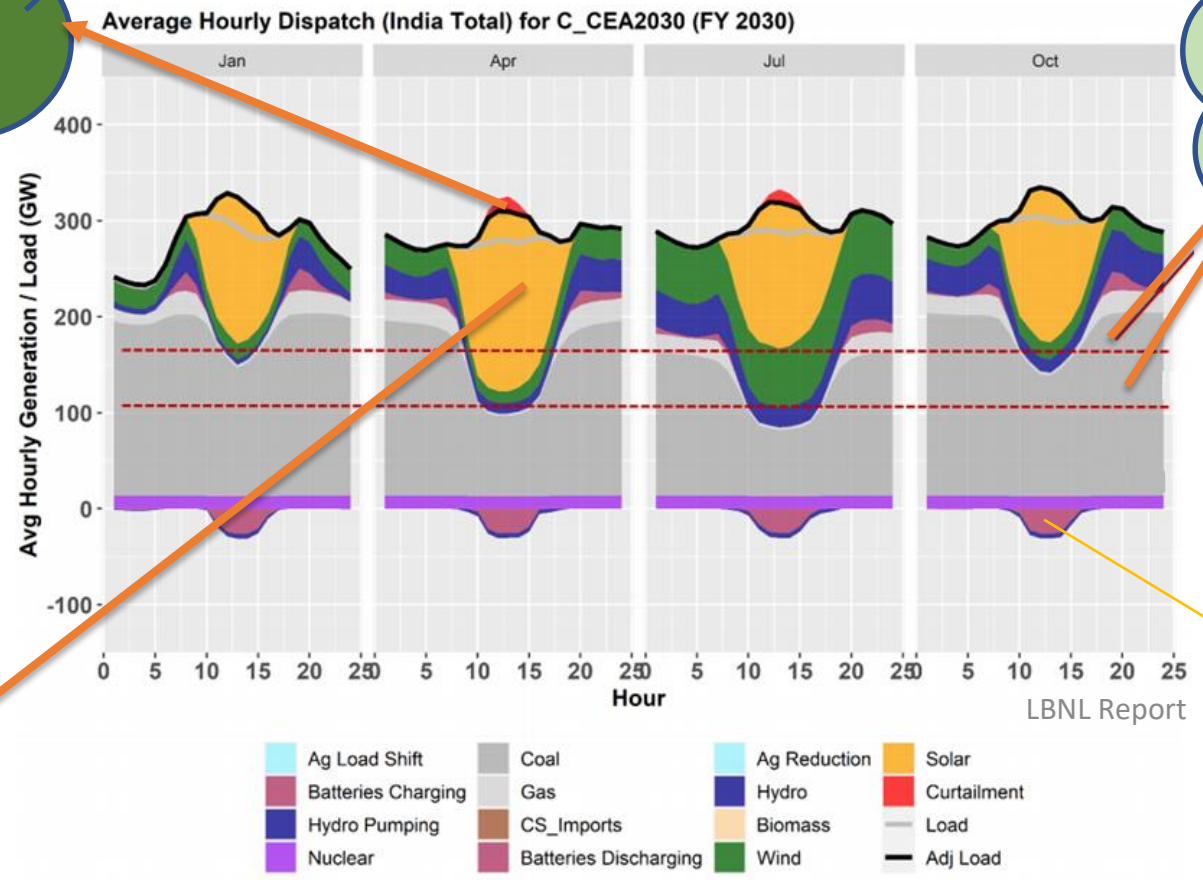


Dr. Y B K REDDY
Addl. General Manager
Solar Energy Corporation of India Ltd.

