To,
The Secretary,
Central Electricity Regulatory Commission,
3rd & 4th Floor, Chanderlok Building, 36 Janpath,
New Delhi 110001

Dear Madam,

Subject: Comments on Staff Paper on Introduction of Electricity Storage System in India

The Hon'ble Central Electricity Regulatory Commission ('**Commission**') has published the Staff Paper on Introduction of Electricity Storage System (ESS) in India and has invited comments from stakeholders. India Energy Storage Alliance (IESA) has been at the forefront of driving awareness and adoption of large-scale energy storage projects in the country through its membership network. IESA hosted a webinar session inviting comments from its members and arranged a stakeholders' consultation with Federation of Indian Chambers of Commerce and Industry (FICCI) in which members of the Commission participated. Subsequently we have collated the key comments/suggestions from the stakeholders and are presenting it as below.

Key recommendations from India Energy Storage Alliance

- Energy storage should be defined through suitable amendments to the electricity act.
- Energy storage should be permitted to be classified as a generation, transmission or a distribution asset based on the application and business model.
- Energy storage technologies provide multiple value proposition to the grid including energy arbitrage, capacity benefit, ancillary services (frequency regulation, ramping support, operational reserves, reactive power support) etc. Allowing stakeholders to capture these values through a market design that takes into account accuracy, speed of response can help adoption of better grid technologies. Advanced storage technologies with the right power conditioning system can also provide reactive power support to the grid.
- Energy storage for ancillary services should be planned in accordance to the proposal under the report for Large Scale adoption of Renewable Energy (RE) that was scheduled for implementation from 1st Apr'17.
- Energy storage technologies have been proven as the most cost effective way of providing ancillary services in past 3-4 years around the globe. In India, we have an opportunity to leapfrog adoption of ancillary services by adopting regulatory mechanisms such as pay for performance, that creates incentives for better performing technologies to be deployed for improving grid reliability. This could offer a significant market opportunity for energy storage in the immediate future if a technology neutral market design allows it to compete with traditional assets.
- ESS assets could be operated by having Storage as a Service where the customer pays on a per MWh basis through a market mechanism. It is also important in not considering the levelized energy costs as only matrix. Storage provides flexibility to grid and can allow optimization or deferral of investments in T&D assets. Credit for

such benefits should be accounted appropriately instead of just socializing the costs of overbuilding T&D infrastructure.

- Separate tariff for renewable energy with storage assets should be considered as these hybrid assets could also be used to provide a firm and dispatchable renewable power and serve the peak load demand.
- Energy storage integration with RE should be considered based on system level savings of optimizing Green Energy Corridor (or similar T&D) investment as well as avoidance of curtailment that is faced by RE developers in states such as Tamil Nadu and Rajasthan.
- There is a need to periodically review the Deviation Settlement Mechanism associated penalties for forecasting errors, as current level of penalties are not sufficient to incentivise measures to address these errors.
- Scheduling and settlement could be set to a 5 min slot from the existing 15mins and ESS could provide the required flexibility.
- Classification of energy storage and an operational framework will enable adoption of Electric Vehicles (EV) and its associated charging infrastructure.
- ESS standardization and safety to be considered. System level standards are required from an Indian context. Appropriate safety standards and recycling frameworks should complement the regulation.
- Appropriate grid code amendments and interconnection standards are required to avoid delays in deployments and uncertainty or customizations that lead to higher costs.

We have enclosed response to the questions raised in the Staff Paper for your kind perusal. Please feel free to reach to undersigned, if we can provide any additional details.

With best regards,

Dr. Rahul Walawalkar

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President & MD, Customized Energy Solutions (India)

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Response to the questions raised in the CERC Staff Paper

1) **Whether Electricity storage facility is required in the Indian Power System to address the various challenges discussed in the paper? Or can these issues be addressed through alternative solutions?**

Yes, electricity storage is crucial for the Indian power system. Since Indian grid is still evolving in terms of deployment of new generation capacity as well as T&D investments, energy storage can be deployed across the grid for improving flexibility and asset utilization by avoiding peak generation and excess T&D investments.

