FORUM OF REGULATORS

REPORT

ON

REGULATORY FRAMEWORK FOR ENERGY STORAGE AND ELECTRIC VEHICLES

November 2022

Forum of Regulators

Working Group constituted by the FOR on 'Regulatory Framework on Energy Storage System and Electric Vehicles'

Foreword

India under its Nationally Determined Contributions (NDC) goal has committed to reduce its emission intensity per unit GDP by 33% to 35% below 2005 level and to achieve about 40% of cumulative electric power installed capacity from non-fossil fuel-based energy sources by 2030. Hon'ble Prime Minister of India in COP-26 Summit at Glasgow, has also announced the target of non-fossil energy capacity of 500 GW by 2030. With such huge intermittent sources of generation in the generation mix, Indian power sector would need to overcome the challenges for stable operation of Indian Grid, ensuring 24x7 power for all. In other words, with increasing RE penetration in its generation portfolio, Indian grid is now faced with issues related to flexibility, reliability, and security. Energy Storage System (ESS) can be an important tool to integrating variable renewable energy into power systems especially for a grid like India where limited flexible generation resources are available.

The FOR, in its 76thmeeting held on 01 October 2021, after deliberation on the Energy Storage Systems (ESS) and Electric Vehicles (EVs)decided to constitute a Working Group (WG)under my Chairmanship. The Scope of the Working Group (WG) was to examine the use cases of Energy storage and study the impact of penetration of Electrical Vehicles (EV)while suggesting appropriate regulatory framework for Energy Storage System and Electric Vehicles.

The Working Group held five meetings and also visited two Pumped Hydro Storage Projects, which have been useful in deliberating on various possible business models for ESS and EVs in Indian Power System. This report is an outcome of extensive consultation and collaboration and a humble attempt at identifying the regulatory issues and suggesting key recommendations on regulatory framework for Energy Storage System and Electric Vehicles.

On behalf of the Working Group I hereby submit the report on '**REGULATORY FRAMEWORK FOR ENERGY STORAGE AND ELECTRIC VEHICLES**' before the Forum of Regulators.

Sutirtha Bhattacharya
Chairperson, West Bengal Electricity Regulatory Commission

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Abbreviations

AEV	All-Electric Vehicle
AGC	Automatic Generation Control
APPC	Average Power Purchase Cost
BEE	Bureau of Energy Efficiency
BESPA	Battery Energy Storage Purchase Agreement
BESS	Battery Energy Storage Systems
BEV	Battery Electric Vehicles
CERC	Central Electricity Regulatory Commission
Cr	Crore
DRE	Distributed Renewable Energy
DSM	Demand Side Management

EA or Act	Electricity Act, 2003
ESS	Energy Storage Systems
ESSA	Energy Storage Service Agreement
EU	European Union
EVs	Electric Vehicles
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FC	Fixed Charge
FCEV	Fuel Cell Electric Vehicles
FOR	Forum of Regulators
FY	Financial Year
GHG	Green House Gases
GNA	General Network Access
GW	Giga Watts
HEV	Hybrid Electric Vehicles
HT	High Tension
IC	Internal Combustion
IEGC	Indian Electricity Grid Code
InSTS	Intra State Transmission System
IESS	Independent Energy Storage System
ISTS	Inter State Transmission System
LB	Lower Bound
LDC	Load Despatch Centre
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MTOE	Mega Tonnes of Oil Equivalent
MW	Mega Watts
MWh	Mega Watt-hours
MYT	Multi Year Tariff
NEMMP	National Electric Mobility Mission Plan
OA	Open Access
PHEV	Plug-in Hybrid Electric Vehicles
PPA	Power Purchase Agreement
PPSP	Purulia Pumped Storage Project
PSH	Pumped Storage Hydro
PSP	Pumped Storage Plants
QCA	Qualified Coordinating Agency
RE	Renewable Energy
Rs	Rupees
RWA	Resident Welfare Association
SAREP	South Asia Regional Energy Partnership

SERC	State Electricity Regulatory Commission
TOR	Terms of Reference
TPDDL	Tata Power Delhi Distribution Limited
TPS	Turbo Power System
TWh	Terra Watt-hours
UB	Upper Bound
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development
V2G	Vehicle-to-Grid
VFC	Variable Fixed Charge
VRE	Variable Renewable Energy
WB	West Bengal
WBERC	West Bengal Electricity Regulatory Commission
WG	Working Group
XFC	Extra Fast Charging

1 Background

The Forum of Regulators (FOR) was constituted vide Notification dated 16 February 2005 in pursuance of the provision under section 166(2) of the Electricity Act 2003 (EA or Act). It consists of Chairperson of Central Electricity Regulatory Commission (CERC) and Chairpersons of State Electricity Regulatory Commissions (SERCs). The Chairperson of CERC is the Chairperson of the Forum.

The FOR, in its 76th meeting held on 01 October 2021, deliberated on the need of Energy Storage Systems (ESS) and assessment of value of storage in the wake of large-scale penetration of renewable, as ESS has the potential of supporting the ramping requirement of the grid. The FOR also deliberated the issue of likely penetration of EVs and its consequential impact on grid and consumer tariff. It was noted that a study was conducted by FOR in the past. Members felt that given the emergence of EVs and the market developments since the last study, it would be desirable to re-examine the issues of EV penetration with focus on appropriate tariff structure for EVs. International experiences on these aspects may also be examined.

1.1 Working Group and Terms of Reference

After deliberations, FOR, decided to constitute a Working Group (WG) headed by Chairperson, WBERC for carrying out a detailed examination of all the issues connected to energy storage systems (ESS) and electric vehicles (EVs). The composition of the Working Group was proposed as follows:

1. Chairperson, West Bengal Electricity Regulatory Commission – Chairperson
2. Chairperson, Rajasthan Electricity Regulatory Commission – Member
3. Chairperson, Delhi Electricity Regulatory Commission – Member
4. Chairperson, Punjab Electricity Regulatory Commission – Member
5. Chairperson, Sikkim Electricity Regulatory Commission – Member
6. Chairperson, Chhattisgarh Electricity Regulatory Commission – Member
7. Chairperson, Tripura Electricity Regulatory Commission – Member
8. Chief, (Reg. Affairs), Central Electricity Regulatory Commission – Member Convenor
9. Chairperson, Uttar Pradesh Electricity Regulatory Commission – Special Invite

The Terms of Reference (ToR) of the WG are as below:

1. Examine the use cases of the energy storage in the power system

2. Study the international experience on use of energy storage, especially in power systems with high share of RE
3. Assess the value of energy storage, with due regards to the need for meeting ramping requirement in the wake of large scale RE penetration
4. Study the likely penetration of electric vehicles in the Indian power system, impact of the increased EV load on the grid, and impact on the consumer tariff
5. Based on the above, suggest suitable regulatory framework for energy storage system and electric vehicles in the Indian power system
6. Any other matter related and incidental to the above

The USAID has offered technical support to the FOR Working Groups under through its subcontractors under SAREP Program. As a part of this technical support, Idam Infrastructure Advisory Pvt. Ltd. through its contractor RTI International has supported the WG for preparing this report.

1.2 FOR endorsement of the Working Group Recommendations

FOR, in its 83rd Meeting held on 18th November 2022, deliberated on the on the recommendations of the Working group and endorsed the report with following modifications:

a) ESS should be encouraged to be charged with renewable energy.

b) Requirement of obtaining consent from Discom for HT EV charging Station should be removed to encourage the HT EV charging station.

c) For domestic connection use for EV charging, additional proviso may be added to specify that charger capacity should not be more than the sanctioned connected load of the domestic consumer.

d) Recommendations for 'green charging station' to procure power from at least 70% of supply from RE sources may be modified to 100% procurement from RE sources to be categorized as 'green charging stations

2 Working Group Meetings on ESS Framework

The WG held five meetings and visited two pumped Storage Hydro (PSH) Projects to interact with project officials and understand their perspective and issues involved in PSH development and operation. The proceedings of these meetings are summarized as below.

2.1 First Meeting on 04 January 2022

The first meeting of the working group of FOR on Regulatory Framework for ESS and EVs was held on 04 January 2022. The agenda of the meeting was to discuss the ToR of the WG, and Report prepared by the Ministry of Power (MoP) on 'Formulation of Comprehensive Policy Framework for Promotion of Energy Storage in Power Sector'.

Further JS (R&R), MoP made a presentation on "Draft National Policy on Energy Storage, 2021". He highlighted the need for ESS, preparation of bidding guidelines for storage, MoP guidelines on storage system, promotion of storage technologies, financial and tax related incentives, and regulatory & policy framework for energy storage. The Working Group (WG) noted the presentation on the draft report on the Energy Storage System and decided to deliberate on regulatory issues emerging out of the draft report in the subsequent meeting of the WG also decided to visit some pumped storage projects operating in different states. The Minutes of the Meeting of the 1stmeeting are attached as **Error! Reference source not found.**.

2.2 Second Meeting on 07 and 08 April 2022

The second meeting of the WG was held at the Purulia Pumped Storage Project (PPSP) in West Bengalon 07 and 08 April 2022. The WG visited PPSP where officials of PPSP made a presentation on the plant. PPSP officials presented the operational philosophy and advantages of the pumped storage plants (PSP), like peak shaving, load balancing, spinning reserves, fast ramp up and ramp down of generation, and longer life. PPSP further added that PSP helps in system stability and helps in regulation of frequency during disturbance. The state of West Bengal (WB) has proposed a 1,200 MWs capacity Mega Solar Power Project and use of solar power for water pumping purpose to reduce the need of conventional power that is currently required for pumping, thereby lowering GHG emissions. The state of WB has proposed to combine Purulia PSP and Turga PSP with solar power projects for balancing the natural fluctuations of solar generation.

Further, Idam Infra, consultant engaged under SAREP project of USAID, delivered a presentation on "Regulatory Framework for Energy Storage and Electric Vehicles". The Consultant presented that ESS can be deployed for various purposes in the grid such as generator for meeting peak demand, consumer for consuming excess power during off peak period, transmission device to manage the transmission congestions etc. Further, ESS can be useful for distribution licensees or RE generators to manage their deviations during real time operation. The international scenario of ESS applications and regulatory treatment provided to ESS in developed markets was also presented. Further, the consultant summarized the recent guidelines issued by MoP under Section 63 of the Electricity Act, 2003, for Procurement and Utilization of Battery Energy Storage Systems and identified basic issues in regulating ESS and EV in Indian context. The Minutes of the Meeting of the 2nd meeting are attached as **Error! Reference source not found.**.

2.3 Third Meeting on 24 and 25 June 2022

The WG held its third meeting on 24 and 25 June 2022, at Pinnapuram PSP, Kurnool Andhra Pradesh. The WG visited the Pinnapuram PSP where plant officials made a presentation covering India's RE capacity and potential, case study on India's solar and wind potential, an overview of ESS, and an overview of the "one nation one grid" initiative. The WG discussed about long duration ESS, various aspects of pumped storage hydro (PSH) and potential for the same in India, and a case study of China's PSH. A case study on Pinnapuram storage project, facilitation of PSH development in India, and advantages of PSH over battery energy storage systems (BESS) were also presented.