RE Integration Challenges @ 450 GW RE

Generation Demand mismatch / curtailment

Demand Creation for RE – Slowly replace Sub optimal thermal Plants



LBNL Report

Poor Utilization of T&D – Solar Power Generation

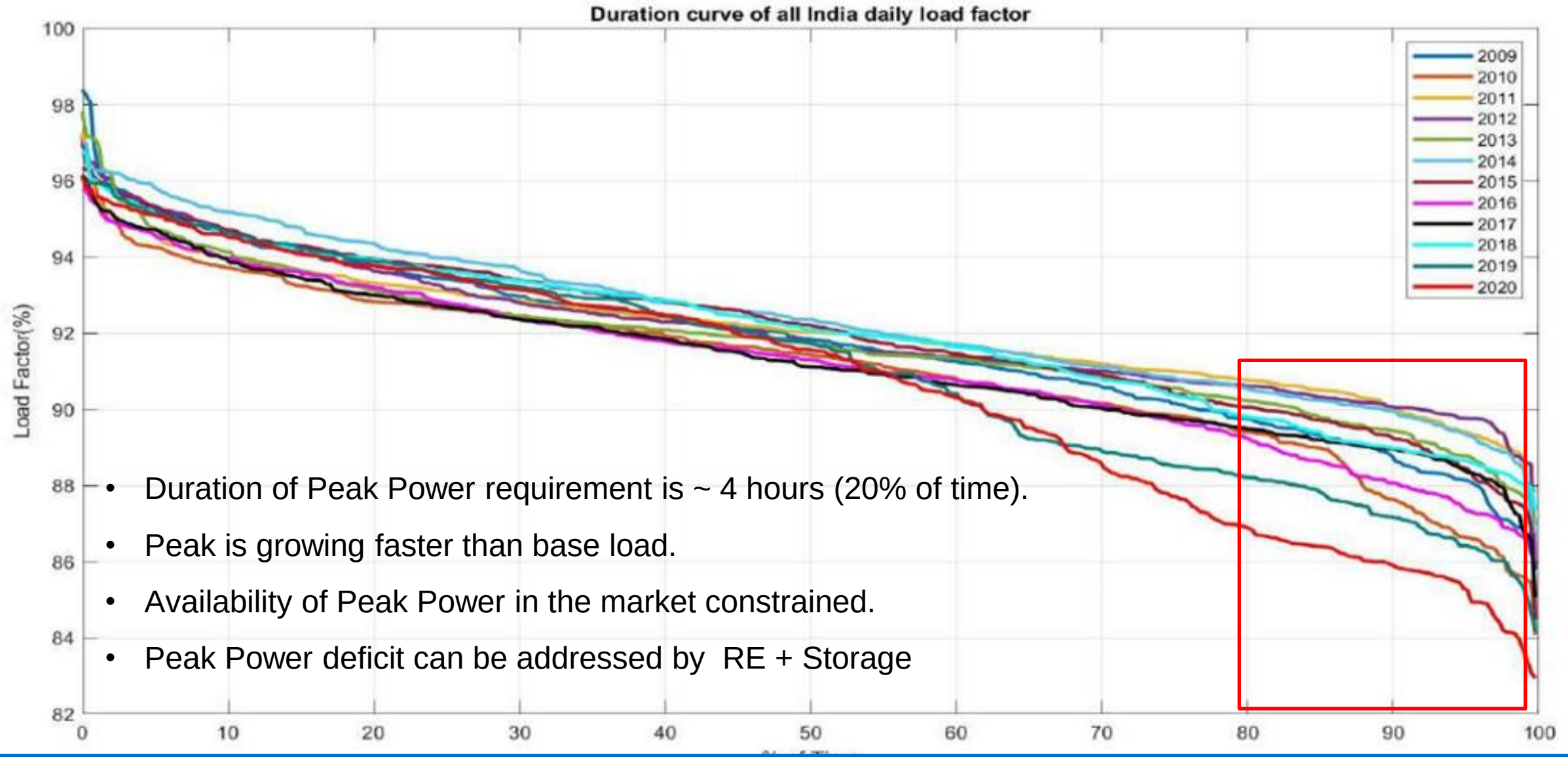
Storage Plays key role in reducing curtailment

Drivers of storage

- **RE to address base load :** Making Base load RE plants with Storage
- **RE to meet Peak Load** : RE+Storage will address peak demand.
- **Spinning reserve** to be replaced by storage in steps
- **Storage for Transmission:** Use of storage for grid extension and expansion
- **Distributed RE and storage** as embedded generation in cities, T&D deferral, DSM avoidance and local grid balancing.

- ➢ Old thermal Plants to be replaced with RTC RE Projects.
- ➢ Low PLF conventional plants shall be replaced with RE+ Storage for peak load
- ➢ Spinning reserve capacity in thermal may be replaced with Stand alone Storage systems.
- ➢ Transmission infrastructure for RE parks /Projects to be developed with Large scale energy storage
- ➢ Discoms and specifically cities are to be mandated to have storage in the network

Peaking power

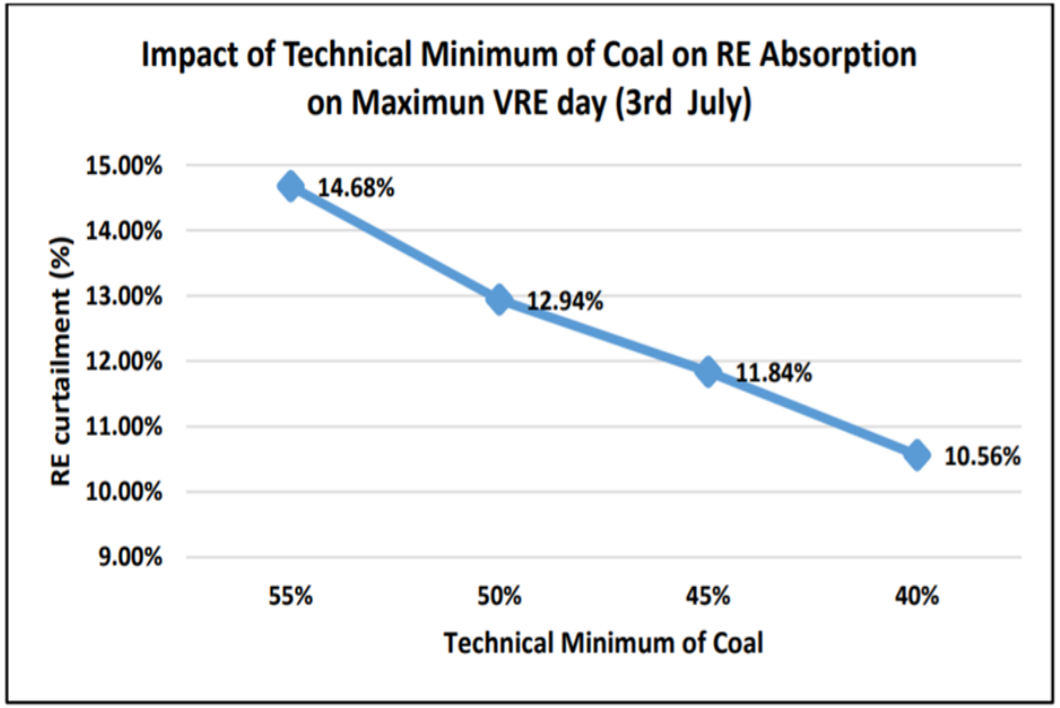


- Duration of Peak Power requirement is ~ 4 hours (20% of time).
- Peak is growing faster than base load.
- Availability of Peak Power in the market constrained.
- Peak Power deficit can be addressed by RE + Storage

Peaking power

- ~ 260 of Solar Capacities are estimated by 2030
- Peak solar generation - leads backing down of thermal.
- 10.56% curtailment anticipated even in the 40% PLF of Thermal Plant Scenario, Source: CEA Report
- Absorb maximum RE and minimize curtailment – manage base leoad.
- ESS + Excess RE
    - reduces curtailment
    - Address Peak power deficit
    - Improves PLF of Balancing plants

Stand alone ESS projects are being planned.



