MINUTES OF THE
60TH MEETING OF THE
FORUM OF REGULATORS (FOR) HELD AT NEW DELHI

Venue	**:**	**Conference Hall, Upper Ground Floor Central Electricity Regulatory Commission Janpath, New Delhi-110001**
Day / Date	**:**	**Friday, the 23 June, 2017**
List of Participants	**:**	**Enclosed as Annexure-I**

Opening Session

Shri Piyush Goyal, Hon'ble Minister of State (I/C) for Power, Coal, New & Renewable Energy and Mines joined the proceedings

The meeting was chaired by Shri Gireesh B. Pradhan, Chairperson, Central Electricity Regulatory Commission (CERC) and Forum of Regulators (FOR). The Chairperson, CERC / FOR welcomed the Hon'ble Minister of State (I/C) for Power, Coal, New & Renewable Energy and Mines, Members of the Forum and Officers of MoP, MNRE, CEA and POSOCO to the 60th Meeting of Forum of Regulators. He also extended a warm welcome to the Secretary & Officers of MoP, Principal Secretaries / Secretaries of State Power / Energy Departments. In his opening remarks, the Chairperson informed that CERC went digital on June 15 , 2017 when it conducted its hearing through electronic mode– the first of its kind in any quasi-judicial regulatory authority in India. This pioneering initiative is aimed at making the proceedings of the Commission, a paperless process. The initiative is in line with the spirit of the Digital India initiative of the Government of India, and seeks to achieve economy and efficiency in disposal of petitions. Oral hearings in the

Commission now onwards would be conducted through soft-copies of petitions. The stakeholders could access digitized records and case information system. Chairperson, CERC also informed that the Commission is sharing its experiences with State regulators to enable them to adapt to this system in their States. In fact, States like Maharashtra and Gujarat have already initiated action on these lines. The Forum is deliberating a proposal for developing a generic web-tool for e-court/ e-filing schemes in States.

The Chairperson informed the participants that the Forum has been playing its role as a platform for sharing experiences, best practices and more importantly consensus building on critical issues related to the power sector. True to its objective, the Forum has helped harmonization of regulation in addition to conducting studies on wide range of issues, viz., consumer protection, tariff rationalization, DSM &EE, open access, retail sale competition, RE integration, standards of Performance, loss reduction strategy etc.

While informing the gathering about the critical role played by FOR Working Groups, he referred to the High powered technical committee of FOR on Renewable Energy which has made several recommendations ranging from the need for adoption of energy accounting and settlement system as the basic building block to the forecasting, scheduling and deviation settlement of RE, creation of reserves and ancillary services at the State level, to the framework of regional cooperation for optimum utilisation of assets in a region. Approach of the Committee is solution oriented, that seeks to ensure roll out through handholding, on Scheduling, Accounting, Metering and Settlement of Transactions (SAMAST),

Model DSM regulations and RPO web-tool for compliance monitoring. For SAMAST, DPRs are being facilitated for funding from PSDF. Andhra Pradesh and Tamil Nadu have acted on this and other States are expected to initiate.

While referring to the critical role of the Government and the Regulators for development of the sector, he stressed on the need for ring-fencing the State Load Despatch Centres for effective discharge of the mandate as the system operator. He further informed that the Forum was also working on emerging issues of the future, e.g. on electricity storage and electric vehicles.

Shri P.K.Pujari, Secretary, Ministry of Power in his address stated that the Ministry of Power is closely working with the CERC and SERCs on policy matters and the outcome of the same has been positive. He mentioned about the "Merit Order Despatch Portal" and "Weather Portal for Power System Operation", which were scheduled to be inaugurated the same day by the Hon'ble Minister. He informed that Merit order dispatch portal captures real-time data, inclusive of deviations and that the seamless flow of information would bring in the much desired transparency in information dissemination in respect of merit order despatch. He also informed that "Weather Portal for Power System Operation" uses real time data from meteorological department to arrive at the forecasting of demand. The portal is expected to bring benefits in terms of accuracy in demand, less power procurement costs and these benefits are expected to be passed on to the consumers.

He further introduced the POSOCO / FOLD report on "Operational Analysis of Optimization of Hydro Resources", which covers analysis on the possibility of

synchronizing generation of hydro power to meet peak demand and its effectiveness in facilitating RE integration into the grid. He informed the Forum that last year, Ministry of Power launched the DEEP portal for dissemination of short term power prices on real-time basis. He shared that since the launch of DEEP Portal, 60,000 MW bidding was carried out resulting in Rs. 2,000 Cr. saving to the distribution sector with regard to short term power procurement. MoP is now extending this facility to medium term power procurement and banking on DEEP Portal. While concluding, he appreciated CERC and all SERCs / JERCs for their proactive and positive support to the initiatives of the MoP.

Hon'ble Minister of State (I/C) for Power, Coal, New and Renewable Energy and Mines launched the "Weather Portal for Power System Operation", "Merit Order Despatch Portal" and released the POSOCO / FOLD report on "Operational Analysis of Optimization of Hydro Resources".

Weather Portal for Power System Operation:

A presentation was made by representative of POSOCO (copy enclosed as **Annexure-II**). It was informed that a tailor made weather portal was designed and developed by Indian Meteorological Department for use of power system operators in the country. The portal provides detailed weather forecast, satellite images, radiogram, radar data, vertical distance of clouds from ground, their movement along with direction, etc. for all five regions of the country. The portal has the potential of assisting the utilities forecast load requirement and facilitate optimization of power procurement resulting in saving of power. Hon'ble Minister desired POSOCO to develop a model which could capture the savings in terms of

capacity (MW), energy (MUs) by considering the projections made in normal course and the optimized projection with the help of the weather portal.

Merit Order Despatch Portal:

A presentation was made by the representative of POSOCO (copy enclosed as **Annexure-III**). It was presented that in order to bring in more transparency in dissemination of information pertaining to merit order operation by state utilities, a web portal has been designed. The portal hosts merit order information (variable cost per unit) of each State/DISCOM on a daily basis. This facilitates the utilities to revisit their power procurement strategy and can help them optimize power procurement costs. Preparation of a mobile App is currently in progress.

Report on Operational Analysis of Optimization of Hydro Resources:

A presentation was made by the representative of POSOCO (copy enclosed as **Annexure-IV**). It was presented that the issues arising due to large grid, substantial RE generation capacity and large market necessitated review of role played by hydro generation segment. Considering the reliability and flexibility of hydro sources, demand patterns were examined in the light of availability of hydro sources. The report is based on a survey and analysis of data for the past nine years. The report recommended multipart tariff for hydro generation (incl. costs for flexibility, black start etc.) , periodical forecasting of water inflow and silt besides analysis of hydrological constraints. It was projected that optimization of hydro resources would facilitate availability of 2% of capacity i.e. 4500 MW in addition to the existing capacity, for ramping up / down and black start, resulting in a saving of approximately Rs. 600 Cr.

Hon'ble Minister desired the report to be examined by the Members of FoR and provide their observations so that the report could be finalized at the earliest.

Interaction of Hon'ble Minister with the Forum:

The Hon'ble Minister, during the interaction appreciated the CERC for going digital on June 15, 2017 when it conducted hearing through electronic mode– the first of its kind in any quasi judicial regulatory authority in India. The initiative was in line with the spirit of the Digital India initiative of the Government of India, and seeks to achieve economy and efficiency in disposal of petitions.

The Hon'ble Minister also appreciated the active role being played by the FoR. Since its inception in 2005, the Forum has held 60 meetings so far and discussed and evolved consensus on wide ranging issues facing the power sector. Shri Goyal reiterated that while the Forum is a recommendatory body, it is incumbent upon the regulators to implement its recommendations in true spirit. For instance, the Forum has made salutary recommendations on RPO compliance including the need and framework of penalty for non-compliance of RPO. Model framework for energy accounting and settlement – which is the basic building block for energy transaction, has also been evolved. States should implement all such recommendations mandatorily in the larger interest of the development of the power sector.

He stressed that the role of the States is of paramount importance in carrying forward reforms in power sector. The Government has come up with important policy initiatives to address chronic issues of power sector through its "UDAY" and "Power for All" schemes. These schemes are not only aimed at resolving legacy

issues, but also provide futuristic roadmap leading to non-recurrence of any of the past problems. State Governments and State Utilities are the major stakeholders in implementation of the scheme. However, the Regulators have a critical role to play in ensuring speedy implementation and close monitoring of compliance of the norms and trajectories specified in the UDAY scheme.

The Hon'ble Minister, while drawing attention to the issues which are *sub judice* at different judicial platforms, asked the Regulators to critically examine the matters before them and offer innovative solutions, so that time lag in approaching judicial forums seeking solutions could be reasonably avoided.

While stressing on the need for independent and efficient discharge of duties by the Regulators, he assured full cooperation of the Centre in resolving any issue that might come in the way of their taking decisions professionally. He drew attention towards the problems of stressed assets and solicited cooperation of the Regulators in resolving them and helping revive such assets.

He emphasised on the need for structured peer review by the Regulators themselves, which could set an example of self imposed accountability. He requested the Regulators to come up with State-wise white papers highlighting the problems specific to States and suggesting possible measures to address the same and offered to have a brainstorming session to jointly resolve such matters and take the reforms story forward in power sector.

The Chairperson, CERC / FoR, on behalf of the Forum of Regulators, thanked the Hon'ble Minister of State (I/C) for Power, Coal, New and Renewable

Energy and Mining, Shri Piyush Goyal for his valuable time to interact with the Forum.

Thereafter, the Forum took up the agenda items for consideration.

Business Session – 1

Agenda Item No. 1 **Confirmation of Minutes of the 59th Meeting of FoR held on 21.4.2017.**

The Forum considered and endorsed the minutes of the 59th Meeting of Forum of Regulators held on 21.4.2017 at Guwahati.

Agenda Item No. 2(i) **Appointment of Tax Consultant for filing the Income Tax Return of "FoR" for FY 2017-18 to 2019-20.**

The Forum noted that M/s M.M.& Associates, Chartered Accountants, New Delhi who were appointed to file the Income Tax Return (ITR) of Forum of Regulators (FOR) for the F.Ys. 2014-2015 to 2016-2017 have since completed their continuous term of three (3) years. The Forum authorized Chairperson, CERC / FOR to appoint the new Tax Consultant to file the ITR of FOR for the F.Ys. 2017-2018 to 2019-2020 (i.e. for the next three years) and decide the professional fees payable, based on the practice followed in the past.

Agenda Item No. 2(ii) **Accounts related Resolutions.**

In view of repatriation of some of the officers back to their parent cadre, the Forum passed resolution for removal of the names of those officers from the list of authorized signatories with the bank.

The Forum passed a resolution for closure of savings bank account of FOR (Plan Fund) maintained with Bank of India, Janpath Branch, New Delhi

The Forum also passed a resolution for opening a new bank account of Forum of Regulators (Plan Fund) with Corporation Bank, K.G. Marg Branch, New Delhi (in lieu of bank account with Bank of India, Janpath Branch, New Delhi) along with the names of the officials to be authorized to open the bank account and names of officials to act as the authorized signatories for operating the bank account.

Agenda Item No. 3(i) **Generic RPO Web Tool designed to monitor RPO compliance.**

and

Agenda Item No. 3(ii) **Presentation on Renewable Purchase Obligation (RPO) compliance.**

Dr. Sushanta K. Chatterjee, Joint Chief (RA), informed the Forum that during the 51st FOR meeting in November 2015, a presentation on "RPO Compliance framework for Captive / OA transactions at State Level" was made before the Forum. This was followed by a presentation on the key functionalities of the Beta version of the Web Tool for RPO Compliance Reporting and Monitoring developed for the State of Rajasthan in the 56th FOR meeting. Subsequently, final version of the Web Tool was developed and integrated with the Rajasthan Renewable Energy Corporation Ltd. (RRECL) website. The Forum has also decided to develop a generic web-tool for facilitating RPO compliance monitoring by different utilities across the country. The FoR Technical Committee also deliberated upon the web-tool and recommended to deploy this tool in the respective States and mandate its use by the concerned State Agency and obligated entities.

Representative of the Consulting firm which developed the generic web-tool made a presentation before the Forum (copy enclosed as **Annexure-V**). The Forum was updated that the generic web-tool has been developed in line with the tool implemented in Rajasthan. However, it was proposed that SERCs may take up the issue of implementation while considering the following:

- Adoption of proposed regulatory interventions as per Model RPO-REC Regulations and suitable amendments in RPO-REC Regulations at State level.
- Hosting of information / Guidebook / Roadmap for RPO Web-tool deployment at State level
- Encouraging States to use and deploy Generic RPO Web-tool
- SERCs to support in creation of Working Group / Technical Committee to provide necessary guidance/suggestions to Nodal Agencies for State specific RPO Web Tool deployment
- Clarity on ownership of the Generic Web-Tool post handover by the Program
- Requirement of hosting of the Generic Web-Tool and Security Audit of Tool
- Training and capacity building of key stakeholders incl. obligated entities
- Pilot testing and operationalizing RPO web-tool at State level
- Documentation and reporting

The Forum noted the recommendations.

Agenda Item No. 3(iii) **Discussion on reference received from KERC regarding interpretation of "Electricity Consumption for specifying RPO under provisions of Section 86(1)(e) of the Electricity Act, 2003.**

The Forum considered the matter related to defining the consumption of electricity for computing RPO target and noted different approaches adopted by various SERCs in this regard.

The Forum while considering the recommendations of the "FOR Technical Committee for Implementation of Framework on Renewable at the State Level" in this regard decided that

a. It would be desirable to compute RPO for Discoms as a percentage of energy input, uniformly across States, as 'sales' in any case will have to be grossed up by T&D losses to arrive at the quantum of purchase of RE by Discoms.
b. In respect of OA and CPP consumers, the RPO be computed as a percentage of metered consumption recorded at drawal / consumption point.
c. SERCs may consider notifying suitable amendments to their RPO Regulations, as per above.

Agenda Item No. 4(a) **Simplification of Tariff Categories – Presentation by the representative of Ministry of Power on the report on "Simplification of Tariff Categories" and "Tariff Rationalization"**

Smt. Jyoti Arora, Joint Secretary (R&R) , Ministry of Power informed the Forum that the Ministry of Power (MoP) had constituted a Committee with a mandate to examine the issues relevant to simplification of tariff categories and

develop a framework for uniform and homogenous tariff categorization across India. The Committee finalized its report on simplification of tariff categories. A presentation was made by the representative of MoP / CEA on simplification of tariff categories (copy enclosed as **Annexure-VI**).

Section 61 of the Electricity Act, 2003 provides Appropriate Commission for determination of multi-year tariff principles, safeguarding of consumers' interest and at the same time, recovery of the cost of electricity in a reasonable manner. The provisions also mandate that the tariff progressively reflects the cost of supply of electricity. However, it has been observed that across States, the tariff categories are large in number leading to complex tariff structures. The cascading effect includes, difficulty for consumers to comprehend the charges, inconsistencies in categorization of consumer segments across States, absence of periodical reviews of slab limits etc.

The study recommended streamlining the consumers broadly into five major categories, i.e. domestic, agriculture, commercial, industrial and institutional. Under these broad categories, it was proposed to sub-categorize the consumers on the basis of voltage. The domestic category may have within itself three sub-categories i.e. cross-subsidizing, cross-subsidized and cross-subsidy neutral. Further, this category may have lifeline category and efforts should be made to gradually phase out un-metered, rural and urban categories. For agriculture consumers, consolidation of sub-categories into agriculture and agriculture-allied categories and efforts should be made to dis-incentivize unmetered consumption. For industry category, a separate "Supported" category may be created to to

facilitate a select group of industries. The SERCs were requested to consider a two year time period to re-cast tariff categories as per above simplified structure.

Secretary (Power) referred to the proposal related to progressivity of tariff made as part of Economic Survey 2015-16 and suggested for determination of tariff on cost to serve basis while leaving the option of grant of subsidy by the State Government, to any particular category / sub-category.

The study also recommended reduction of cross subsidy between any two categories, avoidance of tariff shock to the consumers besides demand management and grid stability.

Discussion & Decision:

The Forum considered the issue of tariff simplification along with the issue of progressivity of tariff and tariff rationalization. The Forum observed that progressivity of tariff has already been discussed earlier. However, upon receipt of reports from MoP on both "Simplification of Tariff Categories" and "Rationalization of Tariff", the Forum will deliberate upon the same and take appropriate action.

Agenda Item. 4(b) **Presentation by Bihar Electricity Regulatory Commission on Simplification of Tariff Categories.**

Bihar Electricity Regulatory Commission notified its Tariff Order for FY 2017-18 on 24.3.2017 for the two distribution utilities i.e. North Bihar Power Distribution Company Limited (NBPDCL) and South Bihar Power Distribution Company Limited (SBPDCL). The Commission substantially reduced the number of tariff categories from 2016- 17 to FY 2017-18. In this regard, the representative

of BERC made a presentation before the Forum (copy enclosed as **Annexure-VII**), underlining philosophy and principles adopted for simplification of tariff categories.

BERC while determining tariff for FY 2017-18 took up the issue of simplification of tariff categories. Prior to the issuance of the said Tariff order, 74 tariff categories / sub-categories were in existence based on voltage level / type of use / urban / rural / time of use etc. The Commission reduced the number of categories to 27 without disturbing the underlining principles of segregation of categories.

BERC also took a radical step by determining tariff on cost of supply basis without creating any regulatory asset, thereby leaving the option of declaring subsidy to appropriate consumer categories by the Government. This move resulted in 54% hike in tariff. Clarity of the tariff order facilitated the State Government to sanction financial assistance in two parts, i.e. tariff subsidy to target consumer categories and separate assistance to meet the operational loss of distribution utilities.

The Forum appreciated the changes brought in by BERC.

Agenda Item No. 5 **Presentation on Report on "Merit Order Despatch and Integration of Renewables".**

The Forum was briefed about the report on "Merit Order Despatch and Integration of Renewables" and a (copy of the presentation enclosed as **Annexure-III)**. The Report recommended that,

a. Mechanism for RE curtailment be adopted Including compensation for curtailment of RE may be adopted

b. Uniformity in preparation of Merit Order may be observed and the merit order should be adhered to.

c. Technical minimum may be notified by SERCs

d. In order to bring in more transparency in dissemination of information pertaining to merit order operation by state utilities, a web portal has been designed. The utilities may utilize the web portal to revisit their power procurement strategy and optimize power procurement costs.

The Forum appreciated the presentation.

Agenda Item No. 6 Presentation and Discussion on "Time of Day Tariff".

Smt. Jyoti Arora, Joint Secretary (R&R) , Ministry of Power informed the Forum that the Ministry of Power had carried out a study on the Time of Day (or ToD) tariff and proposed a roadmap for implementation of the same. A Representative of Central Electricity Authority made a presentation on the subject (copy enclosed as **Annexure-VIII**).

It was presented that Time of Day Tariff provides for a structure consisting of different rates applicable for use of electricity at different times of the day. Various provisions of the Electricity Act 2003, National Electricity Policy and Tariff Policy, 2016, also stipulate implementation of ToD. ToD has been considered as an important Demand Side Management (DSM) tool which facilitates improving the load factor significantly. Differential tariff structure under ToD is basically aimed at managing the peak demand through consumer participation. Most of the SERCs have notified ToD tariffs, but limited to the industrial category of consumers.

The proposed roadmap includes implementation of ToD in two blocks i.e. for morning peak load and evening peak load. ToD implementation may be considered for HT, LT and Commercial consumers initially and then sequentially move to the bottom of the pyramid, consisting of single phase domestic consumers. Most of the electronic meters are having ToD features, which can be activated through installation of a software patch.

Discussion & Decision:

The Forum while appreciating the initiative of MoP, observed that before drawing achievable timelines for implementation of ToD, the matter needs to be examined in detail by the FoR Technical Committee headed by Shri A.S. Bakshi, Member, CERC. The Committee, which consists of Technical Members of various SERCs, may consult CEA, consider examining techno-economic feasibility of implementation of ToD with the existing metering infrastructure and give its recommendations for facilitating effective implementation along with achievable timelines.

Agenda Item No. 7 **Presentation on FoR Study Report on "Impact of Electric Vehicles on Grid".**

Dr. Sushanta K. Chatterjee, Joint Chief (RA), informed the Forum that a study on "Impact of Electric Vehicles on Grid" was commissioned by the Forum with the objective to carry out techno-economic analysis of the integration of electric vehicles (EVs) along with the regulatory preparedness and policy prescriptions requisite for effective and smooth integration. For technical analysis, the consultant sought assistance of a Professor of IIT Mumbai. Recommendations

inter alia include, required regulatory interventions, policy prescriptions, besides suggestions on relevant legal issues and some business models.

A presentation was made by the representative of consultant i.e. M/s MP EN Systems (copy enclosed as **Annexure-IX**). In the light of the mandated objective, the study has been carried out. As part of the study, simulation exercises to understand the impact of the EVs on feeders has been studied. It was observed that the simulation results have shown no adverse impact in terms of voltage drops / gains on the residential, commercial and mixed load feeders.