Further, M/s Greenko delivered a presentation on "Regulatory Framework for Energy Storage". It covered grid integration solutions such as round-the-clock RE supply. Key enabling regulatory provisions such as hydro purchase obligations and Hydro Energy Certificates (HEC) on the lines of Renewable Energy Certificate (REC) were also discussed.

The WG deliberated guiding principles for promotion of ESS and EV and key issues and recommendations for regulatory provisions for the same. The WG suggested key recommendations on legal status, connectivity and scheduling aspects and tariff structure for ESS and EV to finalize in the subsequent meeting. The Minutes of the Meeting of the 3rd meeting are attached as **Error! Reference source not found.**.

2.4 Fourth Meeting on 07 July 2022

The WG had its 4th meeting on 07 July 2022 at CERC, New Delhi. Idam Infra, consultant engaged under SAREP project of USAID, delivered a presentation on "Regulatory Framework for Energy Storage and Electric Vehicles". It covered a summary of key issues and recommendations for ESS and EVs. The WG deliberated on the issues and recommendations presented in the 3rd meeting and made further modifications to the same. The Minutes of the Meeting of the 4th meeting are attached as Error! Reference source not found..

2.5 Fifth Meeting on 26 July 2022

The WG in its fifth and final meeting held on 26th July 2022 adopted the report.

3 Technology Overview

3.1 Need of Energy Storage in India

India has seen multi-fold increase in RE capacity during last decade, from around 20 GW in 2010-11 to around 100 GW in FY 2020-21. Intermittent sources like wind and solar have heavily contributed to this capacity build-up over last ten years. At COP26, the Indian Government announced plans to increase the non-fossil fuel capacity to 500 GW by 2030 and reach net zero by 2070. As evident from the various optimal capacity expansion studies as well as Government of India's thrust on clean energy, the Indian power sector is poised to witness significant RE capacity addition resulting in increase in variable renewable energy (VRE) penetration. This high integration of intermittent sources in the grid has its own challenges and has created an urgent requirement for efficient grid-scale storage systems for full capacity utilization during low demand periods and meeting demand during low generation periods. The energy associated with wind and solar sources can be stored through energy storage systems and its usage can be time shifted. Energy Storage System (ESS) is essential to integrating VRE into power systems especially for a grid like India where limited flexible generation resources are available. India's power system is dominated by conventional power sources like coal, and there aren't enough gas resources to provide flexibility in generation. Hydro resources hence become very critical in providing flexibility on the generation side. However, these resources also need to maintain schedules for irrigation requirements and water security and, hence, there is a need to look for other flexible resources in the system to handle the intermittency of renewable resources like wind and solar. ESS would play a critical role for flexibility and balancing purpose with increased penetration of wind and solar to ensure safe and smooth operations of the grid. ESS also offers several utility scale applications, including peak shaving, load levelling, load following, energy arbitrage, backup power, and uninterruptible power supply (UPS). Therefore, discoms in India should consider ESS for their resource adequacy planning and large-scale RE integration. Various countries have recently started deploying large-scale storage systems to take advantage of the many uses and facilities that ESS has to offer. Well-designed policy, market and regulatory frameworks are critical to assess and plan ESS for required flexibility in the system.

3.2 Energy Storage Systems

Energy storage systems (ESS) are systems that convert electrical energy into a stored form, and later convert it back into electrical energy. These systems are characterized by rated power in megawatts (MWs) and energy storage capacity in megawatt-hours (MWh). The following figure shows classification of various types of ESS:

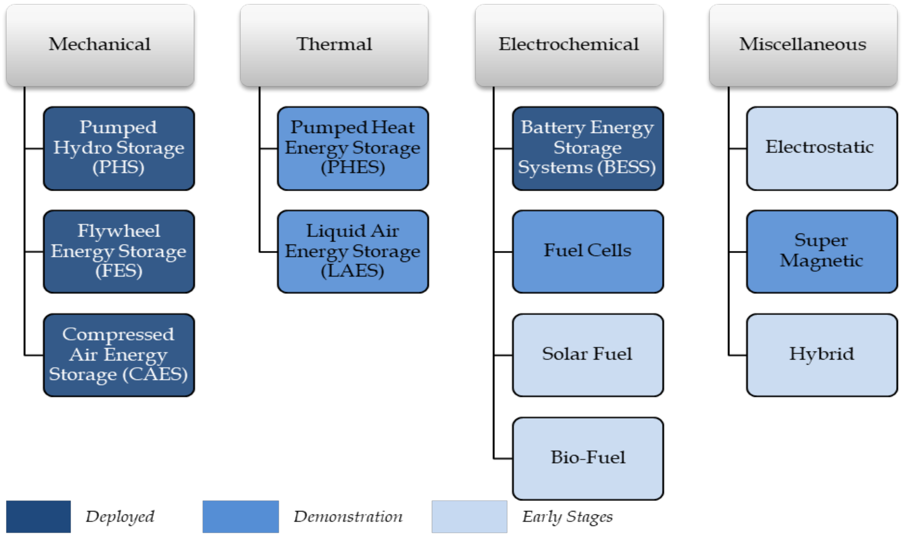

Figure 1: Classification and Maturity of ESS[1]

Pumped hydro, flywheel, compressed air, and battery energy storage systems have been deployed across the world. Pumped heat, liquid air, fuel cells, and super magnetic energy storage systems are in demonstration/commercialization stage while solar fuel, biofuel, electrostatic and hybrid technologies are still in early stages of development.

Among deployed ESS technologies, pumped storage hydro (PSH) and battery ESS (BESS) are found to have significant presence in India and internationally. PSH particularly constitutes over 90% of global deployment of ESS[2]. However, recently electrochemical storage technologies are among fastest growing ESS technologies due to significant reduction in the battery cost complimented with technological improvement.

In India, similar to many other countries, PSH is dominating the ESS with 4,746 MW of installed PSH capacity, of which 3,306 MW are in operation, as on 30 April, 2022[3].The following table shows installed PSH and BESS capacities in India and internationally:

Country	PSH	BESS
India	4,746	10
USA[4]	22,000	2,000
UK[5]	3,000	1,300
Australia[6]	1,600	260

[1]https://css.umich.edu/publications/factsheets/energy/us-grid-energy-storage-factsheet
[2]RENEWABLES 2021 Global Status Report
[3]https://cea.nic.in/wp-content/uploads/hepr/2022/04/pump_storage_4.pdf
[4]https://www.energy.gov/eere/water/how-pumped-storage-hydropower-works
[5]https://www.hydropower.org/blog/the-uk-has-the-opportunity-to-lead-the-way-on-building-clean-energy-storage

Country	PSH	BESS
China[7]	31,490	3,000

Table 1: PSH and BESS Installed Capacities (MWs)

PSH Projects are generally classified as on-stream and off-stream PSH projects depending on being part of riverine system or not. Off stream PSH further called closed loop off stream PSH which are developed away from natural river course and open loop off stream PSH which are developed using one reservoir using river stream while another reservoir is away from river stream. While existing PSH are mostly fixed speed, latest generation models have an adjustable speed with lesser response time. Further, while most of the existing PSH in India are open-loop PSH on the river, closed-loop off-river PSH offer many advantages such as:

1. Independent of irrigation management
2. Size of dams and water conductor systems is limited to power generation requirement only
3. Environmental impact is minimal

CEA has identified various suitable locations for off stream PSH projects which are widely available across the country. Considering the multiple advantages of off-stream closed loop PSH projects over open loop PSH and the availability of suitable locations for the same, India is placed suitably to explore these types of the projects in the wake of large scale RE penetration in the Grid in future.

PSH is known to operate in all four quadrants of active and reactive energy to cater to flexibility requirements of the grid. The following table summarizes these modes of operation[8]:

Quadrant	Active	Reactive	PF	Mode
I	Inject	Inject	Lagging	Generation
II	Absorb	Inject	Leading	Pumping
III	Absorb	Absorb	Lagging	Pumping
IV	Inject	Absorb	Leading	Generation

Table 2: Four Quadrant Operation of PSH

These operations can be further elaborated by the following figure:

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[6]https://www.ge.com/renewableenergy/sites/default/files/related_documents/GEA34801%20PHS_Development_Australia_WP_R2.pdf
[7]https://assets-global.website-files.com/5f749e4b9399c80b5e421384/60c37321987070812596e26a_IHA20212405-status-report-02_LR.pdf, https://www.energy-storage.news/china-targets-30gw-of-battery-storage-by-2025-as-bess-output-grows-150/#:~:text=China%20is%20aiming%20for%2050,year%2C%20state%20media%20has%20said.
[8]https://www.energyforum.in/fileadmin/user_upload/india/media_elements/misc/20200000_Misc/20200820_lr_Online_Training/Soonee_Pumped_Storage.pdf

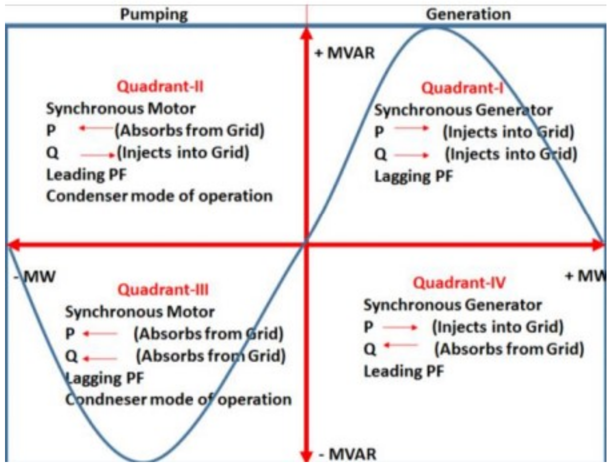

Figure 2: Four Quadrant Operation of PSH

PSH provides grid stability by offering necessary rotational inertia to the grid to improve the transient stability. It also provides flexible generation for managing demand, pumping operations during off-peak period for managing load as well as synchronous condenser operation.

On the other hand, BESS is fast gaining importance due to shorter gestation periods and in the expectation of declining capital cost. Lithium-ion is the most prominent battery technology seen in India and internationally.