Energy storage technologies provide multiple value proposition to the grid including energy arbitrage, capacity benefit, ancillary services (frequency regulation, ramping support, operational reserves, reactive power support) etc. Advanced storage technologies with the right power conditioning system can also provide reactive power support to the grid.

Policy makers are paying special attention to storage considering the electric grid is witnessing significant Renewable Energy (RE) capacity addition. The International Finance Corporation (IFC) report[1] says, "Energy storage is a crucial tool for enabling effective integration of renewable energy and unlocking the benefits of local generation and a clean, resilient energy supply". Energy storage systems offer the desired flexibility across the generation, transmission and distribution systems in the grid. Energy storage could compliment RE assets like solar to provide smoothing and firming in addition to meeting peak demand and provide ancillary services like frequency regulation etc.

Energy storage technologies have been proven as the most cost effective way of providing ancillary services in past 3-4 years around the globe. In India, we have an opportunity to leapfrog adoption of ancillary services by adopting regulatory mechanisms such as pay for performance, that creates incentives for better performing technologies to be deployed for improving grid reliability. This could offer a significant market opportunity for energy storage in the immediate future if a technology neutral market design allows it to compete with traditional assets.

The existing alternative solutions include thermal and gas power plants but they are not the most cost-efficient considering the reduced capacity utilization factor that is witnessed due to changing load and renewable power mix in the grid. Hydropower and pumped hydro are other alternatives however as the commission observes their utilisation is low currently and as a technology they cannot be scaled up owing to environmental constraints.

2) **How the requirements of storage facilities is to be assessed in the grid? What can be the specific criteria to be considered for development of storage facilities and associated transmission system?**

[1] Energy Storage Trends and Opportunities in Emerging Markets; IFC; 2017

The requirement for energy storage could be assessed depending on the applications and services provided to the electric grid. The key determination of the quantity required could vary based on the underlying supply – demand mismatch as well as the evolution of storage technologies. A detailed system level cost benefit analysis could be conducted to determine the amount of energy storage required as compared to alternate options such as transmission expansion or peaker power plants. Various studies around the globe particularly in USA (California) have led to mandate for deployment of 1300 MW energy storage. A recent study[2] for the state of Massachusetts evaluated the need for energy storage and recommended a development of 600MW of advanced energy storage in the state by 2025. IESA believes that the value proposition for India is much clearer and even larger system level benefits can be achieved in India.

Quantum of storage for ancillary services can be determined based on the experience from other countries. For example, US markets witness close to 1% of peak power capacity as frequency regulation ancillary service requirement and similarly in an Indian context close to 2-2.5% of peak power capacity is recommended by POSOCO for frequency regulation. This would make the requirement for freqnecy regulation to be 3-5 GW by 2022. In US, energy storage serves close to 25% of the ancillary service market in regions such as PJM, which have adopted pay for performance regulations.

Conventional generation assets balancing intermittent RE will be challenging considering RE penetration will be high in a few states and in order to balance the system existing Transmission and Distribution (T&D) network should be upgraded. Numerous academic studies around the globe have demonstrated that using thermal plants for backing up varability of renewable energy could lead to higher SOx and NOx emissions as well as heigher fuel consultion leading to drastic reduction in the environmental benefits anticipated from RE deployment. Energy storage technologies can provide a cleaner alternative for such support. Energy storage facilities could also be built to defer investment in T&D development and could be used to serve the local distribution network.

Currently, SECI has started pilots with 10% of solar power capacity is proposed for energy storage in India and going forward this ratio is likely to be increased. The IFC report remarks that to overcome barriers to storage development, this type of requirement for combined solar PV plus storage maybe crucial for establishing local technical expertise and developing investor trust in technology and project development process.

3) What are the perceived policy changes required to deploy the bulk storage facilities in the Indian Power System?

As the commission observes there is a need for regulatory change to enable energy storage in the electricity grid. The commission highlights the need to identify the ownership of the storage assets and the operational framework for the assets.