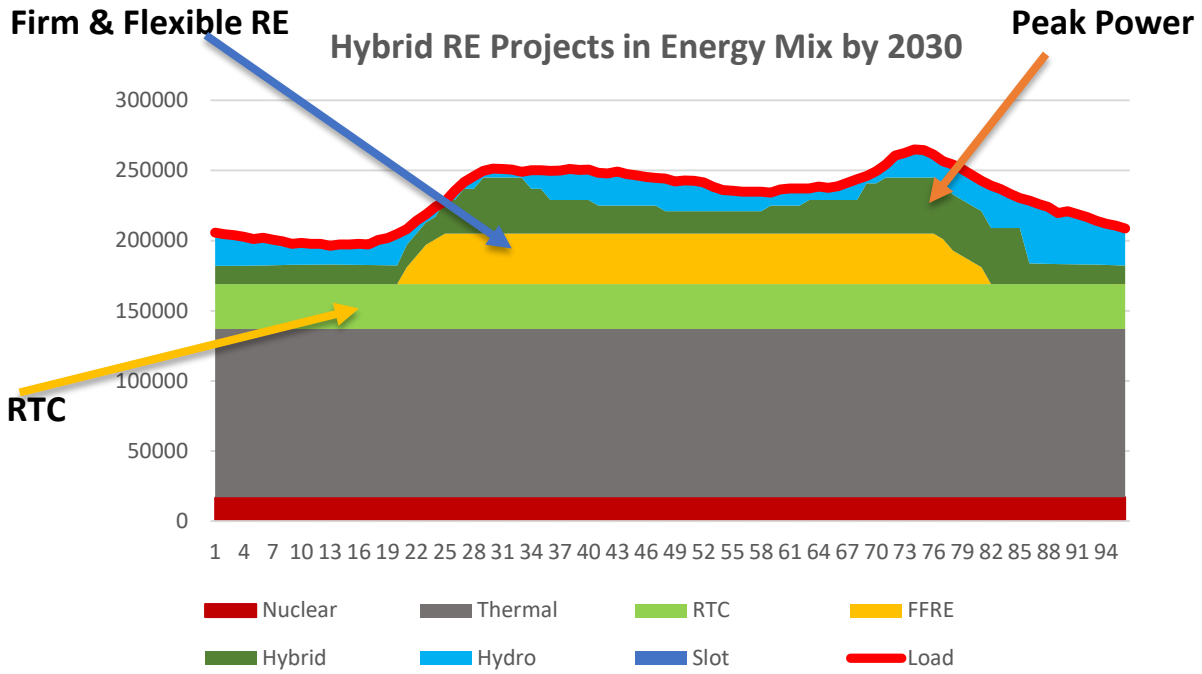
Impact of Technical Minimum of Coal on RE Absorption

RE firming & transmission Optimization

Innovative RE projects under implementation:

Developed Contracts for Hybrid RE projects with high PLF and storage to

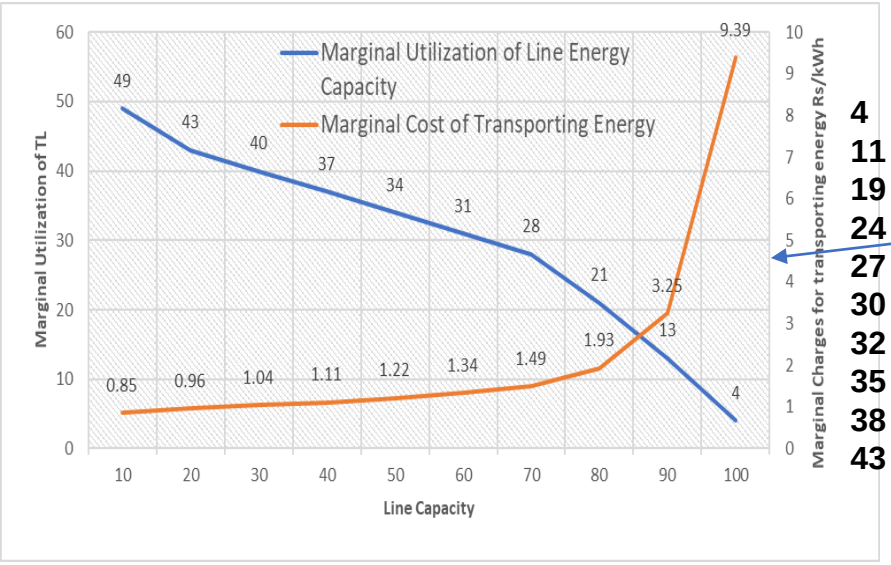
- Avoidance curtailment of RE power
- Reduced dependence on conventional balancing power
- Ramp rate control- avoidance of duck curve.
- Initial projects at Multiple locations for POC.
- Future projects at Single location to Improve the utilization of transmission network

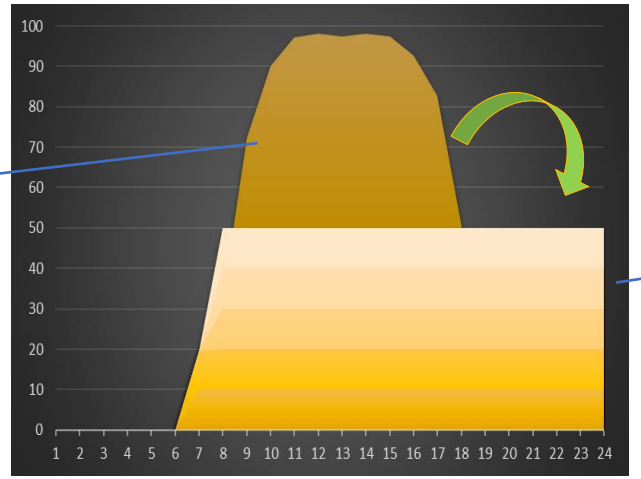


Hybrid Mode	~ CUF (%)	Purpose
Peak Power RE	40	Peak load
Firm and Flexible RE	60	Base load
Round the Clock RE	80	Interim base load
Load following RE	60	To provide RE power to meet predefined Load pattern

RE firming & transmission Optimization

- **Solar generation is parabolic in nature**
  - **lower utilization of the transmission infrastructure**
  - **higher transmission charges**





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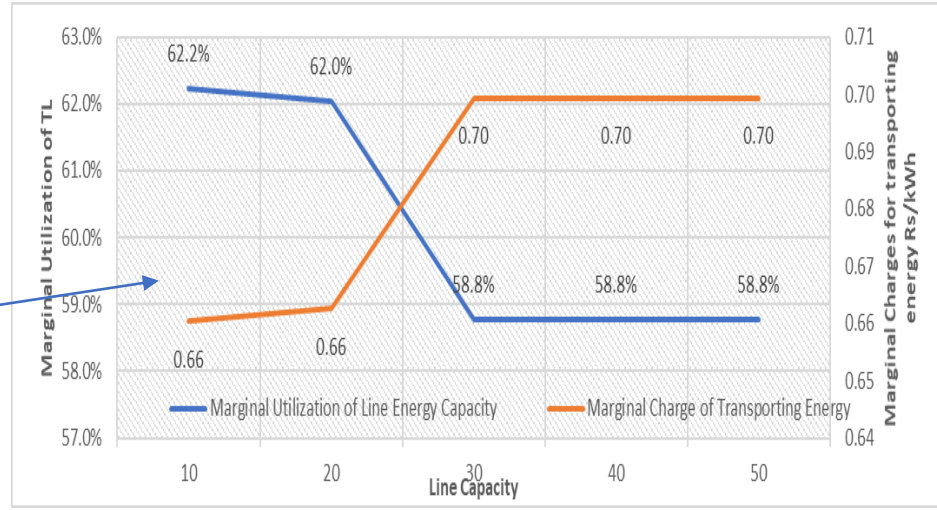


Current Scenario:
100 MW TL - Low Utilization

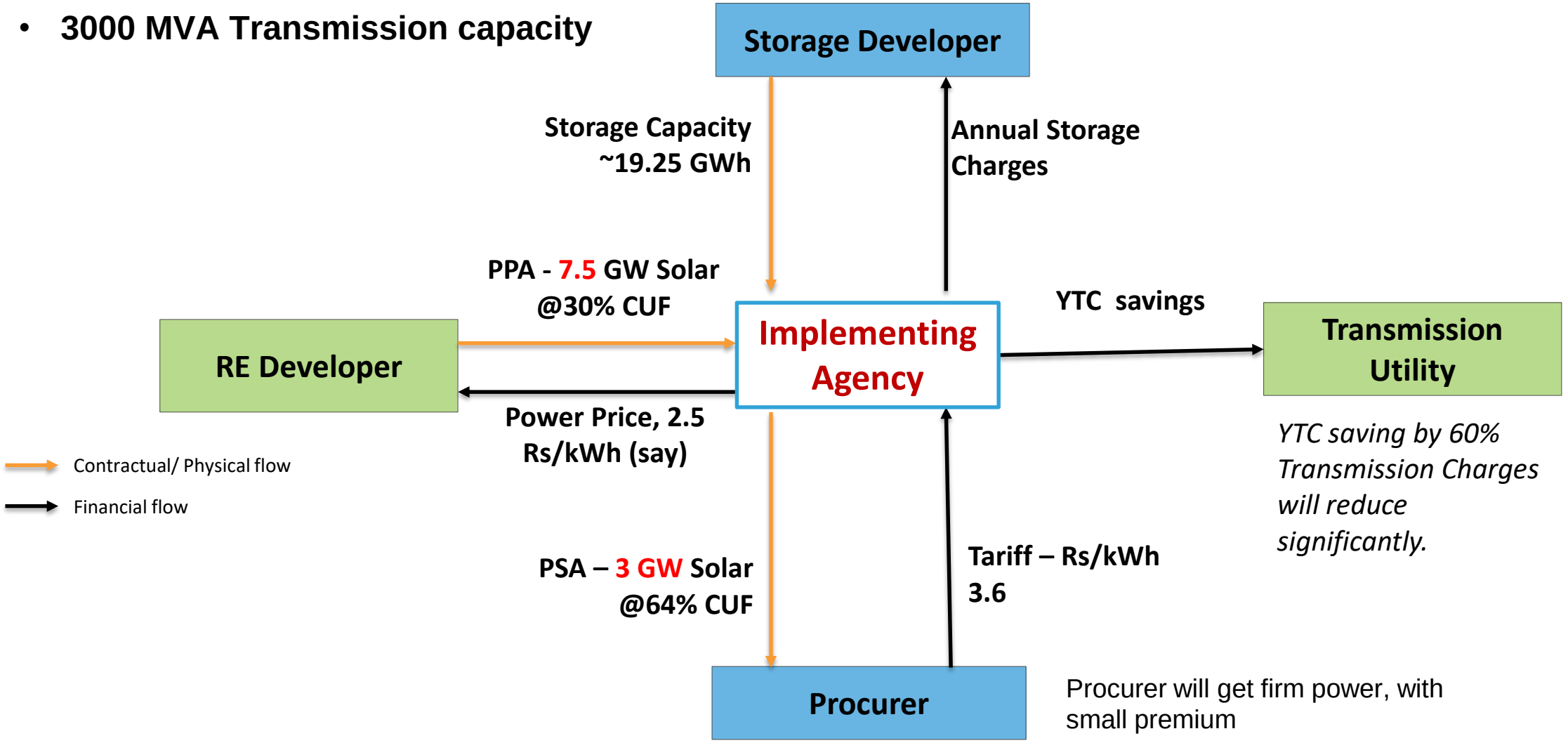
Generation profile for a 100 MW solar project