- EV charging falls under the purview of electricity distribution and therefore such charging service needs to be regulated through determination of tariff under a separate category.
- Considering the provisions available under the Act and Policies, three business models were suggested, i.e. utility owned installations, installations by franchisee (including public-private partnership) and aggregation by battery swapping stations.
- The study analyzed the tariff impact of investment in EV charging infrastructure under low growth and high growth assumptions in the light of the targets specified under NEMMP (National Electric Mobility Mission Plan of Government of India) and NEMMMP+ (a projected aggressive scenario) plans.
- Considering a test case in Maharashtra with specific reference to MSEDCL, the tariff impact on wheeling charges was analyzed.
- Action for creation of specific EV penetration targets, provisioning of

indirect tax benefits (road taxes etc.) may be taken.

- Regulatory interventions such as, framework for franchise agreements between the distribution licensees and private sector/interested Public Sector Undertakings/associations for setting up public charging infrastructure, regulations to allow pass through of investments made in EV charging infrastructure may be considered.
- Other interventions such as creation of special EV tariff category for consumers including ToD option, Open Access for battery swapping aggregators etc. may also be considered.

Discussion & Decision:

The Forum noted that any other model apart from utility owned installations, installations by franchisee (including public-private partnership) and aggregation by battery swapping stations (standardization of batteries is still being debated at other fora), would necessitate amendment to the rules / provisions in the Electricity Act, 2003. However, the study may look at preparing a model franchisee agreement and creating a special category of consumers for EV charging with specific reference to any State . It was also felt that option for pre-paid metering for charging the EVs may be included in the Report. However, SERCs may require to explore and examine the matters related to space for charging stations, various pricing models (one option may also to include charges towards parking of the vehicle along with charging of the battery) etc. With the above suggestions, the Forum approved the Study Report on “Impact of Electric Vehicles on Grid”.

Agenda Item No. 8 **Update on initiatives and progress achieved by the FoR Technical Committee for Implementation of Framework on Renewables at the State Level.**

The Forum was apprised that the Technical Committee of Forum of Regulators (FOR) was formed under the Chairmanship of Shri A.S. Bakshi, Member, CERC and comprising Technical Members of State Commissions of renewable rich States viz. Tamil Nadu, Gujarat, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka and Madhya Pradesh. The Technical Committee was mandated to ensure timely action on deployment of Framework on Forecasting, Scheduling and Deviation Settlement of wind & solar generators, implementation of Availability Based Tariff (ABT) framework at the State level, introduction of Ancillary Services and Reserves and implementation of Automatic Generation Control (AGC) and primary control within States.

The Forum was also informed about the key initiatives and the progress achieved by the Committee, which *inter alia* include,

a. Implementation of Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST) Report.
b. Implementation of State Level Forecasting & Scheduling Framework
c. Model Deviation Settlement Mechanism (DSM) Regulations
d. RPO Web-Tool
e. Development of Model RPO Regulations for SERCs
f. Regional Co-operation for Optimum Utilization of Generation Resources

g. Introduction of 5 Minute Time Block

The Forum noted the tasks executed by the Technical Committee and appreciated the initiatives brought out.

Agenda Item No. 9 Generic Web-Tool for E-Court / E-Filing Schemes in States.

Joint Chief (RA) informed the Forum that as an initiative towards Digital India, CERC has developed the e-filing software under technical guidance of NIC-Court Division after hiring technical manpower from NICSI and launched its e-Court Project SAUDAMINI (System for Adjudication Using Digital Access & Management of Information through Network Integration) on 4 April 2016. A presentation of the SAUDAMINI project was made in the 54th Meeting of the Forum of Regulators (FOR) held on 8.4.2016 at Varanasi. The Members of the Forum appreciated the initiatives of CERC and urged CERC to extend support to all SERCs for implementing e-Filing and digitization at their offices.

It was confirmed that CERC had discussed the matter with NIC and it is estimated that NIC may charge approximately Rs. 30 lakhs for developing generic web-tool for implementation of e-court system in other SERCs / JERCs. For installation of e-court system, the SERCs would require to meet only the expenditure towards hardware, annual maintenance etc. The Forum deliberated on the proposal and approved the same.

Agenda Item No. 10 Discussion on UDAY Scheme.

The Forum was briefed about Ujjwal Discom Assurance Yojana (UDAY) Scheme launched by the Ministry of Power, Government of India to provide the

financial turnaround and revival of power distribution companies of the States through financial restructuring and efficiency improvement. The following suggestions were made by MoP for implementing UDAY in the States:

- In order to facilitate improvement in net worth and credit worthiness of discoms, any improvement in efficiency by the Discoms in operational/financial parameter/ cost of procurement, may be passed on to Discoms.
- Trajectories as specified in UDAY MoU may be taken as benchmark, in case these trajectories differ from trajectories specified in tariff orders etc.
- Investments under capex towards achieving operational targets viz. feeder metering, feeder segregation, smart meters etc. may be allowed under tariff orders.
- ERCs may monitor compliance of UDAY trajectories by the utilities.

The Forum noted the suggestions.

On conclusion of the meeting, Chairperson, CERC/FOR thanked all the dignitaries present in the meeting He also thanked the staff of "FOR" Secretariat for their arduous efforts in organizing the meeting.

The meeting ended with a vote of thanks to the Chair.

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/ ANNEXURE – I /

LIST OF PARTICIPANTS ATTENDED THE 60TH MEETING

OF

FORUM OF REGULATORS (FOR)

HELD ON 23RD JUNE, 2017 AT NEW DELHI.

S. No.	NAME	ERC
01.	Shri Gireesh B. Pradhan Chairperson	CERC / FOR – in Chair.
02.	Justice (Shri) G. Bhavani Prasad Chairperson	APERC
03.	Shri R.P. Singh Chairperson	APSERC
04.	Shri Naba Kumar Das Chairperson	AERC
05.	Shri S.K. Negi Chairperson	BERC
06.	Shri Narayan Singh Chairperson	CSERC
07.	Shri Anand Kumar Chairperson	GERC
08.	Shri Jageet Singh Chairperson	HERC
09.	Shri S.K.B.S. Negi Chairperson	HPERC
10.	Shri M.K. Goel Chairperson	JERC (State of Goa & UTs)
11.	Shri M.K. Shankaralinge Gowda Chairperson	KERC
12.	Dr. Dev Raj Birdi Chairperson	MPERC
13.	Shri W.M.S. Pariat Chairperson	MSERC
14.	Er. Imlikumzuk Ao Chairperson	NERC
15.	Shri U.N. Behera Chairperson	OERC

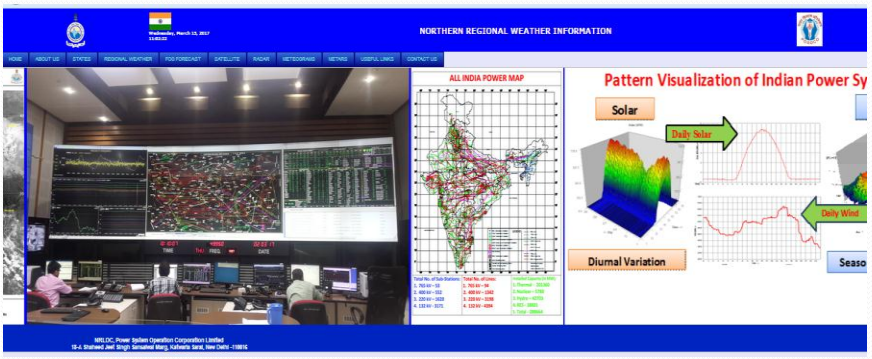
16.	Shri D.S. Bains Chairperson	PSERC
17.	Shri Vishwanath Hiremath Chairperson	RERC
18.	Shri S. Akshayakumar Chairperson	TNERC
19.	Shri Niharendu Chakraborty Chairperson	TERC
20.	Shri Desh Deepak Verma Chairperson	UPERC
21.	Shri Subhash Kumar Chairperson	UERC
22.	Shri Rabindra Nath Sen Chairperson	WBERC
23.	Shri B.P. Singh Member	DERC
24.	Shri R.N. Singh Member	JSERC
25.	Dr. Sushanta K. Chatterjee Joint Chief (RA)	CERC
MOP		
26.	Shri Piyush Goyal, Hon'ble Minister of State (I/C) for Power, Coal, New & Renewable Energy & Mines	MOP
27.	Shri Pradeep Kumar Pujari Secretary	MOP
28.	Ms. Jyoti Arora Joint Secretary	MOP
29.	Shri Aniruddha Kumar Joint Secretary	MOP
MNRE		
30.	Shri P.C. Maithani Adviser	MNRE
SPECIAL INVITEES		
31.	Shri A.K. Singhal Member	CERC

32.	Shri A.S. Bakshi Member	CERC
33.	Dr. M.K. Iyer Member	CERC
34.	Shri Rajeev Amit Member	BERC
35.	Smt. Geetu Joshi Chief (Eco.)	CERC
36.	Shri S.C. Shrivastava Chief (Engg.)	CERC
CEA / POSOCO		
37.	Shri Ajay Talegaonkar Chief Engr.	CEA
38.	Shri A.K. Rajput Chief Engr.	CEA
39.	Shri Vikram Singh Director	CEA
40.	Shri K.V.S. Baba CEO	POSOCO
41.	Shri S.K. Soonee Adviser	POSOCO
REPRESENTATIVE(S) OF STATE GOVERNMENTS		
42.	Shri Ajay Jain Principal Secretary (Energy)	Govt. of Andhra Pradesh
43.	Shri Ashish Kundra Commissioner Finance, Power & Hydro Power	Govt. of Arunachal Pradesh
44.	Ms. Varsha Joshi Secretary (Power)	Govt. of NCT of Delhi
45.	Shri Sujit Gulati Addl. Chief Secretary	Govt. of Gujarat
46.	Shri Sanjay Goel Secretary (Power)	Govt. of Goa
47.	Shri Ajay Misra Special Chief Secretary (Energy)	Govt. of Telangana
48.	Shri Himanshu Kumar Managing Director	BSPGCL

49.	Shri R. Lakshmanan Managing Director	SBPDCL
50.	Shri Ravi Prakash Dubey Chief Engr.	UPPTCL
51.	Shri Wesley Colaco	

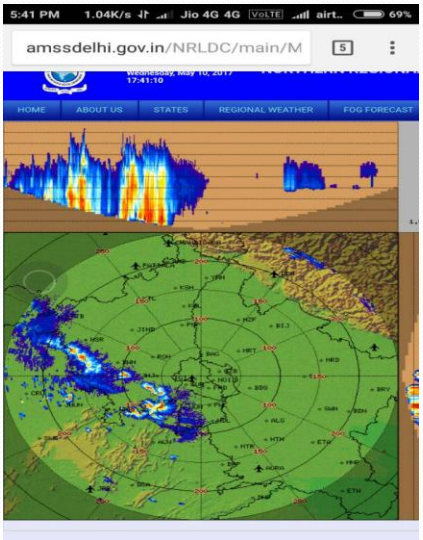
Weather Portal For Power Sector

(http://amssdelhi.gov.in/NRLDC/index.html)



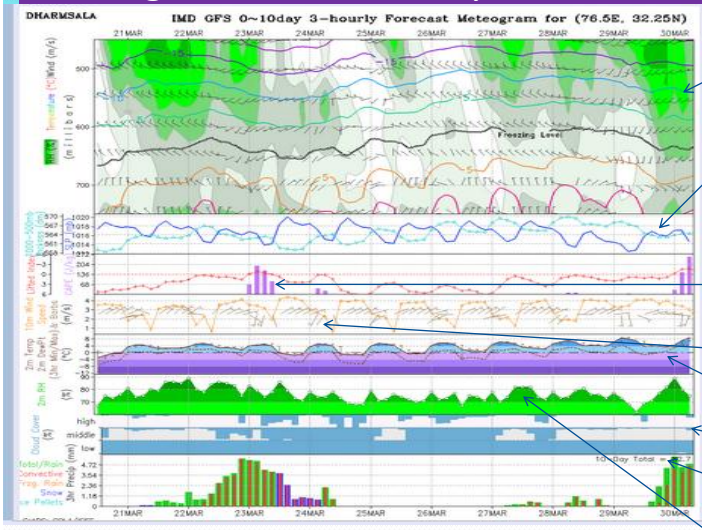
Weather Portal for Power Sector has been developed using readily available products of IMD

Radar Image



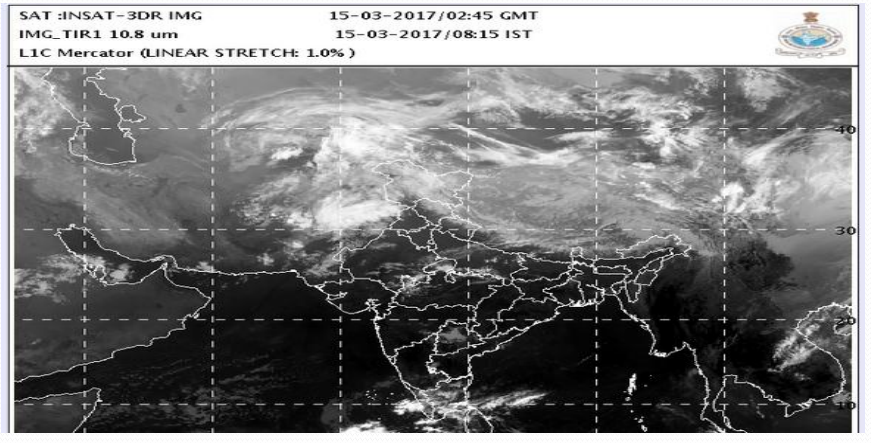
- It can be used for
  - Indentifying distance and height of Clouds (Kms)
  - Movement of clouds /Thunderstorm/Rains
  - Location of Rainfall and its intensity in mm/h
    - {Assessment of the impact and advance control measures required to maintain the Grid Security}
  - Total Rainfall in mm in the last 24 hours (mm)
    - Assessment of demand in next 24 hours
  - Wind speed and direction at the Location of Radar (knots)
    - load reduction due to factors, like, switching off of distribution lines to prevent collateral damage/distribution network outage

Meteogram : Three Hourly Forecast for 10 Days



Available for 450 Locations in the Country

Satellite Image



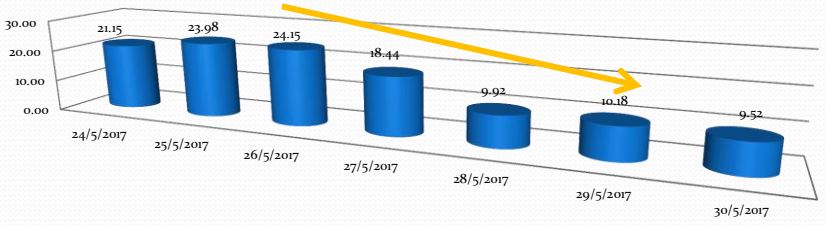
INSAT 3D is being used to monitor the Weather .
Image is updated every 30 minutes
Useful in tracking Cloud vector ,Cyclones etc.

Benefit achieved by Uttar Pradesh

Case-1

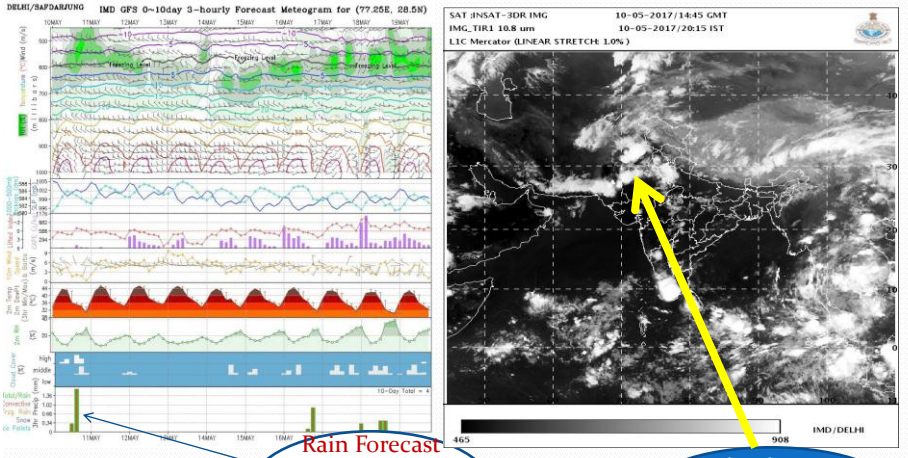
- Meteogram, wind and rain forecast for 27/28/29-05-2017 helped in better load assessment of UP control area by U.P. State Load Despatch Centre.
- As anticipated, UP demand went down from 19000 MW to 17000 MW due to change in weather conditions.
- Accordingly, STOA & purchase from Power Exchange of the order of 2000 MW was reduced. i.e Backing down of approximately 13 MU of costly thermal generation .

Total Power Exchange & Bilateral

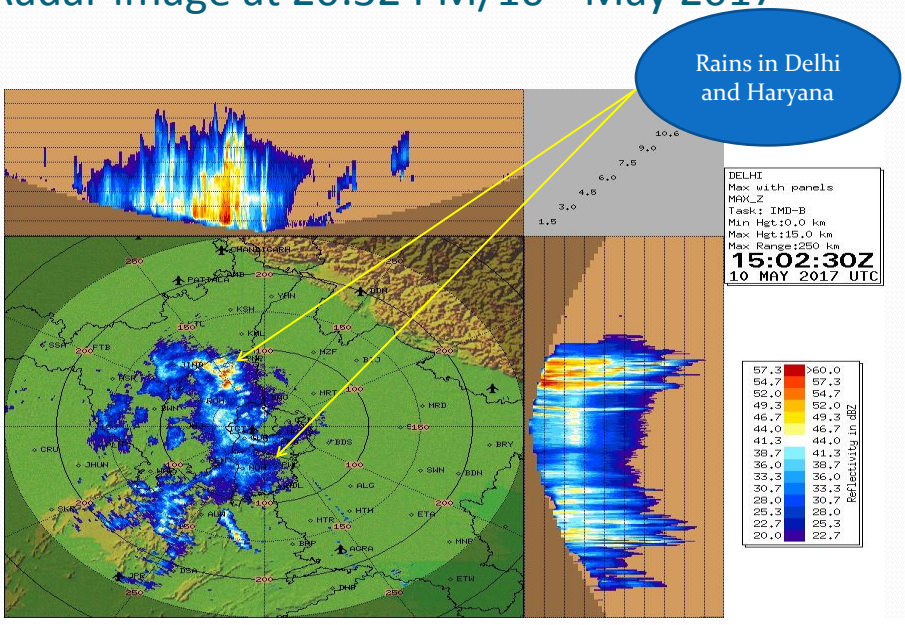


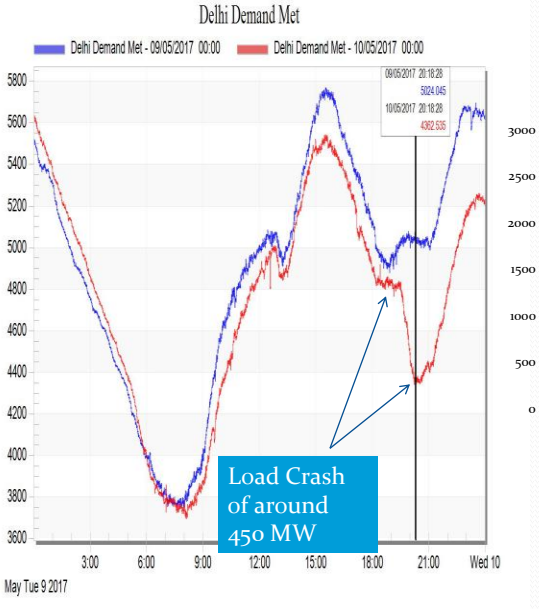
Case-II

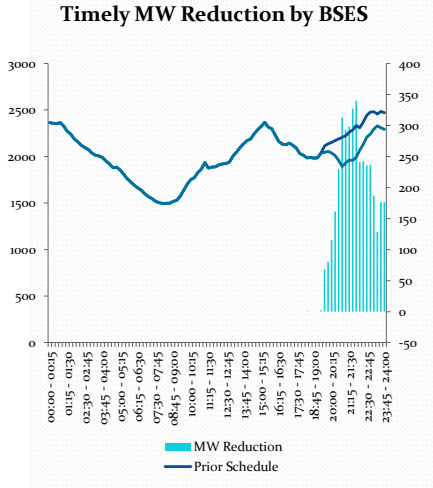
Weather Forecast for Safdarjung -10th May 2017



Radar image at 20:32 PM/10th May 2017








THANKS
http://amssdelhi.gov.in/NRLDC/index.html

सत्यमेव जयते

Ministry of Power

Merit Order Despatch and Integration of Renewables

June 2017

Merit Order Despatch and Integration of Renewables

- During the Power Ministers' conference held at Vadodara it was decided to constitute a committee to examine the status of implementation of Merit Order Dispatch, issues involved therein and for ensuring proper dispatch of renewable energy sources while following the merit order principle.
- Merit Order Dispatch Committee was constituted in October 2016 with Chairperson, CEA as its Chairperson and Joint Secretary (OM), MoP as its Member Secretary. The committee had representation from MNRE, CERC, POSOCO and states.
- Recommendations of the Committee have been prepared with regard to
  - **Promotion of Renewables** through effective implementation of Must Run status of Renewables
  - **Transparency** in Merit Order operations .

2

Issue-1

Promotion of renewables through effective Implementation of Must Run Status of Renewables

Existing framework:

- 'Must Run' status for Renewable Energy Sources is already existing in the Central Grid Code (IEGC) and State Grid Codes.

Issues :

- Curtailment of RE Energy is being done in some situations citing Technical/System constraints.
- Transparent Declaration is required if curtailment of renewable power is done due to operational reasons.
- No compensation mechanism in case of curtailment of RE Energy.

Suggestions:

RE Curtailment mechanism :

i. Each SLDC/DISCOM while curtailing renewable energy, will send instructions in writing to renewable generator stating exact reason of curtailment.

ii. Every day, the quantum of curtailment and reasons thereof will be published by the SLDC/DISCOM on its website along with name of generator/site, to whom curtailment instruction was given.

iii. A system of incentive/disincentive need to be formulated to minimize Renewable curtailment.

Issue-1

Compensation for curtailment of renewable energy

Committee Recommendations

SN	Curtailment reason and suggested compensation keeping in view the international practices
1.	**Curtailment due to Transmission constraints**
	• **Upto 2% of annual energy** : No compensation
	• **From 2-7%** : 50% of curtailed energy above 2% at contracted price.
	• **Beyond 7%** : Limited to 50% of curtailed energy above 2% and upto 7% . Matter will be enquired by expert group of CEA/ POSOCO/ PowerGrid to ascertain the reason for so high curtailment and recommend compensation, if any.
2.	**Curtailment due to Grid security reasons**
	No compensation. Grid Security reasons are to be given transparently by SLDC/DISCOM in writing with parameters like line flows, voltage or angular difference necessitating RES curtailment.
3	**Curtailment due to low system demand**
	(i) If curtailment is done after curtailing conventional generators upto technical minimum limits, then compensation at 50 paise/kwh. (ii) Else at power market price during the concerned time block.

4

Issue-1

Compensation for curtailment of renewable energy

Committee Recommendations

- **Eligibility**: Compensation for curtailment would be applicable only to the Renewable Energy Sources giving Real Time generation data , Day ahead forecast & schedule.
- RE Curtailment decision shall be based on the balancing cost of renewable generation as published by Appropriate commission. Till the time the concerned SERC declares this, the balancing cost as decided by Central Commission may be applied.
- Curtailment compensation shall be as per provisions in the PPA. In the absence of PPA, the compensation shall be as per regulations notified by the Appropriate Commission.
- **FOR will prepare detailed framework for this which will be adopted by SERCs so that the proposed mechanism is implemented at the earliest.**

5

Issue-2

Transparency in Merit Order Operations

- Presently, SERCs under Electricity Act, 2003 section 86(1) (b) and Tariff policy 2016 section 8.2.1 instruct State/Discoms to follow merit order for power procurement .
- Most of the states claim to follow Merit order operation. However, details in this regard are not transparently available. Also, there is need of a mechanism to quantify deviation from Merit order and check its reasonableness.
- The uniformity in preparation of Merit order is required: Landed cost at State periphery is considered.
- Adherence to Merit order optimizes the power procurement cost and benefits both utility and ultimate consumer.
- **Even a small saving of around 10 paise per unit on procurement of 1000 MW power over a year could generate saving of around Rs 100 Crs to a Utility.**

Typical Merit Order

6

Issue-2

Transparency in Merit Order Operations

Committee Recommendations

- **Uniform approach in Merit Order Operations**
  - Merit order to be prepared based on variable cost of generation along with transmission losses at state periphery
  - In merit order, short-term contracts would be considered including those based on “Take or pay” condition keeping in view cost benefit.
  - ISTS transmission charges not be considered for long term transaction as this is sunk/fixed cost. However, it is to be included for short term transactions .

7

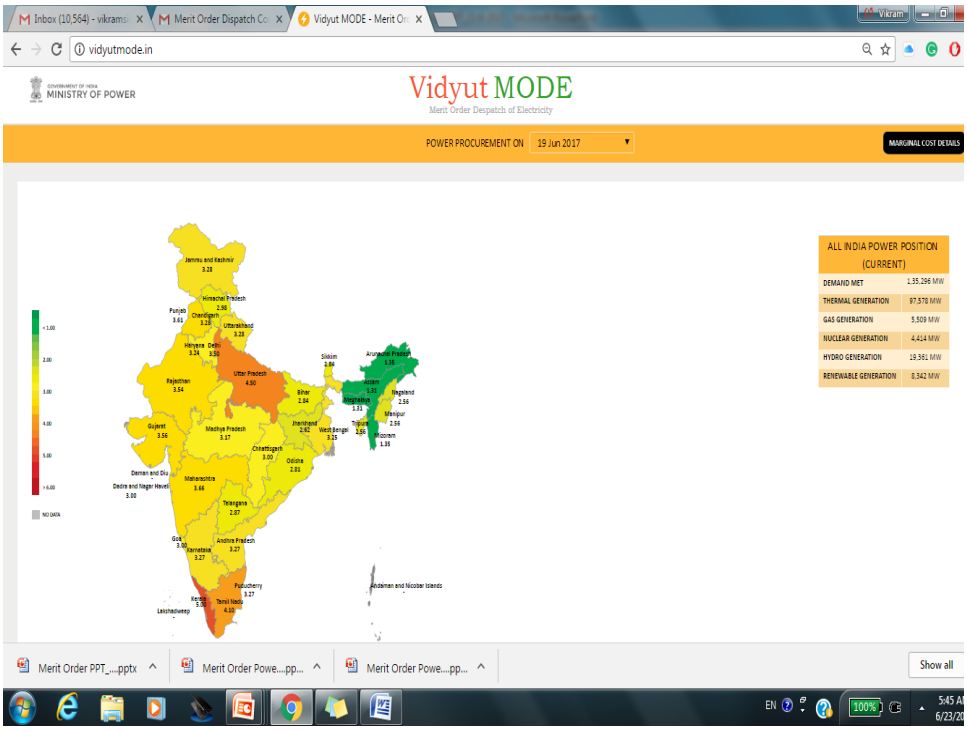
Issue-2

Transparency in Merit Order Operations

Committee Recommendations

- **Transparency in Merit Order Operations**
  - Web portal for Merit Order has developed, in which merit order information of each State/DISCOM will be available.
  - All States to give requisite information on regular basis for keeping Merit Order Portal updated.
  - Earlier data was received from the States/UTs via email. Facility of online uploading of data by the States has also been developed. Data is now filled online.
  - A Mobile APP shall also be developed shortly.

8



Issue-2

Transparency in Merit Order Operations

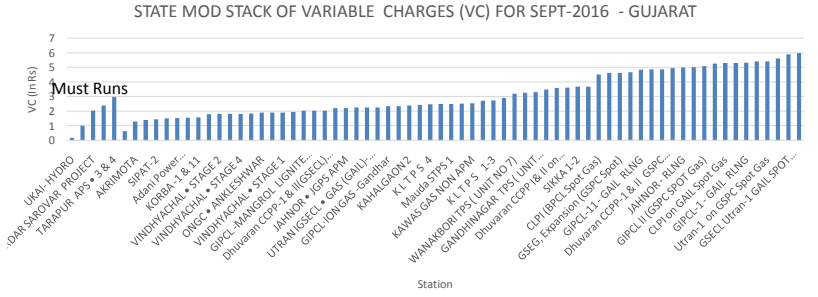
Committee Recommendations

- SERCs to notify Technical Minimum. They may get study conducted by CPRI for each type of thermal generating machine based on its capacity and vintage.
- For complying with environment norms, cost (of lime) due to operation in FGDs (Flue-gas desulfurization) would not be considered for merit order.
- CEA would help in formulating optimum power procurement plan for States. A pilot project with the help of DFID is already under implementation.

Thank you

11

Graph of Merit Order Despatch of Gujarat



12

Tariff Policy

8.2 Framework for revenue requirements and costs

8.2.1 The following aspects would need to be considered in determining tariffs: (1) All power purchase costs need to be considered legitimate unless it is established that the merit order principle has been violated or power has been purchased at unreasonable rates.

13

Report on Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India

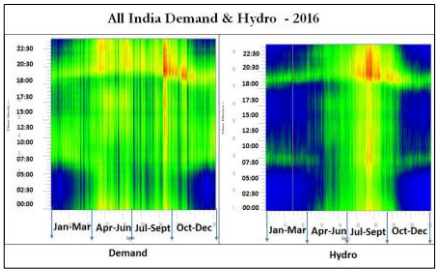
Forum of Load Despatchers
India

June 2017

Motivation

- **Sub optimal operation of some hydro generators**
  - JS (Transmission), MoP Meeting with BBMB in Nov 2016
  - Scope for optimization & flexible operation along with economic gains
  - Requirement of flexibility in view of large scale Renewable Integration

- **Hydro Power - a source of flexibility & reliability**
  - Overload capability
  - Fast ramping
  - Peaking support
  - Voltage Regulation
  - Black Start Capability



- **Constitution of FOLD Working Group**

Process

Survey of hydro power stations
- 35 GW (79%) out of 44.5 GW
- 149 hydro stations
- 486 generating units

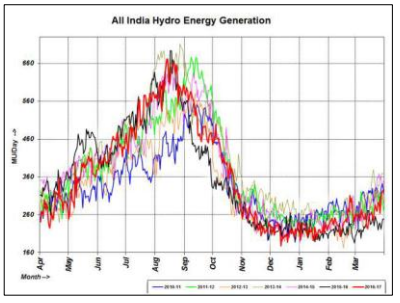
Consultation with hydro generators / State Load Despatch Centres
- Appreciation of constraints
- Philosophy of dispatch

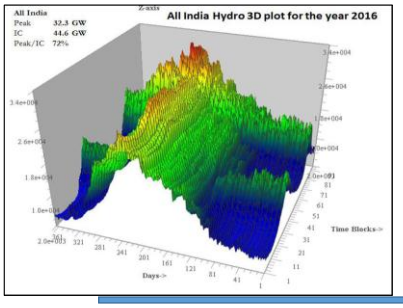
Big Data Analysis
- 9 Years Data Analysis
- 38 Million Data Points
- Data Visualization

Brain Storming in FOLD Meetings
- 6 months work
- Around 50 Contributors
- More than 1000 man hours

Summary of Findings

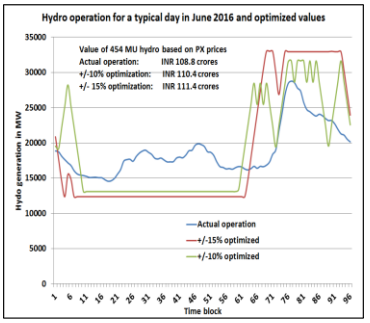
- **Defining Flexibility Indices**
  - Peaking, Ramping & Capacity Utilization
  - Flexibility Indices as a metric for improvement
  - Plants having multi part tariff performing better
- **Operational Performance**
  - Peak Hydro Support 30 GW in high hydro season & 18-20 GW in lean hydro season against IC of 45 GW
  - Seasonal Hydro Flexibility
  - 87 tested for black start
  - 25 Stations out of 150 have synchronous condenser facility to be harnessed

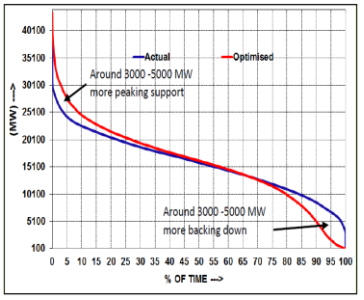




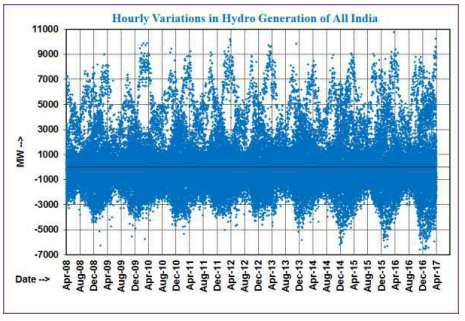
Summary of Findings

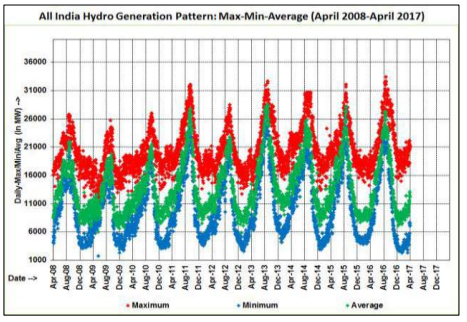
- **Valuing Hydro**
  - 128 BU of annual hydro generation ~ Rs 30000 Cr
  - 32 BU Reservoir energy content worth ~ Rs 7500 Cr
  - Around Rs 600 Cr (2%) economic gains with further optimization
- **Optimization based on Production Cost Modelling**
  - 5 GW Extra Peaking Support during peak
  - 4 GW Extra Backing down during off peak
  - Overall flexibility enhanced





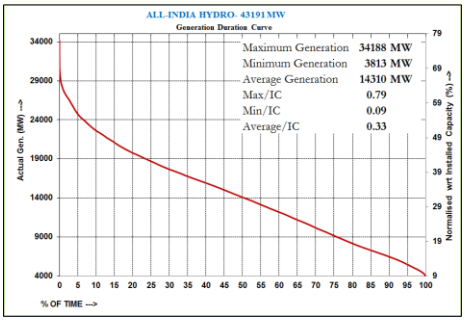
Flexibility Analysis of Hydro Generation

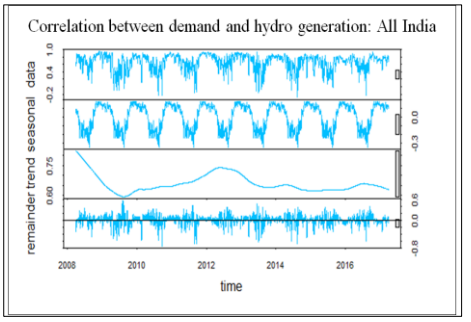




- Seasonality in Hydro Variation / Max / Min /Average Generation
- Less Variation in High Hydro Season
- More Variation in Low Hydro Season
- More scope for peaking support and off peak backing down

Flexibility Analysis of Hydro Generation





- Max Gen : 34 GW
- Min Gen : 4 GW
- Average Gen : 14 GW
- Max/IC : 0.79
- Min/IC : 0.09
- Average/IC : 0.33

- Seasonal Decomposition to identify trend and seasonality
- Decreasing Correlation between Demand and Hydro Generation
- Higher Correlation during lean hydro season

Key Recommendations

Optimization & Incentives for Flexibility	Ancillary Services from hydro power stations
Coordinated Scheduling & Despatch	Transmission planning impacting hydro flexibility
Multi Part Tariff	Silt Forecasting & Coordinated Flushing
Inflow Forecasting	Review of standards
Revisiting Hydrological Constraints	Renovation & Modernization

Report Outline

- Introduction
- Pattern Analysis & Survey
- Flexibility Metrics
- Flexibility Assessment
- Pumped storage Capability
- Constraints in Hydro Generation
- Tariff Structure
- Scheduling & Despatch
- International Experience Recommendations

265 Pages
10 Chapters
20 Appendices
112 Figs
31 Tables

Thank You !

USAID FROM THE AMERICAN PEOPLE

GOVERNMENT OF INDIA MINISTRY OF NEW AND RENEWABLE ENERGY

PARTNERSHIP TO ADVANCE CLEAN ENERGY-DEPLOYMENT TECHNICAL ASSISTANCE PROGRAM

Development of Generic Renewable Purchase Obligation Compliance Web-tool

Presentation to: Forum of Regulators
Date: June 23, 2017

1

Background of Webtool for RPO compliance monitoring and related discussions at FOR Technical Committee

- RPO compliance monitoring Web tool has been developed for Rajasthan, as an initiative of USAID under PACE-D TA programme, which was presented to FOR on Nov 2016.
- FOR had referred to Technical Committee to explore the possibilities for scaling up and generalisation this Web tool for other states.
- The committee deliberated on need of generic web tool for RPO monitoring by states and agreed upon for necessity of framing Regulatory support for web tool implementation.
- The Committee directed the consultant to draft the required model amendments in RPO-REC Regulations, which were deliberated during 9th and 10th Meeting of Technical Committee.
- During 10th meeting of Technical Committee, the **model regulatory interventions** required for rolling out the web tool for monitoring compliance of RPO were agreed upon deliberations.
- During 11th meeting, details of Beta Version of Generic RPO tools with modalities were presented and it was decided to undertake implementation in Gujarat.
- During 12th meeting, status update on RPO Webtool implementation for Gujarat and key state specific parameters were deliberated.

Proposed Draft Provisions for amending State level RPO Regulations (1/3)

1. **Appropriate Provisions for Mandatory reporting of RPO compliance through web portal**:
   - i. The **State Agency** shall formulate procedures and develop RPO Web-portal for RPO Compliance monitoring and reporting, within six months.
   - ii. All **Obligated Entities** shall mandatorily register themselves with RPO Web-portal and shall furnish requisite information to State Agency through RPO Web-portal as per the prescribed Procedures.
   - **iii.** **Electrical Inspectorate and Nodal Agency** for Open Access (SLDC/STU or Distribution Licensee, as the case may be) or Third Party Verifier appointed by State Agency, shall verify and confirm the data submissions by Obligated Entities from time to time.
   - iv. The State Agency shall submit **Quarterly Report** of status of RPO Compliance by Obligated Entities in the State to State Commission.
   - **v.** **Failure to provide** necessary information, data, reports by Obligated Entities & stakeholders shall attract penal actions under Section 142 of EA 2003.

Proposed Draft Provisions for amending State level RPO Regulations-2/3

2. **RPO as Percentage of Consumption or Input Energy**:
   - i. In case of Distribution Licensee as Obligated Entity, RPO target percentage shall be applicable on the Energy Input for concerned Distribution Licensee (i.e. Energy Sales grossed up for transmission and distribution losses).
   - ii. In case of any other Obligated Entity (other than Distribution Licensee), RPO target percentage shall be applicable on the actual Electricity Consumption (excluding consumption supplied by Distribution Licensee) recorded *at Drawal point or Consumption point of such Obligated Entity.*

Proposed Draft Provisions for amending State level RPO Regulations-3/3

3. Rooftop Solar Projects as RPO Compliance -

The electricity generated by the Consumer from the Roof-top Solar PV System under the Net Metering arrangement shall, qualify towards meeting the Solar RPO.

If Eligible Consumer is Obligated Entity

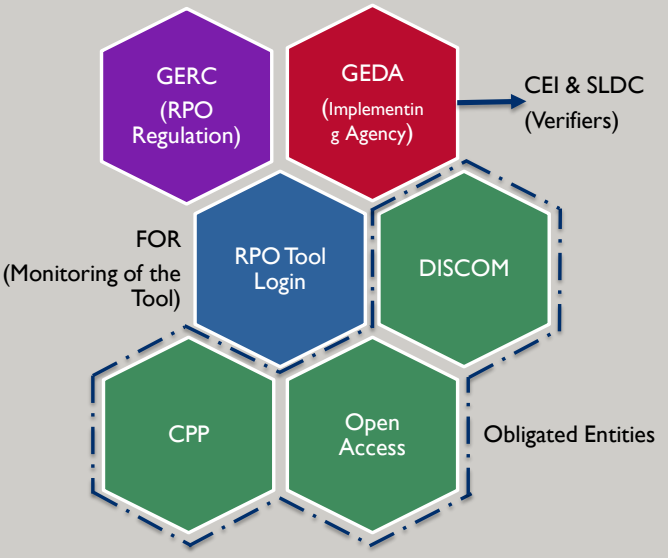
- First right is with Consumer to retain solar generation towards fulfillment of its RPO targets
- If he is willing to do so, he has to install separate solar generation meter at his cost for recording solar generation.
- Solar Generation meter shall be maintained by Discom

If Eligible Consumer is not Obligated Entity

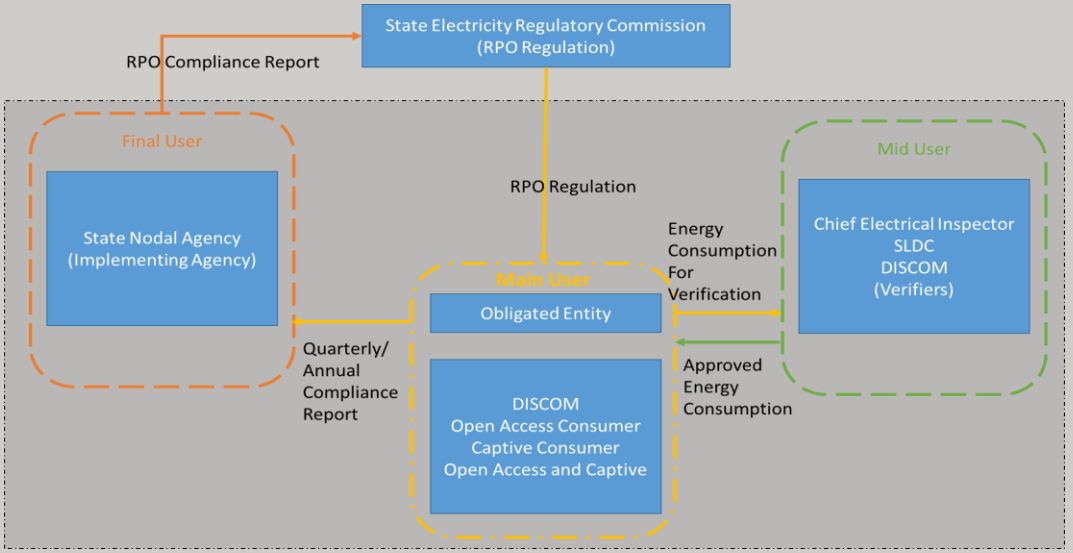
- Benefits of solar generation can be passed on to Discom for meeting RPO obligations of Discom
- Solar Generation meter shall be installed by Discom, at its own cost with the consent of the Consumer,
- Solar Generation Meter shall be maintained by Discom at its cost.

User Logins for RPO Generic Webtool

The tool is designed to facilitate all relevant stakeholders to provide reliable compliance reporting platform to share compliance information in transparent manner for all Obligated Entities, to ensure monitoring by State Agencies and to facilitate timely enforcement actions by the Regulators in case of shortfall or non-Compliance by Obligated Entities



Functioning of RPO Generic Webtool



Modifications in Generic RPO Tool

Based on interactions with GERC/GEDA and FOR technical committee, following changes have been incorporated in the generic RPO tool

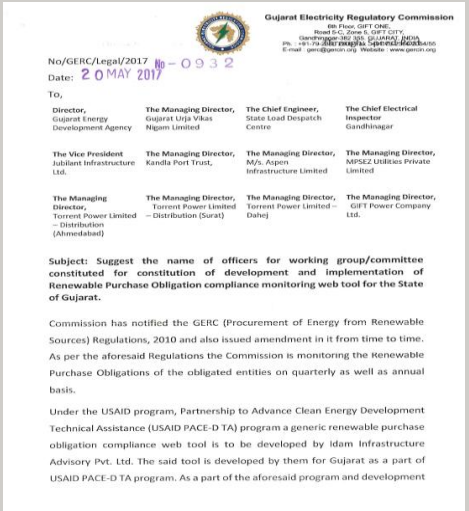
S. No.	Parameters	Addition / Modification	Description
1	Two step verification process	Addition	Feature to create a new login for data operator at Obligated entity level, one user will be admin user that will decide the role of other users.
2	Carry forward of the deficit RPO target to next year	Addition	Some states follow carry forwarding of RPO deficit to next year. The logic for the same is incorporated in the tool.
3	Inter-se adjustment of solar and non-solar RPO targets	Modification	If states want to monitor combined RPO met for certain class of obligated entities, instead of tracking separate compliance for solar and non-solar then, the provision for same has been incorporated.
4	Summary report for total obligated entities	Addition	A summary report has been prepared on the dashboard so as to provide snapshot of information covering following: • number of OEs registered • OEs updating the data • OEs not updating the data

Modifications in Generic RPO Tool

Based on interactions with FOR technical committee, following changes have been incorporated in the generic RPO tool

S. No.	Parameters	Addition / Modification	Description
5	Summary report for status of RPO	Addition	A summary report is prepared on the dashboard that provided status of all OEs in numbers • Total RPO fulfilled by state • Total no. of OE (category wise) with RPO met and RPO deficit
6	Reports in PDF format	Addition	The reports can be downloadable in PDF format.
7	Reports in Excel format	Addition	The reports can be downloadable in excel format.

Constitution of Working Group for RPO webtool implementation at Gujarat



Gujarat Electricity Regulatory Commission
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Road 5-C, Zone 5, GIFT CITY,
Gandhinagar-382 355, (GUJARAT) INDIA
Ph. +91-79-[illegible] Fax No. +91-79-[illegible]
E-mail : gerc@gercin.org Website : www.gercin.org

No/GERC/Legal/2017 No - 0932
Date: 20 MAY 2017

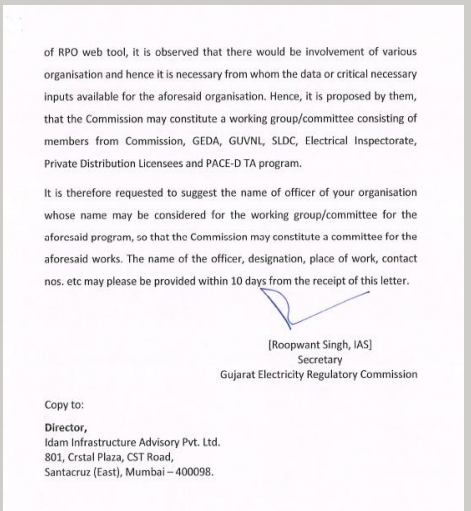
To,

Director, Gujarat Energy Development Agency	The Managing Director, Gujarat Urja Vikas Nigam Limited	The Chief Engineer, State Load Despatch Centre	The Chief Electrical Inspector Gandhinagar
The Vice President Jubilant Infrastructure Ltd.	The Managing Director, Kandla Port Trust,	The Managing Director, M/s. Aspen Infrastructure Limited	The Managing Director, MPSEZ Utilities Private Limited
The Managing Director, Torrent Power Limited – Distribution (Ahmedabad)	The Managing Director, Torrent Power Limited – Distribution (Surat)	The Managing Director, Torrent Power Limited – Dahej	The Managing Director, GIFT Power Company Ltd.

Subject: Suggest the name of officers for working group/committee constituted for constitution of development and implementation of Renewable Purchase Obligation compliance monitoring web tool for the State of Gujarat.

Commission has notified the GERC (Procurement of Energy from Renewable Sources) Regulations, 2010 and also issued amendment in it from time to time. As per the aforesaid Regulations the Commission is monitoring the Renewable Purchase Obligations of the obligated entities on quarterly as well as annual basis.

Under the USAID program, Partnership to Advance Clean Energy Development Technical Assistance (USAID PACE-D TA) program a generic renewable purchase obligation compliance web tool is to be developed by Idam Infrastructure Advisory Pvt. Ltd. The said tool is developed by them for Gujarat as a part of USAID PACE-D TA program. As a part of the aforesaid program and development



of RPO web tool, it is observed that there would be involvement of various organisation and hence it is necessary from whom the data or critical necessary inputs available for the aforesaid organisation. Hence, it is proposed by them, that the Commission may constitute a working group/committee consisting of members from Commission, GEDA, GUVNL, SLDC, Electrical Inspectorate, Private Distribution Licensees and PACE-D TA program.

It is therefore requested to suggest the name of officer of your organisation whose name may be considered for the working group/committee for the aforesaid program, so that the Commission may constitute a committee for the aforesaid works. The name of the officer, designation, place of work, contact nos. etc may please be provided within 10 days from the receipt of this letter.

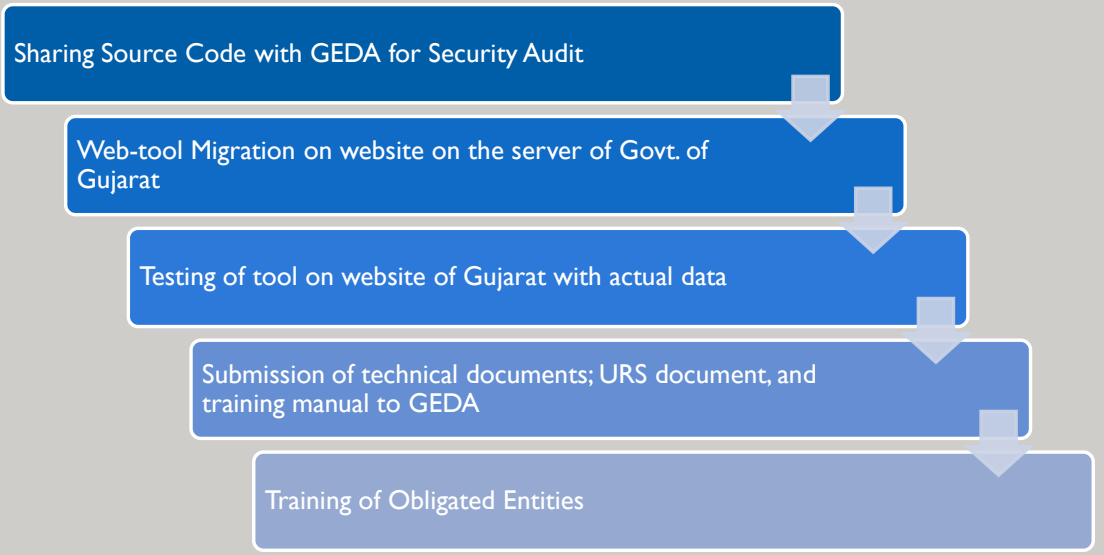
[Roopwant Singh, IAS]
Secretary
Gujarat Electricity Regulatory Commission

Copy to:

Director,
Idam Infrastructure Advisory Pvt. Ltd.
801, Crstal Plaza, CST Road,
Santacruz (East), Mumbai – 400098.

The Commission has issued notice for constitution of Working Group for RPO Webtool implementation in Gujarat. Two Licensees have nominated officials for Working Group.

Next steps for Generic RPO Tool



Facilitation / Support requirement from Forum of Regulators

National level:

- Adoption of proposed regulatory interventions as per Model RPO-REC Regulations and suitable amendments in RPO-REC Regulations at state level.
- Hosting of information /Guidebook / Roadmap for RPO Webtool deployment at state level
- Encouraging States to use and deploy Generic RPO Webtool at state level

State level:

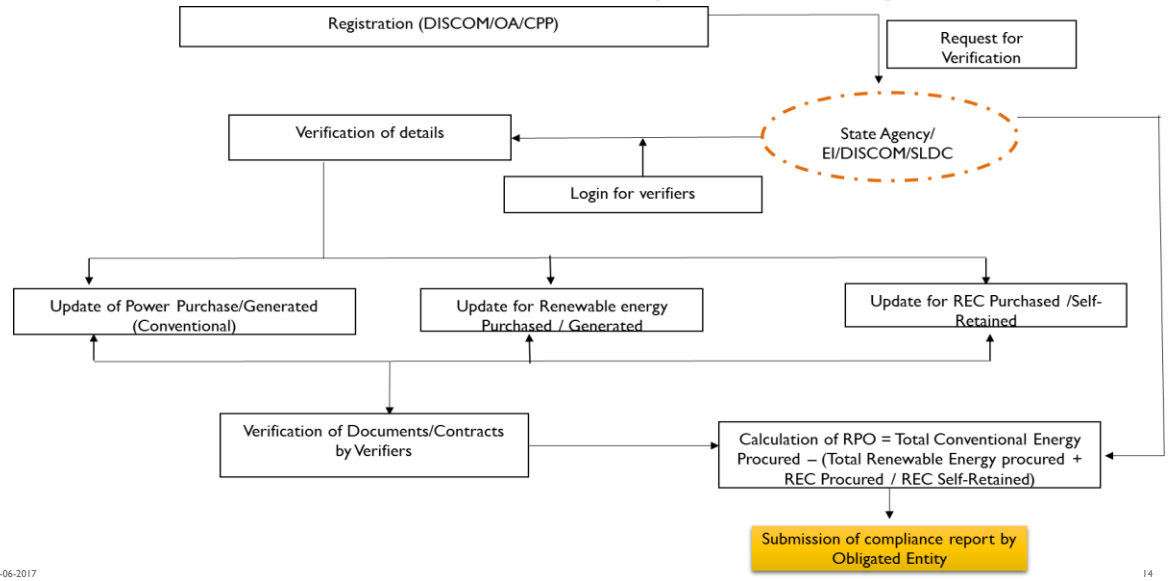
- SERCs to support in **creation of Working Group / Technical Committee** to provide necessary guidance/suggestions to Nodal Agencies for state specific RPO Web Tool deployment;
- Clarity on **ownership of the Generic Web Tool** post handover by the Program;
- Requirement of **hosting of the Generic Web Tool and Security Audit** of Tool;
- **Training and capacity building** of key stakeholders incl. obligated entities
- **Pilot testing** and operationalizing RPO webtool at state level – **documentation and reporting**

12

Visuals of Generic RPO Web-tool

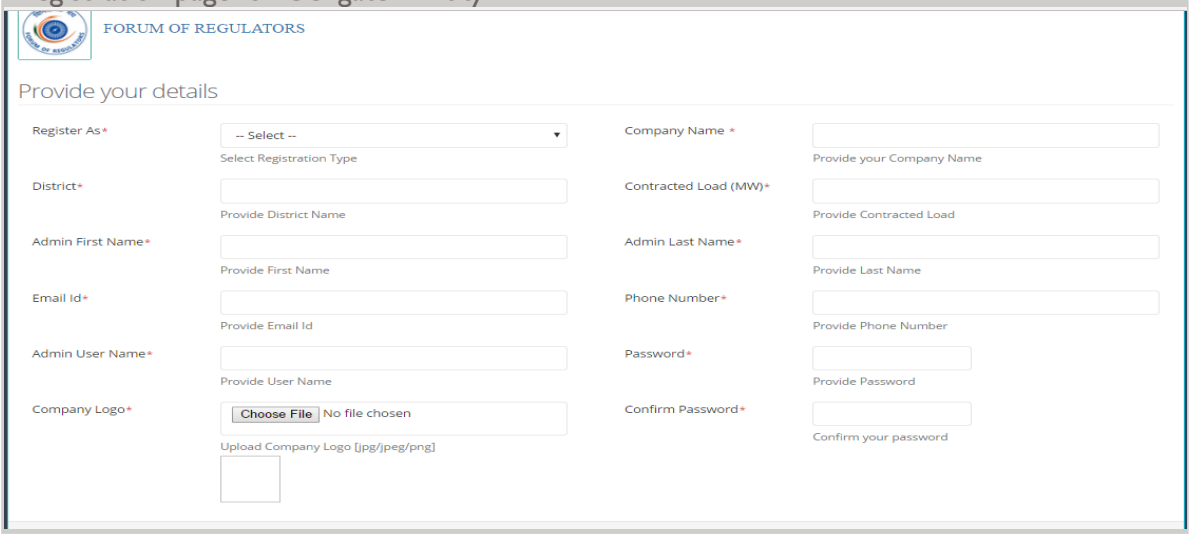
(Beta version)

Process flow chart for Obligated Entity



Generic RPO Web-tool for Obligated Entity: Beta Version

Registration page for Obligated Entity



Dashboard for Obligated Entity

Dashboard Summary of an obligated entity

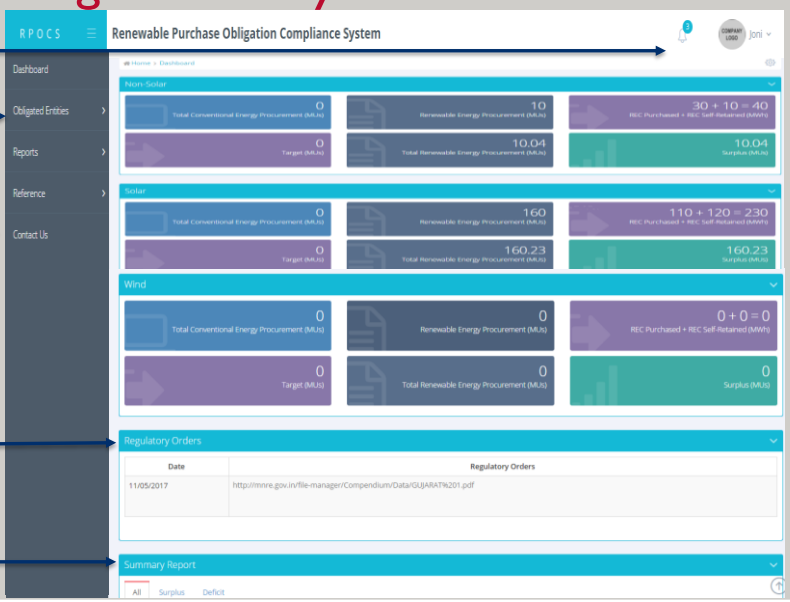
Vendor Requests, Contracts & Periodical Consumptions

All RPO related Regulatory Documents for Help

SNA Contact Details

List of Pending Verifications: Contracts & Periodical Consumptions

Compliance Report Summary of all obligated entities

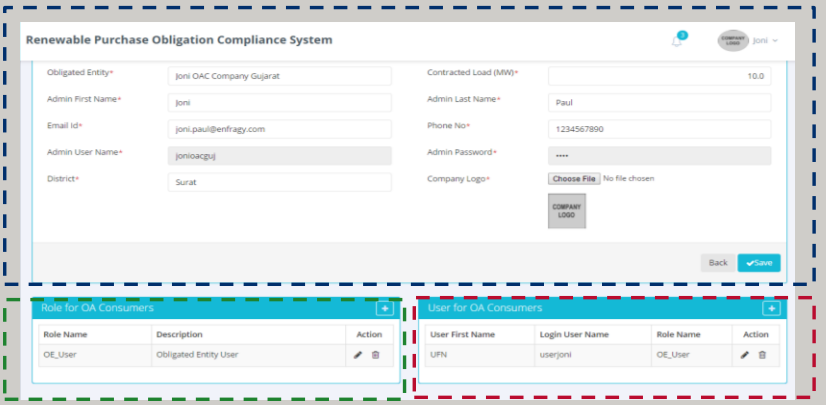


Maker and Checker for Obligated Entity

- Two-step verification login for Obligated Entity have been incorporated. Here, the obligated entity will design a new maker login and assign roles to it.

Obligated Entity information page (The information provided at the time of registration can be edited by OE if needed)

OE can define the role of Data Operator



OE defining Login Credentials for Data Operator

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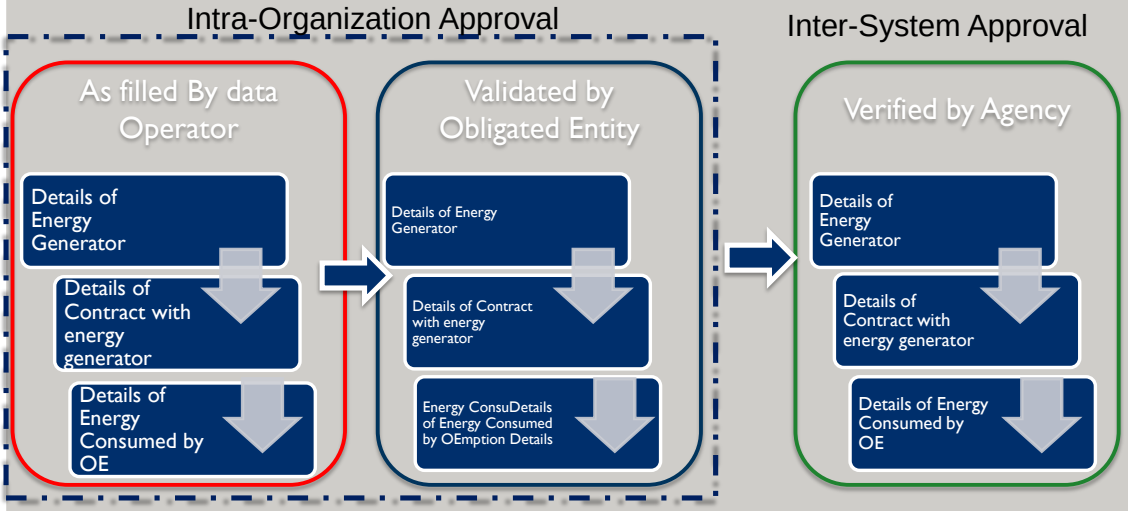
Energy Consumption Data - Validation & Verification Process

The Energy consumption data process is a three step process. Initiated by data operator and approved by OE. Subsequently, the data is forwarded to verifiers (CEI, SLDC and DISCOM).



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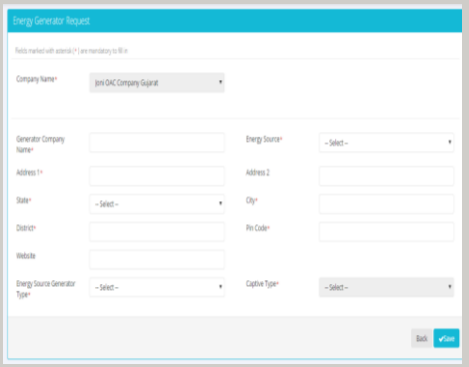
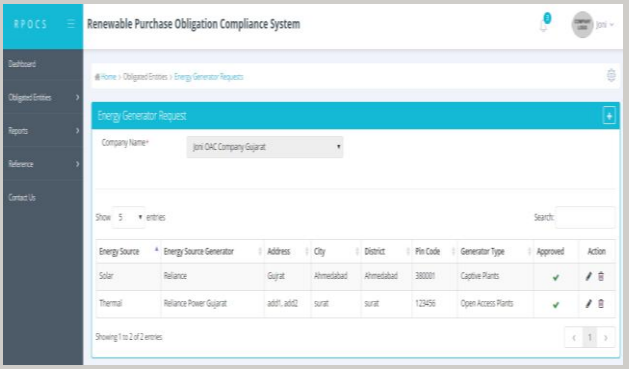
Details of Energy Generator contracted by Obligated Entity

Details of energy generator can be filled in a single form. The filled details are forwarded to the verifiers.

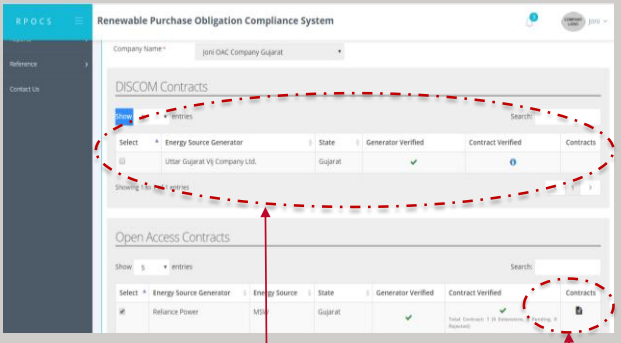


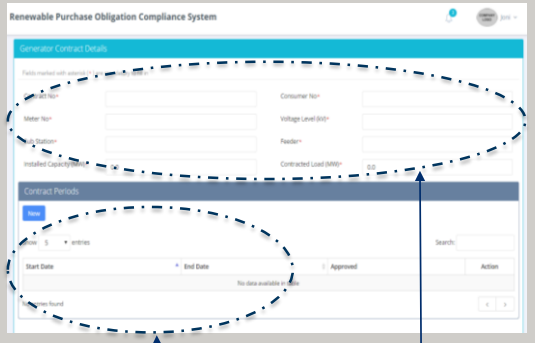
Energy generator request page for Obligated Entity



List of Energy Generators and their approval status by verifiers

Details of Contracts with Energy Generator





Approved List of Energy Generators (DISCOM, OA and CPP generators).

Select generator to fill-in the contract details.

Tab to update Energy Consumption Contract

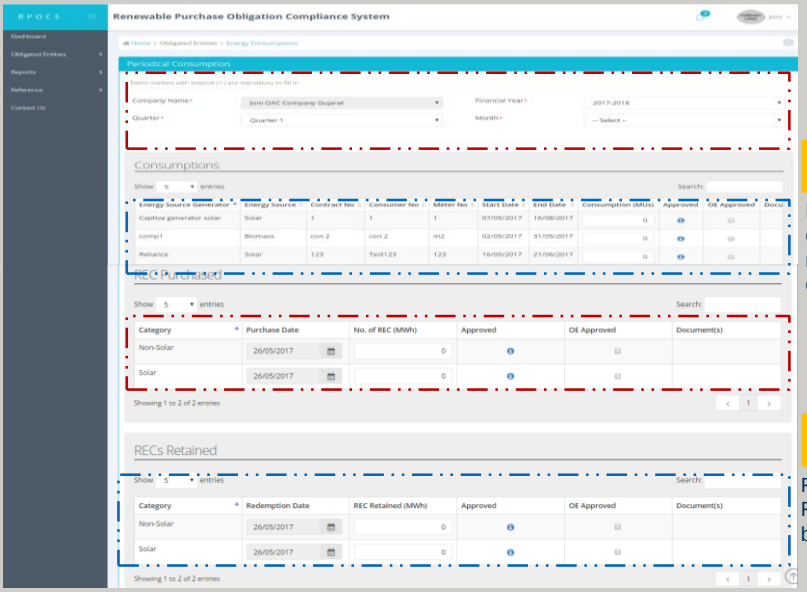
Energy Consumption Contract Period

Energy Consumption Contract Details

Details of Energy consumed as per the contract with Energy generator

1

Select financial Year, Quarter and month to update the Energy Consumption details



2

Fill-in the conventional and non conventional energy procured

3

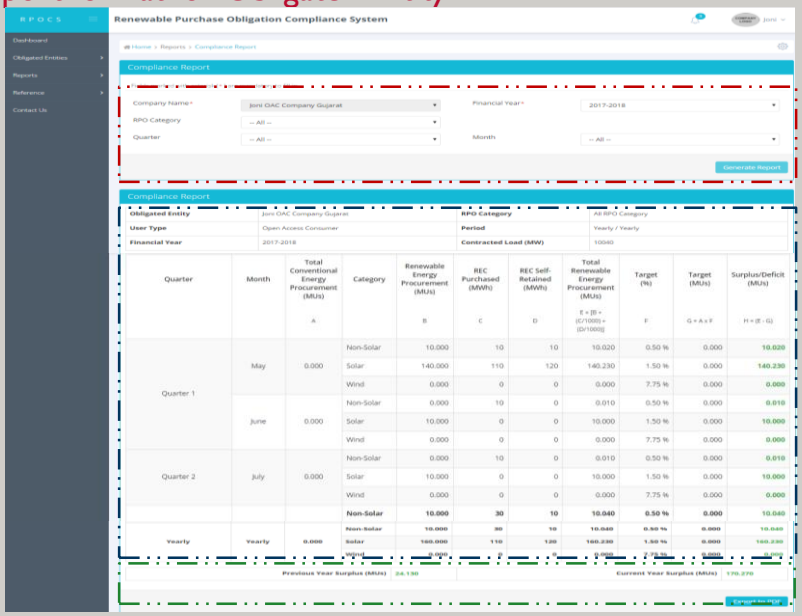
Fill-in Number of RECs procured by Obligated Entity

4

Fill-in Number of RECs self-retained by Obligated Entity

Compliance report format for Obligated Entity

Select financial Year, Quarter and month to generate Compliance Report



RPO Compliance Report also covers the previous year deficit, and carry forward that deficit to current year's deficit/ surplus to determine the final status of RPO Compliance.

RPO compliance is determined by applying the RPO% specified by SERC on Conventional energy consumed by OE.

Dashboard GEDA and FOR

System Settings page to setup mails and other settings

State Agency page to define financial year-wise RPO %

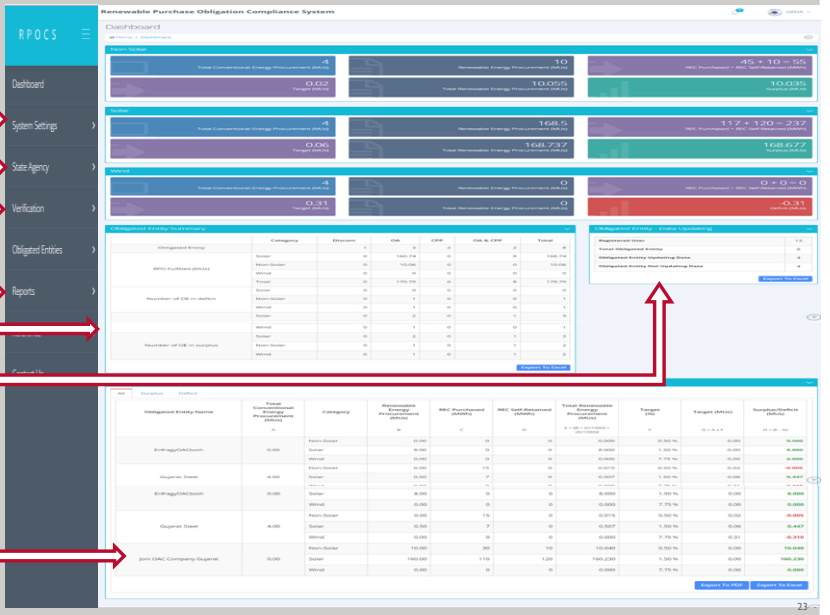
Verification of energy generator requests, Contracts with energy generator and Periodical consumption.

Compliance report and other report formats

Obligated entity summary

List of Obligated Entitles updating data

Compliance Report Summary of all obligated entities



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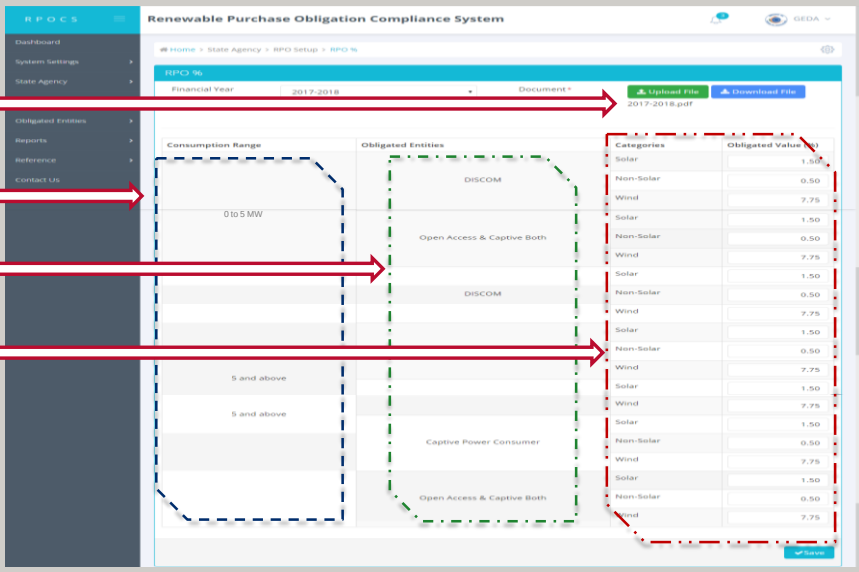
RPO Percentage setup page for State Agency

The State Agency will upload RPO Regulation while setting up RPO percentage.

Consumption ranges as per RPO Regulation

Obligated Entities falling in different Consumption Ranges

RPO percentage input for different Obligated Entities.



27-06-2017

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twitter.com/PACE_DTAProgram

सत्यमेव जयते

Ministry of Power
Central Electricity Authority

Simplification and Rationalization of Consumer Tariffs

23rd June 2017

Drivers for Simplification and Rationalization of Consumer Tariffs

- **Non cost-reflective tariffs** and **high cross subsidies** among the consumer categories
- **Lack of scientific basis** for determining the consumer tariffs
- Creation of tariff categories **based on demand from marginal consumer sections** etc. instead of specific needs and requirement
- Need for **better targeting of consumers** who require subsidized tariffs
- Complexity of tariff schedules making it difficult to **comprehend and assess tariff charges** for an average consumer
- **Legacy issues** of tariff structure from state electricity boards

Findings in FOR studies on reduction in cross-subsidy and standardization of electricity bill have also been considered in the process of developing tariff simplification and rationalization guidelines

2

Background

Two Committees were set up by the Ministry of Power:

Committee for Simplification of Tariff Categories, with following objectives:

1. Suggest measures for simplification of tariff structure
2. Reduction in number of tariff categories of consumers
3. Provide any other recommendation on tariff structure

Committee for Rationalization of Tariff Structure with following objectives:

1. Simplifying the tariff structures to improve transparency and possibly enhancing operational performance of the Distribution utilities, along with bringing in governance benefits
2. Rationalization of tariffs so they progressively reflect the actual cost of supply and incentivize efficiency

3

Approach

As-is review: Analysis of existing tariff structures for select 10 states

Identification of prevailing issues

Review of international best practices

Formulation of insights and recommendations

Sample Exercise

4

Issues identified

Tariff Simplification

1. **Large number of categories leading to complex tariff structures**
   - Difficult for consumers to comprehend and calculate applicable charges
2. **Lack of suitable rationale** for categorization of consumers
   - As a result**, inconsistency in categorization** of consumer segments across states
3. **Lack of periodical reviews** of slab limits
   - Long-standing slab limits that have not been revised

Tariff Rationalization

1. **Non cost-reflective tariffs** leading to loss for distribution companies
2. **High cross subsidy** among categories
3. **Limited implementation of demand side measures** (ToD, kVAh metering etc.) in tariffs across states
4. **Incomplete implementation of two part tariff** across all states and inadequate fixed cost recovery from corresponding fixed/demand tariffs

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Simplification of Tariff Categories

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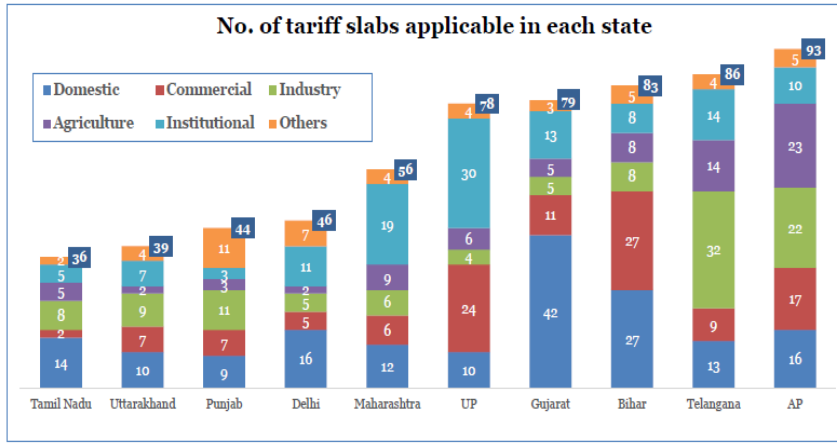
Issues: Large no. of categories & tariff slabs



No. of categories as per tariff schedule									
18	11	11	10	14	14	21	17	17	9

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Issues: Inconsistency in categorization across states

S. No.	State / Type of Consumer	Maharashtra	Uttarakhand	Delhi	Telangana	Tamil Nadu	AP	Bihar	Gujarat	UP	Punjab
1	Places of Worship	D	D	D	S	IST	S	C	-	D	D
2	Charitable Institutions	-	C	D	IST	D/IST	IST	C	-	I	D
3	Pvt. Educational/Welfare Institutions	IST	-	C	C	S	C	C	S	IST	C
4	Govt. Educational/Welfare Institutions	S	C	D	IST	IST	IST	C	S	IST	D
5	Pvt. Educational/Welfare Residential Establishments	D	-	C	C	S	C	-	-	C	D
6	Govt. Educational /Welfare Residential Establishments	D	C	D	C	IST	C	C	-	C	D
7	Crematoriums	S	-	D	IST	D/IST	IST	C	-	D	-
8	Cattle Farms	A	-	C	I	I	I	-	-	-	I
9	Floriculture/ Nurseries/ Horticulture	A	S	C	I	I/A	I	-	-	A	A
10	Fisheries	I	-	C	I	A	I	A	C	-	A
11	Poultry Farms	A	-	C	I	I/A	I	-	-	-	I
12	Public Parks	IST	IST	D	IST	-	IST	-	-	C	S

D Domestic | C Commercial | I Industry | S Specific/Individual Category | IST Institutional | A Agriculture

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International best practices on tariff simplification

Countries studied: South Africa, Australia, Malaysia and Thailand

1. Basis of primary classification

- **Uniform primary classification**, typically based on **'Purpose of use'** and voltage levels
  - Primary consumer groups: Residential, Business, Industrial and Non-profit services
- Grouping of customers to **improve process efficiency** and minimize transaction costs

2. Addition of Categories

- Creation of new categories/sub-categories **based on cost differential**
  - For example, in South Africa, new category created if cost differential exceeds 10%
- **"Opt-in" tariff plans** (e.g. Australia) to ease transition of consumers
- Type of metering based sub-categories to incentivize consumers

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International best practices on tariff simplification …2

3. Sub-categories in Domestic

- Limiting the number of consumption slabs with predefined criteria
  - Design of existing tariff slabs in South Africa for domestic category: **Slab 1**–Free basic electricity, **Slab 2**–Cushion for low income families, **Slab 3**–Average household consumption, **Slab 4** –Remainder
- ***Affordability study***
  - To assess space for tariff changes and to design appropriate slab limits

4. Sub-categories in Commercial

- Sub Categories are formed based on contracted demand
- Separate sub-categories for prepaid metering and TOU (Time of Use)

5. Sub-categories in Industrial

- Sub-categories created on the basis of voltage levels
- Separate tariffs for time of use (TOU)
- Rebate for energy intensive industries as percentage of total bill amount (e.g. Malaysia)

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Recommendations for tariff simplification

1. Domestic Category

- **Sub-categorization on the basis of voltage**; Further classification for LT based on consumption
- **Limit of 3 consumption slabs** (1st slab -20%, 2nd slab, 3rd slab +20% of CoS)
- **'Lifeline' slab** to accommodate BPL consumers; re-classification only if annual consumption exceeds a prescribed limit for 2 consecutive years
- **Gradual phasing out of other classifications** - unmetered, rural/urban, etc.
- **Affordability study** to determine appropriate consumption slab limits
- Inform consumers on future trends

2. Agriculture Category

- **Sub-categorization should be based on voltage levels** viz. LT & HT
- Consolidate agriculture and agriculture allied categories - horticulture, floriculture, mushroom cultivation, etc.
- Dis-incentivizing unmetered consumers through suitable tariff interventions to encourage consumers to shift towards metered connection

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Recommendations for tariff simplification

3. Commercial

- **Sub-categorization should be based on voltage levels** viz. LT & HT
- **Subsidized slab under LT sub-category for small businesses/shops**

4. Industry

- **Sub-categorization based on voltage levels** viz. LT and HT
- Creation of further slabs/ sub categories only **on the basis only on a notable cost differential**
- **A 'Supported' sub-category** for the state to support select industries/mills etc.

5. Institutional

- Consisting of consumers such as street lights, public water-works, public tube-wells, sewage treatment plants, places of worship, etc.
- Sub-categorization should be based on voltage levels

No individual category/subcategory for temporary supply - temporary supply may be provided at fixed multiple of prescribed tariff for relevant category

The above recommendations may be implemented by states within the next 2 years.

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Case Study - Maharashtra

Existing

Category	Sub-categories/slabs
Domestic	12
Industry	6
Commercial	6
Institutional	19
Agriculture	9
Others	4
Total	56

A sample exercise was conducted to devise a simplified tariff structure for Maharashtra

Proposed

Category	Sub-categories/slabs
1. Domestic	
LT - Domestic (BPL)	1
LT – Domestic (other than BPL) (0-100, 100-500 and >500 Units)	3
HT Bulk Supply (Residential)	1
2. Industry	
LT – Industry (supported, Others)	2
HT – Industry	1
3. Commercial	
LT – Commercial (0-200, >200 Units)	2
HT Commercial	1
4. Institutional (LT, HT)	2
5. Agriculture (LT, HT)	2
Total	15

Case Study - Bihar

Tariff Rationalization in Bihar – Previous and Simplified Tariff Structure

Sr. No.	Consumer Category	Pre simplification	Post simplification (As approved for FY 18)
1	DOMESTIC (DS)	48	11
	Kutir Jyoti (KJY)	7	3
	Other Domestic	41	8
2	NON-DOMESTIC (NDS)	51	8
3	IRRIGATION & AGRICULTURE (IAS)	12	4
4	LT INDUSTRIAL (LTIS)	12	2
5	PUBLIC WATERWORKS	2	1
6	STREET LIGHTS (SS)	9	2
7.1	HIGH TENSION SUPPLY-I (11 kV)	2	2
7.2	HIGH TENSION SUPPLY-II (33 kV)	2	2
7.3	HIGH TENSION SUPPLY-III (132 kV)	2	2
7.4	HIGH TENSION SUPPLY-IV (220 kV)	2	2
7.5	HIGH TENSION SPECIAL SUPPLY	2	2
8	RAILWAY TRACTION SUPPLY	2	2
	Total	**146**	**40**

- ***Fixed cost coverage*: Two part tariffs** introduced for all metered categories;
- ***Increased support for BPL***: Consumption limit of **Kutir Jyoti (BPL)** increased **from 30 to 50** units per month (load from 100 W to 250 W);
- ***Power factor reflective tariff*: kVAh billing** introduced for LTIS categories, with a plan of rolling out the same for PWW, SS and large NDS subsequently;
- ***Demand based tariff*:** made compulsory for all metered consumers (except KJ, DS-I, NDS-I and Agriculture).

Recommended Structure of Consumer Bill

*Sample Section for Bill calculation – **As per FOR study**:*

BILL CALCULATIONS					
Fixed charges (A)		**Energy charges (B)**			
Rate (Rs/KW/Month)	**30**	**Slabs per month**	**Rate (Rs/unit)**	**Units Consumed**	**Amount (Rs.)**
Fixed charges for a month	Rate X Sanctioned load	0-100	4	100	400
Fixed charges to be paid	30 x 7 = 210	101-200	5	100	500
		201-300	6	100	600
		301-Above	7	396	2772
Total fixed charges	210	**Total Energy Charges**		696	**4272**

Sample final payable tariff: As per FOR study

DETAILS OF YOUR BILL	
Item	**Amount (Rs.)**
Fixed Charges (A)	210.00
Energy Charges (B)	4272.00
FPPPA (C)	139.20
Electricity Duty (D)	69.60
Total Bill	4690.80
Previous Arrear (E)	151.50
Payment to be made	4842.30 = 4842.00

Recommended Structure of Consumer Bill

Sample Breakup of tariff charges:

Proposed additional information to communicate level of subsidy

Component	**Rate per unit (Rs./unit)**	**Amount (Rs.)**
Cost of power supply (Rs./unit) (A)		
Applicable Tariff (Rs./unit) (B)		
Subsidies (Rs./unit) (C)		
Subsidy by Govt. of <state>		
Cross-subsidy by other consumers		
Payable tariff charges (Rs./unit) (D)=(B)-(C)		

Additional components for the bill:

- ***Consumption history** for past 3 months, and for the same month in the preceding year highlighting the pattern of usage of the consumer*
- ***Other pieces of information***
  - *complaint lodging and resolution mechanism*
  - *information about different payment channels*

Tariff Rationalization

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Identified Issue: Non cost-reflective tariffs

State	Utility	FY	ACoS (Rs./kwh)	ABR* (Rs./kwh)					ACoS coverage				
				Domestic	Agricultural	Industrial	Commercial	Overall	Domestic	Agricultural	Industrial	Commercial	Overall[1]
Uttarakhand	UPCL	FY17	4.70	3.56	1.55	5.17	5.44	4.70	76%	33%	110%	116%	100%
Punjab	PSPCL	FY17	5.98	5.54	4.58	6.41	6.71	5.76	93%	77%	107%	112%	96%
Gujarat	DGVCL	FY17	6.35	3.83	2.07	6.04	4.87	6.59	60%	33%	95%	77%	104%
Maharashtra	MSEDCL	FY16	6.03	5.83	3.12	7.64	10.97	5.96	97%	52%	127%	182%	99%
Uttar Pradesh	DVVNL	FY 17	5.91	3.70	2.38	7.43	7.62	5.13	63%	40%	126%	129%	87%
Bihar	NBPDCL	FY17	5.74	5.25	5.76	6.53	6.01	5.38	91%	100%	114%	105%	94%
Andhra Pradesh	SPDCL+ EPDCL	FY17	5.33	3.66	3.54	6.81	9.43	5.33	69%	66%	128%	177%	100%
Delhi	TPDDL	FY16	7.35	5.55	3.32	9.28	10.65	7.80	75%	45%	126%	145%	106%
Telangana	TSSPDCL+ TSNPDCL	FY17	5.94	4.95	3.19	7.03	9.32	5.94	83%	54%	118%	157%	100%
Tamil Nadu	TANGEDCO	FY 15	5.77	4.02	2.96	7.81	9.19	5.74	70%	51%	135%	159%	99%

[1] Inclusive of other categories * Inclusive of Govt. Subsidy

As can be seen, overall cost recovery is not sufficient and commensurate to costs incurred by the Discoms

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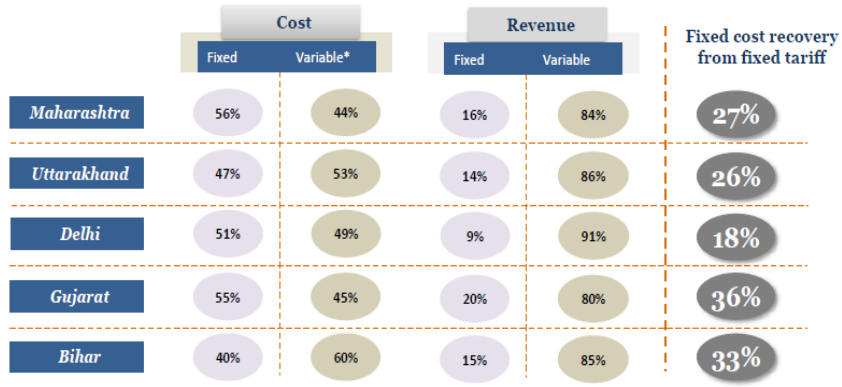
Identified Issue: Inadequate fixed cost recovery from corresponding demand tariff



	Cost		Revenue		Fixed cost recovery from fixed tariff
	Fixed	Variable*	Fixed	Variable	
Maharashtra	56%	44%	16%	84%	27%
Uttarakhand	47%	53%	14%	86%	26%
Delhi	51%	49%	9%	91%	18%
Gujarat	55%	45%	20%	80%	36%
Bihar	40%	60%	15%	85%	33%

As can be seen, fixed cost recovery is not sufficient and commensurate to fixed costs incurred by the Discoms

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International best practices on Tariff Rationalization

1. Reduction of cross-subsidies

- Cross-subsidies reduced in Thailand & Philippines through **unbundling of tariffs** & replacement by a universal charge
- In Australia, **special mandate to end cross-subsidy** between domestic and commercial, and increase fixed charges to signal to customer the value of being connected to the network
- Additionally, **uniform tariffs established** in states in Australia through inter-utility transfers via an equalization fund

2. Demand based tariffs

- Australia recently extended **demand based tariffs to residential and small business categories** for greater reflectivity of fixed costs

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International best practices on Tariff Rationalization

3. Instituting time of day tariffs

- **Significant move towards alternative tariff structures** (Time of Day) that act as a price signal for consumer to shift their demand to off peak hours in countries such as Thailand and Malaysia
- South Africa instituted a **roadmap for sophisticated ToU rates**

4. Assessing affordability of tariffs

5. Promotion of Renewable Energy

Policy cost incorporated in tariffs to finance renewable energy promotion with a pass-through mechanism in Thailand, Malaysia and Germany

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Recommendations for Tariff Rationalization

1. *Improving cost-reflectivity in tariffs*
   - **Gradually reflect the cost of supply** of each consumer category in the respective tariffs on a uniform and scientific basis
   - **Implementing two-part tariffs** for all tariff categories; Ensuring adequate fixed cost recovery from fixed/demand charges
     - *Recovery of fixed costs 75-100% for all categories; 25-50% for Domestic & Agriculture*
2. *Reducing cross-subsidy between categories*
   - Achieve **cost neutrality** for a category to the extent possible (cross-subsidy to be within permissible limits of ±20%)
   - Ensuring **progressivity in tariffs**; design of tariff slabs should encourage efficient consumption; allow intra-category cross subsidy
   - Tariff determination without considering the resource gap grant from State Govt. to bring in transparency and actual cost to consumers

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Recommendations for Tariff Rationalization

3. *Avoiding tariff shocks for consumers*

- **Moderating tariff trajectory** over a period of 5 years to ensure that there is no alarming hike
- **Conducting affordability studies** to determine efficient slab limits
- Consumers to be kept informed about the **future trends in tariffs**

4. *Demand management and grid stability*

- Demand management & grid stability should be ensured with **ToD and demand based tariffs;** kVA and kVAh based billing should be implemented to subsume power factor linked incentives/penalties
- **Dis-incentivising unmetered consumers** with tariff interventions to phase out unmetered connections in an expedited manner
- **Up-gradation of metering infrastructure** and introducing smart meters

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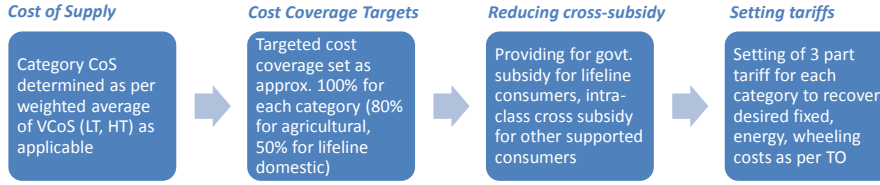
Case Study- Maharashtra

Tariff rationalization process



Roadmap for tariff rationalization: moderated trajectory

Category	Parameter	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22
Domestic	**Cost Coverage**	**95%**	**91%**	**92%**	**96%**	**98%**	**99%**
	CoS	6.75	7.11	7.13	6.99	6.99	6.99
	ABR	6.41	6.46	6.55	6.71	6.85	6.91
Industrial	**Cost Coverage**	**145%**	**133%**	**126%**	**126%**	**121%**	**116%**
	CoS	5.86	6.33	6.44	6.4	6.4	6.41
	ABR	8.52	8.41	8.09	8.03	7.72	7.45
Commercial	**Cost Coverage**	**188%**	**170%**	**154%**	**142%**	**129%**	**112%**
	CoS	6.37	6.76	6.82	6.73	6.73	6.73
	ABR	11.96	11.51	10.5	9.57	8.69	7.57
Institutional	**Cost Coverage**	**111%**	**110%**	**107%**	**106%**	**106%**	**106%**
	CoS	6.21	6.58	6.67	6.6	6.6	6.6
	ABR	6.89	7.25	7.11	7.02	6.99	7
Agriculture	**Cost Coverage**	**51%**	**55%**	**59%**	**66%**	**73%**	**80%**
	CoS	6.71	7.07	7.1	6.96	6.97	6.97
	ABR	3.42	3.86	4.2	4.62	5.08	5.57

Thank You

BIHAR ELECTRICITY REGULATORY COMMISSION

Simplification of Tariff Categories

Consumers' mix and Sales of the State for FY 2017-18

Category	No of Consumers approved(Projection) as % of total	Sales approved for the year (Projection) as % of total
Domestic	94.02%	56.14%
Industrial	0.34%	17.66%
Agricultural	0.98%	3.45%
Railways	0.00%	3.94%
Commercial	4.64%	9.24%
Others	0.03%	9.57%

Legacy Issues

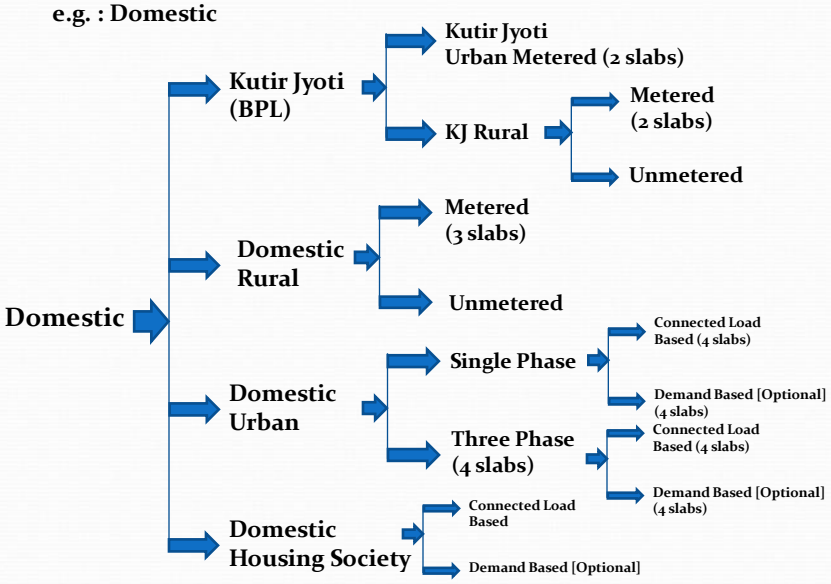
- Treatment of Resource Gap / Subsidy
- Complex Tariff Structure
- Others :
  a) Complex mechanism for Power Factor Surcharge/ Rebate
  b) Not enough focus on Energy Efficiency or Energy Conservation
  c) Connected load based tariff
  d) Inequitable methodology for levying demand charge in domestic category.
  e) Absence of two-part tariff in many categories
  f) Levy of monthly minimum charges
  g) No incentive for online payment of bills.

Treatment of Resource Gap/Subsidy

- Till Tariff order of FY 2016-17,the State Government had been providing upfront information of resource gap/subsidy.
- The Commission, accordingly, had been determining the ARR and retail tariff considering the above resource gap/subsidy in the following order:
  - Disallowed Power purchase cost due to higher Distribution Losses than the approved by the Commission
  - Govt. subsidy to four categories
    - Kutir Jyoti (BPL)
    - Domestic rural
    - Commercial rural
    - Private Irrigation & agricultural
  - Balance amount, if available, was used to reduce the ARR.
- The Commission had been showing subsidised tariff of the above four subsidised categories in its approved tariff schedule without showing extent of subsidy.

Complex Tariff Structure

Total No. of Sub-categories : 74 ; in domestic : 27
e.g. : Domestic



Tariff Simplification

Background

- With an aim to simplify and rationalise the tariff structure across the nation, Ministry of Power, GoI formed a Committee in September, 2016.Bihar is also part of the committee.
- SBPDCL and NBPDCL filed tariff petitions for FY 2017-18 with rationalised tariff structure.
- The Electricity Act, 2003 and the Tariff Policy 2016 envisage for determination of tariff initially without subsidy and thereafter subsidised tariff shall be arrived at considering the subsidy by the State Govt.

Tariff Simplification .... Contd.

Benefits

- Easy understandability of energy bills to consumers
- True reflection of ACoS & Govt. Subsidy.
- Provide informations to encourage DSM measures such as pf improvement, use of energy efficient gadgets, energy conservation, flattening of load curve, etc.

Tariff Categorization / Sub Categorization

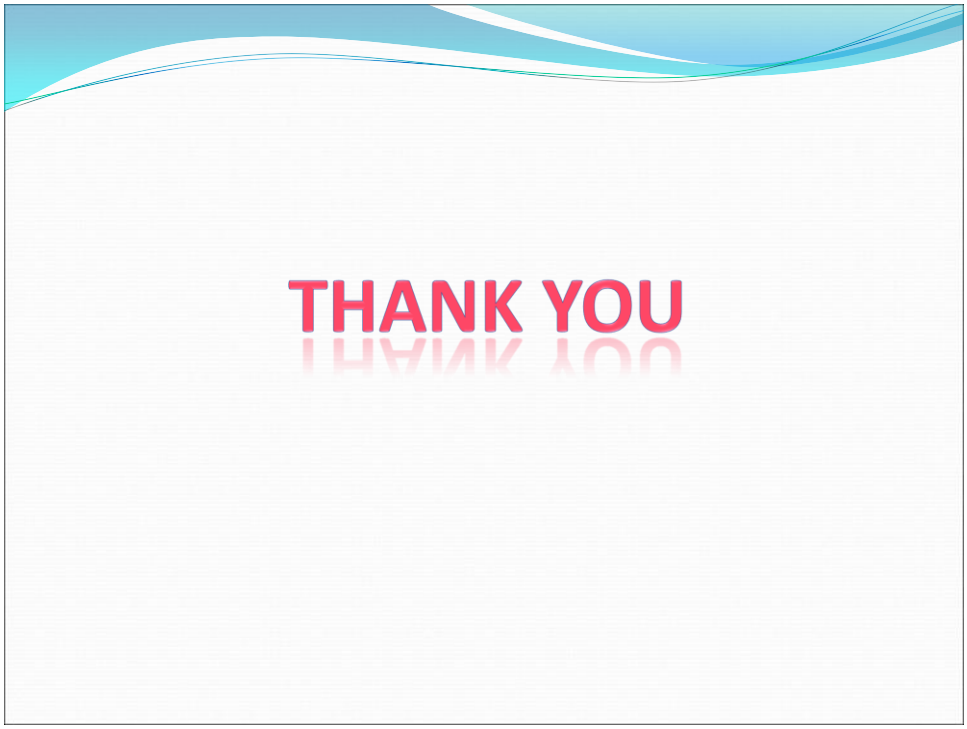
- *Purpose for supply of electricity*
  - Domestic
  - Commercial
  - Industrial
  - Agricultural
  - Public Water Works
  - Street Lights
  - Railway Traction
- *Voltage of Supply of Electricity*
  - Low Voltage
  - High Voltage
  - Extra High Voltage

Tariff Categorization / Sub Categorization… contd.

Tariff Category (based on purpose of supply)	No of Sub-categories pre Tariff simplification	No of Sub-categories Post Tariff simplification (w.e.f. 01.04.2017)
Domestic	27	11
Commercial	27	8
Industrial	8	7
Agricultural	8	4
Street Light	2	2
Public Water Works	1	1
Railway Traction	1	1
Total	**74**	**34**

Salient features of Tariff order for FY 2017-18

- Cost reflective tariff with & without Government subsidy determined.
- Total no of tariff subcategories reduced from 74 to 34.
- Introduction of two part tariff structure in all metered categories.
- Monthly Minimum Charges (MMC) withdrawn from all categories of consumers.
- Introduction of demand based tariff for urban consumers.
- Introduction of kVAh based tariff for all industrial consumers.
- Introduction of demand charge on per kW basis for domestic categories.
- Introduction of incentive for online payment of bills.


THANK YOU

Presentation on Time of Use (ToU) Tariff Implementation

A K Rajput, Chief Engineer

Central Electricity Authority

Ministry of Power

Time of Day (ToD) Tariff and Framework for Implementation

- **ToD Tariff –** Different rates for electricity consumption, higher than normal during system peak and rebate during off-peak hours.
- Different price during different seasons. Conceptually **Time of Use (ToU) or Seasonal Time of Day (SToD) tariff**.

FRAMEWORK

- The **Electricity Act, 2003, National Electricity Policy, Tariff Policy (8.4.3)** and **CEA Regulations** on metering have adequate provisions as regard to ToD metering and use of new technologies.
- FoR Working Group Report on "Metering Issues" (August, 2009) also recommends ToD on certain consumers.

2

Drivers for ToU

- **ToU** - a component of demand side management (DSM) – managing the peak through consumer participation – tariff an incentive for consumer participation.
- *Solar* power generation target of 1,00,000 MW by 2022, so during day time use of electricity to be encouraged.
- Encouragement for modified electricity utilization pattern.
- Peak to be met by ramping up of conventional generation after sun set.
- Thus there is a need to devise time-use of electricity into more than two blocks (morning – evening peaks), this to be examined by FOR.

3

ToD Tariff Design in Different States

- In most of the states, **ToD** tariff has been introduced as a means of **Demand Side Management (DSM) measures. ToD** also helps in improving the load factor.
- SERCs have followed diverse mechanisms - with different tiers, different number of periods within a day, and different rates (3-4 time blocks).
- Mostly **HT and high end LT consumers** are covered – different incentives and dis-incentives.
- 26 entities of 21 (States and Union Territories, 2016-17) following ToD. 15 remaining.

4

Analysis (All India, 2014-15)

- Average daily consumption of domestic consumers 3.20 units, whereas it is 43.58 and 4344.10 units (kWh) respectively for Industrial Power (LV&MV) and Industrial Power (HV).
- Applicability of ToD concept is more beneficial in respect of the categories of consumption having higher consumption per day. **Numbers being less, require comparatively lesser efforts in implementation.**

5

Analysis (All India, 2014-15)

- Percentage consumption in domestic and Industrial category of consumers are almost same (26.70 and 28.31% respectively of the total consumption), domestic consumers are about **78%,** Industrial and Commercial Consumers put together 10.83% of total consumers.
- **Much more effective to have Time-of-Use (ToU) meters initially for the large consumers i.e. Industrial and Commercial Consumers.**
- The ToU features for domestic consumers **could be implemented at a later stage.**

6

Feasibility of implementation of ToD on existing consumer installations

- Different tariffs can be configured in **10 different tariffs in three phase** meter while **6 different tariffs can be configured in single phase meter**.
- In the recent supply of meters of different makes (say for the past 4 years) in the country, ToD features are being asked for by most of the utilities as default, **but these need to be enabled at site through uploading of applicable tariff files** .
- Period of one year can also be divided into different seasons. Seasons can be decided by the Electricity Regulatory Commissions according to load usage requirement in winter and summer.

7

Implementation of TOD on existing meters at site

- Applicable tariff files can be prepared by the meter manufacturers and loaded in to the meter by physically accessing the optical port of the meter, through pre-configured Common Meter Reading Instrument **(CMRI).**
- This process takes from 1 to 10 minutes depending upon the make of the meter.

8

Interaction with the Major Meter Manufacturers

- Three phase meters supplied after 2011, which are mostly DLMS compliant have **inbuilt ToD functionality**.
- It is estimated that at present 75-80% running three phase meters in the field are as per DLMS features and are capable of ToD metering, based on the assumption that the life of an average electronic meter is 7-8 years, while guaranteed meter life is 5 years.
- ToD functionality is not available in electro-mechanical meters, these will require replacement.

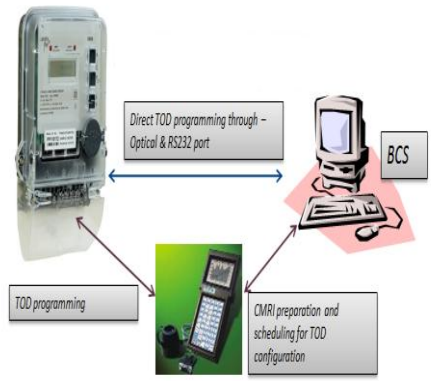
9

Suggestions Regarding Smart Meters

- The Tariff Policy of 2016 also mandates that all consumers with monthly consumption of over 500 units must have smart meters by 31.12.2017 and those with over consumption of 200 units per month by 31.12.2019.
- These meters would also enable demand response for **balancing intermittent type** of renewable sources of energy like wind and solar power. Action may, therefore have to be taken by State Regulatory Commissions in this regard also.
- If the old meters for three phase consumers in a State need to be replaced to facilitate ToD metering, then, keeping in view the above provision, it is suggested that those may be replaced by smart meters.

10

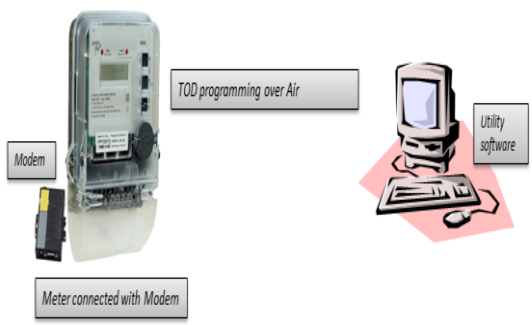
Method of ToD configuration for Normal Electronic Meters



- ToD can be configured **directly from PC to meter through optical/ RJ communication port.**
- **For meters installed in the field ToD can be configured through Common Meter Reading Instrument (CMRI).** For this, CMRI need to be prepared first.
- Authorised personnel has to go door to door (installation to installation) for configuration.
- Utility may have to bear cost for one-time programming and activation in each meter.
- The rates can be negotiated.
- Alternatively, the State Distribution Utility can deploy its personnel.

11

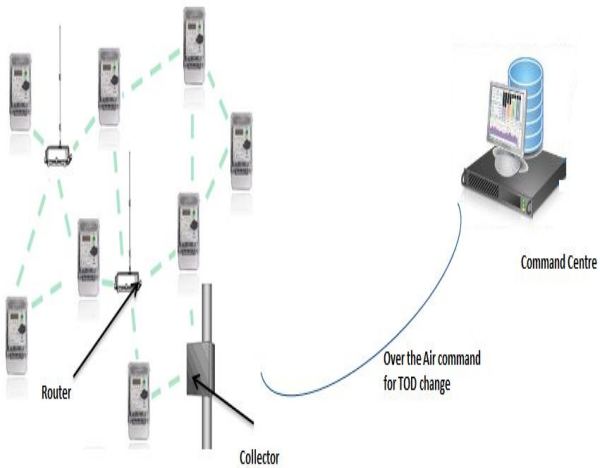
Method of ToD configuration for Normal Electronic Meters having Modem



ToD configuration is also possible through GSM/GPRS communication, but it can be done on meters which are connected through communicating modem.

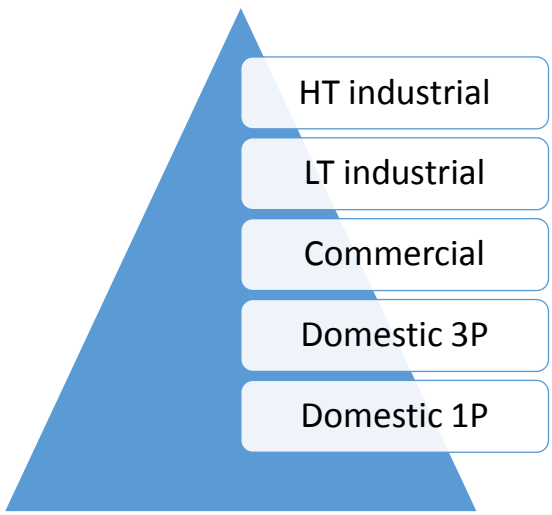
12

ToD configuration in Smart Meters



In Smart Meters communication card is connected with meter, ToD programming will be initiated by command center. Meters and command center are connected through RF mesh network. **ToD in all field Smart meters will be changed/configured in few minutes with the help of one broadcast command.**

Proposed roadmap for of ToD implementation in India



ToD implementation be done starting from HT, LT and Commercial consumers at the top of the pyramid and then sequentially move to the bottom of the pyramid, consisting of single phase domestic consumers.

14

Thank You

15

Analysis of "Category wise number of Consumers, Connected Load and Consumption – All India basis"

Category of consumers	Number of Consumers (in Lakhs) (as on 31-03-2015)	Connected load (MW) - (as on 31-03-2015)	Consumption (MU) (2014-15)	Average Connected load per consumer (kW) - (as on 31-03-2015)	Average Consumption per consumer per day (kWh) -(2014-15)
Domestic	1859	216557	217404.72	1.17	3.20
Commercial	222	66406	78391.39	3.00	9.69
Industrial Power (LV & MV)	34	46632	53571.18	13.84	43.58
Industrial Power (HV)	1.45	83145	230503.17	571.94	4344.10
Public Lighting	10	3645	8744.45	3.65	24.01
Traction	0.012	4959	16176.94	4170.51	37275.34
Agriculture	202	111204	168913.46	5.49	22.86
Public Water works and sewage pumping	8.1	8113	18837.11	9.97	63.42
Any other category	33	20374	21707.58	6.14	17.93
Total	2369	561033	814250.00	2.37	9.42

Category wise number of consumers, connected load and consumption (in percentage terms for both number of connection and consumption)

Category of consu	% of total consumers	% of total Connected load	% of total Consumption
Domestic	78.45	38.60	26.70
Commercial	9.35	11.84	9.63
Industrial Power (LV & MV)	1.42	8.31	6.58
Industrial Power (HV)	0.06	14.82	28.31
Public Lighting	0.42	0.65	1.07
Traction	0.001	0.88	1.99
Agriculture	8.54	19.82	20.74
Public Water works and sewage pumping	0.34	1.45	2.31
Any other category	1.40	3.63	2.67
Total	100.00	100.00	100.00

17

Framework for Implementation of ToD Tariff

The Electricity Act, 2003: Section 62(3)

Guides the SERCs to incorporate ToD tariff is:

"The Appropriate Commission shall not, while determining the tariff under this Act, show undue preference to any consumer of electricity but may differentiate according to the consumer's load factor, power factor, voltage, total consumption of electricity during any ***specified period or the time at which the supply is required*** *or the geographical position of any area, the nature of supply and the purpose for which the supply is required."*

18

National Electricity Policy

"5.4.9 The Act required all consumers to be metered within two years. The SERCs may obtain from the Distribution Licenses their metering plans, approve these, and monitor the same. The SERCs should encourage use of pre-paid meters. In the first instance, ***ToD meters for large consumers with a minimum load of one MVA are also to be encouraged****. The SERCs should also put in place independent third-party meter testing arrangements".*

19

Tariff Policy

Revised Tariff Policy notified on 28.01.2016 has specified various provisions for introduction of differential tariff between peak and off peak hours, for both consumers and generators, within a certain period from the date of notification of the Policy.

20

Tariff Policy

Para: 6.2(1)

"A two-part tariff structure should be adopted for all long-term and medium-term contracts to facilitate Merit Order dispatch. According to National Electricity Policy, the Availability Based Tariff (ABT) is also to be introduced at State level. This framework would be extended to generating stations (including grid connected captive plants of capacities as determined by the SERC). ***The Appropriate Commission shall introduce differential rates of fixed charges for peak and off peak hours for better management of load within a period of two years****…"*

21

Tariff Policy

Para: 8.4(1)

"Two-part tariffs featuring separate fixed and variable charges and ***time differentiated tariff shall be introduced on priority for large consumers (say, consumers with demand exceeding 1 MW) within one year and subsequently for all consumers within a period of five years or such period as may be specified.*** *This would also help in flattening the peak and implementing various energy conservation measures."*

22

Forum of Regulators (FOR) Recommendations

FoR Working Group Report on "Metering Issues" (August, 2009):

*"**Time of the day metering is important while propagating and implementing Demand Side Management (DSM)** and achieving energy efficiency. Hence, **ToD metering** and automatic meter reading system should be introduced wherever it has not already been done. **High-end consumers with the connected load of 25 kW and above should be covered under ToD metering.**"*

23

Para 8.4(3) of the Tariff Policy:

"The Appropriate Commission may provide incentives to encourage metering and billing based on metered tariffs, particularly for consumer categories that are presently unmetered to a large extent. The metered tariffs and the incentives should be given wide publicity. Smart meters have the advantages of remote metering and billing, implementation of peak and off-peak tariff and demand side management through demand response. These would become essential in future for load-generation balancing due to increasing penetration of intermittent type of generation like wind and solar power.

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Para 8.4(3) of the Tariff Policy (contd.):

Appropriate Commission shall, therefore, mandate smart meters for:

(a) Consumers with monthly consumption of 500 units and more at the earliest but not later than 31.12.2017;

(b) Consumers with monthly consumption above 200 units by 31.12.2019….”

25

States/UTs where ToD is not in Vogue

	STATES/UTs
1	HARYANA
2	HIMACHAL PRADESH
3	PUNJAB
4	RAJASTHAN
5	D & N HAVELI
6	TAMILNADU
7	LAKSHADWEEP
8	ORISSA
9	SIKKIM
10	A & N ISLS.
11	MANIPUR
12	MEGHALAYA
13	NAGALAND
14	ARUNACHAL PRADESH
15	MIZORAM

26

Interaction with the Major Meter Manufacturers

- ToD configuration is part of the Indian DLMS (Device Language Message and Specification) Standard i.e. IS 15959 Part 1. DLMS can facilitate transfer or communication of data with the meter.
- Three phase meters supplied after 2011, which are mostly DLMS compliant have inbuilt ToD functionality.
- It is estimated that at present 75-80% running three phase meters in the field are as per DLMS features and are capable of ToD metering, based on the assumption that the life of an average electronic meter is 7-8 years, while guaranteed meter life is 5 years.
- ToD functionality is not available in electro-mechanical meters.

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Study on 'Electric Vehicle: Impact on Grid'

Presentation at Forum of Regulators
23 June 2017

Terms of Reference

1. Review existing literature and best practices – national as well as international - on Electric Vehicles (EVs);
2. Compile and analyse case studies from various countries on experience with & management of EVs and the electric grid, as well as costs incurred;
3. Conduct technical and economic assessment of the impact of electric vehicles on the grid;
4. Analyse role of system operators, regulators and utilities in operations, planning and monitoring of EVs;
5. Recommend measures to address the impact of usage of electricity to power vehicles and impact on the grid.
6. Suggest framework to enable implementation of EVs in India
7. Provide inputs for draft regulations

Following specific topics were explored during the study

1. What are the international best practices for EV integration and promotion?
2. What has been the role of regulators and distribution utilities in the uptake of EVs?
3. What would be the impact of EV load on the local distribution system?
4. What business models can be developed for public charging infrastructure development in the context of the Electricity Act, 2003? and;
5. What would be the tariff impact of a distribution utility's investment in public charging infrastructure?

Key Findings and Recommendations

- I. Learning from international experiences
- II. Technical impact of EV integration
- III. Legal aspects and business models
- IV. Economic / tariff impact of EV charging infrastructure investments
- V. Way forward – action points

I. Learnings from international experiences

- Specific policies in different countries stated targets for EV penetration
- Purchase Subsidies and indirect tax waivers (such as road taxes, VAT, free parking) are offered
- Regulators from North America approved the capital expenditure towards EV charging infrastructure as a part of tariffs
- Electricity distribution licensees offered attractive time-of-day tariffs to promote off-peak charging
- Distribution licensees developed public charging infrastructure
- Grid operators and distribution licensees experimenting with EVs as grid assets (demand response resource or for providing ancillary services through Vehicle-to-Grid technologies)

Summary of policies, incentives, regulatory directives

			US		Norway	France	China	Japan
			Vermont	California				
Policy Support	Targets for EVs		✓	✓	✓	✓	✓	✓
	Government commitments / legislation for EVs		✓	✓	✓✓	✓	✓✓	✓
Fiscal incentives provided	Direct subsidies on EV purchase	Upfront	✓	✓	✓✓	✓✓	✓✓	✓
		Offered to leased vehicles		✓✓	✓✓	✓✓	✓✓	✓✓
		Available for Company vehicles		✓✓	✓✓	✓✓	✓✓	✓✓
		Available for a definite period	✓	✓✓	✓✓	✓	✓	✓✓
	Indirect incentives (Road tax waiver, VAT waiver, access to reserved lanes, free parking)		✓	✓✓	✓✓	✓	✓✓	✓✓
Regulatory directives and role of utilities	Directives from regulator on EVs			✓		✓		
	Regulatory orders			✓				
	Approval of Budget/electrical tariff		✓	✓	✓	✓	✓	✓
	Utility initiatives and programs		✓	✓	✓	✓	✓	✓
	Time of use tariff		✓	✓✓	✓	✓	✓✓	✓
Domestic EV Auto Industry	Local EV manufacturer			✓✓	✓	✓✓	✓✓	✓✓
	Battery manufacturing			✓	✓	✓	✓✓	✓✓
EVSE business	Private players		✓	✓✓	✓✓	✓✓	✓	✓✓
	Utility/Government		✓	✓✓	✓✓	✓	✓✓	✓

II. Technical impact of penetration of EVs

- Three conditions simulated using Matlab
  - Predominantly residential, predominantly commercial and mixed load feeders were simulated with varying EV loads,
  - In case of Residential feeders, EV loads of 8MW (85 kWh, 24 kWh) and 4 MW (24 kWh) were studied,
  - Commercial and mixed load feeders with 4 MW of EV load with and without impedance were simulated
- Simulation results show no adverse impact on the voltage levels

No adverse impacts seen with 20% to 40% EVs connected to the feeders (threshold numbers)

Feeder Type	Transformer capacity, MW	Baseline load, %	Baseline transformer load, MW	Additional EV Load (MW, %of feeder capacity)	Total feeder utilization, MW
Residential	20	50%	10	8, 40%	18
Commercial	20	50%	10	4, 20%	14
Mixed	20	70%	14	4, 20%	18

Results from the Matlab simulations show no substantial impacts

Residential feeder analysis

Parameters	Residential load	Residential Load (Impedance)	Residential + Electric Vehicle Load	Residential + Electric Vehicle Load (impedance)
Voltage (V)	450.98 (phase voltage~552.3354)	449.1 (phase voltage~550.33)	443.615 (line voltage~542.56)	442.1 (~phase voltage 541.45)
Current (x10^4 amps)	1.584	1.5806	1.868	1.81

Commercial feeder analysis

Parameters	Commercial Load	Commercial Load (Impedance)	Commercial Load + EV	Commercial Load+ EV (Impedance)
Voltage (V)	452 (phase-voltage ~553.58)	451.7 (phase voltage ~553.21)	449.1 (phase-voltage~550.03)	448.7 (~phase voltage 549.54)
Current (x10^4 amps)	1.6	1.58	2.195	1.95

Mixed feeder analysis

Parameter	Residential + Industrial	Residential + Industrial (Impedance)	Residential + Industrial + EV	Residential + Industrial + EV (Impedance)
Voltage (V)	7800 (phase voltage~9553)	7750 (phase voltage ~9491.8)	7750 (Phase voltage~9491.8)	7720 (phase voltage ~9455)
Current (amps)	530	528	658	656

III. Legal aspects and possible business models

- Propositions to be considered (applicable provisions of EA, 2003)
  - Would setting up of public charging stations fall under the jurisdiction of distribution systems?
  - Does it entail supply of electricity to public at large?
  - Who can invest in Public charging infrastructure?
- Evaluation of above questions suggests the following:
  - EV charging service would fall within the ambit of electricity distribution (a licensed activity)
  - EV charging service to EV users/drivers entails supply of electricity, thus needs to be regulated
  - Tariff charged to the consumers needs to be regulated and determined by respective Regulatory Commissions

Business models based on enabling provisions and prospective actions

- Enabling conditions in the current Act allow the following business models:
  - Utility-owned charging station installations
  - Franchisee model to promote and encourage installation of charging infrastructure
  - Battery swapping stations installed by private players/PSUs
- Long-term solution would include amending the Act to allow EV charging businesses to resell the electricity without specific licensing arrangements

Business models for EV charging infrastructure based on review of Legal aspects

Utility owned installations	*•Supply of electricity by the Charging Station to vehicle owners would be part of the activities of the distribution licensee*

- The retail supply tariff for supplying to the electric vehicle owners will be determined by the SERC

Installations by franchisees	*•Utility can authorize a third party (Franchisee) to install and/or operate charging stations on its behalf in its area of supply. The franchisee can also be a public private partnership*

- The franchisee model would vary based upon the degree of responsibility sharing and payment structure of the franchisee. Some relevant models could be: Input based franchisee or Operation and maintenance franchisee
- Charging stations can receive electricity at a single point as bulk supply
- The single point supply tariff as well as the tariff cap for retail sale will be determined by the SERC

Aggregation by battery swapping stations	*•Utility, its distribution franchisee or any other third party can aggregate the demand for batteries and set up battery swapping stations*

- Battery swapping will not amount to electricty resale and hence third parties can set up the stations without authorization from distribution licensee
- The Charging Station can receive electricity in bulk at single point from a distribution licensee to charge the batteries
- The bulk supply tariff/single point supply tariff will be determined by the SERC

IV. Tariff impact of investments in the EV charging infrastructure

- Two scenarios were studied for their tariff impact –
  1. NEMMP targets and corresponding EV charging infrastructure requirements and
  2. An aggressive target termed the NEMMP+ (based on Ministry of Power's draft note with specific vehicle stock numbers)
- Within NEMMP and NEMMP+ scenarios, this study uses two possible vehicle stock options - Low Growth and High Growth; assumptions made related to cost of EV charging infrastructure
- Tariff impact assessment was carried out in two ways:
  - Entire investment socialized to all the consumers of the distribution licensees, and
  - Investments charged only to the EV category
- A new category for EV Charging is recommended

Base numbers used in tariff impact calculations

- NEMMP vehicle stock numbers
  - Low Growth scenario (2.2 lacs vehicles excluding 2-wheelers)
  - High Growth scenario (4 lacs vehicles excluding 2-wheelers)
- NEMMP+ vehicle stock numbers
  - Low Growth scenario (4.95 lacs vehicles excluding 2-wheelers)
  - High Growth scenario (8.4 lacs vehicles excluding 2-wheelers)
- Investments in the charging infrastructure
  - NEMMP scenario
    - Low growth (2,873 MUs and INR 603 Crores investment) – 547 MW additional load
    - High growth (5,322 MUs and INR 834 Crores investment) – 1013 MW additional load
  - NEMMP+ scenario
    - Low growth (7,993 MUs and INR 1,142Crores investment) – 1,521 MW additional load
    - High growth (25,218 MUs and INR 3,372 Crores investment) – 4,798 MW additional load

Insignificant tariff impact (additions to the wheeling charges) noticed

Scenario	Business models	Growth options	Tariff Impact (Paise/kWh)
NEMMP	Scenario 1A: Investments socialized to all the consumers - Utility Investments	Low Growth	00.07
		High Growth	00.10
	Scenario 1B: Investments charged only to EV category sales - Franchise's Investments	Low Growth	28.10
		High Growth	20.97
NEMMP+	Scenario 2A: Investments socialized to all the consumers - Utility Investments	Low Growth	00.13
		High Growth	00.40
	Scenario 2B: Investments charged only to EV category sales - Franchise's Investments	Low Growth	19.12
		High Growth	17.90

Special category tariff options – based on MSEDCL numbers

		NEMMP		NEMMP+	
#	Detail	High growth - socialized	High growth - charged only to EV users	High growth - socialized	High growth - charged only to EV users
1	Tariff impact as incremental wheeling charges, INR/kWh	0.001	0.281	0.004	0.191
Base tariff options					
2A	ACoS, INR/kWh	6.74	6.74	6.74	6.74
2Ba	Commercial consumer base (HT) energy charges, INR/kWh	11.4	11.4	11.4	11.4
2Bb	Commercial consumer base (HT) energy charges, INR/kWh	0.59	0.59	0.59	0.59
2C	Average Power Procurement Cost, INR/kWh	4.01	4.01	4.01	4.01
2D	Highest marginal cost from the merit order stock, INR/kWh	4.86	4.86	4.86	4.86
3	Differential between ACoS and APPC, , INR/kWh	2.35	2.35	2.35	2.35
Total charges including incremental wheeling charges, INR/kWh					
4	Total charges at ACoS, INR/kWh (=1+2A)	**6.74**	**7.02**	**6.74**	**6.93**
5	Total charges at Commercial (HT), INR/kWh (=1+2Ba+2Bb)	**11.99**	**12.27**	**11.99**	**12.18**
6	Total charges at APPC, INR/kWh (=1+2A+3)	**6.74**	**7.02**	**6.74**	**6.93**
7	Total charges at highest marginal cost, INR/kWh (=1+2A+3)	**7.59**	**7.87**	**7.59**	**7.78**