[2] State of Charge, Massachusetts Energy Storage Initiative Study, 2016

In terms of amendments needed for existing regulations, the following suggestions is made on the **Electricity Act (2003)** and Amendment Bill, 2014

- Section 2, Clause 15A "Decentralised Distributed Generation": Energy storage could be classified as decentralised distributed generation along the lines of hybrid power system defined in the clause.
- Section 2, Clause 57A "Renewable Energy Sources": Energy storage integrated with Renewable Energy (RE) could be classified under this clause and would provide firm power.
- Section 3, National Electricity Policy and Plan: Energy storage should be considered as part of the planning process along with renewable energy sources, aimed at promoting smart grid, ancillary services, and decentralised distributed generation.
- Section 7, Clause 1 "Spinning reserve": The definition accounts for any backup capacity installed in the generating stations and energy storage should be classified accordingly.
- Section 13/14 'Licensing' : Energy storage delivered as part of Electric Vehicle charging infrastructures should be either classified as an exempted authority or as a licensee.

Indian Electricity Grid Code

- Role of CTU; if storage is part of the transmission asset as proposed in the paper, CTU will be unable to trade or sell electricity.
- "Bilateral transaction": Enabling energy storage to participate in the power exchange market would require it to be classified along the lines of a traditional bilateral transaction.
- "Demand response": Energy storage, which could participate in demand response, should be incentivised accordingly as specified in the grid code.

Bulk storage facilities could be deployed by framing policies that consider the additional value add of energy storage. Regulations for ancillary services and enforcement of Deviation Settlement (DSM) penalties along with a narrow tolerance band will enhance the grid and could create a market for deployment of ESS.

On a general note, Government subsidies like Viability Gap Funding (VGF) is needed for enabling energy storage with RE projects. For manufacturing, custom duty benefits and tax benefits for local manufacturing will aid development of the energy storage sector.

Also, one of the low hanging fruits is to allow energy storage technologies to provide ancillary services (particularly frequency regulation service to the grid). CERC has already asked POSOCO to start procuring ancillary services (with tertiary response) since last year. This year the secondary response (frequency regulation services) was scheduled to start procurement from 1st April 2017. Making this procurement technology neutral and performance based could be a great start.

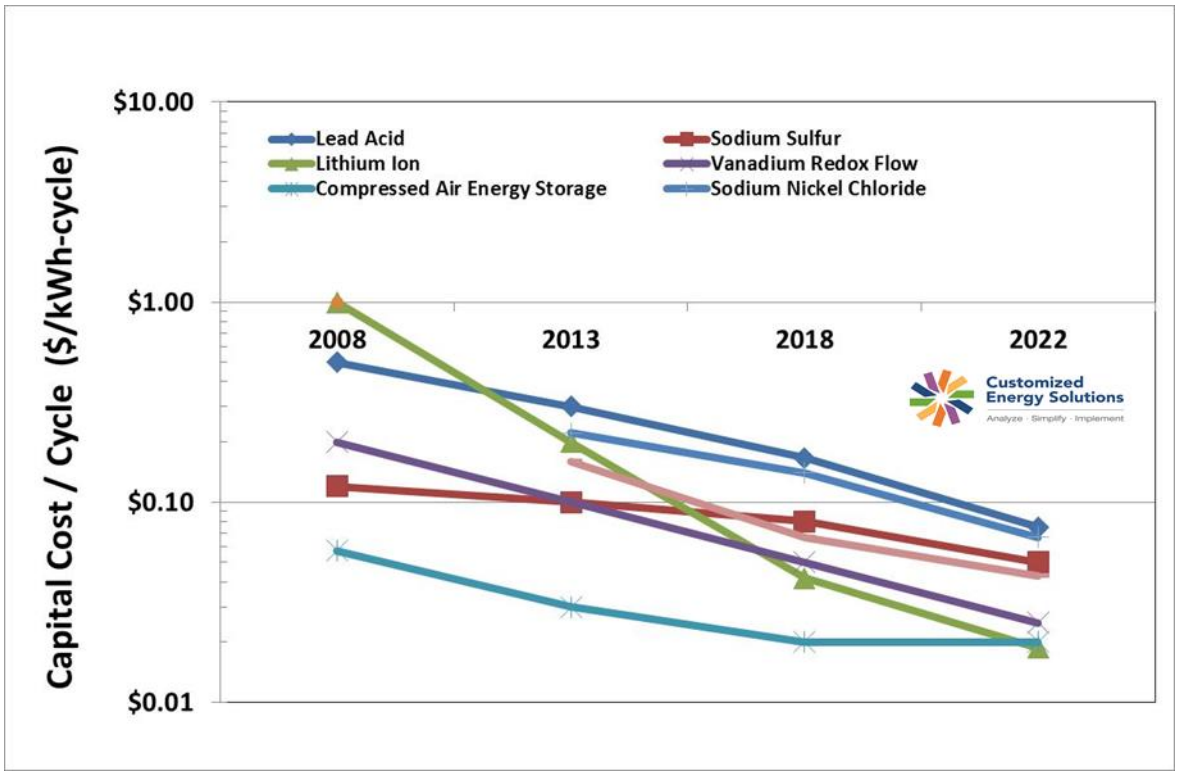
4) Whether Electricity storage technology is expected to achieve commercial viability as believed in the international market?