ESS can be deployed for a wide range of size and duration requirements as shown below:

Technology	Power Rating	Discharge Time	Application
PSH	Up to 1,000 MWs	8-10 hrs	• T&D grid support • Load shifting • Bulk Power Management
Li-ion Batteries	Up to 1 MW	2-4 hrs	• Uninterrupted power supply • T&D grid support (limited) • Load shifting (limited)

Table 3: Size and Discharge Times of PSH and BESS[9]

ESS has a wide range of applications across energy, grid, and ancillary services[10]:

1. Energy services: energy management, mitigating intermittency, time shifting, peak shaving, load levelling etc.

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[9]https://css.umich.edu/publications/factsheets/energy/us-grid-energy-storage-factsheet
[10]https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, https://www.energy.gov/eere/water/how-pumped-storage-hydropower-works#:~:text=Vital%20to%20grid%20reliability%2C%20today,every%20region%20of%20the%20country

2. Grid services: ramping, load following, grid/network fluctuation suppression, seasonal energy storage
3. Ancillary services: black start, voltage regulation and control, spinning reserve, emergency back-up power

To elaborate further on grid ramping services provided by ESS, it is important to note that high renewable adoption creates significant ramping and balancing challenges for utilities. In 2013, California published a chart showing net load against time of the day, which is now referred to as the "duck curve". It showed that as solar output increased during the day, net load to be met from dispatchable resources reduced. But as solar output dropped by evening, dispatchable resources needed to be ramped up to meet that shortfall in supply. The chart showed that with increasing solar penetration, this ramping down and up of dispatchable resources increased significantly. This situation would be worsened if the system would typically have an evening peak.

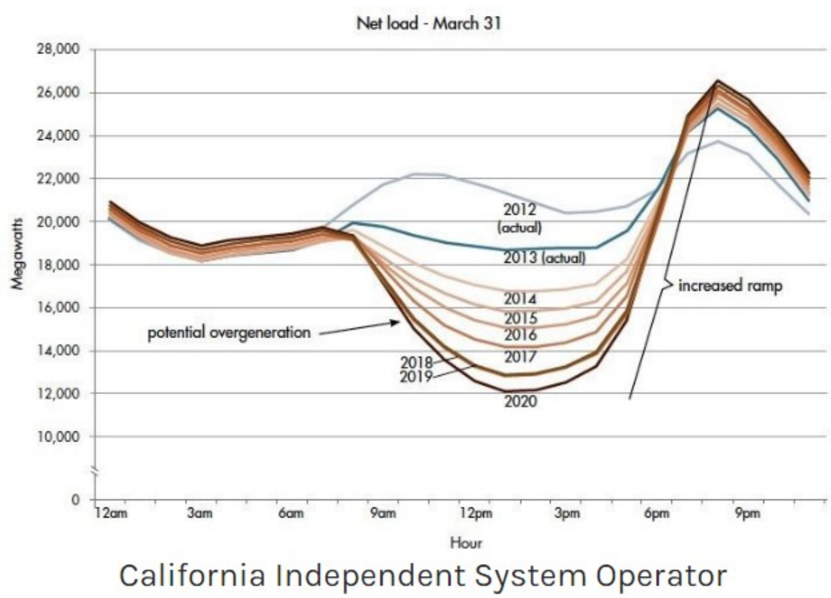

Figure 3: California's Duck Curve[11]

This ramping requirement can potentially lead to either conventional resources running inefficiently or renewable resources getting curtailed. However, this is where ESS can come in and store power by charging when RE is in excess, and supply power by discharging as RE output reduces and ramping up requirement increases.

The services offered by PSH can be summarized as shown below:

[11] https://www.energy.gov/eere/articles/confronting-duck-curve-how-address-over-generation-solar-energy

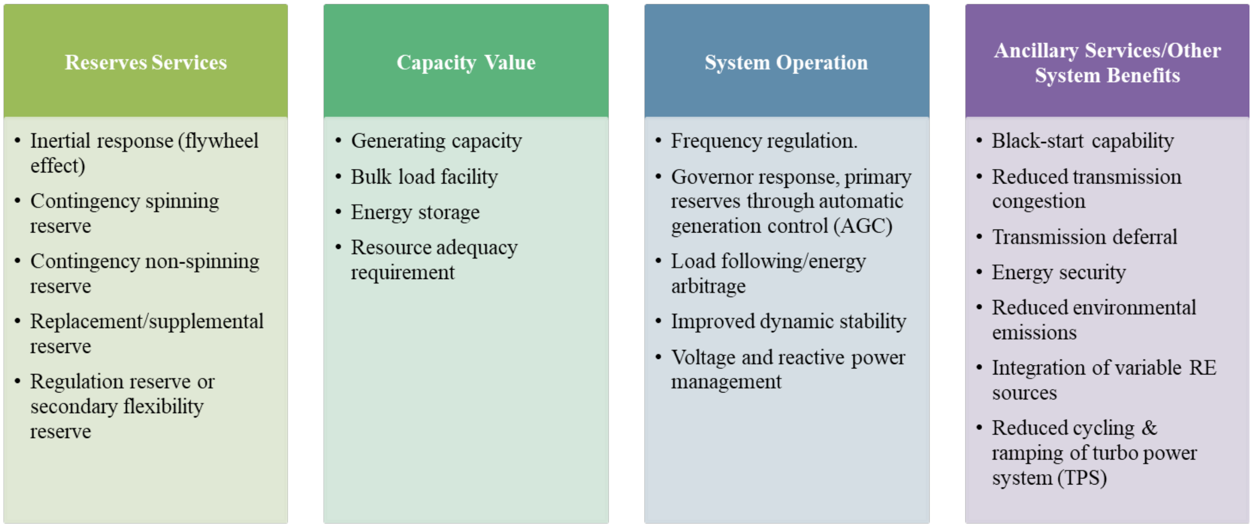

Figure 4: Services Offered by PSH

The services offered by BESS can be summarized as shown below:

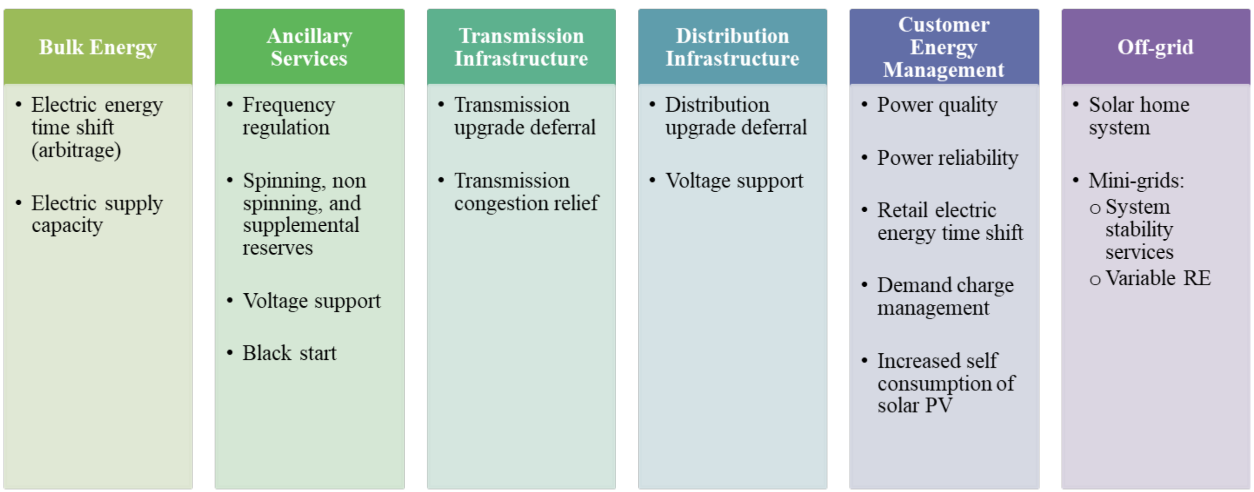

Figure 5: Services Offered by BESS

These unique nature and services offered by PSH and BESS lead to a host of questions with regards to large-scale deployment of these technologies in India:

1. What is the definition and legal status of ESS?
2. What are the potential asset categories and business models for ESS?
3. What are connectivity and open access provisions for ESS?
4. How should ESS be scheduled?
5. What should be the tariff framework for ESS?

These questions have been further analyzed by the WG in detail in **Section 5**.

3.3 Electric Vehicles

India's transition to electric mobility is guided by three main imperatives - energy security, curbing local air pollution, and curtailing GHG emissions from the transport sector. The transport sector is the largest user of oil and second largest source of CO2 emissions world-wide. Indian transportation sector accounts for one-third of the total crude oil consumed in the country, where 80% is being consumed by road transportation alone. The transportation sector is witnessing a transition from oil-based system to electricity-based system, and this will reduce oil import burdens substantially. This shift in transportation sector would also have implication on other sectors including electricity. Even though the penetration of EVs have remained far from the National Electric Mobility Mission Plan (NEMMP) 2020 target of 6-7 million EVs, there is a steady uptick in the sales of EVs since 2017.

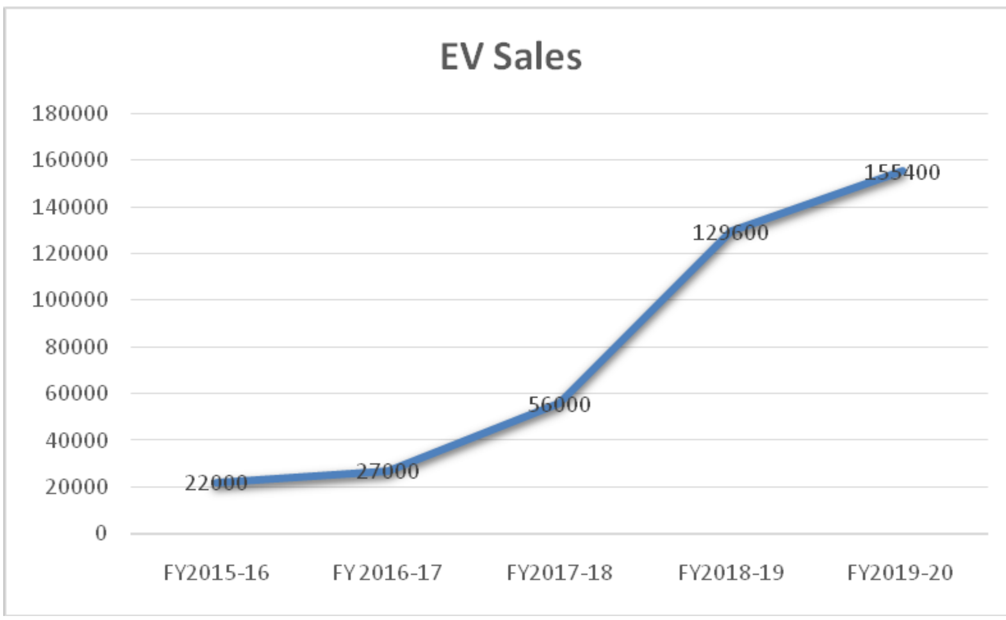

Figure 6: EV sales in India (e-2Ws and e-Cars) [12]

Source: CEEW Report, 2020

the demand of electricity is also expected to increase rapidly in the future with increase of Electric Vehicles (EVs). EV penetration in India requires substantial boost through development of EV charging infrastructure. The electrical vehicle load is non-linear and can cause harmonic

[12]Soman, Abhinav, Harsimran Kaur, Himani Jain, and Karthik Ganesan. 2020. India's Electric Vehicle Transition: Can Electric Mobility Support India's Sustainable Economic Recovery Post COVID-19?. New Delhi: Council on Energy, Environment and Water

distortion, DC offset, phase imbalance, and voltage deviations in the distribution network. Hence it is important to assess the impact of large-scale penetration of EVs on the grid and to evolve appropriate regulatory framework to facilitate the roll-out of the EVs in the country.

India has implemented several emission norms, with the most recent one being the Bharat Stage – VI across the county. However, EVs offer several benefits that have a higher impact on curbing emissions and air control, such as zero tailpipe emissions leading to no air pollution, no noise pollution as they are quite to drive, low maintenance, and low running costs. They're also more efficient, converting around 60% of the electrical energy from the grid to power the wheels, as against petrol or diesel cars using only about 17-21 % of the energy stored in the fuel to power the wheels.

Electrical vehicles operate, either partially or fully, on an electric motor instead of fully running on conventional IC engines. They serve various benefits such as low running costs, low maintenance, zero emissions, no noise pollution, and other environmental benefits. Based on operation and components used, there are four types of EV models as follows[13]:

1. Battery Electric Vehicles (BEVs): BEVs, also known as All-Electric Vehicles (AEVs), run entirely on battery-powered electric drivetrain. BEVs are charged by plugging the vehicle onto electrical supply and have a range of 150-400 miles.

2. Hybrid Electric Vehicle (HEV): HEVs use both IC engine and battery power for propulsion but charging of battery is not through external charging plug as in the case of BEVs but through regenerative braking.

3. Plug-in Hybrid Electric Vehicle (PHEV): PHEVs also use both IC engine and electric motor. Additionally, PHEVs have an external plug for battery charging and can also charge from regenerative braking. PHEVs can operate in all-electric and hybrid modes. Typical range is 20-40 miles on the electric mode.

4. Fuel Cell Electric Vehicles (FCEV): FCEVs use fuel cell technology and are under early stage of development.

As per NITI Aayog[14], there has been a 133% growth in EV sales from FY15 to FY20, with about 7,59,182 registered EVs currently in India. EV sales constituted about 1.32% of all vehicle sales in FY 21-22. EVs have contributed to a reduction of 2,675 kilo tonnes of CO_2 emissions. There

[13]https://e-amrit.niti.gov.in/types-of-electric-vehicles
[14]https://e-amrit.niti.gov.in/home

are about 380 manufacturers operating and 1800 charging stations installed across India.25+ states have notified or drafted EV policies.

NITI Aayog projections[15]further show an 80% growth in EV sales penetration for two and three-wheelers, 50% for four wheelers, and 40% for buses by 2030. The ambitious target of adoption of EVs, if achieved, would result in savings of 474 MTOE of oil (approx. ₹15.21 trillion) annually and would cut down CO_2 emission by ~846.3 Mn Tons annually.

With increasing EV penetration, several questions will have to be answered as below:

1. What will be the impact of EVs on demand?
2. What are potential charging infrastructure options for EVs?
3. What tariff structure would be ideal for EV charging?

These questions have been further analyzed by the WG in detail in **Section 5.6**.

[15]https://www.niti.gov.in/sites/default/files/2021-04/FullReport_Status_quo_analysis_of_various_segments_of_electric_mobility-compressed.pdf

4 International Overview of ESS and EVs

The WG studied international mechanisms for enabling ESS and EVs in markets with high levels of penetration of RE and EVs respectively.

4.1 International Mechanisms for ESS Promotion

In the US, ESS is permitted unbiased transmission access with intra-hour scheduling. Various markets offer pay-for-performance and feed-in-tariffs for ESS. The state and central governments provide various tax rebates and financial incentives to promote investment in and deployment of ESS. The authorities also fund various demonstration projects. Importantly, there are state-level mandates and targets for ESS deployment and ESS is included in clean energy targets and resource planning. The US allows ESS of min. capacity 100 kW to participate in markets as both generator and load. It can participate in wholesale markets such as energy, resource adequacy, and ancillary.

In the UK, there are tax rebates and exemptions for ESS projects. There are also multiple financial incentives provided to encourage investment in ESS. ESS can participate in markets as generator only with an effort of integrating using current codes rather than developing new codes. ESS is allowed to participate in energy, resource adequacy, and capacity markets.

Australia provides financial incentives and government grants to ESS and invests in demonstration projects. It also provides competitive funding for large-scale battery projects. ESS is allowed to participate in energy and ancillary markets, but not in resource adequacy markets or transactions.

The above-mentioned mechanisms are summarized in the table below:

Markets	USA	UK	Australia
Promotion	• Unbiased transmission access • Intra-hour scheduling • Pay-for-performance • Feed-in-tariffs • Tax rebates • Financial incentives • Investments • Demo/pilot projects • Mandates and targets • Include in clean energy goals • Include in resource planning	• Tax rebates and exemptions • Financial incentives • Investments • Contracts for differences can include ESS	• Financial incentives • Investments • Government grants • Competitive funds for large-scale BESS • Demonstration projects

Markets	USA	UK	Australia
Participation	• Participate as both load and generator • Minimum capacity of 100 kW • Technology-agnostic	• Participate as generator only • Integrate using current codes rather than develop new codes • Contracts for differences can include ESS	• Restricts the grid from owning or controlling behind-the-meter resources • Distribution operators can purchase behind-the meter services from customers
Energy	Yes	Yes	Yes
Capacity	Yes	Yes	No
Ancillary	Yes	Yes	Yes

Table 4: International Mechanisms for ESS

4.2 International Mechanisms for EV Promotion

The WG looked at EV statistics and policies in the US market. The US has over 2 million registered all-electric EVs on the road in 2021, with the states of California, Florida, and Texas leading the way. Key federal policies and incentives are summarized as follows:

1. Federal tax incentive on EVs
2. Target of 50% EV sales by 2030
3. Budgetary provisions for EV charging, manufacturing, and recycling
4. National network of EV chargers
5. Guidance and standards for states and cities for strategically deploying EV charging stations
6. Loans and grants to domestic battery supply chains and projects

The US has various state-level policies and incentives as well. The following points summarize key EV policies in the states of California, Florida, and Texas:

1. California
    a. Tax rebates for buying EVs
    b. Mandatory standards for EV charging stations in buildings
2. Florida
    a. Tax rebates to business customers for purchase and installation of EV charging
    b. Funding to property owners for installation of EV charging
    c. *"EV charging is not considered as retail sale of electricity. Therefore, EV charging services are not subject to regulation"*
3. Texas
    a. Tax rebates for buying EVs
    b. Bill credit to residential customers who own charging stations and allow the utility to make remote adjustments
    c. Bill credit to owners for charging during off-peak hours

The above-mentioned national and state-level mechanisms have been summarized in the following two tables[16,17]:

Initiative/Office	Highlights
Bipartisan Infrastructure Law	• 50% of EV sale share by 2030 • US $ 7.5 billion for first-ever national network of EV chargers • US $ 3 billion for battery minerals and refined materials • US $ 3 billion for manufacturing and recycling of batteries
Joint Office of Energy and Transportation	• Department of Energy and Department of Transportation to work together to ensure EV infrastructure implementation; "one-stop-shop" for EV-related resources • EV Charging Request for Information • Issue guidance and standards for states and cities for strategically deploying EV charging stations • Partnership with domestic manufacturers • US $ 17 billion in loan authority to support domestic battery supply chain • US $ 260 million for battery storage project grants
Tax Incentives	US $ 2,500 up to US $ 7,500

Table 5: National Mechanisms for EV Promotion in US

Policy	California	Florida	Texas
National EV Infrastructure Plan	• Submit by August 2022	• Submit by August 2022	• Submit by August 2022
Tax Rebate	• US $ 2,000 for EVs • US $ 4,500 for fuel-cell EVs • US $ 1,000 for plug-in hybrid • US $ 750 for zero-emission motorcycles	• Rebate for business customers of up to US $ 5,000 for purchase and installation of EV charging stations	• US $ 2,500 tax rebate for buying an electric car
EV Charging	• Small businesses with storage can avail a rebate of 10-15% on loan • Projects in disadvantaged communities are eligible for additional 30% credit • Mandatory EV charging stations building standards	• Funding to property owners for installation of EV charging • Plan for EV charging along state highways • "EV charging is not considered as	• US $ 250 bill credit to residential customers who own charging stations and allow the utility to make remote adjustments • US $ 125 bill credit for charging during

[16] https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf

[17] https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/13/fact-sheet-the-biden-harris-electric-vehicle-charging-action-plan/#:~:text=President%20Biden%20has%20united%20automakers,in%20the%20U.S.%20by%202030

Policy	California	Florida	Texas
		retail sale of electricity. Therefore, EV charging services are not subject to regulation"	off-peak hours

Table 6: State Mechanisms for EVs in US

5 Key Issues and Recommendations for ESS

5.1 Legal Status of ESS

The Working Group debated on the following key questions to achieve clarity and recommendations on the legal status of ESS:

1. Whether ESS can be classified under relevant sections of the EA?
2. Whether there is a need for specific provisions for ESS under the EA?
3. Whether there are any legal hurdles for framing regulations for ESS?

5.1.1 Analysis

The WG discussed issues around the legal status of the ESS within the framework laid down under the Electricity Act 2003. It was highlighted that ESS can be considered on an independent basis and as well as in complement with generation, transmission, and distribution. Accordingly, it was suggested that regulatory framework should be facilitative to promote various applications of the ESS across values chain of the power sector. In order to examine the legal status under the extant legal framework, following documents and provisions were studied by the WG:

1. Electricity Act 2003, sections 2(30) and 2(50)[18]
2. MoP Clarifications dt. 29 January 2022[19]
3. MoP Guidelines dt. 11 March 2022[20]
4. International context

Relevant Sections in the Electricity Act 2003:

Section 2(30) of the EA defines "generating station" as:

> *"any station for generating electricity, including any building and plant with step-up transformer, switchgear, switch yard, cables or other appurtenant equipment, if any, used for that purpose and the site thereof; a site intended to be used for a generating station, and any building used for housing the operating staff of a generating station, and where*

[18]https://cercind.gov.in/Act-with-amendment.pdf

[19]https://powermin.gov.in/sites/default/files/Clarification_regarding_usage_of_Energy_Storage_System%28ESS%29_in_various_applications_across_the_entire_value_chain_of_power_Sector.pdf

[20]https://powermin.gov.in/sites/default/files/webform/notices/BESS.pdf

electricity is generated by water-power, includes penstocks, head and tail works, main and regulating reservoirs, dams and other hydraulic works, but does not in any case include any sub-station".

Section 2(50) of the EA defines "power system" as:

"all aspects of generation, transmission, distribution and supply of electricity and includes one or more of the following, namely:- (a) generating stations; (b) transmission or main transmission lines; (c) sub-stations; (d) tie-lines; (e) load despatch activities; (f) mains or distribution mains; (g) electric supply-lines; (h) overhead lines; (i) service lines; (j) works".

Upon deliberations on the above definitions from the Act 2003, the WG noted that the definition of 'Power System' under sub-section 50 of section 2 of the Electricity Act is comprehensive and wide enough to cover ESS. ESS acts like a generating station generating while discharging and a while charging it uses electricity as input. Accordingly, in so far as the activity of charging is concerned, it can be treated as an input to the activity of generating electricity. Further, it was noted that definition of 'generating station' prescribes the process of producing electricity and it does not put any restrictions of the form of energy it was earlier in or on duration for which it was in that form. For generating electricity, the input could be any fuel source or the electricity itself. The Act does not cast any prohibition or restriction in this regard.

Clarification of Ministry of Power on Energy Storage System:

The WG noted **MoP's Clarification dated 29 January 2022**, titled "Clarification regarding usage of Energy Storage Systems (ESS) in various applications across the entire value chain of Power Sector-Reg". Under Section 3(i), it states that:

"*The ESS is a part of the power system defined under sub-section (50) of Section 2 of the Electricity Act, 2003."*

The clarifications issues by the MoP stipulate legal status of ESS same as that of its owner. According to the clarification, ESS can be owned or developed by a generating company, or a transmission licensee or a distribution licensee or a standalone energy storage service provider.

Further, **MoP's** "Guidelines for Procurement and Utilization of Battery Energy Storage Systems as part of Generation, Transmission and Distribution assets, along with Ancillary Services – Reg" **dated 11 March 2022 under section 63 of the Electricity Act 2003 were studied.** Section (3) of the Guidelines, discusses various use cases for BESS, such as:

1. *RE supply with BESS*
2. *BESS with transmission infrastructure*
3. *Storage for ancillary services/ balancing services/ flexible operations*

4. *Storage for Distribution*
5. *Standalone BESS*
6. *The BESS developer/owner may sell storage space for a particular duration*
7. *Any other business cases as found suitable*

It was also observed that Government through Solar Energy Corporation of India (SECI) have already issued Request for Proposal (RFS) for large scale standalone battery storage. The tender is for two BESS projects to be interconnected to the 400/220kV at Fatehgarh ISTS substation in the State of Rajasthan. SECI would act as intermediary nodal agency for use of the BESS for buying entity which can use the system for delivery of power on demand during both peak and off-peak period. The charging and discharging of the BESS would be under the scope of buying entity. The buying entity would schedule charging of BESS with equal amount of energy plus energy expected to be lost as conversion losses. SECI would enter into a Battery Energy Storage Purchase Agreement (BESPA) with successful bidders based on the RFS for providing BESS facility to buying entity/ SECI as per the terms and conditions of the BESPA. Battery Energy Storage System Developer (BESSD) would set up the BESS on Build Own Operate Transfer (BOOT) basis. SECI would have obligation for offtake of 60% of contracted capacity of the project and energy utilization of remaining 40% capacity is to be managed by the Developer. With respect to the capacity which SECI is obligated to off-take, 30% capacity should be utilized for Ancillary Service by NLDC, POSOCO with SECI being intermediary.

Further, it was noted that **CERC's Tariff Regulations and SERC's MYT Regulations** provide framework for PSH. The WG also noted that various Regulations issued by the Central Commission has recognized ESS as Ancillary Service Provider and a grid entity eligible for connectivity respectively. The definition of the ESS has also been stipulated in the CERC (Connectivity and General Network Access) Regulations, 2022 as follows:

"2.1. (q) "Energy Storage System" or "ESS" in relation to the electrical system, means a facility where electrical energy is converted into any form of energy which can be stored, and subsequently reconverted into electrical energy and injected back into the grid;"

The WG also examined the treatment given to ESS internationally. It was observed that while in USA and Australia ESS has been recognized as a bidirectional resource, some countries like EU and Japan have recognized ESS as a generation facility.

1. US: FERC Order 841 (2018) defines ESS as *"a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid"*.
2. UK: Grid Code (2020) defines ESS as *"the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy"*

3. EU: Directive 2019/944 defines ESS as *"in the electricity system, deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored"*

5.1.2 Recommendations

Based on the analysis mentioned above, the WG gives the following recommendations on the legal status of ESS:

Recommendations:
• Section 2(50) of the Electricity Act 2003 that defines a power system is comprehensive enough to cover ESS. • While discharging, ESS acts like a generating station and supplies electricity to the grid with time deferral. • ESS can also qualify as "works" in case of which relevant GST incentives shall be applicable. • Independent Energy Storage System (IESS) can accordingly be treated at par with a generating station. In so far as the activity of charging is concerned, it can be treated as an input to the activity of generating electricity with time lag to inject electricity back into the grid. For generating electricity, the input could be any fuel source or electricity itself. The Act does not cast any prohibition or restriction in this regard.

5.2 Asset Category of ESS (Business Models)

The WG debated on the following key questions to attain clarity and recommendations for asset classification of ESS:

1. How should ESS assets be categorized?
2. What should be the ownership structure of these assets?
3. What should be the operating structure of these assets?

5.2.1 Analysis

Considering the multiple applications of the ESS, the WG deliberated on different possible business model for ESS as an independent system, distribution asset, VRE asset, and transmission asset.

As explained in Section **5.1** of this report, MoP's clarification states that ESS is part of power system as defined in EA, and further states in Section 3(ii):

> *"ESS can be utilized as either on standalone basis or in complementary with generation, transmission, and distribution. ESS shall be accorded status based on its application area i.e., generation, transmission, and distribution".*

It was deliberated that ESS can qualify as generation/transmission/distribution asset as per various provisions of the EA. ESS as an independent energy storage system (IESS) can be treated at par with a generating station. Under the Act, Generation is delicensed activity and hence any entity can establish, own and operate generation asset. Whenever ESS is collated with a generating station or owned by a generating station, it can have the legal status of a generating station. Excess generation would be used for charging the ESS and would be discharge in shortfall against the schedule. This will facilitate the participation of ESS in market operation. Most of the PSH operating in the country can be categorized as a generating asset owned by the distribution licensee. ESS can also be part of a distribution licensee, owned by a customer. ESS as a distribution asset can be connected to and form part of a distribution system and charging and discharging can take place as per the requirement of the distribution licensee. It can be managed by the distribution licensee as generation portfolio in such a way that it can charge the ESS when there is excess generation during off peak hour and discharge the same during peak hours. The required regulatory framework for the same is already established for PSH by CERC and some SERCs. Such ESS can also be utilized by the distribution licensee to provide Ancillary Services and also to manage deviations to reduce DSM charges. To be considered a transmission asset, issues such as licensing and charging/discharging would have to be considered.

> *"To provide further insights on ESS as transmission assets, Section (41) of the EA on "Other business of transmission licensee" states that:*
>
> *A transmission licensee may, with prior intimation to the Appropriate Commission, engage in any business for optimum utilisation of its assets:*
>
> *Provided that a proportion of the revenues derived from such business shall, as may be specified by the Appropriate Commission, be utilised for reducing its charges for transmission and wheeling:*
>
> *Provided further that the transmission licensee shall maintain separate accounts for each such business undertaking to ensure that transmission business neither subsidises in any way such business undertaking nor encumbers its transmission assets in any way to support such business:*
>
> *Provided also that no transmission licensee shall enter into any contract or otherwise engage in the business of trading in electricity :"*

The WG observed that ESS could be useful for congestion management, ancillary services, and deferral of new investment. Country is witnessing faster growth of variable RE there would be a need of new transmission capacity for evacuation of such capacity. Adding ESS at transmission level can defer or eliminate in some cases the need for upgradation or addition in transmission capacity. The use of ESS for deferment may also be explored with required cost benefit analysis and regulatory scrutiny. The key consideration is that small amount of ESS can be used to provide enough scope to defer the large investment in the transmission augmentation. The Act does not debar a transmission licensee, except CTU, from engaging in generation activity. As such, a transmission licensee can set up an ESS for the purposes mentioned above but not for trading. However, the WG also emphasized that required cost benefit analysis for the competent authority for identifying such locations for ESS at transmission system is critical for necessary regulatory approval.

The WG deliberated on various types of asset category, ownership, and operation structures: ESS as an Independent Energy Storage System (IESS), ESS as a distribution asset, and ESS as a transmission asset. Under these options, the WG deliberated on various business models depending on charging/discharging arrangements.

Additionally, the WG discussed tolling arrangements in case ESS were to procure charging energy by entering into an agreement with the local distribution licensee. A tolling agreement for energy storage is one in which the seller develops, owns, and operates ESS. The off-taker supplies the charging energy, and hence the energy in the system belongs to the off-taker. Charging and dispatch can be controlled by the seller or the buyer, depending on the agreement.

5.2.2 Recommendations

Based on the analysis mentioned above, the WG makes the following recommendations on asset category and business models of ESS:

Recommendations:
• **The primary objective of ESS is to promote and integrate large-scale RE into India's power system**
ESS as an independent energy storage system (IESS) • An IESS may enter into contract with any other entity recognized under the Act to provide storage services. • **Business Model 1**: for charging purposes, IESS can procure input energy from the generation (wind/solar/both) owned by it. • **Business Model 2**: This would be tolling arrangement where ESS would procure power from the buyer (local distribution licensee/open access consumer) during off-peak period and give it back during peak period after discounting for cycle efficiency of the ESS. The tariff for such an arrangement shall be mutually agreed by the ESS and the buyer. In case of tolling arrangement by the distribution licensee, it shall obtain approval for the arrangement from the appropriate Commission. • **Business Model 3**: for charging purposes, IESS can procure input energy by entering into an agreement with any other entity recognized under the Act. Under this model, the ESS would procure power for charging from the market or by entering into a PPA with any supplier. The tariff for procuring power from the ESS shall be discovered primarily through competitive bidding route. However, if tariff is to be determined under Section 62 of the EA, it shall be after due justification of the need for the same and on satisfaction of the Appropriate Commission. Cross-subsidy surcharge and additional surcharge will not be applicable.

ESS as a distribution asset • **Business Model 4** • ESS could be owned and operated by the distribution licensee. • Discoms can establish ESS either through Capex or Energy Storage Service Agreement (ESSA) route. • In case of Capex route, discoms would undertake competitive bidding for procurement of the system. • Discoms would clearly present the rationale and value streams in its Capex approval proposal to SERC • Discoms would supply power to ESS for charging. • Scheduling of ESS shall be the responsibility of discoms. • ESS shall primarily be charged from RE sources and Discoms shall utilize such ESS for compliance towards RPO as per applicable norms. • Discoms will have to submit annual report on utilization of ESS to the Commission on yearly basis. Format for the report will be prescribed in the Regulations.
ESS as a transmission asset • **Business Model 5** • ESS could be useful for congestion management, ancillary services, and deferral of new investment. These applications would require ESS at transmission level. The Act does not debar a transmission licensee, except CTU, from engaging in generation activity. As such, a transmission licensee can set up an ESS for the purposes mentioned above but not for trading. • The transmission licensee shall not enter into any contract or otherwise engage in the business of trading of electricity on exchanges as per Section (41) of the Electricity Act, 2003.

5.3 Connectivity and Open Access for ESS

Access to the grid is paramount for ESS to realize its multiple value stream such as ramping support, avoiding RE curtailment, time shift operation, ancillary services etc. Depending upon the connectivity of ESS at Transmission or Distribution level would require various regulatory and statutory compliance depending upon the ownership of ESS. Considering the unique characteristics of ESS to act as both supply or load and also to respond in seconds for grid security, it is important that policy and regulatory interventions are conducive to exploit these unique characteristics of ESS and possible different business models that may emerge with ESS. With this understanding, the WG deliberated on connectivity and open access provisions for ESS.

5.3.1 Analysis

The WG studied CERC's "Connectivity and General Network Access to the inter-state Transmission System Regulations, 2022". (Hereafter referred as GNA Regulations). It defines Energy Storage System (ESS) as follows:

> *"ESS means a facility where electrical energy is converted into any form energy which can be stored, and subsequently reconverted into electrical energy and injected back into the grid"*

Regulation 4 of the GNA Regulations specify the eligibility criteria for standalone Energy Storage System to apply for grant of connectivity as follows:

"*4.1 (c) Standalone ESS with an installed capacity of 50MW and above individually or with an aggregate installed capacity of 50MW and above and above though a Lead ESS or Lead Generator*"

Regulation 5 of the GNA Regulations further states that a standalone ESS shall apply for grant of Connectivity for a quantum of its proposed maximum injection to ISTS or proposed maximum drawal from ISTS, whichever is higher.

The WG noted the provisions specified by the CERC in recognizing the standalone ESS at par with a generating station. It was also observed that a provision to allow standalone ESS having capacity of 5MW and above can also sought connectivity through the electrical system of a generating station already having connectivity to ISTS. The provisions specified in the GNA regulations specific to standalone ESS were appreciated by the WG. Allowing connectivity for maximum of injection to ISTS or drawal from ISTS would address the challenges of recognizing both charging and discharging of ESS as a single transaction as far as connectivity is concerned. Once granted connectivity, the ESS would be treated to have deemed access to the transmission system equivalent to the connectivity quantum. Accordingly, it was suggested that within the connectivity and access quantum granted, the ESS should have the freedom to inject or draw as per requirement without the requirement to pay any transmission access charge. The WG recommended that similar approach can be taken for ESS facility connecting at intra-State system. On the issue of open access charges in case of drawal or injections by the ESS, the WG suggested that in order to promote the charging of ESS capacity with renewable energy generation, transmission charges for drawal / injections of ESS may be exempted in case ESS is charged from Variable RE. It was also observed that CERC has proposed similar provision in its recent draft CERC (Sharing of Transmission Charges and Losses) Regulations, 2022.

Further, ESS would be complementing more absorption of intermittent RE into the system, it was recommended that ESS facilities should also get same tax benefits as for example given to solar projects, particularly as storage will help in shifting the excess solar generation during daytime to evening peak hours. Therefore, both BESS as well as PSP should be exempted from payment of custom duty and should brought in lowest GST slab for cost component wherever applicable.

5.3.2 Recommendations

Recommendations:

- The CERC Regulations on Connectivity and General Network Access (GNA) enable connectivity and access for the ESS to the ISTS treating the ESS at par with a generating station. In other words, the ESS like any other generator is required to apply only for connectivity and once connectivity is granted, such an entity is deemed to have GNA equivalent to the quantum of connectivity granted.
- An ESS is required to apply for grant of connectivity for a quantum equivalent to its maximum drawal or injection to the system.
- Further, under the new regime post implementation of GNA, the generating stations are not required to pay inter-State transmission charges. As the ESS is treated at par with a generating station, it will also not be required to pay any inter-State transmission charges and losses. ESS should be encouraged to be charged with renewable energy.
- It would be desirable to extend similar treatment to the ESS at intra-State transmission and distribution system.
- .

5.4 Scheduling of ESS

As discussed in previous sections, ESS can be developed as an IESS . Such systems may enter into an arrangement for meeting their charging requirements. Such arrangement should be based on the organised market products. Any entity including a generating company, transmission licensee, distribution licensee or an end consumer may be allowed to seek services from such IESS. Based on the ownership and operation of ESS, appropriate regulatory framework for scheduling is an important topic that requires clarity. The WG discussed the following key points in this regard:

1. Scheduling of ESS under various ownership and operating models
2. Discharging/charging specifications
3. Regulatory/policy provisions

5.4.1 Analysis

The WG has observed that MoP's Guidelines dated 29 January 2022 provide clarity on scheduling of ESS if the ownership and operation is with an ESS developer, VRE generator, and discom. The Guidelines state that even though the ESS may have legal status as that of the owner, for the purpose of scheduling and dispatch and other matters, ESS would be treated at par with a generator. The owner of the ESS may use part or whole of the storage space for himself to buy and store electricity and sell the stored electricity at a later time or date.

The WG also observed that the MoP guidelines dated 10.03.2022 "for procurement and Utilization of BESS as part of Generation, Transmission and Distribution Assets, along with Ancillary Services" envisage different business models regarding utilization of BESS in supply of energy and grid maintenance. ESS can be used by the developer for arbitrage operation. IESS could also be contracted for part of full capacity by grid entity. There could be an appropriate mix of short term and long-term contract. For example, part capacity of an ESS could be tied up through a bilateral / multilateral agreement on long / medium / short term basis and the balance capacity may be kept open on merchant basis for sale in the market. For ESS as Distribution Asset scheduling for charging and discharging could be managed by the distribution companies. BESS with transmission infrastructure would aim at maximisation of utilisation of the transmission assets, increasing duration of transmission system and strengthening grid stability. In such cases, respective Load Despatch Centres would be managing the scheduling of the ESS facility. Accordingly, WG deliberated on scheduling framework as follows:

1. An IESScould submit sell/buy bids on exchanges with fixed duration of discharging/charging respectively.
2. A discom could use ESS to reduce peak demand as embedded generation; it could charge during off-peak hours to maintain optimum transformer loading
3. For a transmission licensee, the load dispatch centre could decide discharging/charging schedules considering line parameters.

5.4.2 Recommendations

Based on the above discussions, the WG recommends the following for scheduling of ESS:

<table>
<tr><th>Recommendations:</th></tr>
<tr><td>ESS as an Independent Energy Storage System (IESS)
Scheduling and dispatch for an IESS should be treated like any other generating station for generation aspects.
In the event of the ESS procuring power through open access, such entity should enter into valid contracts of different duration for its charging under organized power market instead of using the UI/DSM.</td></tr>
<tr><td>ESS as a distribution asset
Would charge during off-peak and discharge during peak hours
Scheduling decisions would be taken by the discom to manage its demand variation/ reduce DSM penalty.</td></tr>
</table>

5.5 Tariff Determination for ESS

The WG discussed various tariff framework options for ESS.

5.5.1 Analysis

The WG noted that PSH is already regulated under CERC Tariff Regulations as well as a few other State regulations. CERC's 2019 Tariff Regulations[21] and MERC's 2019 MYT Regulations[22] include return on equity, interest on loan, interest on working capital, depreciation, and O&M expenses in calculations for annual fixed charges. They define the useful life of PSH to be 40 years. Annual fixed charges are recovered on a monthly basis through capacity and energy charges. Capacity charges have a threshold of 75% and energy charges provide an incentive of 20 paise/kWh for when generation is greater than design. To elaborate further, these regulations allow 50% of the fixed costs to be recovered through Fixed Charges (FC) and remaining 50% through Variable Fixed Charge (VFC) (₹/kWh) for design energy. This creates incentive for ensuring availability as well as operation. Only annuity/availability-based payments would ensure creation of capacity and not actual operation, thereby potentially leading to creation of stranded assets. Two-part mechanism as included in CERC and SERC ensures both availability and operation.

The following potential tariff options were studied by the WG:

1. Annuity-based tariff in Rs. Cr/MW to cover all fixed costs; it was noted that this may not cover charging energy cost and may only incentivize availability but not actual operation, thereby leading to stranded assets
2. Single-part tariff in Rs/kWh to cover all fixed costs; it was noted that this may not cover charging energy cost
3. Two-part tariff consisting of fixed charge and charging energy cost; it was noted that this will be exposed to risks in variation of charging costs
4. Two-part tariff consisting of fixed charge and Rs/cycle; this would be dependent on no. of cycles; responsibility of charging energy may be with beneficiary
5. Three-part tariff consisting of fixed + energy + ancillary charge; covers all costs and provides incentive for ancillary services; responsibility of charging energy may be with beneficiary

The WG highlighted the need of different ESS technologies such as PSH and BESS emphasis that in view of very small potential of PSH being explored in the country. The WG recognizes the importance of ESS for meeting the ramping requirement in wake of the large-scale integration of intermittent RE sources in the grid. Considering the fact that only 3.3 GW capacity of PSH is being operational as of now against the vast potential of 95 GW as estimated by the CEA and recent development in performance improvement and possible cost reduction in the

[21] https://cercind.gov.in/2019/regulation/Tariff%20Regulations-2019.pdf
[22] https://www.mahadiscom.in/wp-content/uploads/2019/08/33.-01.08.2019-MYT-Regulation-2019_English.pdf

BESS, the WG is of the opinion that enablers such as taxational and financial incentive would also play critical to accelerate the deployment of various ESS technologies. Any concession and incentives to these technologies would help to reduce the cost of these technologies and would the paved way for required deployment in the next few years.

5.5.2 Recommendations

Based on detailed discussions on the above, the WG recommends the following for tariff structures for ESS:

Recommendations:

• The tariff for ESS shall be primarily discovered through competitive bidding process under section 63.
• In cases where tariff determination under section 62 is required for any Business Model for ESS and the Appropriate Commission is satisfied, the following approach should be adopted.
    o Two-part mechanism as included would ensure both availability and operation. Similar mechanism should be developed for all types of ESS.
    o With regard to energy charges, ESS should declare efficiency of the storage system.

ESS as an IESS • Operator may be selected on the basis of rate of generation quoted. It shall be responsibility of the IESS to procure energy at a rate which would be viable for it to operate.
ESS as a distribution asset • Two-part tariff akin to PSP may be paid to ESS operator at distribution level. • Discom would supply electricity to ESS and receive back electricity as per declared efficiency.

5.6 Tax Provisions for ESS

The WG deliberated on tax structures for ESS in the country, including a discussion on points such as current benefits, intentions etc.

5.6.1 Analysis

The WG studied that the US has a Energy Storage Tax Incentive and Deployment Act in place that enables an investment tax credit for ESS. The tax credit is of 30% for battery systems charged by RE for more than 75% of the time. Minimum size requirement is of 5 kWh. The WG also deliberated on the possible impact of the duties and taxes and of the opinion that concessional taxation and waiver of duties should be considered by the Government/ Competent Authority in order to promote ESS in the power sector. Currently, combined customs and imports on BESS stand at almost 40%[23]. The MoP is recommending a uniform 5% tax slab on all RE components nation-wide[24]. The WG is of the opinion that like Renewable energy projects, ESS may also be considered for exemption from Electricity Duty with some sunset clause if it is being charged with renewable energy sources. Further, in order to attract investment in the ESS, the WG also recommended that exemption in custom duty and reduction in GST rate for cost component of ESS may be considered by the appropriate authority

5.6.2 Recommendations

The WG makes the following recommendations for tax provisions for ESS

Recommendations:
• ESS should be considered for custom duty exemption and GST rate reduction for Cost component by Competent Authority • Exemption of Electricity duty at par with RE generation may be considered as ESS complement RE generation.

[23]https://www.ft.com/content/1346531a-13b3-4b40-916e-bdb51ce027ea
[24]https://mercomindia.com/ministry-of-power-uniform-slab-gst-on-renewable-components/

6 Key Issues and Recommendations for EVs

6.1 Impact of EV Charging on Demand

Increasing EV penetration is expected to have a significant impact on demand. The WG studied this impact to gain clarity on the following key points:

1. What will be the capacity impact on demand?
2. What will be the energy impact on demand?
3. What should discoms factor for while preparing for EV charging demand?

To answer these questions, the WG studied the following key documents:

1. FOR, "Study on Impact of Electric Vehicles on the Grid", 2017[25]
2. LBNL, "All Electric Passenger Vehicle Sales in India by 2030: Value Proposition to Electric Utilities, Government, and Vehicle Owners", 2017[26]
3. Brookings, "Electrifying Mobility in India: Future Prospects for the Electric and EV Ecosystem", 2018[27]
4. IIT-Kanpur, "Impact of Plug-in Electric Vehicles on Power Distribution System of Major Cities of India: A Case Study". 2019[28]
5. Analysis of fast charging technology
6. Analysis of vehicle-to-grid or "V2" technology

Detailed analysis of these reports and recommendations are given in the following section.

6.1.1 Analysis

The 2017 FOR report analyzed that, with a penetration of 5-6 million EVs leading to ~5000 MWs of additional capacity, impact on the national system would be negligible. However, impact of fast charging on the distribution system would be significant. The study summarized that:

1. A baseline 50% loaded commercial feeder can absorb additional 20% of load from EV fast charging
2. Residential feeders can handle a ratio of 60%-40% EVs

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[25] http://www.forumofregulators.gov.in/Data/study/EV.pdf
[26] https://www.osti.gov/servlets/purl/1364441
[27] https://www.brookings.edu/wp-content/uploads/2018/05/20180528_impact-series_ev_web.pdf
[28] https://home.iitk.ac.in/~ansharma/EV_Report_V1.pdf

3. Loading of peak coincident charging should be 20%
4. Impact of slow charging is negligible

However, this study was conducted in 2017 and considered 2015-16 data. Since then, the Government and states have announced many targets and policies for EVs which could have a more pronounced impact on demand.

The 2017 LBNL study estimated only ~3% contribution of EV charging in the total electricity demand in India by 2030 from 2 wheelers and cars alone. However, it did not consider other categories such as 3-wheelers or commercial/bus/truck operations.

The 2018 Brookings study shows category-wise electricity demand (in TWh) in 2030 based on assumptions for penetration levels and input charging requirements. It considers various types of EV categories such as cars, taxis, buses, 2W, and 3W. It estimates a demand of 9-26 TWh from cars, 4-10 TWh from taxis, 11-28 TWh from buses, 5-16 TWh from 2 wheelers, and 8-16 TWh from 3 wheelers. This study further estimated that peak contribution of EVs at busbar could be between 120 and 332 GW with medium charging.

The 2019 IIT-Kanpur study highlights that charging current increases with reduction in charging times, which increases kW or MW demand on the distribution network. This study also forecasted impact on demand from various categories of EVs, such as 2-wheelers, rickshaws, 3-wheelers, commercial and non-commercial 4-wheelers, and commercial heavy vehicles, for metropolitan cities such as Mumbai, Delhi, Kolkata, and Chennai. It undertook distribution system forecasting for various scenarios of charging infrastructure, such as charging at home or at charging stations and combinations thereof. It estimated significant peak load impact across all cities, ranging from a 74.8% impact to as high as 206.31% impact when fully charged at a charging station. However, it is important to note that this study only looks at EV penetration in key metropolitan cities and does not cover a national analysis.

With increasing penetration, adoption of fast charging is anticipated to increase. There are three types of fast chargers available in the US: Combined Charging System (CCS), CHAdeMO, and Tesla[29]. Furthermore, Extreme fast chargers or "XFCs" are capable of power outputs of up 350 kW and higher and are rapidly being deployed in the United States for heavy-duty vehicle applications.

	Level 1 (110V, 1.4 kW)	Level 2 (220V, 7.2 kW)	DC Fast Charger (480V, 50 kW)	Tesla Super Charger (480V, 140 kW)	XFC (800+V, 400 kW)

[29]https://afdc.energy.gov/fuels/electricity_infrastructure.html

	Level 1 (110V, 1.4 kW)	Level 2 (220V, 7.2 kW)	DC Fast Charger (480V, 50 kW)	Tesla Super Charger (480V, 140 kW)	XFC (800+V, 400 kW)
Range Per Minute of Charge (miles)	0.082	0.42	2.92	8.17	23.3
Time to Charge for 200 Miles (minutes)	2,143	417	60	21	7.5

Table 7: Comparison of EV Charging Technologies

In case of XFCs, the BEV battery pack voltage increases from the current industry standard of 400 V to over 800 V, which in turn drops current by at least half and increases the pack voltage. This brings about new challenges associated with charging infrastructure, high-voltage system architecture and charging systems[30], such as[31]:

1. Voltage sags
2. Grid instability and power quality issues
3. Faster ageing of transformers
4. Cost of providing electricity to fast chargers esp. XFCs
5. Excessive harmonic emission and amplification[32]

V2G technology involves discharging energy stored in batteries towards end users or distribution licensees / system operators[33].

Deploying V2G economically requires an understanding of local markets, enough vehicles to bid into energy markets, equipment to provide power back to the grid, and an aggregator to manage the project[34]. Services that can be offered by V2G are summarized by:

1. Generation:
    a. Virtual Power Plan (VPP)
    b. Reduction of renewable energy intermittence
    c. Congestion mitigation
2. Distribution:

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[30]https://www.energy.gov/sites/prod/files/2017/10/f38/XFC%20Technology%20Gap%20Assessment%20Report_FINAL_10202017.pdf
[31]https://www.nrel.gov/docs/fy20osti/74838.pdf
[32]https://ieeexplore.ieee.org/document/9336258
[33]https://www.mdpi.com/1996-1073/14/12/3673/pdf
[34]https://www.nrel.gov/docs/fy17osti/69017.pdf

   a. Frequency and Voltage regulation
   b. Spinning regulation
3. Consumer:
   a. Peak Shaving
   b. Load levelling
   c. Renewable energy storage

Benefits of the V2G technology are summarized below[35]:

1. **For EV owners**: V2G can reduce the total ownership cost of EVs, and V2G also can be extended for local utilization as a home energy storage and emergency backup storage.
2. **For grid operators**: V2G serves as a new resource for both up- and down-regulation and power storage. It provides and facilitates a solution to the fluctuation due to the high share of renewable energy, as well as the solution to the grid congestion and circumvents the need to upgrade the grid infrastructure.
3. **For the Government**: V2G creates a new circular economy in society, provides higher energy security (supply and quality), facilitates a greener environment, and reduces the noise due to vehicle engines. EVs and V2G will restructure the lifestyle and infrastructure in the city, leading to huge movement in economic activities.
4. **For aggregators/EV operators**: V2G presents a new business opportunity in the electricity sector, including grid balancing services (in correlation with utilities, grid operators, and consumers) and renewable energy storage services (e.g., storage and minimization of curtailment and fluctuation).
5. **For offices, factories**: V2G can facilitate local peak shaving, load leveling, and balance out the electricity demand. Therefore, the total cost of electricity might be reduced.

Certain recommendations, based on the above analysis and international study, can be summarized as follows[36]:

1. Expansion of bidirectional charging stations
2. Model driving behaviour and develop algorithms for optimizing the pooling of vehicles
3. Mechanism to bid into various electricity ancillary markets
4. Financial incentives for EV owners to support power grid

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[35] https://www.mdpi.com/1996-1073/15/2/589/pdf
[36] https://www.researchgate.net/publication/336279939_Analysis_of_the_possibilities_of_using_V2G_technology_for_power_system_balancing

5. Even distribution of cars across the country
6. Estimation of the costs and benefits of V2G for all participants

6.1.2 Recommendations

From the above-mentioned studies, it is evident that EV charging is expected to have significant impact on the regional and state-level distribution networks, for which the WG makes the following recommendations for discom readiness:

Recommendations:
• Stringent technical standards for EV chargers and infrastructure • Revision of supply code for EV charging connectivity standards • Studies to assess impact of EV charging on Discom network • Discoms to develop process to account above assessment of impact of EV Charging Infrastructure on its network. • Discoms would build strong back-end links between the grid and EV charging facilities to achieve necessary grid balance • Discoms would factor in the impact on demand and proactively consider the same in resource adequacy plans • Changes to Grid Code so that EV Charging Infrastructure could act as a flexible load • Encourage EV charging stations with DRE generation and storage systems to manage their own peaks esp. with fast charging facilities

6.2 EV Charging Infrastructure

Increasing EV penetration would require ramping up of charging infrastructure with detailed planning for types of consumers and charging technologies. The WG debated on various options for infrastructure as analyzed in the next section.

6.2.1 Analysis

The WG discussed various types of EV charging infrastructure, such as:

1. Domestic consumer
2. Society/community chargers
3. Large charging stations/fast chargers/battery swapping stations

6.2.2 Recommendations

Key recommendations for each category are as follows.

Recommendations:
• Domestic consumer: If domestic connection is used to charge the vehicle, slow charger must be used with charger capacity not exceeding the sanctioned connected load of the consumer category. • Society/ community charges: Societies/ RWAs/ communities may install charging infrastructure either through ownership or third-party service provider. This will be separate LT connection from the Discom. For this purpose, separate 'LT EV Charging Station' category would be created by SERC. • Large charging stations/ fast chargers/ battery swapping stations: SERC would create separate 'HT EV Charging station' as a category. • BEE may be asked to develop standard specifications for three types of charging infrastructure. • For commercial charging stations, discoms shall take steps to direct RE towards charging stations for promotion of RE.

6.3 Tariff Determination for EVs

Increasing EV penetration and charging infrastructure are expected to have a significant impact on the demand, esp. at the distribution network level. The WG deliberated on ideal tariff frameworks for EV charging, details of which are in the section below.

6.3.1 Analysis

The Government of India launched "National Electric Mobility Mission Plan (NEMMP)" in 2020 under which "Faster Adoption and Manufacturing of Electric Vehicles (FAME)" was launched in 2015. The main purpose of FAME was to support the development of hybrid/electric vehicles[37]. Multiple states released draft and final versions of EV policies while many other states are working on their policies. Tariffs for different states are summarized in following table:

State	Category	Energy Charges	Fixed charges
Delhi[38]	• Separate Category	• LT – Rs. 4.50/kWh,	• No fixed charges

[37]https://indiasmartgrid.org/reports/ISGF-Study-Report-EVCharging-India_July2019.pdf
[38]http://www.derc.gov.in/sites/default/files/Tariff%20Schedule%202020-21.pdf

		• HT – Rs. 4.00/kVAh	
Punjab[39,40]	• Separate Category	• Rs. 6.00/kVAh	• No fixed charges
Rajasthan[41]		• Rs. 6/kWh	• LT: 40 HP/Month • HT: 135 kVA /Month
WBSEDCL FY 2021-22[42]	• EV Charging Station	• Rs. 6.98 /kWh	
Chhattisgarh FY 2022-23[43]	• LV-2: non-domestic • HV-3: Other Ind. and General	• Rs. 5/kWh	
Maharashtra (MSEDCL) FY 2021-22[44]	• HT IX: HT EV Charging Stations	• Rs 5.50/kWh	• Rs. 432/kVA/ Month
	• LT VIII: LT EV Charging Station	• Rs 5.50/kWh	• Rs. 70/kW/ Month
Uttar Pradesh FY2021-22[45]	• Domestic Consumer: LMV-1 • Multi Storey Building: • LMV-1b, • HV-1b • Public Charging Stations: • LT • HT	• Fixed charge as per domestic category for category 1 • The consumer will be required to pay one-time charges etc. wherever applicable for category 2 & 3	• Tariff as per domestic category a) Rs. 6.20 / kWh b) Rs. 5.90 / kWh c) Rs. 7.70 / kWh d) Rs. 7.30 / kWh
TSECL FY 2020-21[46]	• No EV tariff approved by the commission. However, TSECL has proposed at 5% discounted rate (in fixed and energy charges) than the applicable rate for LT commercial or HT commercial as applicable		

Table 8: Existing State-level EV Tariffs

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[39] http://pserc.gov.in/pages/7.%20Chapter%207%20PSPCL%20Tariff%20Order%20FY%202020-21.pdf
[40] http://pserc.gov.in/pages/Tariff%20Rates%20for%20FY%202020-21.pdf
[41] https://e-amrit.niti.gov.in/electricity-cost-for-charging
[42] https://wberc.gov.in/sites/default/files/TP-89_20-21.pdf
[43] https://e-amrit.niti.gov.in/electricity-cost-for-charging
[44] https://indiasmartgrid.org/reports/ISGF-Study-Report-EVCharging-India_July2019.pdf
[45] https://www.uperc.org/App_File/Final_TariffOrderUPStateDISOCMsFY2021-22(29-07-2021)DigitallySigned-pdf729202113115PM.pdf
[46] https://terc.tripura.gov.in/sites/default/files/Tariff%20Order%20-%20FY%202020-21%20Clean%20Mode-converted%20%281%29-converted_0.pdf

6.3.2 Recommendations

The WG deliberated on existing tariff policies and are proposing the following key recommendations going forward:

Recommendations:
• Domestic: Prevalent residential tariff • LT EV Charging Station: Tariff for this category will not be more than 110% of the Average Cost of Supply of Discom for that year • HT EV Charging Station: Tariff for this category will not be more than HT Industry Tariff in the State • Consumers in this category would be encouraged to procure power from RE sources for which OA charges (and not losses) and surcharges should be waived off.

7 Summary of Recommendations

7.1 WG Recommendations on ESS

The key recommendations of the Working Group on issues related to ESS are as follows:

1. **Legal Status of ESS**
   a. Section 2(50) of the Electricity Act 2003 that defines a power system is comprehensive and wide enough to cover ESS.
   b. While discharging, ESS acts like a generating station and supplies electricity to the grid with time deferral.
   c. ESS can also qualify as “works” in case of which relevant GST incentives shall be applicable.
   d. Independent Energy Storage System (IESS) can accordingly be treated at par with a generating station. In so far as the activity of charging is concerned, it can be treated as an input to the activity of generating electricity with time lag to inject electricity back into the grid. For generating electricity, the input could be any fuel source or electricity itself. The Act does not cast any prohibition or restriction in this regard.
2. **Asset Category of ESS (Business Models)**
   a. The primary objective of ESS is to promote and integrate large-scale RE into India’s power system
   b. ESS as an Independent Energy Storage System (IESS)
      i. An IESS may enter into contract with any other entity recognized under the Act to provide storage services.
      ii. **Business Model 1**: for charging purposes, IESS can procure input energy from the generation (wind/solar/both) owned by it.
      iii. **Business Model 2**: this would be tolling arrangement where ESS would procure power from the buyer (local distribution licensee/open access consumer) during off-peak period and give it back during peak period after discounting for cycle efficiency of the ESS. The tariff for such an arrangement shall be mutually agreed by the ESS and the buyer. In case of tolling arrangement by the distribution licensee, it shall obtain approval for the arrangement from the appropriate Commission.
      iv. **Business Model 3**: for charging purposes, IESS can procure input energy by entering into an agreement with any other entity recognized under the Act. Under this model, the ESS would procure power for charging from the market or by entering into a PPA with any supplier. The tariff for procuring power from the ESS shall be discovered primarily through competitive bidding route. However, if tariff is to be determined under Section 62 of the EA, it shall be after due justification of the need for the same and on satisfaction

of the Appropriate Commission. Cross-subsidy surcharge and additional surcharge will not be applicable.

c. ESS as a distribution asset

i. **Business Model 4**

ii. ESS could be owned and operated by the distribution licensee.

iii. Discoms can establish ESS either through Capex or Energy Storage Service Agreement (ESSA) route.

iv. In case of Capex route, discoms would undertake competitive bidding for procurement of the system.

v. Discoms would clearly present the rationale and value streams in its Capex approval proposal to SERC.

vi. Discoms would supply power to ESS for charging.

vii. Scheduling of ESS shall be the responsibility of discoms.

viii. ESS shall primarily be charged from RE sources and Discoms shall utilize ESS for compliance towards RPO as per applicable norms.

ix. Discoms will have to submit annual report on utilization of ESS to the Commission on yearly basis. Format for the report will be prescribed in the Regulations.

d. ESS as a transmission asset

i. **Business Model 5**

ii. ESS could be useful for congestion management, ancillary services, and deferral of new investment. These applications would require ESS at transmission level. The Act does not debar a transmission licensee, except CTU, from engaging in generation activity. As such, a transmission licensee can set up an ESS for the purposes mentioned above but not for trading.

iii. The transmission licensee shall not enter into any contract or otherwise engage in the business of trading of electricity on exchanges as per Section (41) of the Electricity Act, 2003.

iv. ESS is not covered in the definition of 'transmission lines' under section 2(72) of EA 2003.

3. Connectivity and Open Access for ESS

a. The CERC Regulations on Connectivity and General Network Access (GNA) enable connectivity and access for the ESS to the ISTS treating the ESS at par with a generating station. In other words, the ESS like any other generator is required to apply only for connectivity and once connectivity is granted, such an entity is deemed to have GNA equivalent to the quantum of connectivity granted.

b. An ESS is required to apply for grant of connectivity for a quantum equivalent to its maximum drawal or injection to the system.

Further, under the new regime post implementation of GNA, the generating stations are not required to pay inter-State transmission charges. As the ESS is treated at par with a generating station, it will also not be required to pay any inter-State transmission charges and losses. ESS should be encouraged to be charged with renewable energy.

c. It would be desirable to extend similar treatment to the ESS at intra-State transmission and distribution system.

4. Scheduling of ESS

a. ESS as an IESS:
   i. Scheduling and dispatch for an IESS should be treated like any other generating station for generation aspects and should be treated as a 'Storage Load' for charging aspects.
   ii. In the event of the ESS procuring power through open access, such entity should enter into valid contracts of different duration for its charging under organized power market instead of using the UI/ DSM.
   iii. In case of ESS combined with variable RE, schedule should be included in VRE generation to manage VRE shortfall/excess and the VR generator should operate ESS to manage VRE intermittency.

b. ESS as a distribution asset:
   i. Would charge during off-peak and discharge during peak hours
   ii. Scheduling decisions would be taken by the discom to manage its demand variation/ reduce DSM penalty.

5. Tariff Determination for ESS:

a. The tariff for ESS shall be primarily discovered through competitive bidding process under section 63.

b. In cases where tariff determination under section 62 is required for any Business Model for ESS and the Appropriate Commission is satisfied, the following approach should be adopted.
   i. Two-part mechanism as included would ensure both availability and operation. Similar mechanism should be developed for all types of ESS.
   ii. With regard to energy charges, ESS should declare efficiency of the storage system.

c. ESS as an IESS:
   i. Operator may be selected on the basis of rate of generation quoted. It shall be responsibility of the IESS to procure energy at a rate which would be viable for it to operate.
   ii.

d. ESS as a distribution asset:
   i. Two-part tariff akin to PSP may be paid to ESS operator at distribution level.
   ii. Discom would supply electricity to ESS and receive back electricity as per declared efficiency.

6. Tax Provisions for ESS

a. ESS should be considered for custom duty exemption and GST rate reduction for Cost component by Competent Authority

b. Exemption of Electricity duty at par with RE generation may be considered as ESS complement RE generation.

7.2 WG Recommendations on EVs

The key recommendations of the Working Group on issues related to EVs are as follows:

1. Demand Impact of EVs

a. Stringent technical standards for EV chargers and infrastructure
b. Revision of supply code for EV charging connectivity standards
c. Studies to assess impact of EV charging on Discom network
d. Discom to develop process to account above assessment of impact of EV Charging Infrastructure on its network.
e. Discoms would build strong back-end links between the grid and EV charging facilities to achieve necessary grid balance
f. Discoms would factor in the impact on demand and proactively consider the same in resource adequacy plans
g. Changes to Grid Code so that EV Charging Infrastructure could act as a flexible load
h. Encourage EV charging stations with DRE generation and storage systems to manage their own peaks esp. with fast charging facilities

2. EV Charging Infrastructure

a. Domestic consumer: If domestic connection is used to charge the vehicle, slow charger must be used with charger capacity not exceeding the sanctioned connected load of the consumer category.
b. Society/ community charges: Societies/ RWAs/ communities may install charging infrastructure either through ownership or third-party service provider. This will be separate LT connection from the Discom. For this purpose, separate 'LT EV Charging Station' category would be created by SERC
c. Large charging stations/ fast chargers/ battery swapping stations: SERC would create separate 'HT EV Charging station' as a category.
d. BEE may be asked to develop standard specifications for three types of charging infrastructure.
e. For commercial charging stations, discoms shall take steps to direct RE towards charging stations for promotion of RE.

3. Tariff Determination for EVs

a. Domestic: Prevalent residential tariff
b. LT EV Charging Station: Tariff for this category will not be more than 110% of the Average Cost of Supply of Discom for that year
c. HT EV Charging Station: Tariff for this category will not be more than HT Industry Tariff in the State

d. Consumers in this category would be encouraged to procure power from RE sources for which OA charges (and not losses) and surcharges should be waived off.
e. Commercial charging stations procuring 100% of supply from renewable energy shall be categorized as “green charging stations”.