Reference: MSEDCL tariff order case 48 of 2016

Special category tariff – TOD options

Maximum level of TOD incentives			
		NEMMP	NEMMP+
Electricty consumed by EVs in MSEDCL area	MUs	532	2521.75
Maximum stranded capacity that can be utilised	MW	145.80	690.89
Total incentive to be offered to the EVs	INR, Crore	91.15	431.93
		1.71	**1.71**

Basis and assumptions:

- Backed-down capacity for MSEDCL in FY 16-17 was ~6400 MW
- Capacity charge related to backed down capacity paid by the MSEDCL was INR ~4000 Crores
- TOD calculations use 3650 hours of use of the stranded assets

Additional TOD benefits can be offered to this category for "night-time charging" as stranded assets can be utilized

Way forward – action points

Specific action points to be considered by the MOP and Hon'ble Commissions

- Policy-level actions: create specific EV penetration targets; propose indirect tax benefits (road taxes,
- Regulatory actions:
  - Frame guidelines or new regulations to allow pass through of investments made in EV charging infrastructure by the distribution licensees, in tariffs
  - Create simplified framework for franchise agreements between the distribution licensees and private sector/interested Public Sector Undertakings/associations for setting up public charging infrastructure
  - Create new tariff category for EVs by allowing recovery of incremental cost of infrastructure as wheeling charges over and above the average cost of service
  - Allow special ToD structure for EV charging infrastructure accounting for use of backed-down assets in the night time
  - Allow Open Access to EV charging infrastructure aggregators with lesser or no additional wheeling charges provided renewable power is tied-up for this object
  - Propose incentives mechanisms to use RE to charge EVs including banking of RE

Thank you

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Additional slides

EV Grid Integration Pilots

• Proposed to build over 3500 EV charging station in multi-unit dwellings (program approved in 2016 by CPUC) • Data collection on price signals' impact on charging behavior	• Joint program between vehicle manufacturer BMW and California utility Pacific Gas & Electric (PG&E) Company • BMW aggregated consumers as demand resource	• Developed by IBM, DONG energy, DTU, Siemens, Eurisco and Danish Energy Association • Demonstrated network issues, market solutions, and integration of high levels of variable renewable energy
SDG&E VGI Rate Pilot, California	**BMWi chargeForward Program, California**	**Denmark: EDISON Project**
• V2G technology pilot • SCE utility partner, demonstrate retail peak shavings • participating in the wholesale market as a (NGR) to provide ancillary services	• Energy management solution - Vehicle-to-Grid (V2G) recharging device • Allow grid balancing services	• Developed under the Spanish-Japanese collaboration • Designed to assess the usage patterns of EVs on day-to-day basis • 4.6mn kms with zero emissions • Prevention of 330 ton of CO_2 emissions
Grid Integration Pilot, (LAAFB), US	**Enel and Nissan V2G Pilot, UK**	**ZEM2All Project, Spain**

International Business Models for investment in Public Charging Infrastructure

- **Manufacturer or business owner funding:**
  - EV Manufacturer or a business owner contributes funding to subsidize the deployment a DC fast charging network for interregional EV travel.
- **Private sector Charging service providers:**
  - Private sector player sell the hardware to the host (lease or monthly EMIs), install and network the installation and take a share of the revenue from charging events. E.g. ChargePoint, EVGo, CarCharging
- **Utility funded installations:**
  - Distribution utilities install EVSE as a part of their business and get the budget approved from the commission as a part of their annual budget PGE, SDGE, SCE.
    - PGE Rate Structure
    - SDGE Rate Structure
    - SCE Rate Structure

Key takeaways from international experience

- Substantial fiscal incentives are the most important driver of EV uptake. However, fiscal incentives need to be supplemented by developing consumer awareness.
- Availability of charging infrastructure is another prerequisite for electric mobility because it helps overcome range anxiety.
- Utilities have a key role to play in development of charging infrastructure and establishing clear pricing policies for charging.
- Regulators in regulated electricity markets have directed or mandated utilities to invest in EV charging infrastructure.
- Public private partnerships have been successful in deployment of infrastructure, supplementing the consumer awareness efforts as well as providing independent incentives to the consumers.

International Case studies

	Vermont	California	Norway	China	Japan
Policy support	• EV Everywhere Grand Challenge of US DoE • ZEV Member state	• Adopted Zero-Emission Vehicle program • target of 1.5 million ZEVs by 2025 in 2013	• Agreement on Climate Policy (Klimaforliket) • Goal of having all new car sales as either ZEV or low (plug-in hybrids) emission by 2025. • Limit of 120–140 g CO2 /km for new vehicles in government fleet and a CO2-neutral fleet by 2020.	• State council's Plan of Energy-Saving and New Energy Vehicle Industry Development (2012-2020 • MOST's 12th Ten-Year Special Plan for Science and Technology Development of Electric Vehicle • MOST's Electric Vehicle Special Project under the 10th Five-Year plan (2001-2005.)	• Next Generation Automobile Industry Strategy's goals of having 15–20% EVs in 2020 and 20–30% EVs of in 2030 passenger vehicle market
Regulatory directives and role of utilities	• Tier III category of Vermont's Renewable Energy Standard • EVSE stimulated by utilities, with utilities buying and coordinating placement of EVSE	• CPUC approved investments by utilities in infrastructure creation • Utilities are utilizing electric vehicles as quick responding resources to de-stress the grid • CPUC has developed a framework for Vehicle to grid integration	• Distribution system operators (DSO) have been actively involved in installing the public charging stations • Fortum, an electricity supplier has the highest share of charging infrastructure in Norway. • Municipality of Oslo has allocated €2 million for building 400 charging points	• State Grid Corporation of China and China Southern Power Grid Company supply all of China's electricity and control electricity pricing. In conjunction with SERC/NEA, the NDRC reviews retail rates annually based on changes to the costs of power generation and the status of generation capacity.	• The electric power companies of Japan have decided to introduce about 10,000 electric vehicles (including plug-in hybrid vehicles) for commercial use by FY2020

	Vermont	California	Norway	China	Japan
Support and incentives provided	Purchase Incentives, Tax credits, Assistance in developing strategic partnership, investments in R&D, consumer awareness, sensitizing corporate sector to develop workplace charging, and creating partnership with research organizations for grid modernization	Purchase incentives up to $2,500 for different types of PEVs. State legislature authorized up to $120 million per year, over seven years to help support the development of PEV technologies including research, pilot demonstration programs, publicly charging stations.	No purchase/import taxes (1990) Exemption from 25% VAT on purchase (2001) Low annual road tax (1996) No charges on toll roads or ferries (1997 and 2009) Free municipal parking (1999) Access to bus lanes (2005) 50 % reduced company car tax (2000) Exemption from the registration tax	Tax credit for automakers Reward to charging infrastructure construction Subsidies for purchasing EV often matched by local governments Tax reduction for purchasing EVs Mandated the use of electric vehicles by some government offices vehicle purchases by 2016. Setting standards for Evs	Purchase incentives for consumers reduction on the acquisition tax (VAT), exempt from an annual tonnage tax during the first year and 50% reduction the second year. Support to manufacturers Investment in R&D
Investments in EVSE and Pricing structure for EV charging	Over half the charging locations offer free charging Monthly memberships Hourly payment Flat "access fee" in addition to the hourly rate Energy-based charges for the electricity consumed	$750 rebate for installing chargers Most of the public charging locations offer free charging Workplace or residential charging at prevailing rate if a separate meter is not installed State Provides loans for EVSE installations	Fortum has a network of 6,725 public charge points of which 208 are CHAdeMO and 142 Combined Charging System (CCS) Energy based pricing models - Charges for per kWh used Minute based pricing – Charge and drive program of Fortum sets prices per minute of vehicle connection to the charger	Beijing electricity customers pay TOU rates with seasonal adjustments (Smith & Kim, 2016). Shenzhen EV drivers can sign up for reduced electricity rates, including off- peak prices of 0.3 yuan (US$0.05) per KWh	The charging infrastructure is largely developed under the public-private partnership mode locally developed CHAdeMO system is dominant (5,500) 15,000 quick and standard stations
Policy Impact	Number of PEVs 1,113 in January 2016. The number of PEV charging stations 111 in January 2016	• Total PEV registration were around 200,000 by Dec 2017	• Norway had a stock of more than 135,000 EVs as on December, 2016 • More than 20% of all new vehicles sold in Norway are 100% electric	• By December 2016, electric vehicle fleet of more than 951,000 vehicles including buses and trucks. • By the end of 2013, ~20,000 EV charging piles and ~500 charging/battery swap stations	The Light-duty plug-in electric vehicle stock was more than 130,000

PGE Rate Structure for EV charging

Rate	Description	Total Energy Rates ($ per kWh)
EV-A (Non-tiered, Time-of-Use)	Single Meter: The price per kilowatt-hour varies depending on the time.	Summer Usage: Peak - $0.45389, Part Peak -$0.24986, Offpeak-$0.12225 Winter Usage: Peak-$0.32018, Part peak-$0.19794, Off peak-$0.12503
EV-B (Non-tiered, Time-of-Use)	Dual meters: The price for charging varies throughout the day. Your home energy use is measured separately.	Summer Usage: Peak - $0.44738, Part Peak -$.24660, Offpeak-$0.12179 Winter Usage: Peak-$0.31325, Part peak-$0.19447, Off peak-$0.12453
E1 (Tiered)	Single meter. Costs are based on three usage tiers.	Baseline Usage ($/kWh) - 0.19979, 101% - 400% of Baseline - 0.27612, High Usage Over 400% of Baseline - 0.40139
Time-of-Use Rate Plan - 3-8 p.m. (ETOU-A)	Single meter. credit for all usage up to your baseline allowance.	Summer: Total Usage Peak $0.39336 Offf-peak - $0.31778 Baseline Credit: Peak - $0.08830, Off peak - $0.08830 Winter: Total Usage Peak - $0.27539, Off-peak - $0.26109 Baseline Credit: Peak - $0.08830, Off peak - $0.08830
Time-of-Use Rate Plan - 4-9 p.m. (ETOU-B)	Single meter. Prices are higher in the summer than in the winter.	Summer: Peak - $0.36335, Off-peak - $0.26029 Winter: Peak - $0.22588, Off-Peak - $0.20708
E6 - (Tiered, Time-of-Use)	Single meter. The price per kilowatt-hour is based on the time and the amount of electricity used	Discontinued now

Peak: 2:00 p.m. to 9:00 p.m. Monday through Friday. 3:00 p.m. to 7:00 p.m. Saturday, Sunday and Holidays. Partial-Peak: 7:00 a.m. to 2:00 p.m. and 9:00 p.m. to 11:00 p.m. Monday through Friday, except holidays. Off-Peak: All other hours. The summer season is May 1 through October 31 and the winter season is November 1 through April 30

SDGE Rate Structure for EV charging

Summer - Electric Vehicle Time-of-Use Rate			
EV-TOU			
Rate	**On-Peak**	**Super Off-Peak**	**Off-Peak**
Time-of Day	Noon - 8:00 PM	Midnight – 5:00 AM	All other hours
Amount	$0.49	$0.19	$0.23
EV-TOU-2			
Rate	**On-Peak**	**Super Off-Peak**	**Off-Peak**
Time-of Day	Noon - 6:00 PM	Midnight – 5:00 AM	All other hours
Amount	$0.49	$0.19	$0.24
Winter - Electric Vehicle Time-of-Use Rate			
EV-TOU			
Rate	On-Peak	Super Off-Peak	Off-Peak
Time-of Day	Noon - 8:00 PM	Midnight – 5:00 AM	All other hours
Amount	$0.23	$0.20	$0.22
EV-TOU-2			
Rate	On-Peak	Super Off-Peak	Off-Peak
Time-of Day	Noon - 6:00 PM	Midnight – 5:00 AM	All other hours
Amount	$0.23	$0.20	$0.23

Note: Summer rates are May through October. Winter rates are November through April. Rates valid as of 1/1/17.

SCE Rate Structure for EV charging

For separate EV meter	Energy Charge - $/kWh/Meter/Day
Summer Season - On-Peak	0.16790
Off-Peak	0.09155
Winter Season - On-Peak	0.16790
Off-Peak	0.09155

On-Peak: 12:00 noon to 9:00 p.m. all year, every day Off-Peak: All other hours - all year, everyday The summer season shall commence at 12:00 a.m. on June 1 and continue until 12:00 a.m. on October 1 of each year. The winter season shall commence at 12:00 a.m. on October 1 and continue until 12:00 a.m. on June 1.

Manufacturer investing in Charging stations

- Own installations
  - Tesla built network of fast-charging Superchargers along highways throughout North America, Europe, and Asia, which are available to Roadster, Model S, and Model X owners for free.
  - In future, Model 3 users are expected to pay to use the Superchargers, possibly as a package added at the time of purchase.
- Partnering with service providers
  - BMW Chargenow: Partnered with ChargePoint, for allowing its users to access the ChargePoint's network through a smart card
  - Nissan No-Charge to Charge Supported by EVGo: two years of complimentary public DC fast and Level 2 charging at participating stations

Third-party Private Players

- ChargePoint
  - Designs, builds and support all of the technology, from charging station hardware to energy management software to a mobile app
  - Mainly Level 2 SAE compliant Chargers
  - Doesn't own the station but provides the hardware and the software installations
    - Installs chargers for the hosts with fixed payments as per usage
    - Avails of the tax credit and the subsidies provided by Government, investments from the private investors, manufacturers
    - Host is free to set the tariff for charging of EVs
- Volta
  - installs EV chargers which are free for usage for EV drivers and free for host for installation
  - leverages advertising revenues

EVGo

- Network of stations installed by NRG Energy (Utility), was sold to Colorado-based sustainable-energy investment firm Vision Ridge Partners
- Works with automakers at developing charging stations
- Installs, operates and maintain its own fast charging network
- Have different charging plans based on the need
- Hosts installation at business and retailers
- Owns CHADeMO and CCS chargers
- Partners with utilities to expand the network

	DC Fast	Level 2 (Plug-ins)	FLEX (Low usage)
Monthly Fee	$14.95	$5.95	None
DC Fast	10¢ / min.	10¢ / min.	$4.95 session + 20¢/min.
Level 2	$1.00 / hr.	$1.00 / hr.	$1.50 / hr.
Contract Term	1 year	1 year	month-to-month
Setup Fee	None	None	$4.95
Early Termination	$29	$29	None

Utility owned/invested infrastructure

- Utilities aggregating the EV installation and appointing third party service providers
  - Utility invites RFP for installation and maintenance,
  - The rate structure decided by Commission,
  - Hosts can choose from the list of selected vendors and installs chargers
  - Host gets federal rebates for installation of chargers
  - Utility installs and maintains the EV service connection and electrical infrastructure
- Utilities offer tariff rebates for domestic EV charging

RMI and Niti Aayog

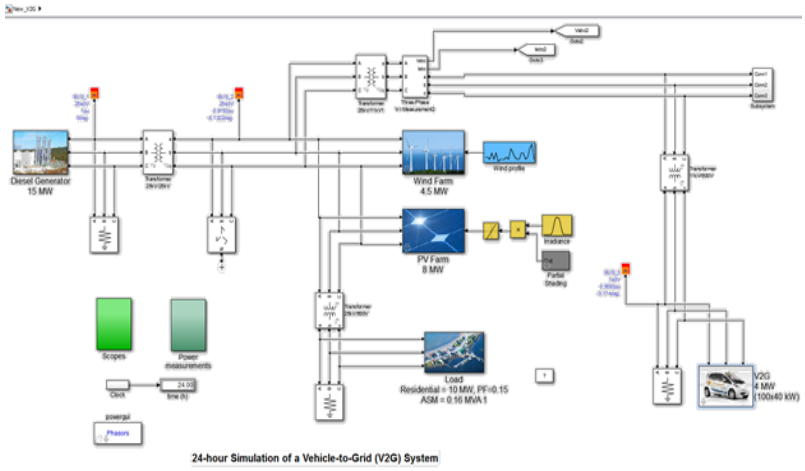
Recently RMI and NITI Aayog organized a first of its kind charrette dialogue process in February 2017 to identify the specific solution for Transformative Mobility in India.

- Following actionable solutions have been suggested
  - Interoperable transport data: central data sharing institution and unified metropolitan planning authority
  - Metropolitan planning councils
  - Networked city-level innovation and incubation centres
  - Feebates
  - Zero Emission Vehicle (ZEV) credits
  - Policies that encourage Mobility as a Service (MaaS)
  - Regulations that enable Electric Vehicle Supply Equipment (EVSE) deployment and Vehicle-Grid Integration (VGI)
  - Manufacturer consortium for batteries, common components, and platforms
  - Integrated transport hubs
  - Enhanced fiscal incentives
  - Nonfiscal incentives
  - Standardized, smart, swappable batteries for 2- and 3-wheelers

Technical Impact Assessment

Technical impact assessment of EVs on the grid

- Simulations performed in Matlab/ Simulink platform
  - Using available blocks in Simulink library



24-hour Simulation of a Vehicle-to-Grid (V2G) System

- The model components:
  - generating stations (Solar PV farm, Wind farm and Diesel generator), connected by 25 kV step down transformers on to the distribution lines.
  - Loads (electrical vehicle, residential load, industrial load),
  - the distribution lines and 3-phase transformers.
- The electric vehicle load is connected to the distribution grid via an 11 kV step down to 600 V transformer and 25 kV step down to 11 kV transformer.
- The generating station size and load values were taken to be the same from the basic model.
- An additional industrial load was added to depict loading conditions typical of a Low Tension industrial estate.

EV Vehicle block configuration

- The vehicle block comprises of 100 cars split into 5 sub-scenarios based on the profile conditions.
  - People going to work with the possibility to charge the car at work (25 cars).
  - People going to work with the possibility to charge the car at work but have a longer driving distance (35 cars).
  - People going to work but have no possibility to charge the car at work (10 cars).
  - People staying at home (20 cars).
  - People working on the night shift (10 cars).
- Within the model, a SoC initialization operator is introduced, holding SoC values on hourly basis.
  - The sharp declines in graphs are due to travel undertaken by the vehicle and the plateaus are from the vehicle being in non-operating condition and not charging
- Due to the uncertainty and influence of different un-controllable real time variables, the model was simulated for a possible worst case scenario assuming:
  - The battery would operate between 20% to 90% of SoC
  - Discharge to 20% of its capacity at least one instance during the day for all vehicle profiles, except for profile 4.

Simulation Scenarios

- **Residential feeder**
  - Baseline Residential load with EV
  - Variation in EV load profiles
    - Scenario A: EV Load of 8 MW with 85 kWh battery capacity
    - Scenario B: EV Load of 8 MW with 24 kWh battery capacity
    - Scenario C: EV Load of 4 MW with 24 kWh battery capacity
    - Scenario D: Simulation with lower transformer capacity
    - Scenario E: Worst-case scenario having peak coincidence between residential and EV load
- **Commercial feeder**
  - EV Load of 4 MW
  - EV Load of 4 MW with Impedance
- **Mixed load feeder**
  - EV Load of 4 MW
  - EV Load of 4 MW with Impedance

Results

Simulation results for Residential feeder

	Baseline		Scenario A		Scenario B		Scenario C		Scenario D	Scenario E
	Residential +EV Load)	Residential +EV Load with impedance	Residential +EV Load)	Residential +EV Load with impedance	Residential + EV Load	Residential + EV Load with impedance	Residential + EV Load	Residential + EV Load with impedance	Residential with EV load	Residential (Peak)* + EV
Voltage (V)	443.615 (line voltage~542 .56)	442.1 (~phase voltage 541.45)	441.05 (line voltage ~540.17)	440.3 (~phase voltage 539.25)	441.6 (line voltage ~540.84)	441.10 (~phase voltage 540.23)	443.16 (line voltage ~540.17)	442.6 (~phase voltage 542.07)	462.8 (phase voltage~566 .81)	443 (phase voltage~ 542.56)
Current (Amps x10^4)	1.868	1.81	2.25	2.191	2.2	2.175	1.805	1.78	2.6	1.91

Simulation results for commercial and mixed load feeder

Parameters	Commercial Load	Commercial Load (Impedance)	Commercial Load + EV	Commercial Load+ EV (Impedance)	Residential + Industrial	Residential + Industrial (Impedance)	Residential + Industrial + EV	Residential + Industrial + EV (Impedance)
Voltage (V)	452 (phase-voltage ~553.58)	451.7 (phase voltage ~553.21)	449.1 (phase-voltage~550. 03)	448.7 (~phase voltage 549.54)	7800 (phase voltage~9553)	7750 (phase voltage ~9491.8)	7750 (Phase voltage~9491.8)	7720 (phase voltage ~9455)
Current (x10^4 amps)	1.6	1.58	2.195	1.95	530	528	658	656

Summary of Simulation results

Feeder type	Baseline load (MW, %)	Additional EV load without transformer failure
Residential	10, 50%	10, 40%
Commercial	10, 50%	4, 20%
Mixed	14, 70%	4, 20%