Energy storage technologies are already commercially viable for a wide range of applications. ESS as a solution would be commercially viable for island grids, remote locations and as an alternative to diesel generators.

As the market for energy, storage is developed by having a suitable regulatory framework there would be more research and development aiding the manufacturing sector, which would further bring down the costs. Adoption of energy storage in telecom towers is an example from an Indian perspective and similar trend could be witnessed in the Electric Vehicle(EV) market.

The response to the enhanced frequency response bid by National Grid, UK where 36/37 generators proposed energy storage demonstrates that ESS is commercially viable under certain market conditions already. (*A detailed global overview is provided in annexure*)

A key need for achieving cost reductions is the scale of deployment. Chart below demonstrates the witnessed trend for past 10 years as well as anticipated trend till 2022. Apart from the technology cost reduction that will be led by setting up of local manufacturing facilities, significant saving can be achieved in system engineering and integration side immediately. What is required is for the Indian policy makers to provide guidance to the industry similar to what was achieved for solar with the launch of National Solar Mission.



5) What could be the appropriate model for fixation of tariff for multiple uses of storage facilities? Can the tariff of the ESS be determined under cost plus or competitive bidding basis as a part of augmentation of generation or transmission assets? What can be the operational or performance parameters for recovery of the cost?

Initially the tariff fixation for energy storage could be in line with CERC's determination of tariff for RE which takes into consideration the trends in technology and costs for different renewable energy technologies. This would enable a level playing field for all developers and projects and as the technology and price-determination through a competitive bidding would be feasible when the energy storage market reaches a maturity.

Tariff fixation should account for the application. If the ESS is for a transmission asset, it should be priced accordingly and as a generating asset, it should be permitted to participate in the power market. The Federal Energy Regulatory Commission (FERC)'s policy statement[3] on energy storage calls for 'Utilisation of Electric storage resources for multiple services when receiving cost-based rate recovery'.

Multi part tariffs like in the international markets could be an option. In US, FERC order 755[4], pay for performance's compensation is based on Capacity payment and a performance cost based on their regulation performance. Likewise the Enhanced Frequency Response (EFR)[5] of the UK through which a cumulative capacity of 200MW of storage assets were chosen makes a 2 level payment, Capacity Payment and an Availability payment. All these services are provided through a market based model and the same would be ideal for India in the long run.

6) What type of financial and nonfinancial data, if any, and what level of detail need to be reported to CERC for the storage technologies for fixation of cost based tariff?

Financial data in terms of system cost for technologies, operation and maintenance costs would be required in addition to evaluating the value benefits through Total Cost of Ownership (TCO).

Technical data like cycle life, C rate, efficiency, capacity etc. should be considered individually for different ESS technologies.

7) How scheduling, energy accounting and open access issues will be dealt when the generation output and energy storage output are measured at two different grid points?