Proposed Scenario:
50 MW TL –Improved Utilization

- **Increased marginal Utilization of transmission system can be achieved by Deploying Energy Storage**
- **Reduces marginal transmission charges as Line utilization increases**

Case Study | Khavda RE Park - Proposed Business Model

- **7500 MW of RE Capacity**
- **3000 MVA Transmission capacity**



Utility anchored storage for C&I consumers

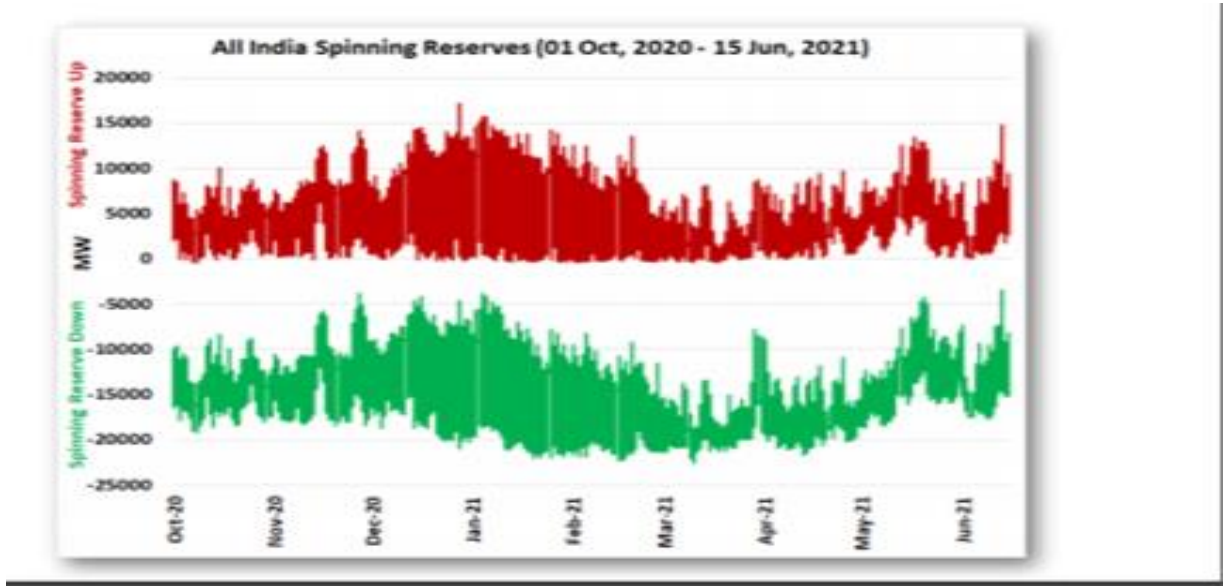
C& I Consumers are Actively perusing BESS projects for following use cases.

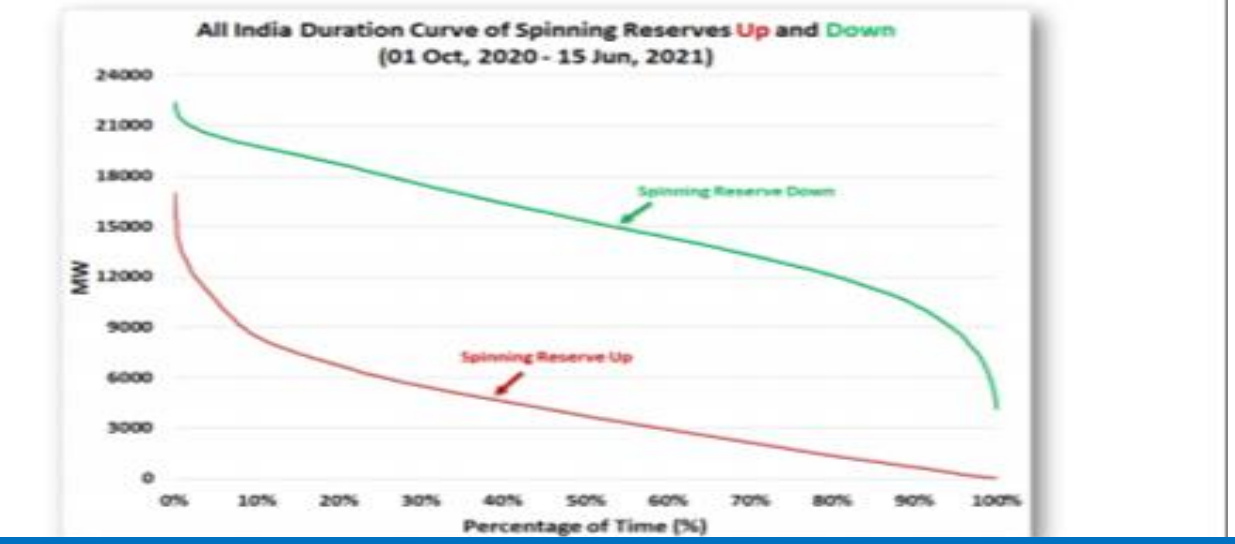
USE CASE	C& I benefits	Benefits to Utility
Contract demand reduction	Savings on fixed demand charges	T&D capex Defferal
Distributed PV consumption at generation	Reduced Dependency on Banking facility	Better promotion of Rooftop Solar Low T&D losses.
Displacement back-up power	Some utilities mandates managing own power during peak hours. Many C&I consumers use DG power BESS can be reliable source.	Effective Peak power management Better utilization of RE power
Price arbitrage:	Savings on ToD Tariff.	Better utilization of RE power Reduced Power procurement during peaks.

Ancillary Services

- Limited Resources for UP and Down Regulation during some times can potentially threaten grid security.
- In developed Energy markets, active Ancillary services markets offer good sources if additional return to developers.

GoI has notified guidelines for ancillary services





Pilot Projects of 500MW/1000 MWh Stand alone BESS

- 4000 MWh stand alone BESS pilot projects are being planned.
- First project of 500MW/1000 MWh has launched.
- Intended applications
  - Energy Arbitrage for utilities
  - Ancillary Services for grid operator
  - Open market for BESS

Salient features of the RfS

Standalone BESS Project : 2 Projects of 500 MWh (250 MW x 2 hrs) each.

To be set up on "B-O-O-T" basis for providing storage facility to Procurer "on-demand" basis. – Transfer at the end of 12th year

Land & connectivity will be provided by the transmission licensee at Fatehgarh-III S/S of ISTS network.

Both Projects to be set up at the same location, a bidder can quote for either one or both of the Projects.

Bidding to be conducted on a single tariff i.e. capacity charges (INR/MW), payable on monthly basis

SECI shall sign BESPA for utilization of 60% of Project Capacity - 40% to be taken care by developer

Performance Criteria

- Min. availability of 95% on annual basis. – Annual Degradation factored.
- Min. 85% Round-trip efficiency to be maintained – LD on lower efficiency.
- Charging/discharging as scheduled by Off-taker - Resting period" of 1 hour
- BESS to be made available for daily utilization of 2 cycles/day.
- Penalty on account of non availability – 2x capacity charges for non-availability

Thank You

Since 2009, Clean Horizon has been a one-stop shop energy storage consultancy

MARKET ANALYSIS

Our team constantly tracks regulatory and market evolutions which support the emergence of energy storage all across the world.

We maintain our monthly Update from the Field market analysis reports, as well as CHESS, our global database of MW-level energy storage projects.

Compass
Market intelligence services

TECHNICAL CONSULTING

Relying on CRE-STORE, our dedicated energy storage modeling tool, we act as owner's engineer and lender's engineer for IPPs and lenders worldwide.

We also work for national utilities to help them quantify their energy storage master plan.

CRE-STORE
Storage simulation tool

Agenda

Business models for storage in India

- **Current revenue streams for energy storage in India**
  - **Tenders**
  - Day Ahead/ Real Time Market/ Green Day Ahead market trading
  - Deviation Settlement mechanism

- Future revenue streams for energy storage in India
  - Ancillary services

Large scale energy storage tenders have been published over the past months.

Large standalone Energy storage tenders in India:

	Capactity (MW)	Energy capacity (MWh)	Status	Other resource	Offtaker	Description
SECI standalone energy storage tender pilot Project Rajasthan	500	1000	Tender launched and closed (June 14th 2022)	No	SECI	Bess purchase agreement 60% of the capacity of the project will be Contracted Capacity that is managed by SECI and energy and utilization of remaining 40% capacity is to be managed by the Developer.
NTPC storage tender – Rajasthan	250	500	Tender launched and closed (June 6th 2022)	No	NTPC	Located on the same site as SECI standalone storage tender project
NTPC Renewables	500	3000	Tender launched and closed (March 2022)	No	NTPC Renewables	Remuneration: energy storage service agreement The renewable power generated from the collocated solar plus wind project will be used to charge the energy storage project. NTPC will use the energy storage facility on a demand basis, as required during the peak and off-peak hours.

Energy storage is also tendered in hybrid tenders

Hybrid projects are becoming very cheap, and even cheaper than thermal powerplants. Indeed, the latest 1.2 GW hybrid tender coupling pumped hydro, batteries, solar and wind power in 2020 resulted in cost for peak demand hours of 76 €/MWh and off peak of 35 €/MWh.

In 2020 1.2 GW Round-The-Clock (RTC) hybrid tender coupling:

2 winners (ReNew Power and Greenko):
- 76 €/MWh peak hours tariff
- off peak of 35 €/MWh

Requirements:
Provide at least 3000 kWh/MW contracted during the peak hours (between 6 and 9 am and between 6 pm and 12 am)

Average coal powerplant cost of electricity fluctuates between 61 and 85 €/MWh

Renewable energy can be cheaper than coal powerplants

SECI plans on releasing other firm power renewable energy tenders such as this one in the future once it has more experience with this type of projects. This type of project will help discoms be interested in renewable energy outside of their obligations to purchase renewable energy.

Business models for storage in India

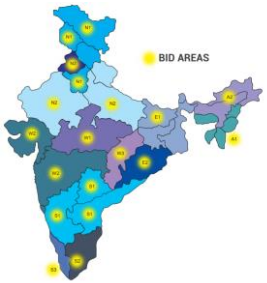
- **Current revenue streams for energy storage in India**
  - Tenders
  - **Day Ahead/ Real Time Market/ Green Day Ahead market trading**
  - Deviation Settlement mechanism

- Future revenue streams for energy storage in India
  - Ancillary services

One of India's goals is to have a centralised market where the generation is traded

India is divided into several bid areas, each area has its own market price because of connection limits between areas

India bid areas (DAM, RTM, GDAM):



- DISCOMs can trade energy on the energy exchange markets to make sure that their generation = demand. Otherwise, they must pay charges via the Deviation Settlement Mechanism.
- Real Time market is used to make close to real time adjustments, helping DISCOMS reduce their imbalance costs.
- The Green Day ahead market enables participants to purchase and sell renewable electricity on a day-ahead basis.

Market	Date of creation	Main goal	Product duration	Average daily spread[1] (€/MWh)	Average daily volume traded (MWh) – April 2022
Day-ahead market	2008	The day-ahead market enables DISCOMs to purchase electricity outside of their generation portfolio and outside their state.	15 min	88	137,000 MWh
Real Time market	2020	Real-Time market enables DISCOMs to adjust close to real time their generation to match their demand.	15 min	86	56,185 MWh
Green Day ahead market	2021	Before GDAM, renewable power was procured through the green term–ahead market, wherein electricity is purchased weekly. However, GDAM allows an entity to participate in bids every day, thus offering more flexibility to procure power.	15 min	63	7000 MWh

1. Based on May 2021 to May 2022 prices found on Indian Exchange Platform website

https://www.linkedin.com/pulse/rtm-its-interaction-other-dispatch-tools-markets-india-p-k-agarwal

Solar Energy Corporation of India (SECI) has launched a tender for 500 MW/1000 MWh standalone battery energy storage systems in the state of Rajasthan.

SECI wants to experiment with this first project to be able to procure more BESS in the future.

The revenue streams of the battery in this tender are :

- the **PPA remuneration** (on all the capacity installed and for 12 years) and
- the **market participation** revenues through 40% of the project's capacity: the battery can generate revenues from trading on the day-ahead and/or real time markets

The tariff that must be bidded on the tender must enable the project to cover its cost. **52 000€/MW/year** can be expected on the day ahead and real time market based on 2021/2022 prices.

Revenue stream considered outside the PPA tariff remuneration	Tariff to bid to break even in the PPA (k€/$MW_{installed}$/year)
Day-ahead and real-time trading	70

If a project uses the 40% of the capacity of the battery to trade both on day ahead and real time market, it can bid a **70 k€/$MW_{installed}$/year tariff** on the tender and it will reach an IRR of 8% in 12 years.

Main assumptions: Battery 250 MW/ 500 MWh; Discount rate: 8%; Prices on the day ahead and real time market: June 2021 – June 2022 assumed constant over the course of the project; Project duration: 12 years; battery prices: energy part: 220€/kWh; Cost of inverters, and installation: 140€/kW

https://www.seci.co.in/whats-new-detail/2205

Business models for storage in India

- **Current revenue streams for energy storage in India**
  - Tenders
  - Day Ahead/ Real Time Market/ Green Day Ahead market trading
  - **Deviation Settlement mechanism**

- Future revenue streams for energy storage in India
  - Ancillary services

BESS can help Discoms reduce their deviation settlement fees

The **deviation settlement mechanism has been introduced in 2022 to penalize entities that deviate from their scheduled injection/withdrawal from the grid**. In this mechanism, sellers and buyers must pay charges according to their percentage deviation from the scheduled injection or drawal[2].

The "normal rate of charges" for a given time slot is calculated as the highest of:
- the weighted average ACP of the Day Ahead market segments of all the Power Exchanges
- the weighted average ACP of the Real Time market segments of all the Power Exchanges
- the weighted average Ancillary Service Charge of all the regions

The charge paid by the discoms depends on the deviation (%): 100 x [(Actual drawal in MWh) – (Scheduled drawal in MWh)] / [(Scheduled drawal in MWh)].

	Deviation by way of under drawal	Deviation by way of over drawal
Battery considered as a "buyer" asset – schedule higher than 400 MW[3]	Deviation < 10%: **90% of the normal rate of charges** Deviation > 10%: **50% of the normal rate of charges**	Deviation < 10%: **100% of the normal rate of charges** Deviation > 10% and < 15%: **120% of the normal rate of charges** Deviation > 15%: **150% of the normal rate of charges**

Over drawal can be heavily penalized, and therefore, battery storage can help ensure that discoms do not overdraw from the grid.
Thus, storage tenders like the one launched by SECI provide a solution for discoms in order to manage the grid and reduce imbalances. **DISCOMS benefit from the BESS as it enables them to reduce their imbalance and therefore pay less Deviation Settlement charges.**

1. https://psuwatch.com/government-proposes-penalty-discoms-failure-24x7-power-supply-all-consumers/
2. https://cercind.gov.in/Regulations/168_reg.pdf
3. Batteries can either be considered buyer or seller depending on the status of their owner. Rates vary depending on the asset status (seller or buyer)
4. ACP: Area clearing price

Business models for storage in India

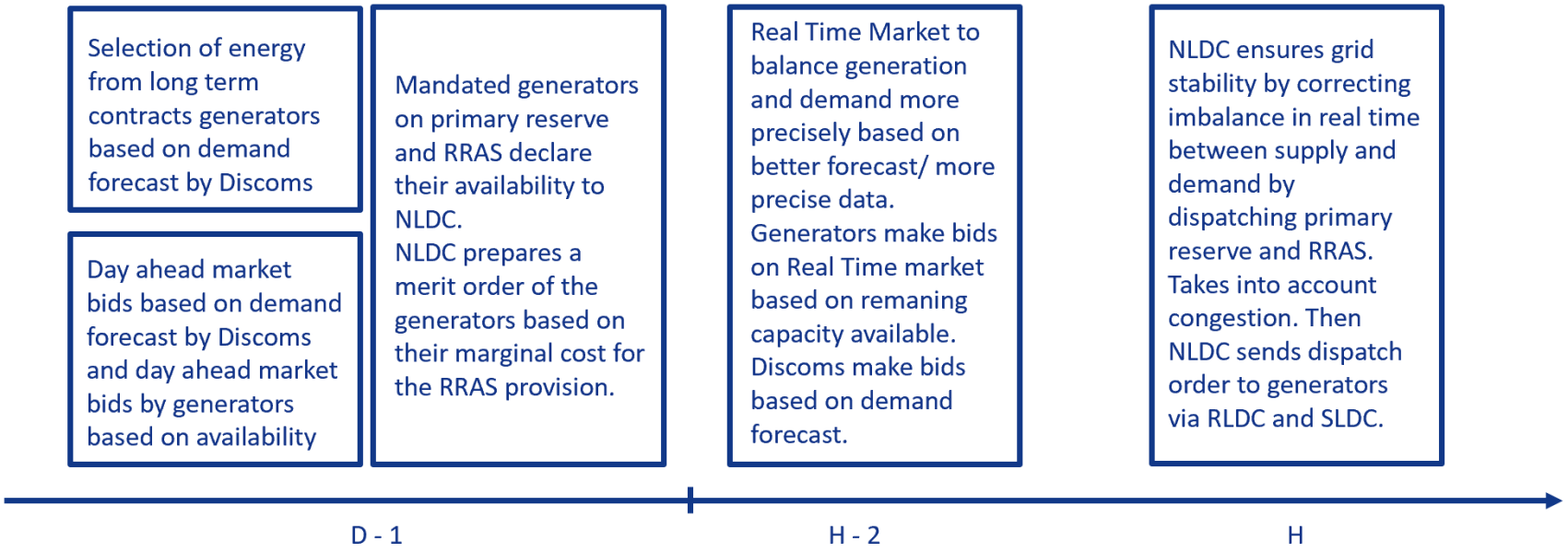
- Current revenue streams for energy storage in India
  - Tenders
  - Day Ahead/ Real Time Market/ Green Day Ahead market trading
  - Deviation Settlement mechanism

- **Future revenue streams for energy storage in India**
  - **Ancillary services**

The current ancillary services in India are provided by mandated generators.

Most of the ancillary services are provided by thermal powerplants.

Illustration of the roles of each stakeholder for electricity generation/demand balance:

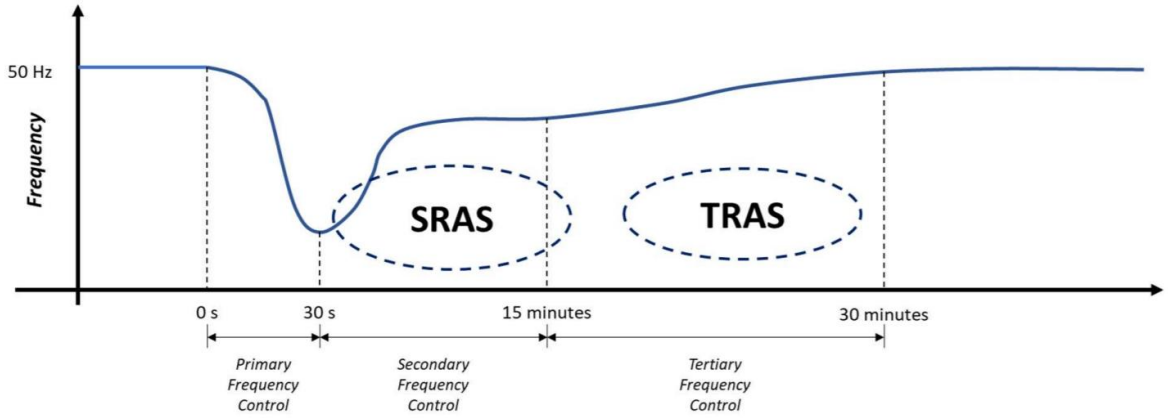


RRAS and other ancillary services are used for handling imbalances during the actual dispatch of electricity. This is performed nationally by the Nodal Agency and then the dispatch orders are sent by the Regional Load Dispatch centers:

- Primary reserve is mandatory and provided by large generators
- There is currently no **secondary reserve** in India (in the process of being implemented)
- Tertiary reserve (RRAS) is provided by mandated generators which are connected to the interstate transmission network and whose contracts are under the CERC regulation

A draft for new regulations of Ancillary Services has been published in May 2021.

The draft introduces the SRAS (Secondary Reserve ancillary services) and TRAS (Tertiary reserve ancillary services) services. For now, primary reserve will remain a mandatory service for some generators.



	Assets which can provide the service	Duration	Revenues	Procurement
SRAS	All types of assets including storage AGC enabled Minimum response of 1 MW	30 min minimum	Assets with high ramping rate and low variable/compensation charge will have a higher probability of getting dispatched. The service is paid at the rate of their variable charge or compensation charge for the SRAS dispatched for every 15-minute block plus a premium depending on the performance of the asset (up to 47 €/MWh).	On a regional basis by the Nodal Agency
TRAS	All types of assets including storage Capable of varying its active power output or drawl or consumption on receipt of dispatch instruction	60 min minimum	Energy payment in €/MWh TRAS up and TRAS down bids. Up: pay as clear (assets gets paid at the price of the last asset selected) Down: pay as bid	Dispatched by the Nodal Agency

CLEANHORIZON
The Energy Storage Experts

Thank you for your attention

Your questions are welcome !

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The regulatory framework for storage is evolving very fast.

The Ministry of Power of India published on the 29th January 2022, clarifications regarding the use of Energy Storage Systems:

1) Storage systems can be used either standalone basis or in complementarity with generation, transmission and distribution. ESS shall be **accorded status based on its application area**.
2) Storage can be **owned by distribution and transmission** system operators. Distribution and transmission system operators can also sign service agreements with developers for storage system usage. Developers can also own their own system and participate in ancillary services with it.
3) In terms of financial security, given that some discoms are financially weak, discoms can be supported by the government for the payment of the service agreement.
4) If discoms own their own storage system, it can be used to reduce their imbalance costs.

The goal of the IESA is to make sure that storage can be used for any purpose without strict regulation. India Energy Storage Alliance is an organization that pushes for the development of the storage market in India.