One of the key parameters would be to ensure there is no double accounting in terms of transmission and distribution charges and duties charged while charging energy storage and then taxing the energy sold from energy storage solutions. The same was referenced in the recent FERC's 16-23 NOPR[6] on deciding the pricing for energy storage assets that participate in energy resale or ancillary services. A recent consultation paper by UK's regulator Ofgem has invited suggestions from the industry in dealing with the double accounting of service charges for energy storage during the transmission and generation cycles[7]. Dealing with a similar scenario in India would require appropriate classification of energy storage assets that

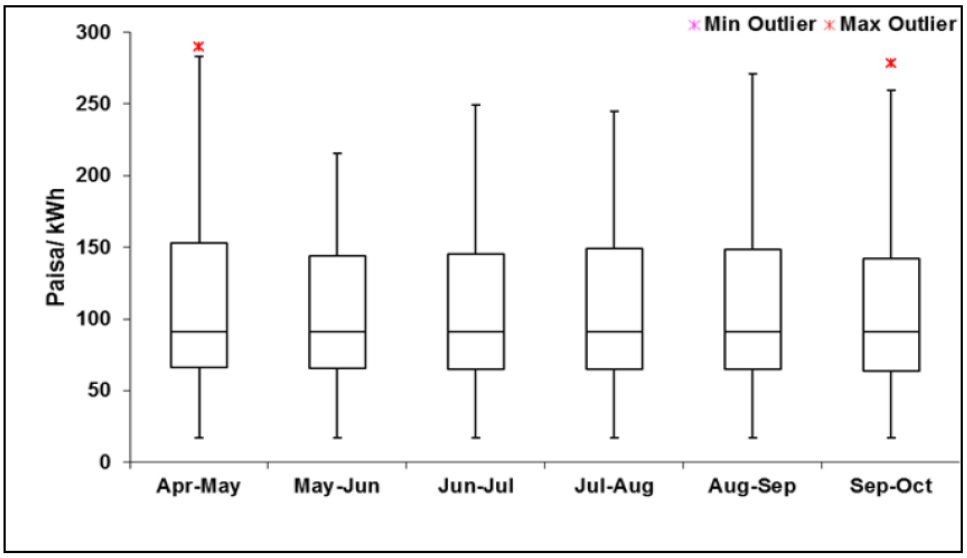
[3] Federal Energy Regulatory Commission, Policy Statement, 2017
[4] Federal Energy Regulatory Commission, Order No 755, 2011
[5] Enhanced Frequency Response, National Grid, 2016
[6] Federal Energy Regulatory Commission, Notice of Proposed Rulemaking 16-23, 2016
[7] Targeted Charging Review: a consultation, Ofgem, Mar 2017

could participate in the energy resale and ancillary services with the assets being charged a different price for charging/discharging.

A report by the Forum of Regulators[8] in 2016 mooted the idea of having a scheduling and dispatch in 5 min intervals. If scheduling and dispatch is implemented on a 5 min basis, energy storage will be crucial to avoid deviations and penalties.

8) What would be the role of system operators and Central Transmission Utility in operations and planning of the Electricity Storage System?

CTUs would be crucial in integrating energy storage through a market mechanism through ancillary services. They would need to access and plan ensure grid adequacy and development. System operators could use ESS for meeting peak demand rather than depending on gas/thermal power plants. In the recent report on Reserves Regulation Ancillary Services (RRAS)[9], POSOCO provides details on the range of services for which tertiary reserves were deployed between April-Oct 2016.



Fixed Charge of RRAS providers (POSOCO, 2016)

The highest and the lowest total charges varied between 1096 paisa/unit and 160.2 paisa/unit respectively. On the other hand, the average price for pay for performance has come down from $45 / MWh to below $15 / MWh in US i.e. from ~300 paisa /kWh to 100 paisa / kWh for frequency regulation in US markets during 2013-16. System operators and CTU can incorporate ESS systems in their capacity planning as these assets can provide the most cost efficient solutions for the services considered. The impact of tariff to the consumers would be less than 5 paise/unit.

[8] Report on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity, FoR,2016
[9] Reserve Regulation Ancillary Services (RRAS), Implementation in Indian Grid, Half year analysis and feedback, POSOCO,2016

Although the Electric Vehicle (EV) market is still in a nascent stage in India, system operators should plan to see a surge of EV in the grid. Utilities should provide incentives for charging in a way to reduce the overall demand during peak time. A recent report from ICCT[10] that looked at the regulatory landscape across countries, highlighted that EVs could provide ancillary services to the grid and with proper planning, electric vehicles' benefits to utilities outweigh their costs.

9) Any other issues for development and market acceptance of storage technologies.

Safety standards for components and systems will be crucial. IESA has initiated task force with other industry stakeholders on working to modify existing standards for Indian grid conditions. Environmental clearances needed for batteries and recycling protocols should be clearly defined.

[10] Literature Review on Power Utility Best Practices Regarding Electric Vehicles; The ICCT; 2017

Annexure: Emerging trends in global energy storage landscape

USA

United States has been the global leader in energy storage deployments in the world. At the grid scale, US installed around 250MW/350MWh of energy storage in 2016. The gas leak in Aliso Canyon and subsequent shortages in gas resulted in the Southern California utilities- SCE and SDG&E deciding to procure around 100MW of energy storage, which were subsequently deployed in a record time between Q4 2016 and Q1 2017. Energy storage deployments in the US has been driven by various state level targets.

US energy storage project snapshot (DoE database, 2017)

State	
California	A mandate of 1,325MW of energy storage by 2020. **Self-Generation Incentive Program**[11]: Provides rebates for energy storage up to $ 1,620/kW. More than 250MW of energy storage have been procured via the **Long Term Procurement Process (LTPP).**
New York	**New York Reforming the Energy Vision (NY REV) Initiative**[12]**:** Aimed at promoting distributed energy and energy storage through policies and R&D.
Massachusetts	**State of Charge, Massachusetts Energy Storage Initiative Study**[13] recommended a suite of policies to promote the development of 600MW of advanced energy storage in Massachusetts by 2025.

[11] Self-Generation Incentive Program, California, 2017
[12] New York Reforming the Energy Vision Initiative, 2015
[13] State of Charge, Massachusetts Energy Storage Initiative Study, 2016

In a recent development, a developer has offered solar plus energy storage solution for Hawaii comprising of 28MW PV with 20MW/100MWh energy storage for $ 11c/kWh operational from late 2018.

UK

The enhanced frequency response service in the national grid seeks to achieve 100% active power output at 1 sec (or less) of registering a frequency deviation. A total of 36 companies' submitted bids for a 200MW tender[14] in 2016 and 35 of them offered energy storage for this service indicating the maturity of energy storage to deliver these services. A few demand aggregators also participated in the bid. Eight companies have been awarded the contracts. UK's national grid has witnessed significant participation by demand aggregators in providing grid level ancillary services through behind the meter energy storage. Subsequently the UK government has released a call for evidence on creating a smart, flexible energy system with storage being an integral part.[15] The call for evidence is currently under review. In a recent development, the UK regulator Ofgem has proposed a consultation on 'Targeted Charging Review'[16]. The review is aimed to address the regulatory impediments in enabling energy storage and related services in the grid.

Australia

The state government of South Australia in March 2017 invited an Expression of Interest (EoI)[17] to build Australia's largest grid-scale battery by end of the year. The EoI comes in the backdrop of recent blackouts in the state, despite having significant renewable energy installations. The proposed battery capacity is 100MW with four hours of backup to offer reserve and grid resiliency. Close to a dozen companies have expressed interest in the bid, which is currently being evaluated. Tesla energy, has publicly announced to develop the project at $250/kWh, a record price in the industry.

[14] Enhanced Frequency Response, National Grid, 2016
15 A Smart, Flexible Energy System; BIES, Ofgem, 2016
16 Targeted Charging Review: a consultation, Ofgem, 2017
17 Expression of Interest, South Australia, 2017

About India Energy Storage Alliance:

The India Energy Storage Alliance (IESA) was launched in 2012 by Customized Energy Solutions to promote energy storage & micro grid technologies and their applications in India. IESA's vision to make India a global leader in energy storage & microgrid technology adoption and hub for manufacturing of these emerging technologies by 2020. IESA's mission is to make energy sector in India more competitive and efficient by creating awareness among various stakeholders in the industry and by promoting information exchange with the end users. IESA also provides insights to technology developers, original equipment manufacturers, policymakers, renewable players and system integrators on the policy landscape and business opportunities in India through frequent interaction with all key stakeholders. As estimated by IESA, the Indian energy storage market is expected to grow to 50+ GW by 2022. Please find more information on IESA at http://www.indiaesa.info/

IESA Members: