MINUTES OF THIRD MEETING OF "STANDING TECHNICAL COMMITTEE FOR IMPLEMENTATION OF FRAMEOWORK ON RENEWABLE AT STATE LEVEL-GROUP-I & II

Venue: Upper Ground Floor,
CERC, New Delhi

Date: 03.01.2020

List of Participants: **Annexure-1**(Enclosed)

The Third meeting of the FOR Standing Technical Committee was held on 3rd January 2020 under the Chairmanship of Shri Indu.Shekhar Jha, Member CERC and Shri P.K. Pujari, Chairperson CERC & FOR. At the outset, Shri I.S. Jha welcomed all the participants and special invitees. Thereafter agenda items were taken up for consideration.

Agenda Item No.1: Launch of the USAID Report on Electricity Contracting in the United States- Insights for India

2. Dr S K Chatterjee, Chief (RA), CERC welcomed Mr. Michael Satin from USAID and his team . He briefly explained the background of the report prepared under the Greening the Grid (GtG) programme of US-India partnership. He informed that the report was prepared by NARUC (with assistance from E3 Consulting Firm), the USAID's implementing partner for this component of GTG, as per the Memorandum of Understanding (MOU) with the Forum of Regulators (FOR). He highlighted that basic objective of the study was to gain insight into international experience around market design, with special focus on treatment of existing and future contracts.

3. Shri Michael Satin expressed his gratitude towards Shri P.K. Pujari , Chairperson CERC and Shri I.S Jha, Member CERC and FOR Standing Technical Committee and acknowledged India's achievements of increasing portfolio of RE and transition of electricity market. He briefed the Committee about USAID's Greening the Grid (GTG) program, being implemented in partnership with the Ministry of Power (MoP), which focuses on supporting peer-to-peer exchanges between U.S and India regulators by providing relevant international

experiences and regulatory expertise. He appreciated the valuable contribution of POSOCO, CERC, and FOR Secretariat which helped in finalizing the repot and making it relevant to provide significant insights to Indian Policy makers in achieving the target of integrating 175 GW of Renewable Energy (RE) by 2022. He emphasized that it was his belief that the report will serve as a reference document for lessons from US experience in market development.

4. Shri P.K.Pujari, Chairperson, CERC/FOR appreciated the efforts that went into the report and importance of such report to provide valuable insights to Indian Policy makers for designing power Market which will be suitable for India's condition. He emphasized on the importance of larger consultation with all stakeholders in India while finalizing the roadmap for designing the power market suitable for India. He briefly highlighted the Regulatory initiatives taken in this regard by CERC/FOR. He congratulated the USAID for the report and expressed confidence that the insights from the US experience would be useful for Indian Regulators and policy makers.

5. The report "Regulatory and Market Guidelines on Key Insights and Considerations of Priority areas for Renewable Integration in India" was formally launched by Shri P.K. Pujari, Chairperson CERC /FOR and Shri I.S Jha, Chairperson of Standing Technical Committee in the presence of Standing Technical Committee Members of Group I & II.

Agenda Item No. 2: Status of implementation of Regulations on Forecasting, Scheduling and Deviation Settlement AND Status of implementation of SAMAST:

6. The Consultant to the Standing Technical Committee (Mr Anish Mandal- M/s. Deloitte) presented status update on SAMAST implementation, Forecasting & Scheduling and DSM Regulations at State level for various States (**Annexure-II**).

7. The consultant apprised the Committee of the progress made for implementation of SAMAST framework, Forecasting & Scheduling and DSM Regulations. He informed that 19 States have notified Regulations for Forecasting and Scheduling and 16 States are in the process of preparing the Regulations for their respective States. It was also informed that 12

States have notified DSM Regulations and Punjab, Telangana, West Bengal, Odisha and Bihar have published draft DSM Regulation, while remaining 19 states are yet to initiate or in drafting stage. It was also updated that the formulation and approval of F&S Procedure along with QCA registration process are in progress in the State of Gujarat and Tamil Nadu.

8. The Consultant briefed the Committee on state-wise developments of implementation of SAMAST. He updated that 13 States have submitted their DPRs for SAMAST out of which 10 DPRs have been approved and remaining 13 States are still in the process of either submitting or preparing their DPRs. Member UPERC updated that the SAMAST DPR for UP has been prepared and have been submitted recently.

9. Shri I.S.Jha emphasized that SAMAST is very crucial especially for smooth integration of RE and expressed concerns over the long process of approval of grants for SAMAST. The Committee reiterated the need for streamlining the approval process for releasing of PSDF support, especially for States intending to implement SAMAST and pointed out that the grants disbursed under SAMAST are relatively small and can be prioritized. The Committee agreed to have a special meeting with PSDF committee to expedite the disbursement for SAMAST.

10. Shri Bakshi suggested the Committee may get regular updates on RPO web-tool of States and implementation of recommendations of Power Quality and CABIL reports approved by the FOR.

Action Point (s) / Decision(s):

The committee noted the status on implementation of Regulations on Forecasting, Scheduling and Deviation Settlement AND Status of implementation of SAMAST and emphasized the need of expeditious disbursement of fund for SAMAST implementation by PSDF Committee.

i. **The Committee decided to have a separate meeting with PSDF Committee under the Chairmanship of Shri I.S. Jha to facilitate expeditious disbursement of PSDF funds for SAMAST.**

ii. **The Committee decided to monitor implementation of the CABIL report on the capacity building of SLDC**

iii. **The Committee also decided to monitor implementation of RPO web tool at State Level**

Agenda Item No.3: Reference from FOR on impact of Renewable Purchase Obligation and RE Integration on Retail Consumer Tariff:

11. Dr S K Chatterjee, Chief (RA), CERC updated the Standing Technical Committee about the agenda item which was one of the action items referred to the Standing Technical Committee, by the FOR during the 69th Meeting held on 20th September, 2019 in Amritsar. He briefed that the Committee has been requested to assess true cost of RE integration into the system at State Level. The representative from Karnataka Electricity Regulatory Commission (KERC) updated the Committee on operational challenges especially during Monsoon and wind Season. Chairperson TNERC also highlighted the requirement of spinning reserves at State level with increase in RE capacity and suggested that the study should also cover cost associated with such technical aspects for integration of RE resources. Chairperson PSERC suggested that the study may examine the economic feasibility of integrating the RE in the study. Chairperson P. K. Pujari, highlighted the importance of the study to undertake detailed financial implications associated with RE integration on the States. Dr. S.K. Chatterjee updated the Committee that the work has already been commenced by the Consultant of the Technical Committee in this regard and detailed approach with some preliminary results will be discussed with the Committee in subsequent meetings.

Action Point (s) / Decision(s):

The Committee suggested that the consultant shall make presentation on detailed approach for the study along with some preliminary results in subsequent meetings.

Agenda Item No.4: Reference from M/s SECURE Meters Ltd. on implementation model to support Smart Prepaid Meter Roll out

12. Mr Sunil Singhvi, representative of M/s. Secure Meters Ltd., presented on the white paper, detailing on implementation model to support Smart Prepaid Meter Roll out (**Annexure-III**). He emphasized on OPEX model for roll out of smart meters as envisaged by the Policy makers. According to him, instead of buying meters, the Distribution Utilities may give contract to Smart Metering Service Providers (SMSP). SMPS will be responsible for asset funding, meter installation, system operation, data distribution and value added services to distribution Licensee. A single SMSP would take all the responsibilities in a distribution circle with no overlap within the distribution circle of the utility.

13. He briefed the committee about the various benefits of SMSP. According to him, no upfront capital expenses and stress on the consumers as payment will be done by collection itself. This will achieve better efficiency and will help in minimizing the overall risk of distribution licensee. He also suggested a National level service and data interface so that each SMSP can feed data into any system, through Smart Metering Data Interface (SMDI). He also sought support from the Regulators on simplifying tariffs to enable prepaid metering, approval of operating expenses for metering and provision for direct benefit transfer for subsidized consumers.

14. Some Members suggested that the cost-benefit analysis of smart meters for the Consumers need to be studied in depth before roll out of technologies. Some also asked question regarding the OPEX model and additional charges consumers will have to bear due to implementation of smart meters. Some members expressed concern over implication of mandatory provisions of Smart Meters for all consumers. Others emphasized the need for examining the proposal of roll out of Smart Meters in line with the provision in the Electricity Act 2003 on choice given to consumers to own the meter. The Chairperson of FOR suggested having phase-wise approach of implementing the smart meters. In the initial phase, Smart Meter roll out can be planned at identified circles with high losses. In the later phase economic feasibility to roll out of Smart meters to other areas can be explored

effectively. Some members suggested that pilots of Smart meters in Haryana and Uttar Pradesh may be examined in details.

Action Point(s) / Decision(s):

The committee noted the presentation of M/s Secure Meters Ltd. and directed to submit additional input on the cost-benefit analysis and cost comparison of different services provided by Smart Meters.

Agenda Item No.5: Reference from M/s KREATE TECHNOLOGIES on Demand & RE Forecasting & SAMAST Implementation.

15. Shri Arun Kumar, representatives of Kreate Technologies presented their learning from Demand & RE Forecasting & Implementing SAMAST (**Annexure-IV**). He emphasized on the challenges faced in getting reliable data in forecasting. The issues of historical data, real time data, and telemetry, unpredicted breakdowns in load due to thunderstorms and rain and also unavailability of SCADA data are the key challenges in forecasting. He explained their forecasting model which uses dual ensemble method to optimize data weather data and historical data at project site. He informed that how data from different weather sources are mapped using an optimization technique to create algorithms for scheduling followed by error analysis. He highlighted lack of continuity in weather data along with requirement of downscaling the weather data of one hour to 15 minutes for forecasting generation. He suggested 15 minutes interval data from the weather department would significantly improve the accuracy.

16. Shri Baba, CMD, POSOCO emphasized the necessity of multifold increase in capabilities of India Meteorological Department (IMD) to receive compatible weather data for power sector, especially for renewable energy generation. It was suggested that Power sector also needs to be included as priority sector in the list for IMD. It was suggested that POSOCO may follow up with IMD to address challenges in this regard.

17. Shri Arun Kumar, also reiterated that accuracy for forecasting and scheduling for RE generation could improve considerably if revision of schedule allowed closer to actual delivery of power. He suggested that existing provision of revision of schedule before 1.5 hours of actual delivery of power may be reduced further. He also emphasized uniformity in the process followed by different State Load Dispatch Centers (SLDCs) to receive data from QCA or Regenerators. Shri Baba highlighted that REMCs are in place in around six places and some of these issues would get resolved with implementation of REMCs . It was decided that a detailed presentation on REMCs may be scheduled for next Technical Committee Meeting.

18. Representative of Kreate Technologies shared the experience on SAMAST implementation in Himachal Pradesh SLDC. He highlighted the challenges faced in SAMAST implementation i.e. turnkey solution of meter and software to a single vendor, API sharing from Meter manufacturer for Meter data variation without manual intervention, API sharing for SCADA manufacturer to share the real time energy data with external application like SAMAST, the need of customized solutions at SLDC level and there should be some degree of technical parameters for evaluation of vendor selection.
19. It was requested that an integrated software solution comprising all the desired software modules may be recommended through SAMAST report which would help the market operation of SLDC.

Action Point(s) / Decision(s):

The committee noted the representations from Kreate technologies on Demand & RE Forecasting & Implementing SAMAST.

i. **The Committee directed the POSOCO to follow up with IMD to resolve the issues regarding compatibility of data.**
ii. **The Committee decided to have a detailed presentation on the Renewable Energy Management Centre (REMC) in the next Technical Committee Meeting.**

Agenda Item No. 6: Update on the Subgroup on Reserves and Ancillary Services at the State Level

20. Dr S K Chatterjee, Chief(RA) briefed about the subgroup which was constituted by this technical committee. He informed that subgroup has finalized a draft report on Reserves and Ancillary Services at State level and the reports were circulated to the members of the technical committee.

21. The Chairperson of the Subgroup Shri S.K. Soonee who is also Advisor POSOCO presented an update on the Reserves and Ancillary Services at the state level (**Annexure-V**). He informed the committee about the involvement of SERC and SLDC- 4 states, NLDC, RLDCs which are RE rich and co-opted two experts namely Dr S K Chatterjee, Chief(RA) and Prof. Abhijit Abhyankar, IIT Delhi in finalizing the report. He briefed the Committee on the terms of reference of the sub group to disseminate the learning from the experience of implementing the reserve regulation ancillary services and fast response ancillary services at the interstate level

22. Shri. S.K. Soonee briefed the committee on the activities of the subgroup and informed that there were 7 meetings held along with multiple interactions and 3 pilot exercises in MP, MH and Gujarat. He envisaged the ancillary service as an essential reliability service and accordingly recognized the need of identifying the generator thresholds. He informed that initially Load was following generation but with adequate generation capacity now the generation has to follow load and this is where active balancing comes into picture. He highlighted the key attributes of active balancing as to determine capacity followed by acquiring the capacity then activate the balancing power and finally financial clearing and settlement.

23. He emphasized that ramping alone will not be able to cater the peak demands and therefore it is recommended to have active balancing with passive balancing with urgent need of massive IT infrastructure. He also highlighted the recommendations of the Group on a road map for implementation of reserves and ancillary services at state level.

24. Shri A K Bakshi discussed and sought clarification on the increase of ramping rate from 1% to 3%. Shri S.K. Sonee emphasized that on the purview of high RE penetration in the Grid the ramping rate needs to be increased in order to avoid the huge investment on battery storage or any other storage technology.

Action Point(s) / Decision(s):

The technical committee appreciated the efforts of the sub group in preparing draft report on Reserves and Ancillary Services at State level. The Technical Committee endorsed the report to Forum of Regulators.

25. Shri P.Ramamohan, Member APERC expressed his gratitude to all Committee Members and Chairperson CERC/FOR and informed that this meeting will be his last meeting of Technical Committee as he will be retiring soon from office. All members recounted his active participation and appreciated his valuable contribution in various Committees and Technical Committee Meetings. The Meeting ended with the thanks vote to Shri P.Ramamohan for his immense contribution and ardors work as Member of the Technical Committee.

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ANNEXURES

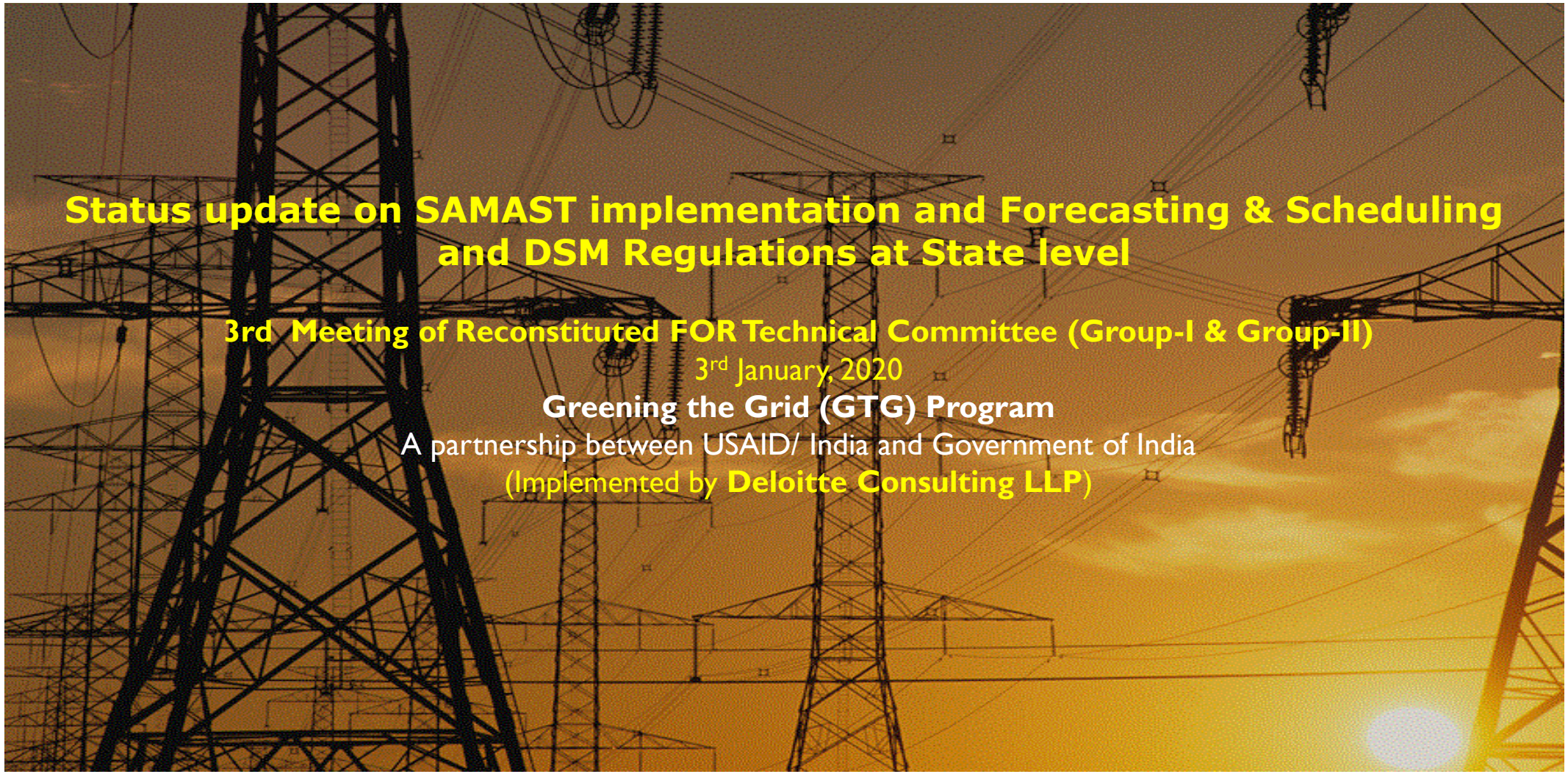
Annexure-I

LIST OF PARTICIPANTS AT THE THIRD MEETING OF RECONSTITUTED TECHNICAL COMMITTEE (GROUP- I & II) HELD ON 03.01.2020 CERC, NEW DELHI

1	Shri P.K. Pujari, Chairperson	CERC
2	Shri I.S. Jha, Member	CERC
3	Shri S.K.Negi, Chairperson	BERC
4	Shri Preman Dinaraj, Chairperson	KSERC
5	Ms K Sidhu, Chairperson	PSERC
6	Shri M.Chandra Shekhar, Chairperson	TNERC
7	Shri A.K. Bakshi, Former Member	CERC
8	Shri P.Rama Mohan, Member	APERC
9	Shri P J Thakkar, Member	GERC
10	Ms A Chandra, Member	PSERC
11	Shri Durgadas Goswami, Member	WBERC
12	Shri K.K.Sharma, Member	UPERC
13	Shri Mukesh Khullar, Member	MERC
14	Shri H.M. Manjunatha, Member	KERC
15	Shri S.N.Kalita, Member	AERC
16	Shri S C Shrivastava, Chief Engg	CERC
17	Dr S K Chatterjee, Chief (RA)	CERC
18	Shri KVS Baba	POSOCO
19	Shri S K Soonee	POSOCO

20	Ms Rashmi Nair, Dy Chief (RA)	CERC
21	Shri Ravi Shankar, Dy Chief (Engg.)	CERC
22	Shri N Pradeep Kumar, Dy Director	KERC
23	Shri Michael Satin	USAID
24	Shri Dev Kant	USAID
25	Shri Vivek Pandey	POSOCO
26	Shri Sanjiv Tinjan, Asst Chief (RA)	CERC
27	Shri Ravindra Kadam, Advisor (RE)	CERC
28	Shri Anish Mandal	Deloitte/GTG-RISE
29	Ms Rashmi Gupta	Deloitte
30	Tushar Sud	Deloitte
31	Ripu B Singh	Deloitte
32	Shri Ankit Gupta, RO	CERC
33	Shri Siddhant Raj Singh, RA	CERC

Guest Speakers		
1	Shri Sunil Singhvi	Secure Meters
2	Shri Jaideep Mukherjee	Secure Meters
3	Shri Anil Mehta	Secure Meters
4	Shri K Mittal	Kreate Technologies
5	Shri Arun Kumar	Kreate Technologies
7	Shri Ashok Ku Aggarwal	Kreate Technologies
8	Shri Sunny Kumar	Kreate Technologies
9	Shri Jitendra Mehr	Kreate Technologies



Status update on SAMAST implementation and Forecasting & Scheduling and DSM Regulations at State level

3rd Meeting of Reconstituted FOR Technical Committee (Group-I & Group-II)

3rd January, 2020

Greening the Grid (GTG) Program

A partnership between USAID/ India and Government of India

(Implemented by **Deloitte Consulting LLP**)

Context (1/2)

Re-constitution of Standing Technical Committee of Forum of Regulators

- A Technical Committee was constituted under the chairmanship of Member, CERC on 18.11.2015 for implementation of Framework on Renewables at State level.
- During 66th meeting of the FOR it was decided that "the standing nature of the Technical Committee would imply that the Committee always be headed by the Technical Member of CERC. But, the members of the Committee would change as per the subject(s) under consideration, so as to ensure representation of all States by rotation.
- In pursuance of the above decision, the Competent Authority in FOR has reconstituted the Standing Technical Committee of the Forum of Regulators (FOR) as under:-

Group - I: Renewable Energy (RE) integration and related matters.
The composition of the Group is as under:-

Shri I. S. Jha, Member, CERC	Chairman
Chairperson/ Member of GERC (Gujarat)	Member
Chairperson / Member of MERC (Maharashtra)	Member
Chairperson / Member of TNERC (Tamil Nadu)	Member
Chairperson / Member of KERC (Karnataka)	Member
Chairperson / Member of RERC (Rajasthan)	Member
Chairperson / Member of APERC(Andhra Pradesh)	Member
Chairperson / Member of HPERC(Himachal Pradesh)	Member
Chairman & Managing Director, POSOCO	Member
Head of Regulatory Affairs Division, CERC	Member Secretary

Special Invitee: Head of Engineering Division, CERC
The committee may co-opt any other member/expert as deemed fit.

Terms of Reference for Group -I

i. Deployment and implementation of framework on Forecasting, Scheduling and Deviation settlement of Wind and solar generating stations at the State Level.
ii. Evolve a framework for Ancillary Services and Reserves at the State Level.
iii. Implementation of Automatic Generation Control (AGC) and Primary Control within the States.

Context (2/2)

Group - II: Implementation of ABT Framework at State Level
The composition of the Group is as under:-

Shri I. S. Jha, Member, CERC	Chairman
Chairperson/ Member of PSERC (Punjab)	Member
Chairperson / Member of UPERC (Uttar Pradesh)	Member
Chairperson / Member of BERC (Bihar)	Member
Chairperson / Member of WBERC (West Bengal)	Member
Chairperson / Member of KSERC (Kerala)	Member
Chairperson / Member of AERC(Assam)	Member
Chairman & Managing Director, POSOCO	Member
Head of Regulatory Affairs Division, CERC	Member
	Secretary

Special Invitee: Head of Engineering Division, CERC
The committee may co-opt any other member/expert as deemed fit.

Terms of Reference for Group -II

i. Introduction/Implementation of the Availability Based Tariff (ABT) Framework at the State Level as mandated in the National Electricity Policy and Tariff Policy.

- The Standing Technical Committee shall provide periodic report to the FOR and may co-opt any other member, as deemed fit.
- 1st meeting of both the Groups of Re-constituted FOR Technical Committee was scheduled on 1st July, 2019.
- 2nd meeting of Group-I of Re-constituted FOR Technical Committee was scheduled on 23rd August, 2019.
- 3rd meeting of both the Groups of Re-constituted FOR Technical Committee is scheduled on 3rd January, 2020

Contents

Model Regulations of Forum of Regulators (FOR) for States

- Forum of Regulators (FOR), published the **Model Regulations for Forecasting, Scheduling and Deviation Settlement** for Wind and Solar Generators for States in 2015.
- FOR entrusted the Responsibility on the **FOR Technical Committee to guide** the States for preparing their Regulations for Forecasting, Scheduling and DSM framework in line with Model Regulations of FOR.
- **United States Agency for International Development (USAID)** along with its contractor Deloitte is providing technical assistance to the Technical Committee of FOR through **its Greening the Grid (GtG) Program under Renewable Integration and Sustainable Energy (RISE)** initiative for assisting the States in preparation of said Regulations for their States.
- Subsequently, FOR also published **Model Regulations for introducing Deviation Settlement Mechanism for States** for Buyers and Sellers.

Implementation of F&S at State level of Group-I states (as on 3rd January 2020)

Sr.	State	Notification of F&S Regulations	Formulation & approval of F&S Procedure	QCA registration process	IT software & Trial operation	Commercial Implementation / DSM Bills issue
1	Andhra Pradesh	Notified (Aug 2017)	Y (approved)	Y	Y	Y
2	Gujarat	Notified (Jan 2019)	In progress (draft)	N	In progress	NA
3	Maharashtra	Notified (July 2018)	Y (approved)	Y	Y	In progress
4	Karnataka	Notified (May 2016)	Y (approved)	Y	Y	Y
5	Rajasthan	Notified (Sep 2017)	Y (approved)	Y	Y	Y
6	Tamil Nadu	Notified (Mar 2019)	In progress (draft)	N	In progress	NA
7	Himachal Pradesh	Notified (Oct 2018)	As part of DSM	Not applicable	Under trial for DSM	NA

Status of F&S and DSM Regulations of Group-I States (1/2) (as on 3rd January 2020)

States	F&S Regulations and Implementation	DSM Regulations and implementation
Gujarat	• Notified (19th Jan, 2019).	• DSM mechanism **implemented** in line with CERC DSM Regulations (17 Feb 2014)
Maharashtra	• Notified on 20th July, 2018. • The Procedure for implementation of Regulation is approved by the Commission on 7 December, 2018. • The Commercial implementation of the Regulation is scheduled from 1st July,2019. • QCA registration & implementation in process; (total 99 Pooling S/S. for 6036 MW comprising Wind 70 Nos Pooling S/S with 4610 MW and Solar 29 Pooling S/S with 1426 MW)	• The State is presently implementing FBSM Mechanism since 2011. • State has **Notified** DSM Regulations on 1st March, 2019 in line with CERC DSM Framework. • The Commercial implementation is expected by 1st April, 2020
Tamil Nadu	• Notified (1st March, 2019)	• **Notified** DSM Regulations in line with CERC DSM Regulations (1st March, 2019) • DSM Software Development is in progress
Karnataka	• Notified (31 May, 2016) • Implementation from 1st June 2017.	• Intra-state ABT mechanism in place from 20 June 2006 **for Open Access**

Status of F&S and DSM Regulations of Group-I States (2/2) (as on 3rd January 2020)

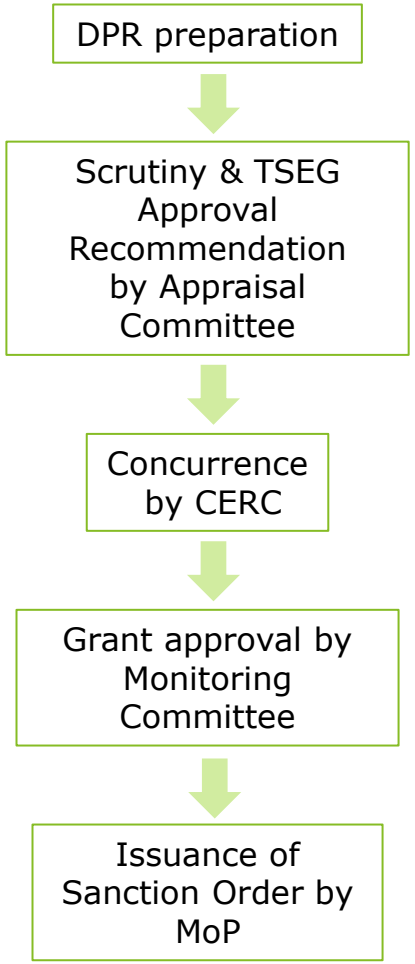
States	F&S Regulations and Implementation	DSM Regulations and implementation
Rajasthan	• Regulations **Notified** (14th Sept 2017) in line with Model F&S Regulations. • Regulations are in Implementation	• **Notified** (8th Nov, 2017 in line with CERC DSM Framework • First **Amendment Notified** (5th March 2019) • DSM Framework is in implementation.
Andhra Pradesh	• Regulations **Notified** (21 Aug 2017) in line with Model F&S Regulations. • Implementation initiated	• DSM regulations not notified • **Balancing and Settlement Code** in place from 11 Aug 2006 (as amended in 2013, 2014, 2016 & 2019) **for intra-state OA**.
Himachal Pradesh	• No major Wind and Solar Resources in the state • Majority of RE potential is Hydro power which covers under DSM Framework notified by the State	• **Notified** (16th Oct, 2018) in line with FOR Model and CERC DSM Regulations. • Draft(First Amendment) (29 June 2019) issued in line CERC 4th and 5th Amendment to DSM Regulations

Status Update of F&S and DSM Regulations (as on 3rd January 2020)

States	F&S Regulations			DSM Regulations		
Region	Notified	Draft Published	WIP or Yet to initiate	Notified	Draft Published	WIP or Yet to initiate
North	**4** RJ, UP, HR, PB		**4** DL, UK, J&K, HP (only Hydro potential)	**5** HP, DL, RJ, UK,HR	**1** PB	**2** J&K, UP
West	**4** CG, MP, MH, GJ		**1** Goa (no major Wind/Solar Potential)	**4** GJ, CG, MP, MH		**1** Goa
South	**4** AP, KR, TS, TN		**1** KL	**1** TN	**1** TS	**3** AP, KR, KL (AP and KR ABT for OA)
East	**2** JH, SK	**1** OR	**2** BR, WB		**3** WB, OR, BR	**2** JH, SK (JH B&S for OA)
North-East	**5** AS, MN, ML, MZ,TR		**2** AR,NL	**2** ML, AS		**5** AR, MN, MZ,NL, TR
UT			**6** CH, PY, DD, DNH, LD, AN			**6** CH, PY, DD, DNH, LD, AN
TOTAL	**19**	**1**	**16**	**12**	**5**	**19**

Status Update of SAMAST DPR & Implementation (as on 3rd January 2020)

States	SAMAST DPR		
Region	DPR Submitted	DPR approved	WIP or Yet to Prepare
North		**4** HP, HR, PB, RJ	**4** UK, UP, J&K, DL
West	**4** MP (DSM implementation) GJ, MH, CG		**1** Goa
South	**1** KL	**4** KA, TS, AP, TN	
East	**1** JH	**2** BR, WB	**2** OR, SK
North-East	**7** AR, AS, MN, ML, MZ,NL, TR		
UT			**6** CH, PY, DD, DNH, LD, AN
TOTAL	**13**	**10**	**13**



Status of SAMAST implementation in (Group I) States (1/2) (as on 3rd January 2020)

States	Category as per SAMAST	Remarks
Gujarat	Group-A	• The State has already implementing Intra-State ABT Mechanism since 2009 in line with CERC DSM Framework • Adequate interface meters at pooling stations & other relevant regulations in line with the SAMAST recommended activities.
Maharashtra	Group-A	• Intra-State ABT/FBSM framework at state level under operation since 2011. • MERC has notified the DSM Regulations on 1st March, 2019. The Commercial implementation of DSM Regulations is envisaged by 1st April, 2020. • MSLDC has initiated process for implementation of DSM Regulations. Draft Scheduling and Despatch Procedure and DSM Procedure is published for public comments. • MSLDC has also published the Tender for selection of Vendor for Software Development for DSM Implementation.
Tamil Nadu	Group-C	Following activities have been completed: • DPR is approved for Rs. 11.98 Cr for PSDF fund for intra-state ABT • TNERC has notified DSM Regulations on 20th March, 2019 • Software for scheduling, energy accounting has been procured. • Pilot run for state owned generators and IPPs are under progress • Provision of ABT meters have been completed to the extent of 67%

Status of SAMAST implementation in (Group I) States (2/2) (as on 3rd January 2020)

States	Category as per SAMAST	Date of Submission	Estimated cost (in Cr)	Remarks
Karnataka	Group-B	22-Dec-2017	10.00	• DPR for SAMAST implementation has been submitted to PSDF for approval 22 Dec, 2017 for Rs. 43.34 Crs. • The proposal was examined by the TESG in the following meetings: 39th TESG: 20.03.2018, 42nd TESG: 24.07.2018 45th TESG: 19.09.2018. • **Proposal recommended by the Appraisal Committee on 26 July 2019, and project cost accepted to Rs. 10.00 Cr**
Rajasthan	Group-B		11.86 Crs Sanctioned	• State Transmission Operation Management System (STOMS) project implemented by RVPN, akin to SAMAST, in the State having additional features as compared to SAMAST. • Estimated cost of Rs 13.54 Cr and 90% (Rs 11.86 Cr) sanctioned from PSDF
Andhra Pradesh	Group-B	6 April-2017	19.33	• DPR is approved 19.33 Cr by PSDF Committee • **Letter of approval issued by MoP on 27 July, 2018** • **Agreement signed on 28 Nov 2018**
Himachal Pradesh	Group-D	8 Oct-2018	8.11	• TESG vide its letter dated 8 May, 2019 has informed HPSLDC that, TESG has recommended the SAMAST DPR to PSDF committee for approval for Rs 9.09 Crore • Proposal recommended by the Appraisal Committee on 26 July 2019, and project cost accepted to Rs. 8.11 Cr.

Summary status of SAMAST, F&S and DSM Regulations (as on 3rd January 2020)

States	SAMAST DPR			F&S Regulations			DSM Regulations		
Region	DPR Submitted	DPR approved	WIP or Yet to Prepare	Notified	Draft Published	WIP or Yet to initiate	Notified	Draft Published	WIP or Yet to initiate
North		**4** HP, HR, PB, RJ	**4** UK, UP, J&K, DL	**4** RJ, UP, HR, PB		**4** DL, UK, J&K, HP (only Hydro potential)	**5** HP, DL,RJ, UK,HR	**1** PB	**2** J&K, UP
West	**4** MP (DSM implementation) GJ, MH, CG		**1** Goa	**4** CG, MP, MH, GJ		**1** Goa (no major Wind/Solar Potential)	**4** GJ, CG, MP, MH		**1** Goa
South	**1** KL	**4** KA, TS, AP, TN		**4** AP, KR, TS, TN		**1** KL	**1** TN	**1** TS	**3** AP, KR, KL (AP and KR ABT for OA)
East	**1** JH	**2** BR, WB	**2** OR, SK	**2** JH, SK	**1** OR	**2** BR, WB		**3** WB, OR, BR	**2** JH, SK (JH B&S for OA)
North-East	**7** AR, AS, MN, ML, MZ,NL, TR			**5** AS, MN, ML, MZ,TR		**2** AR,NL	**2** ML, AS		**5** AR, MN, MZ,NL, TR
UT			**6** CH, PY, DD, DNH, LD, AN			**6** CH, PY, DD, DNH, LD, AN			**6** CH, PY, DD, DNH, LD, AN
TOTAL	**13**	**10**	**13**	**19**	**1**	**16**	**12**	**5**	**19**

- **RISE Contracting Officer Representative: Monali Zeya Hazra**, USAID India, mhazra@usaid.gov
- **Chief of Party: Tushar Sud**, RISE, tsud@deloitte.com

Impact of Renewable Integration/ RPO Compliance by States

Analysis for Forum of Regulators

Renewable Integration and Sustainable Energy (RISE) Initiative

under

Greening the Grid (GTG) Program

A Joint Initiative by USAID and Ministry of Power

(Implemented by **Deloitte Consulting LLP**)

Financial Implications of renewable management
Impact and Suggestions

States will face certain additional costs in integrating Renewables

- **Maintenance of standby balancing generation** capability to offset intermittent wind energy generation
- **Higher per unit fixed charg**e due to lower Power Load Factor
- Decrease in generation level **lowers the efficiency** of the power plants
- **Higher transmission charges** due to lower capacity utilization factor of the transmission & distribution system
- Reserve shutdown & cold start causes **wear & tear** and consequently consumes Equivalent Operation Hours of the plant
- **Opportunity cost of mandatorily using renewable energy** despite availability of cheaper alternative power sources
- **High DSM charge** due to higher imbalances between the scheduled and actual generation with respect to the schedule of intermittent renewable generation

Assumptions Used

CEA Analysis
Stand By Charge Stand-by capacity has been taken to be 10% of maximum renewable generation. Fixed Cost of this stand-by capacity has been assumed to be stand-by charge
Balancing Charge (ISGS + State Gencos) The decrease in efficiency due to sub-optimal production is taken from CERC norms as mentioned in IEGC. The loss of equivalent operating hours for every start from cold condition is assumed as per data from Siemens & General Electric. Increase in per unit cost due to lower PLF has also been calculated
Impact on Tariff 25% of the wind/solar generation (existing PPAs with an average tariff of Rs. 4.00/kWh) assumed to replace the cheaper fuel charge of coal based stations (average fuel charge of Rs. 2/kWh). *Calculation: If RE generation is **x**, **0.25x** of cheaper generation (Rs4 - Rs2) is displaced. Thus impact over RE generation =* $(0.25x \times (4-2))/x = 0.5$ In 2022 scenario, RE tariff has been assumed to be lesser than new coal based station tariff due to competitive bidding
Impact on DSM Only deviation from RE sources are considered. In the absence of schedule, actual generation was used as a proxy and a max. of 15% deviation was allowed. This deviation, to the extent of which exceeded the state's deviation limit was used to calculate DSM penalty
Transmission Charge There is a higher transmission charge due to lower CUF of RE, mainly to the extent of evacuation of power from solar park/wind pooling station. An extra injection charge of Rs. 0.26/kWh for RE is assumed, which is approx. twice the max coal based injection charge.

Financial Implications of renewable management

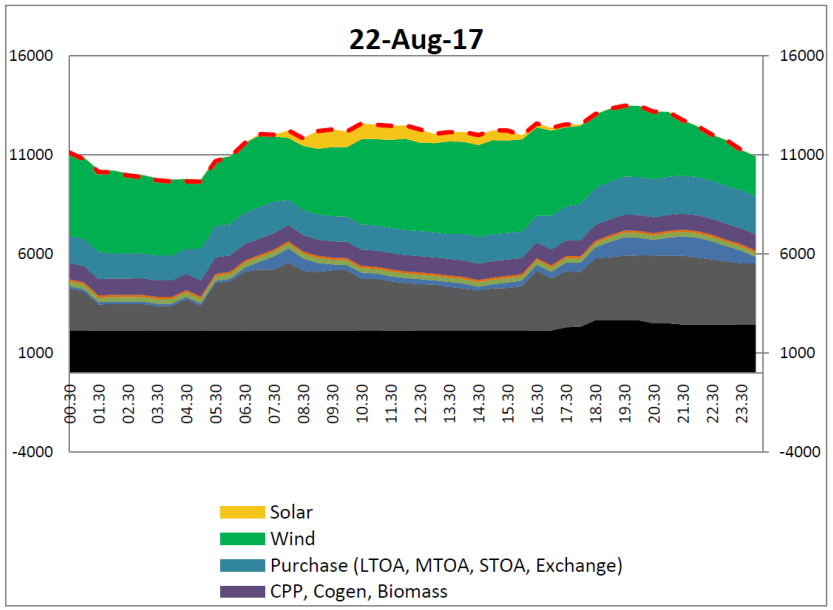
Tamil Nadu 22 Aug, 2017		
1	Total balancing charge for CGS Coal and gas based station (FC + VC)	**Rs 0.20 /kWh**
2	Total balancing charge for state Coal based station (FC + VC)	**Rs 0.03 /kWh**
3	Impact of DSM	**Rs 0.35 /kWh**
4	Impact on tariff for Tamilnadu discom for backing down Coal generation (solar and wind - Rs. 4/kWh and coal cost - Rs. 2.0/kWh- (Considering 25% on account of renewables)	**Rs 0.5 /kWh**
5	Stand by charge	**Rs 0.23 /kWh**
6	Extra transmission charge	**Rs 0.26 /kWh**
	Total Impact	**Rs 1.57 /kWh**

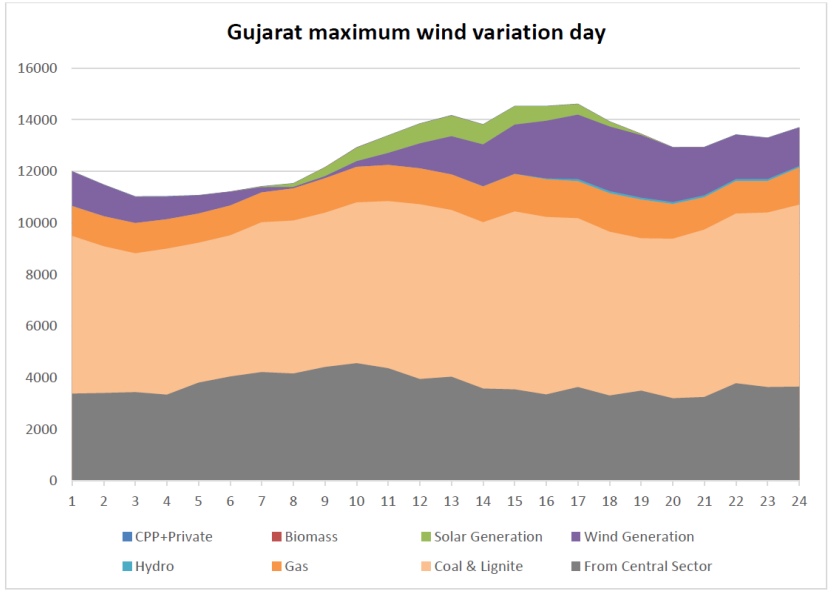
Gujarat 25 May, 2017		
1	Total balancing charge for CGS Coal and gas based station (FC + VC)	Rs 0.24 /kWh
2	Total balancing charge for state Coal based station (FC + VC)	-
3	Impact of DSM	Rs 0.12 /kWh
4	Impact on tarrif for Tamilnadu discom for backing down Coal generation (solar and wind - Rs. 4/kWh and coal cost - Rs. 2.0/kWh- (Considering 25% on account of renewables)	Rs 0.5 /kWh
5	Stand by charge	Rs 0.33 /kWh
6	Extra transmission charge	Rs 0.26 /kWh
	Total Impact	**Rs 1.45 /kWh**

Major part is because of replacement of the cheaper fuel with RE.

This cost is expected to reduce to zero or negative due to competitive bidding for RE & increasing coal prices.

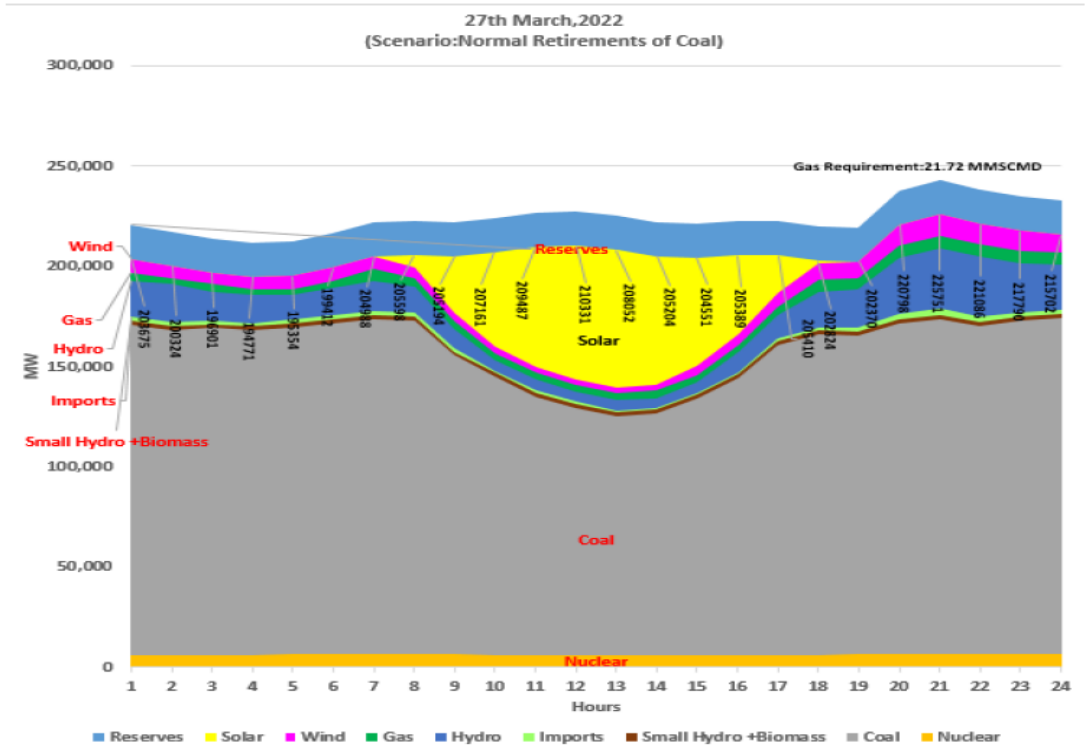
The financial impact of renewable capacity would reduce to about Rs 1 per unit from the current Rs. 1.5





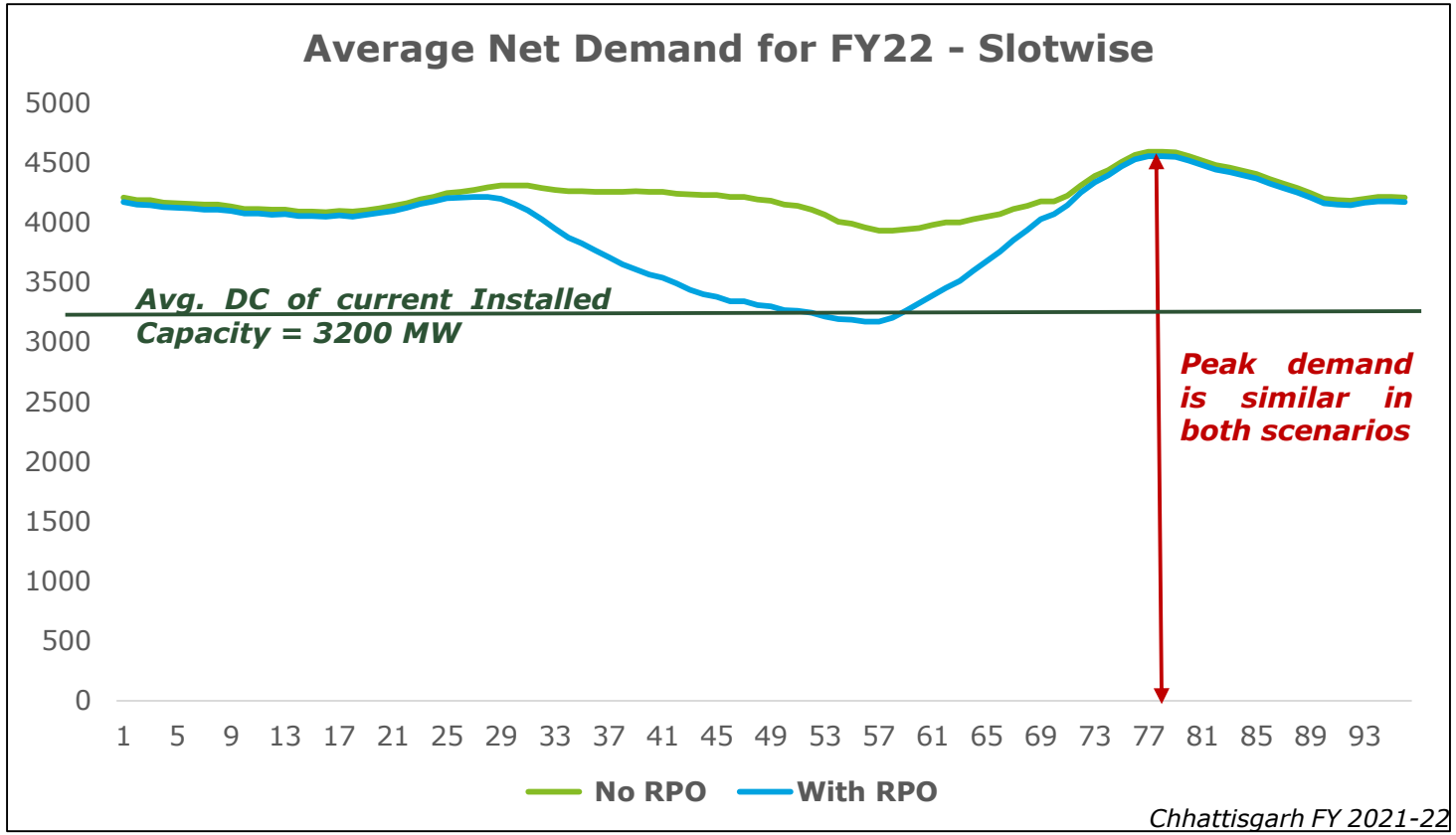
Financial Implications of renewable management – All India 2022

Item No.	Balancing Cost	Rs./Unit
1	Total balancing charge for Gas based station (fixed +fuel charge)(Rs/kWh)-Spread over renewable generation	0.04
2	Impact of DSM per unit- Spread over renewable generation	0.30
3	Impact on tariff (Rs/kWh) for All India Discom for backing down Coal based generation assuming solar and wind at Rs. 2.50/kWh and tariff of coal based generation at Rs. 3.50/kWh- Spread over renewable generation	0
4	Stand by charge (Rs/kWh)- Spread over renewable generation	0.50
5	Extra transmission charge (Rs/kWh)- Spread over renewable generation	0.26
	Total Impact- Spread over renewable generation (Rs/kWh)	1.11



Increase in the rate of DSM charge and stand-by charge compared to the figure in Tamil Nadu and Gujarat is due to higher mix of renewable energy within the total energy source. This would create more variability, thus requiring more stand-by generation capability and deviation from the pre-determined limit

Estimation of impact of meeting RPO targets on retail tariff - States
Should impact on tariff be really zero going forward?



- The peak demand is almost the same in both the scenarios and is greater than the average DC of the current installed capacity
- Thus a new thermal plant will be required to meet the demand. The capacity required will be the same in both scenarios and thus, the fixed cost to be payed will also remain the same.

Estimation of impact of meeting RPO targets on retail tariff - States
Deloitte Approach

- A modelling exercise can be undertaken for a year for one state to determine the financial implications of RPO.
- Two scenarios would be run:
  - Scenario 1: State meets its demand in the year 2022 by complying to its RPO targets
  - Scenario 2: State meet its demand in the year 2022 w/o any RE in the portfolio

Step-I

Determination of Demand

- 15 min time block-wise demand to be met projected for FY 2021-22
- *For scenario 1: Solar & wind generation determined using state's RPO targets and typical solar & wind profiles for the state/ adjacent state.*
- *Net Load Curve established*

Step-II

Merit order dispatch by taking ramping constrains (Scenario 1 & 2)

- Generating stations for the state stacked up in Merit ordered
- Generators dispatched to meet the demand incorporating technical constraints viz
  - Technical min-55% of DC
  - Ramp rate-1%/min as per IEGC
- New thermal Power station is considered to meet the unmet demand and any residual demand (due to ramping constraints) is met from DSM

Step-III

Estimation of Impact of meeting RPO targets on retail tariff

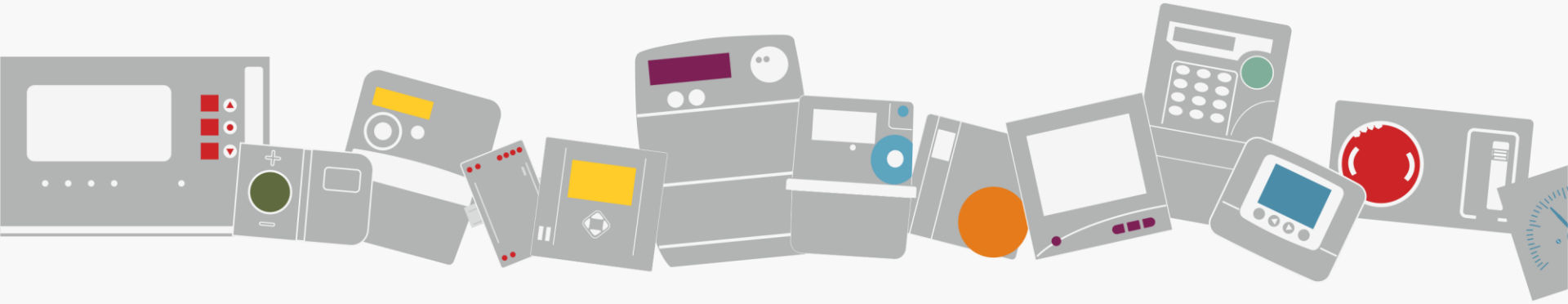
- Total System cost in both scenarios compared to determine impact of meeting RPO targets on the tariff
- Impact on fixed cost and SHR & Auxiliary compensation
- Impact of DSM is calculated based on 15% deviation by RE generation and limit on deviation allowed for the state
- Using benchmarks costs for balancing sources like gas, storage, demand response, etc., we arrive at the total balancing cost
- Standby cost based on thumb-rule established

Assumptions to be used - Summary

CEA Analysis	Deloitte Analysis
Stand By Charge Stand-by capacity has been taken to be 10% of maximum renewable generation. Fixed Cost of this stand-by capacity has been assumed to be stand-by charge	As per CEA Methodology
Balancing Charge (ISGS + State Gencos) The decrease in efficiency due to sub-optimal production is taken from CERC norms as mentioned in IEGC. The loss of equivalent operating hours for every start from cold condition is assumed as per data from Siemens & General Electric. Increase in per unit cost due to lower PLF has also been calculated	As per CEA Methodology
Impact on Tariff 25% of the wind/solar generation (existing PPAs with an average tariff of Rs. 4.00/kWh) assumed to replace the cheaper fuel charge of coal based stations (average fuel charge of Rs. 2/kWh). *Calculation: If RE generation is **x**, **0.25x** of cheaper generation (Rs4 - Rs2) is displaced. Thus impact over RE generation =* $(0.25x \times (4-2))/x = 0.5$ In 2022 scenario, RE tariff has been assumed to be lesser than new coal based station tariff due to competitive bidding	Will differ from State to State
Impact on DSM Only deviation from RE sources are considered. In the absence of schedule, actual generation was used as a proxy and a max. of 15% deviation was allowed. This deviation, to the extent of which exceeded the state's deviation limit was used to calculate DSM penalty	As per CEA Methodology
Transmission Charge There is a higher transmission charge due to lower CUF of RE, mainly to the extent of evacuation of power from solar park/wind pooling station. An extra injection charge of Rs. 0.26/kWh for RE is assumed, which is twice the max coal based injection charge.	As per CEA Methodology

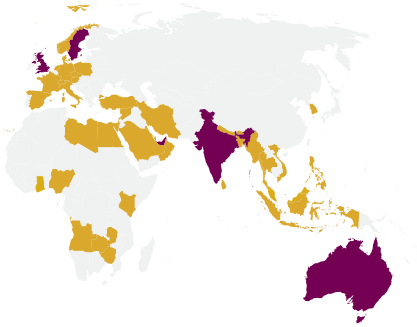
Enabling Smart Metering Rollout in India

A service delivery framework for distribution licensee



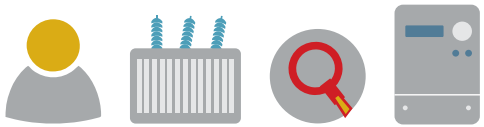
Secure Meters Limited

A brief



- Udaipur based Multi National (MNC)
- Presence in over **50** countries
- Supplied **42,000,000** products
- Providing **meter data & field services**

- **Retail experience**- Gas & electricity supply for **650,000** consumers in UK
- **Managing electricity consumer services** in Bhilwara, India for **85,000** customers
- Leading **Gas meter** suppliers in world

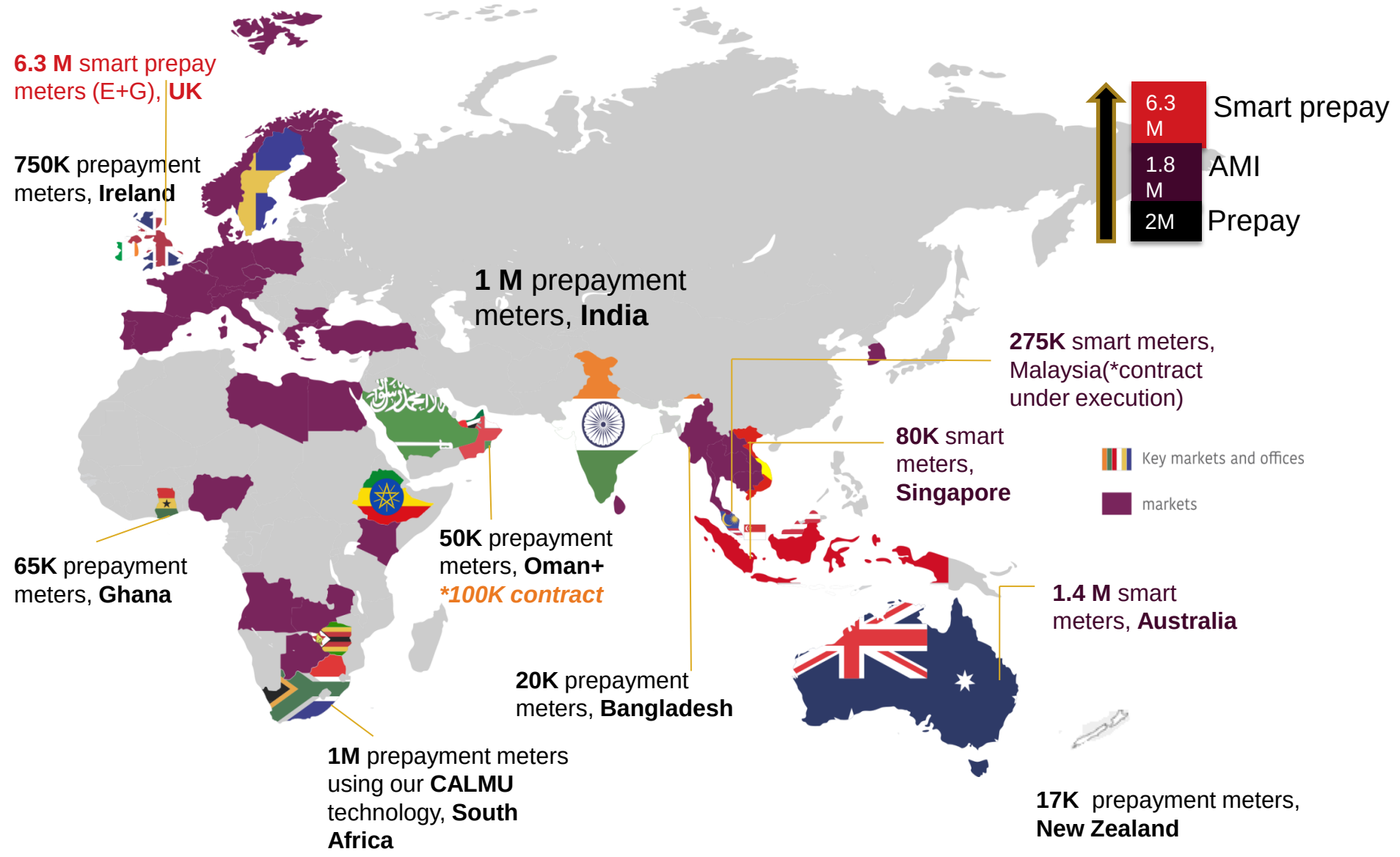


- **Water pump** monitoring system, O&M of municipal pumps at **Indore & Udaipur**
- Indexing: **2,600,000** consumers
- Energy audit: **31,000** feeders and **210,000** distribution transformers
- Testing: **7,000,000** meters

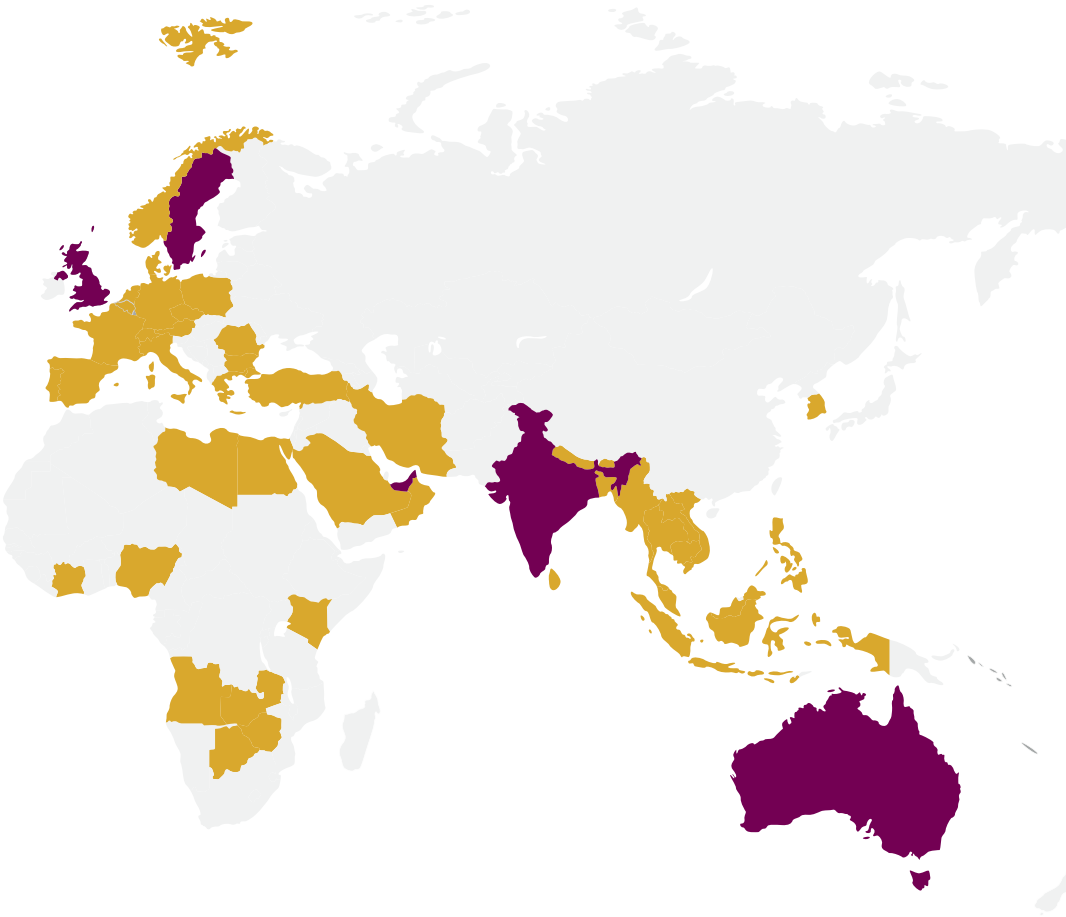
- **Approx 4000** workforce across the globe

Global AMI + prepay metering experience

Install base of 10 Million+



Our presence



R&D, manufacturing and logistics, sales and our biggest markets

Our other key markets

Our factories and logistics centres

India
Secure Meters Limited, Udaipur
Secure Meters Limited, Solan
Secure Meters Limited, Sanand
Secure Meters Limited, Gurgaon

UK
Secure Meters (UK) Limited, Winchester

Australia
Secure Meters (Australia) Pty Limited, Melbourne

Sweden
Secure Meters (Sweden) AB, Nyköping

UAE
Secure Meters (Middle East), Dubai

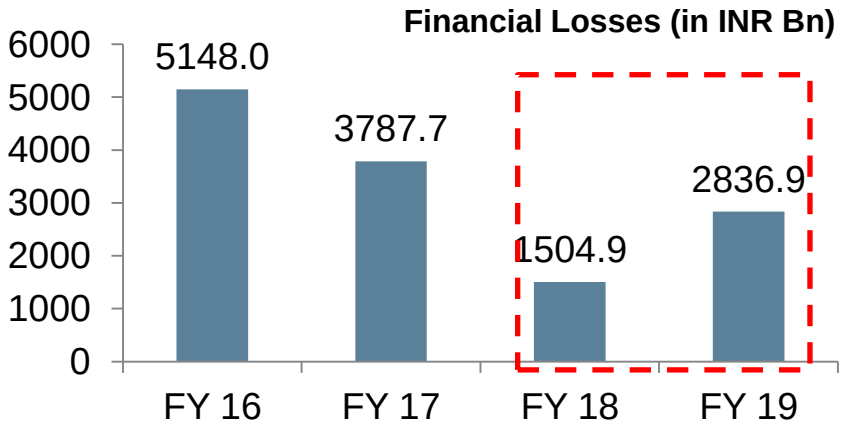
Where are we today?

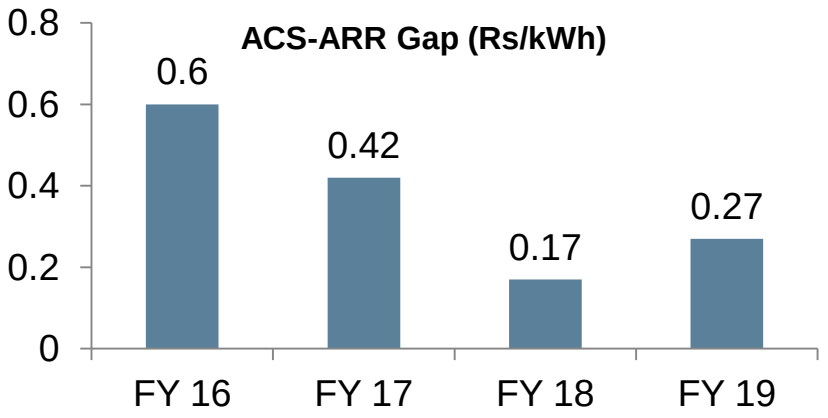
Relook

Over two decades, spending in access of ~ INR 6,000 Bn, we are still struggling to make DISCOMs financially viable.

Discom losses, which had progressively reduced in the first couple of years since 2016, have rebounded in FY ’19 to nearly double the losses recorded the previous year.

The data also points to discoms lagging behind in eliminating the gap between the average cost of supply and realisable revenue (ACS-ARR gap).





Source: Uday Portal

New Initiatives

A quick glace

Five year vision & new tariff policy by Government of India to:

Improve financial viability of discoms

1. Provision of Letter of Credit (LC) for gencos from discoms
2. 100% smart prepayment metering through opex model
3. Direct transfer of subsidy to beneficiaries
4. Linkage of tariff to cost to serve

24 x 7 quality power for all

1. Revival of stranded generation assets
2. CERC regulations to increase contribution of short term market
3. Strengthening of distribution sector by bringing in private sector participation
4. Linking of disbursement of aid with 24x7 quality power for all

Consumer centric policies & actions

1. SAUBHAGYA to electrify each household
2. Discoms to pay consumers in case of power cuts other than force majeure events
3. Simplified tariffs

Metering Issues

Still persists

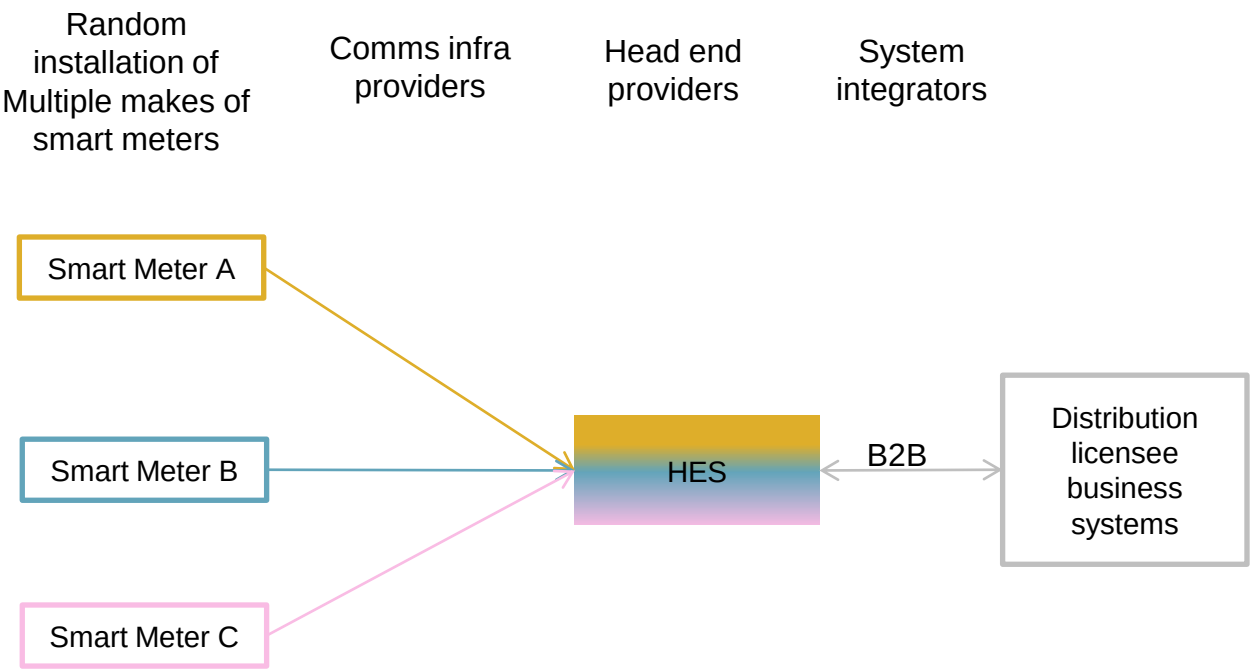
1. Frequent change of metering asset brings mistrust from consumer segment
2. Lack of agricultural metering and heavy cross subsidization
3. Unstructured DT metering which leads to inaccurate energy accounting and AT&C loss calculations
4. Compulsory metering of government and municipal bodies like street lighting, water works etc is missing
5. Metering, Billing and Collection activities outsourced to multiple entities
6. Distribution Licensees lack appropriate skilled manpower to handle IT

Smart prepayment metering is one of the major focus of Government of India. However, rollout is minuscule since last 3 years. Major issues identified –

- **Commoditization of each component of smart prepayment metering**
- **Missing system approach, interoperability challenges, communication reliability and obsolescence risks**
- **Random installations, not following feeder-DT-consumer installation practice**

Current Scenario

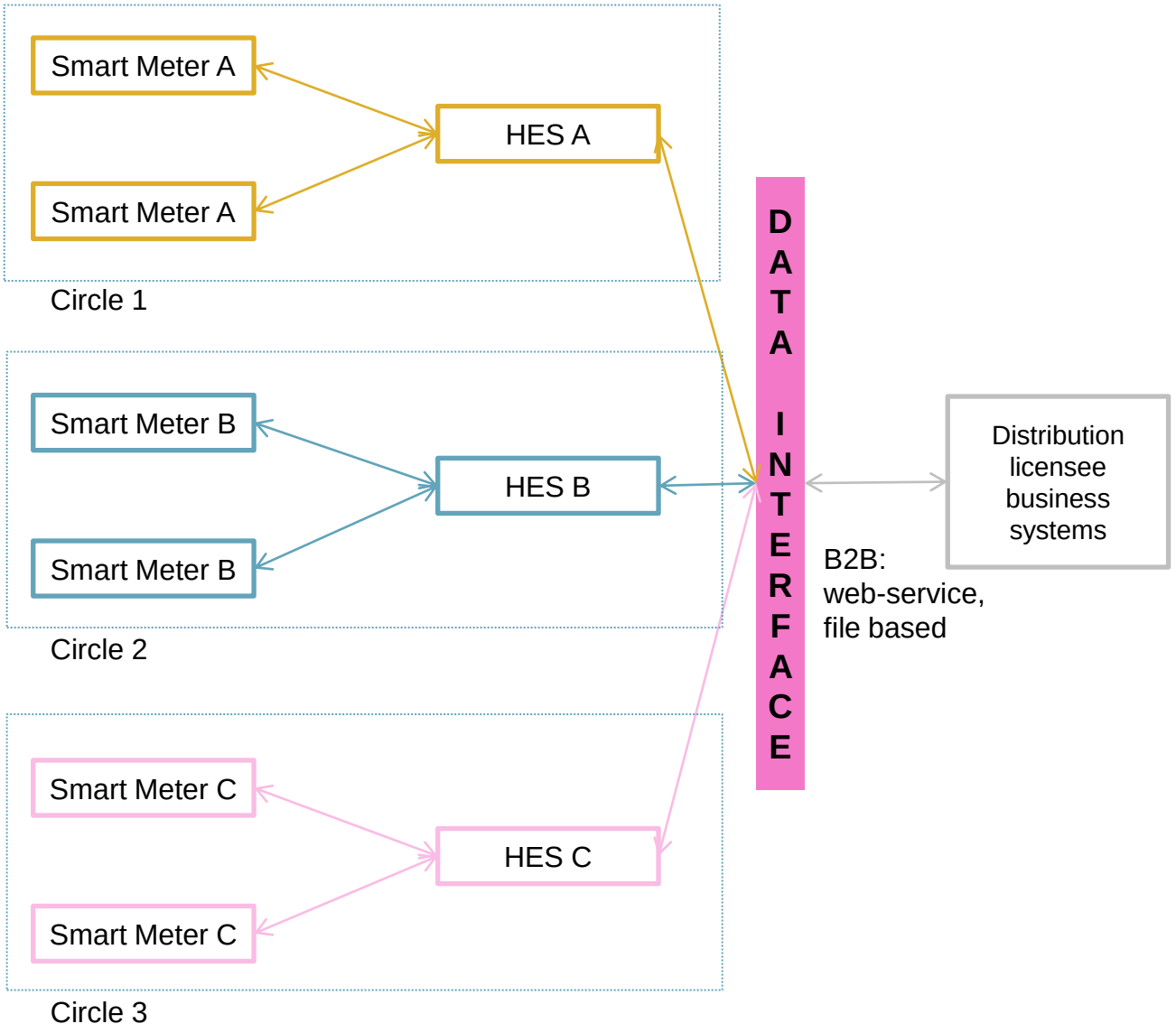
Complex project implementation



1. ***Lack of system accountability***
2. ***Unplanned installation and interoperability challenges***
3. ***Limited use of data (only monthly reading)***
4. ***No linkage of feeder-DT-consumer to reduce losses***
5. ***Distribution licensee specific B2B integration invites big effort for any change in either side***

Proposed Solution

Simplified project implementation



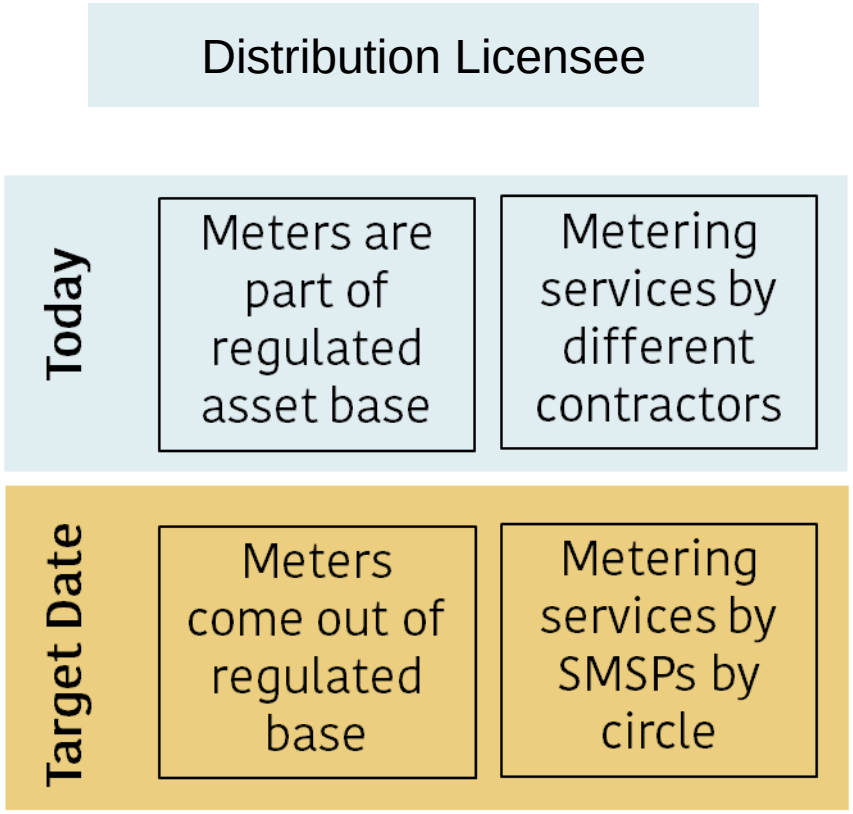
All components including communication network managed by single entity

Meter –to-HES shall be unique combinations; interoperability established at data delivery point through common data interface

This arrangement will simplify project implementation and bring better system performance

A new industry participant

Bringing metering out of regulatory asset base



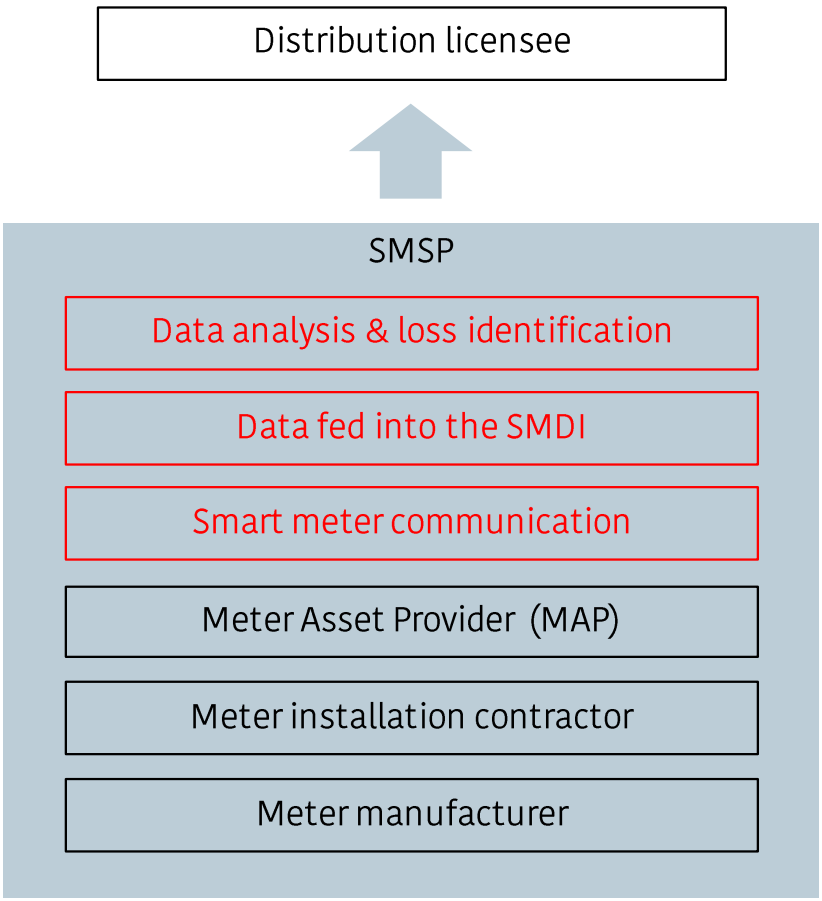
1. Shifting of metering infrastructure from capital expenditure to O&M expenses which will further provide Meter Asset Provider (MAP), meter manufacturer and others with demand certainty .

2. Ensure quality of metering assets

3. This can be achieved by introducing new industry participant, the Smart Metering Service Provider (SMSP) to work on opex based end-to-end services

Smart Metering Service Provider (SMSP)

The solution



1. Sourcing, installation and upkeep of all meters in one circle from feeder to consumer for 10 years

2. Prepayment service provision with tariff inside meters in rupee terms for consumer convenience

3. Data delivered to Smart Metering Data Interface (SMDI)*

4. Loss identification as input to reduce losses

5. Preparation of data needed to lodge FIRs in all theft cases

Scope of SMSP vs discom

The purview

SMSP Responsibility

1. **Meter asset provisioning and metering services** (supply, installation, O&M) across network for feeders, transformers, and consumers in a circle
2. **Smart prepay system infrastructure provision** like vending and recharge, interface with multiple payment options, help desk support
3. **Data delivery** to distribution licensee at specified frequency through SMDI*
4. **Analysis and MIS reports** to distribution licensee with energy accounting, loss identification

Distribution Licensee Responsibility

1. **New Connection** release and service line provisioning to connection point
2. **Network augmentation** and operation & maintenance of distribution network
3. **Managing consumer records, tariff definition and payment collection**
4. **Customer care**, complaint handling and generating monthly statement to consumer
5. **Monthly payment to SMSP** for all bundled services during project lifetime

Benefits of SMSP

The merits

1. **Opex based services contract**. Therefore, no upfront capital expense and stress on distribution licensee's exchequer. Payments will be done from collection itself

2. **Achievement of better operational efficiency** and ensuring quality of meters & services for 10 years, through end-to-end service contract entailing meter assets and metering services

3. **Single point responsibility** in each circle from feeder to DT to consumer for better loss identification and roll out of smart metering while keeping minimum contracts

4. **Feeder and DT data analysis** along with consumer consumption pattern will draw full picture of circle-wise performance

5. **Better predictability** of cost to serve

6. **Consumer visibility on consumption** in monetary terms, helping in energy budgeting and conservation

7. **Diversity of deployments** with multiple SMSPs, minimizing the overall risk of distribution licensee

Successful implementation of SMSP

Rules

1. Licensee shouldn’t be any SMSP

2. Metering shall be done from feeder to consumers for proper measurement of loss reduction.

3. High density rollout of metering with the concept of one circle one SMSP

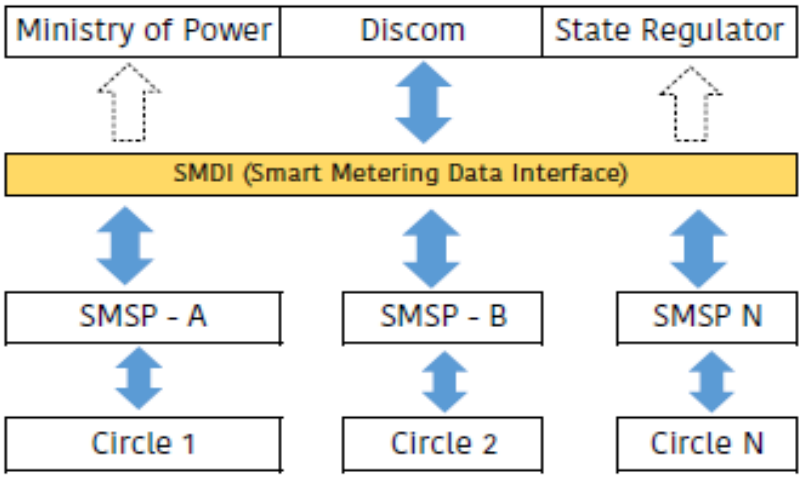
4. A national level service & data interface so that each SMSP can feed data into any discom’s systems, through Smart Metering Data Interface (SMDI).

5. SMSP to select communication technology based on geography and application

Smart Metering Data Interface

A solution to system interoperability

Smart Metering Data Interface (SMDI)* will play a crucial role in achieving interoperability. SMDI will be an interface similar to GST network



A common data format that will be decided and published nationally, for all discoms to follow.

This format will be common to all the SMSPs in which they will provide data to discoms with provision of prepayment services and loss identification

The data received from SMSPs will be fed into the discom's systems, it will also be fed into national loss calculation systems and can be published on state and federal portals from here

Support from Hon'ble Regulators

The catalysts

1. Simplify tariffs to enable prepaid metering

2. Approval of operating expenses for metering

3. Direct benefit transfer for subsidized consumers

Thank You

Wish you a wonderful 2020; we are confident that decade will see path-breaking technological innovation in the power sector with your guidance

03.01.2020

REDFx The Forecasting Expert "Enabling Better Decision Making Through Data Driven Solutions"

Our Learnings from - Demand and RE Forecasting & Implementing SAMAST

Arun Kumar
.Kreate Technologies

Agenda

- Kreate has provided power management solutions to multiple clients
- Kreate Forecasting Solution RED Fx and Process Flow
- Challenges faced in achieving high level of accuracy- Data, Telemetry
- Weather forecast is significant Impact on forecast accuracy more so for RE
- SAMAST Implementation Challenges

We provide credible solutions to major power sector companies

- **Demand Forecasting**
  - ✓ Load Forecast Provider to SLDCs & Discoms
    (NRLDC, WRLDC, CGSLDC, RJSLDC & MPSLDC)
- **Renewable Energy (RE) Forecasting**
  - ✓ RE Forecast Provider to IPPs & Utilities located across India
  - ✓ QCA Service Provider
    (NRLDC, MPSLDC,RJSLDC & RE IPPs)
- **Automation** Software for Power **Scheduling** ,Energy **Billing** and **Accounting**
  (NRPC, NTPC, HVPNL, PTCUL, GMR, TATA)

Awarded **SAMAST** implementation in **HPSLDC** (1st project in NEW region)

Our learning is derived from a large RE & Demand Forecasting Portfolio

RE Forecasting

States	Solar (MW)	Wind (MW)	Grand Total (MW)
Utilities			
Rajasthan	3281	4292	7573
Madhya Pradesh	1296	2467.3	3763.3
Sub Total	**4577**	**6759.3**	**11336.3**
IPP			
Sub Total	4240.16	1983.8	4286.96
Grand Total	8817.16	8743.1	17560.26

Demand Forecasting

States	(MW)
NRLDC	63166
WRLDC	56675
MPSLDC	13815
RJSLDC	13276
CGSLDC	4746
Grand Total	**151678**

Average Monthly Accuracy of REDFx forecasting services

RE Forecasting

State	Solar	Wind
AndhraPradesh	90.56%	90.90%
Gujarat	88.40%	70.09%
Haryana	87.90%	-
Karnataka	90.48%	79.46%
Rajasthan	90.80%	86.36%
TamilNadu	80.61%	-
Maharashtra	94.69%	83.58%
Madhya Pradesh	96.64%	82.81%
Telangana	96.06%	-
Uttar Pradesh	94.94%	-

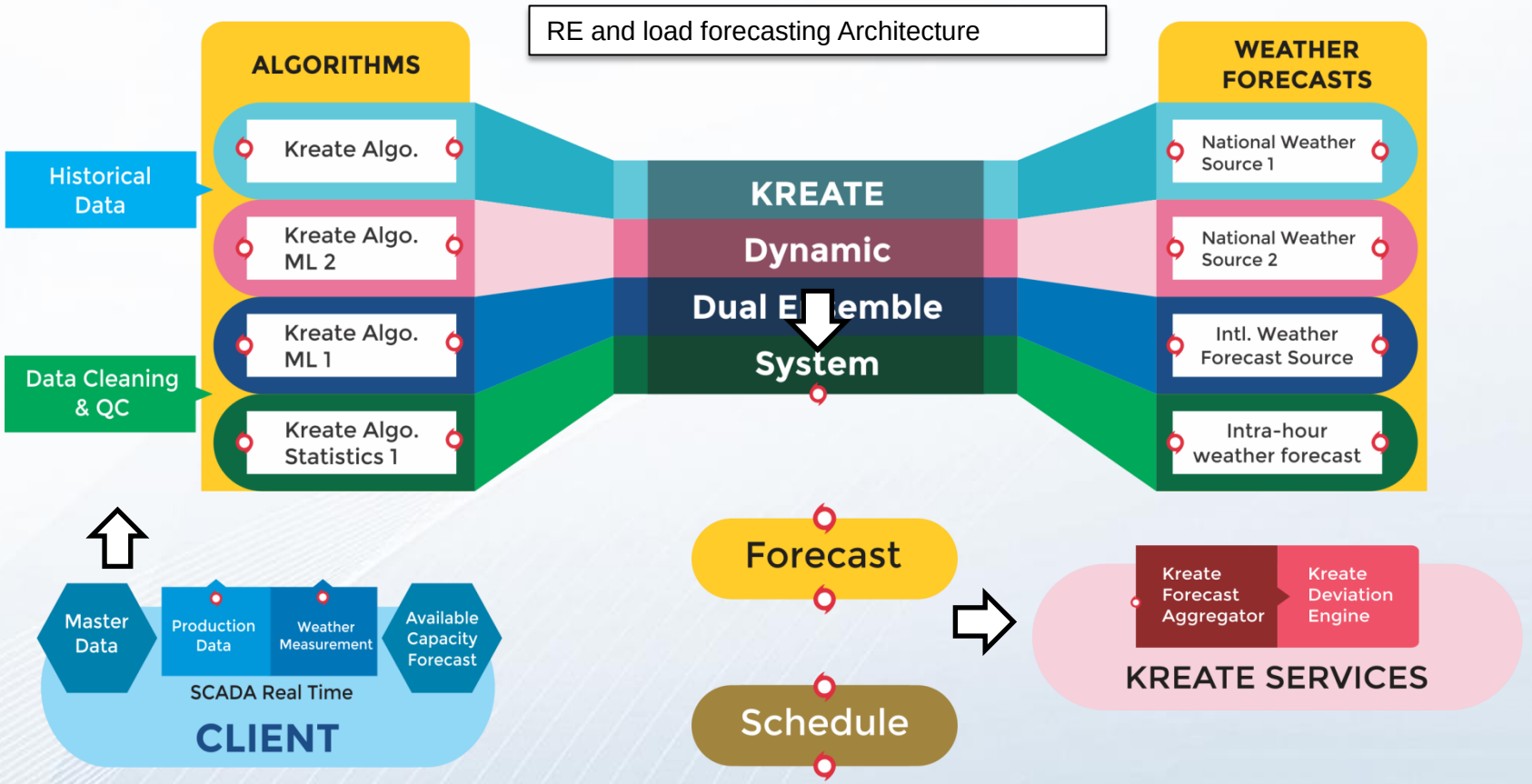
Demand Forecasting

State	Nov'19	Dec'19
Chandigarh	96.74%	96.18%
Haryana	96.53%	96.41%
HP	97.29%	97.29%
J & K	95.88%	96.90%
Delhi	97.57%	97.58%
Punjab	97.44%	97.27%
Rajasthan	97.73%	97.65%
Uttar Pradesh	97.09%	96.41%
Uttarakhand	96.93%	96.98%
Chhattisgarh	98.06%	98.07%
Dadra & Nagar Haveli	98.58%	98.71%
Daman & Diu	98.21%	97.98%
Goa	97.24%	97.10%
Gujarat	98.19%	98.29%
Madhya Pradesh	97.98%	97.47%
Maharashtra	98.20%	98.27%
Mumbai	97.81%	97.51%

Kreate Forecasting Solution RED Fx- Demand & RE Forecasting Services

- Dual-ensemble method
- AI, Machine Learning and Statistics based algorithms for forecasting
- Multiple weather forecast services from leading International and Indian institutions
- Real-Time Analytic Dashboard for monitoring load/ generation data and grid penalties

Kreate Forecasting Model and Architecture



Saas based model

Achieving a high level of forecasting accuracy

Process flow and accuracy at each stage is important..

Relevant data collection and processing of data	The inputs that will be used for forecasting are : • Historical Demand Data, • Historical and Forecasted Weather data i.e. Temperature, Humidity, Wind speed & Weather Conditions • Real time demand data (in 15 mins block wise manner)
Trend Analysis	Historical data is used to study the trend of the state with respect to : • Seasonality, • Weather impact, • Festival behavior and special days (if any).
Weather Analysis & its Procurement	As per the areas of high energy drawn/great importance, weather locations are chosen for the purpose of demand & RE forecast. Weather is procured through multiple weather sites for particular locations (usually 2-3 locations per state).
Algorithm Deployment	The algorithm make use of **Artificial Intelligence (AI) and Machine learning based** formulation as per **dual ensemble approach** for Demand & RE Forecast combined with Statistical Techniques.
Result Analysis	The output is analyzed as per the best metrics to test the accuracy of any deployed model by machine learning and through manual observations

Forecasting accuracy depends on - Reliable data, Robust algorithm and Accurate weather forecast

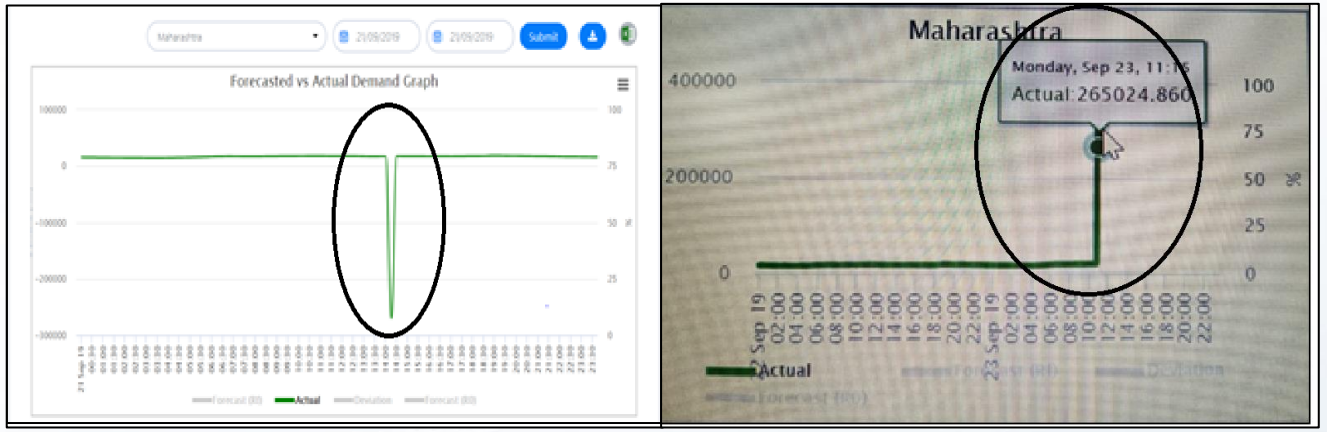
We face 3 key challenges in forecasting
Data related Challenge -

- **Issue of historical data, real time data and telemetry:**

Historical data- Large gaps in multiple time blocks
Real time data- Frequent interruptions and missing time blocks
Data Telemetry- issues in some of the blocks during a day Graph.1.
RE Generators often give us single generation data of day instead of real time

- **Unpredicted breakdowns in load due to thunderstorms and rain :**

In most of the states, whenever turbulent weather conditions occur, the unaccounted breakdowns in demand pattern observed as shown in Graph.2



Graph.1

Graph.2

Challenges in RE (Wind & Solar) forecasting

SCADA data unavailability : High forecasting accuracy can not be achieved without real time SCADA data from RE plants.

It has been observed that if the real-time SCADA data is not available then on an average forecast accuracy decreases by 12% which in turn increases the DSM amount by 54%. It may vary case to case.

Case study :Week wise accuracy and DSM comparison of Intrastate RE Generator :

Date	1st-7th Sep'19	8th- 14th Sep'19
Plant Type	Solar	
Capacity (MW)	30	
Data Availability	Yes	No
Accuracy	88.69%	77.86%
% Change in Accuracy	12.21%	
DSM Charges (Paisa/unit)	4.68	7.23
% Change in DSM (paisa/unit)	54%	

Non-uniformity of RE DSM Implementation across states

- State regulations vary between states and deviate from FOR/CERC recommendations
- PSS aggregation is allowed only in KA and AP, but not in other states, which is major cause of high DSM
- Change in schedules less than 2%, schedules are not accepted (Punjab & GJ SLDC)
- High QCA registration and PSS registration charges.
- There is no clarity on schedule update **in case of grid fault and applicability of DSM during those time blocks** in GJ SLDC and MSLDC.

Accuracy of Weather Forecast remains a huge challenge

Weather related Challenge -

- **Difference in actual & forecasted weather:** Our experience shows there is wide variation in actual weather and forecasted weather (Graph). Both wind (Fig. 1 & 3) and solar forecast (Fig. 2) are not able to capture the sudden rise and sudden fall in actual value.

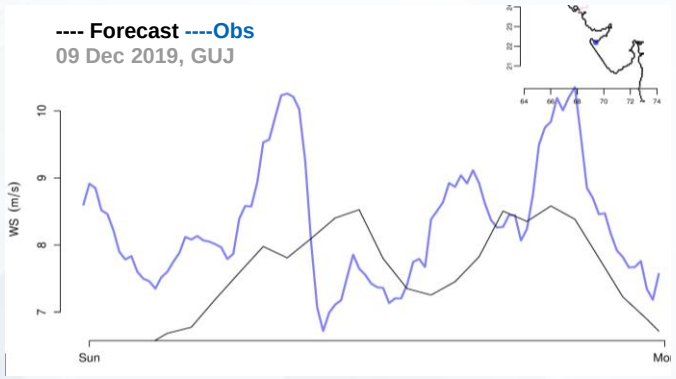


Fig. 1

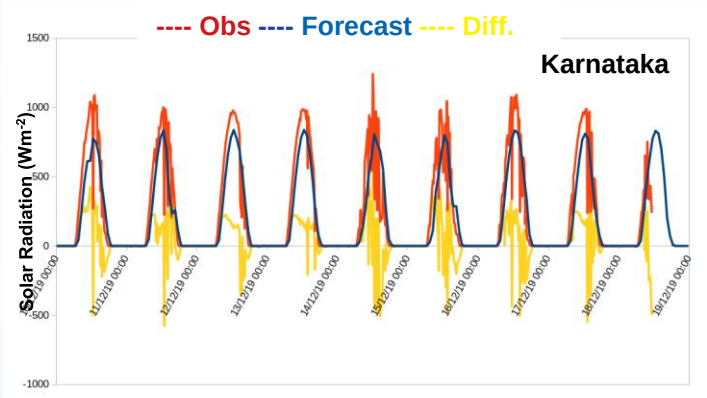


Fig. 2

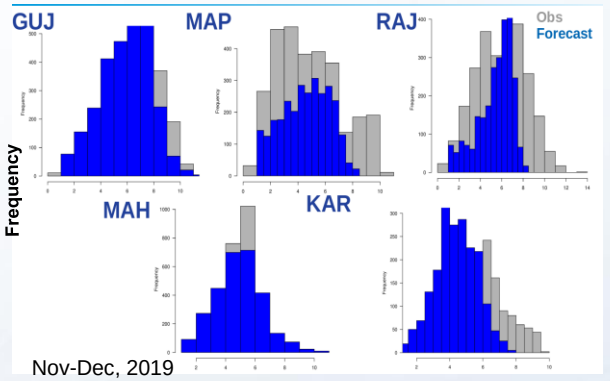
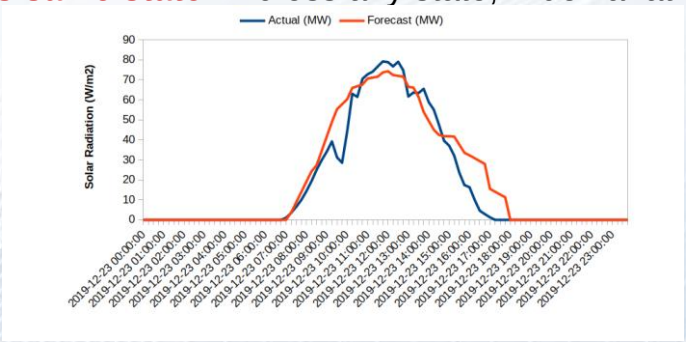
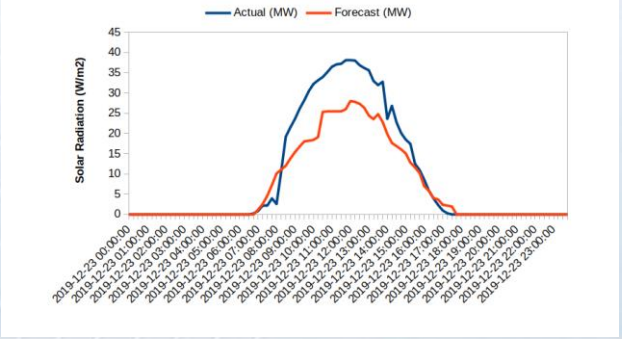


Fig. 3

- **Wide weather variation across same state :** Across any state, wide variation in weather forecast are noticed which cause high deviation in RE pattern.

Maharashtra -Location 1





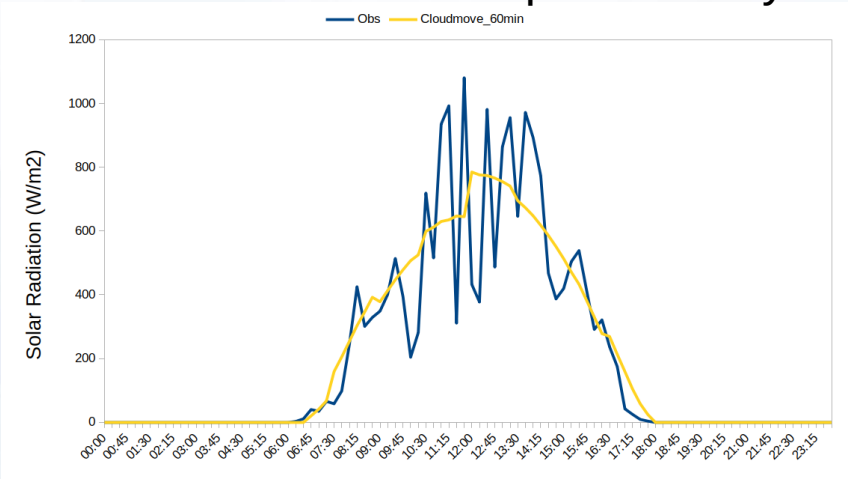
Maharashtra -Location 2

Accuracy of Weather Forecast remains a huge challenge

Weather related Challenge -

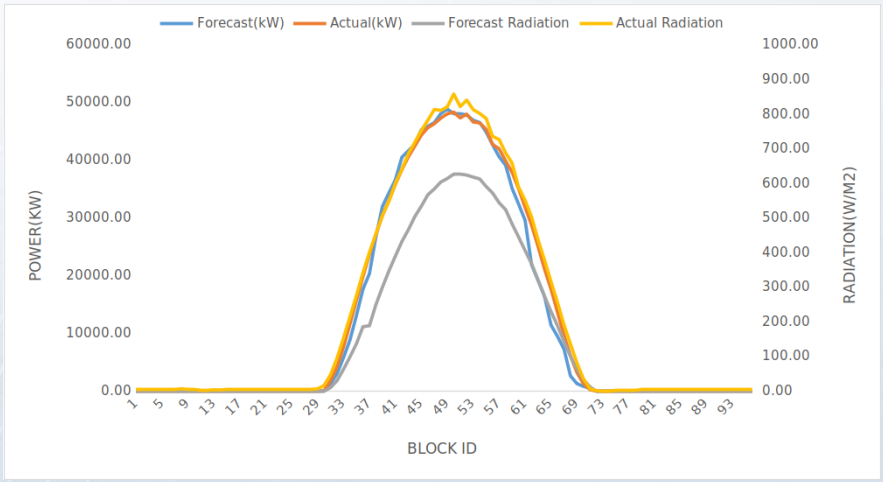
- **Interpolation of weather forecast:**
  - **None of the existing weather forecasters are providing more than 4 forecast updates a day.**
  - **The downscaling of hourly or three hourly forecast to 15 min time blocks is not provided by most forecasters. As shown in case study 1 below, hourly or 3 hourly forecast are of nominal use when there is high fluctuation in weather condition.**
  - **Forecast at actual hub height, i.e., 80-150 m and actual co-ordinate is not available due to low resolution of NWP models.**

Forecast and Actual data input in our system



Case Study 1: 08 Nov 2019, A Location in Karnataka

Forecast (REDFX) under normal condition



Case Study 2: 10 Dec 2019, A Location in Rajasthan

SAMAST Software Modules

Kreate has implemented an integrated software solution for SLDC comprising all the desired software modules which is recommended through SAMAST report.

1. Entity Management

2. Energy Meter Data Management
1. Data Processing
2. SEM Active and Reactive Energy

3. Scheduling and Dispatch
1. Day- Ahead Scheduling
2. Same Day Scheduling
3. Reconciliation & Implemented Scheduling
4. Schedule and Revision
5. Curtailment

4. Energy Accounting
1. State Energy Accounts
2. State DSM Accounts
3. State Reactive Energy

5. State Transmission Losses
1. Weekly/Monthly Loss on 66 KV and Above feeders

6. Billing, Collection and Disbursement
1. State Deviation Charges
2. State Reactive Energy Charges
3. State Deviation Pool Account
4. State Reactive Pool Account

7. Open Access
1. Open Access (Bilateral & Collective)
2. OA Schedule
3. OA Contract Management
4. OA Charges Computation
5. OA Accounting
6. OA NOC & E-bidding

8. Renewable Energy
1. Weekly/ Monthly energy injection

9. Outage Planning and Management
1. Manage the Transmission Element and Generators
2. Manage Planned and Emergency Outage

10. MIS and Dashboard
1. Reports For Website
2. Interactive Dashboards and Report for all Modules

Wide variation across states on SAMAST implementation

Trunkey solution of Meter and Software to a single vendor.

API sharing from Meter Manufacturer for Meter data validation without Manual Intervention.

API Sharing for SCADA manufacturer to share the real-time energy data with external Application Like SAMAST.

Our interaction with SLDCs across country suggest people at functional level are struggling with multiple issues and want customized solutions

Current L1 based procurement does not help, there should be some degree of technical parameters introduced in the evaluation process for vendor selection.

Challenges in SAMAST implementation

Non cooperation in sharing of APIs / Meter Data Protocol by meter manufacturers- Hamper Meter Data Validation Module

Non cooperation in sharing of Web APIs by SCADA Vendors- Hinders SCADA Vs SEM comparison, Scheduling module

Separate Vs Integrate Tender (Software & its Hardware Vs Meter Supply + Software) – Restricts competition in the overall procurement as in case of Integrated Tender limited vendors are present with experience of Software development

Management Dashboard

THANK YOU

To disrupt is to evolve

Contact us at :
redforecast@kreatetechnologies.com
bd_reforecasting@kreatetechnologies.com

.Kreate

FOR Sub-Group on

Reserves and Ancillary Services at State Level

3rd Meeting of FOR Standing Technical Committee (Gr-I & Gr-II)

Venue: New Delhi, Date: 03 Jan 2020

Sub Group Composition

- Chairman - Shri S.K Soonee, Advisor POSOCO
- *Convenor Member – CERC/FOR representative*
- 4 SERC representatives- MP, MH, GJ, TL
- 4 SLDC representatives- MP, MH, GJ, TL
- 1 NLDC representatives
- 2 RLDC representatives- WRLDC, SRLDC
- Chief (RA), CERC – coopted members
- 1 academia representative – IIT Delhi

- Terms of Reference -

Disseminate learning from experience at interstate level

Recommend Implementation Roadmap

Recommend Model Regulation

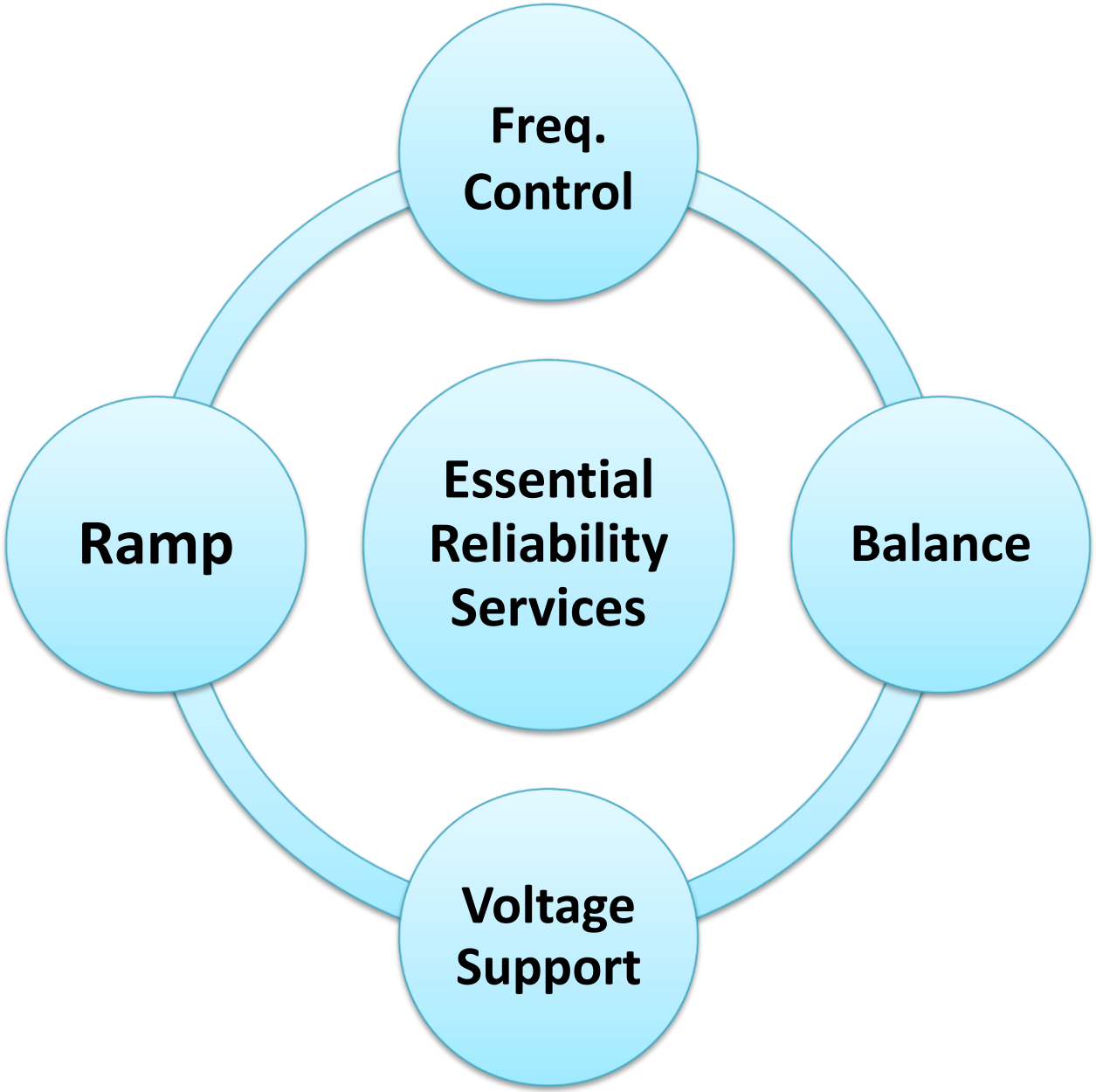
Deliberations and activities

- 7 meetings
- Multiple interactions for Capacity Building
- Multi-disciplinary working group in SLDCs
- Capacity building on Optimisation Techniques
- 3 pilot exercises – SLDC MP/MH/GJ
- SLDC survey (22 responses received)
- Literature survey

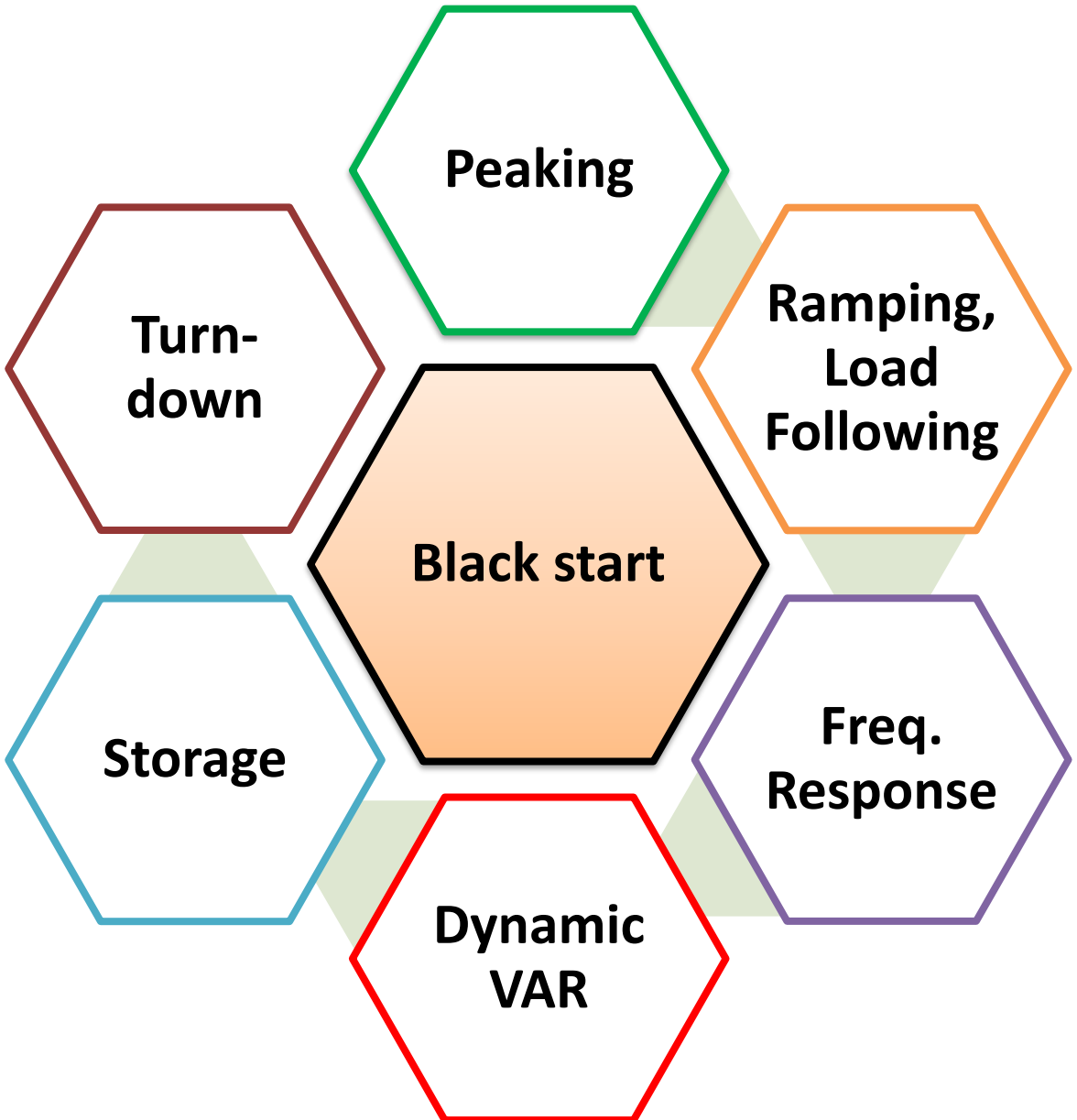
Key Aspects Deliberated

Need for intra-state reserves	Prevailing Practice on Imbalance Handling	Reserve Assessment & Monitoring	Despatch of Reserves
Replenishment of reserves	Learning from RRAS, FRAS	Essential Reliability Services	Intra-state vs Inter-state reserves
Defining Generator thresholds	Unit Commitment	Cost Recovery	Settlement systems

Survey of International Practice

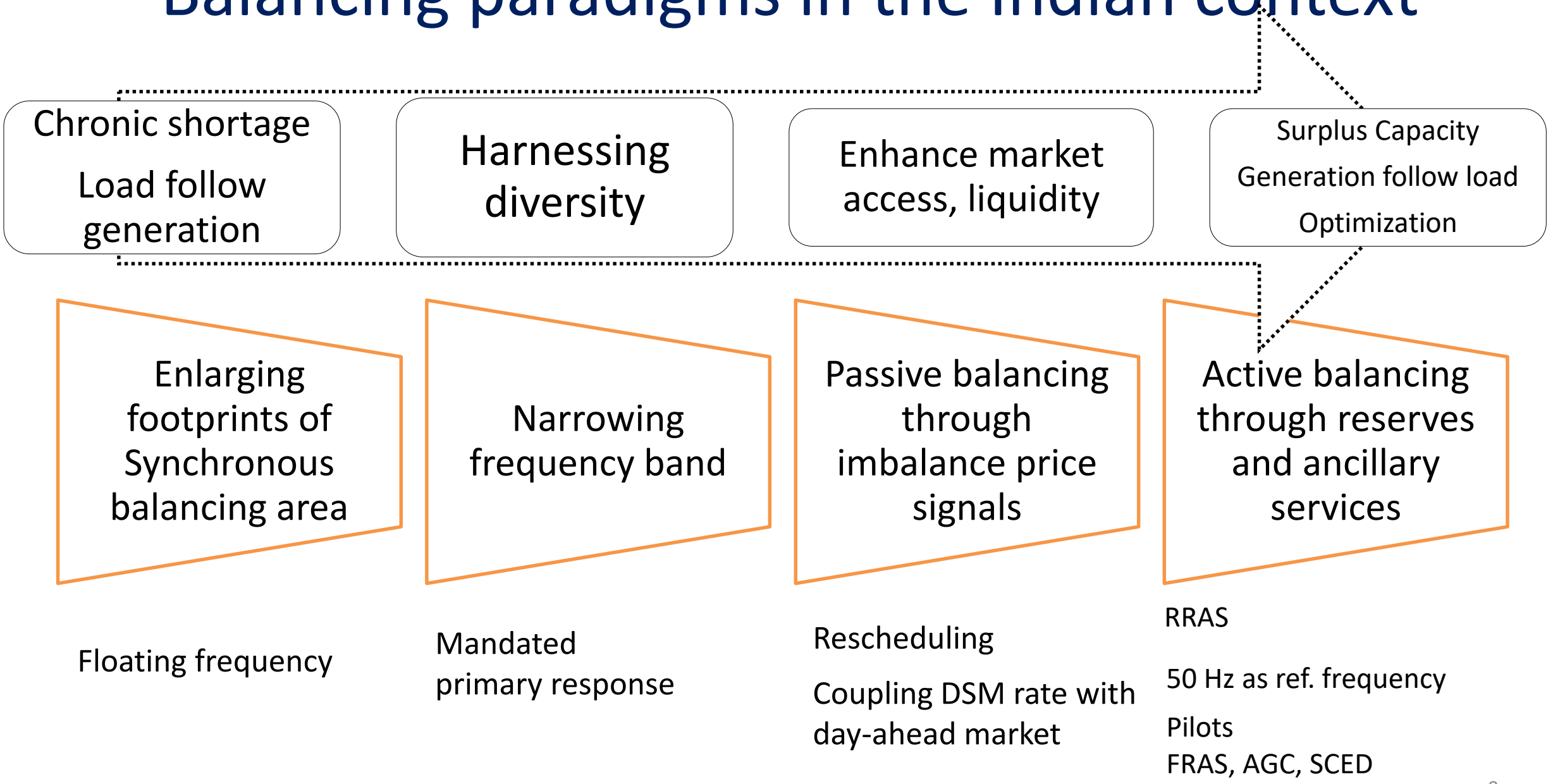


Flexibility Attributes of Generators



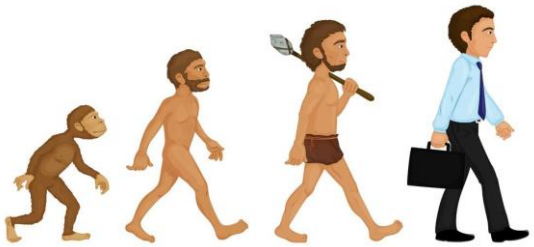
Suitable regulatory frameworks would help harnessing Gen. Flexibility

Balancing paradigms in the Indian context

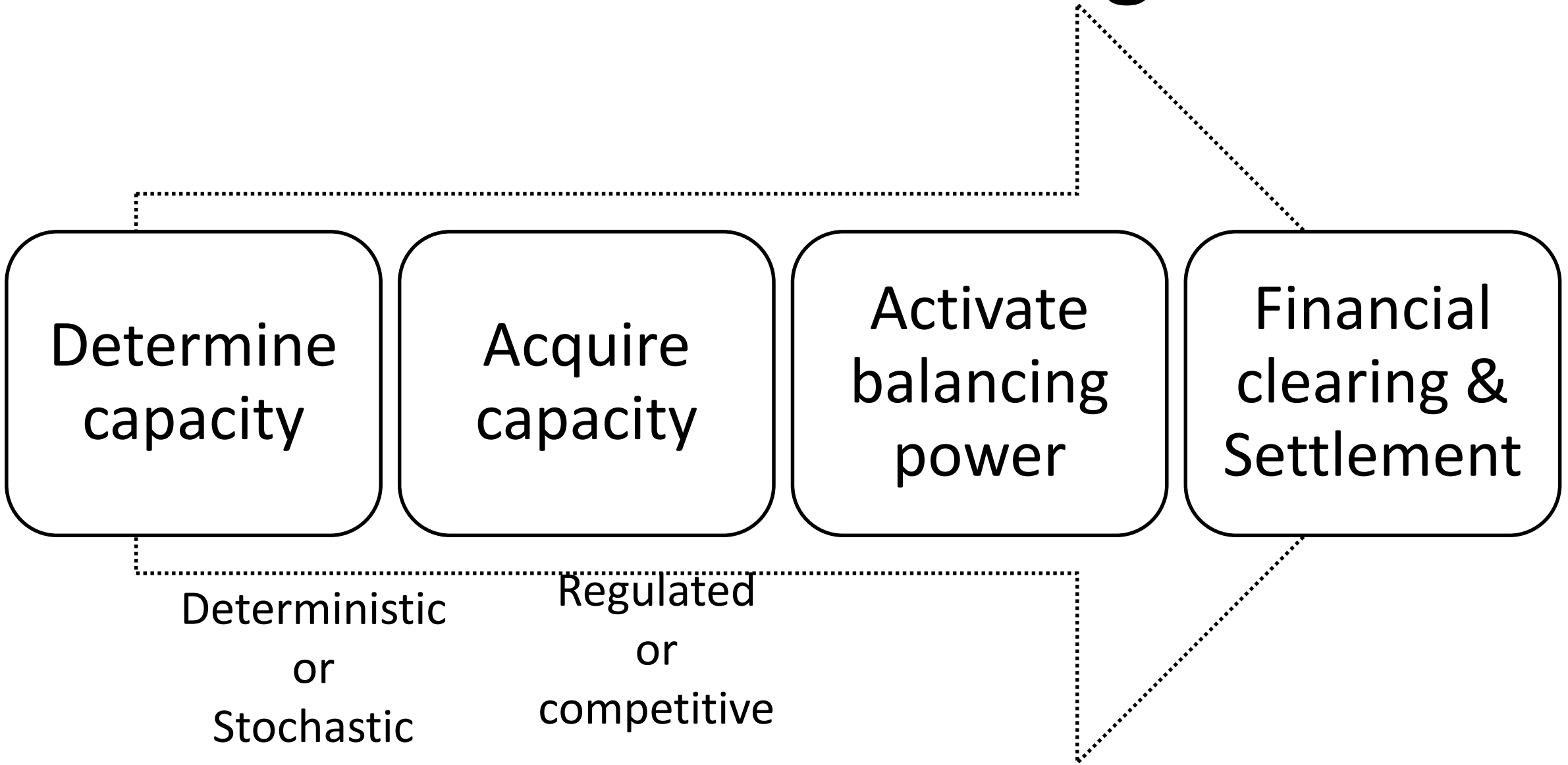


Evolution of framework at ISTS level

1. Policy for 5% spinning reserve at national level
2. CERC - Road map to operationalise Reserves
3. Defining Generation Thresholds - Tech Min, Pmax
4. Ancillary Services – RRAS, FRAS
5. Automatic Generation Control pilot
6. Security Constrained Economic Despatch pilot



Active balancing



Capacity building program (19-21 Sep)

'Implementation of Optimization Techniques for Indian Power System Operation'

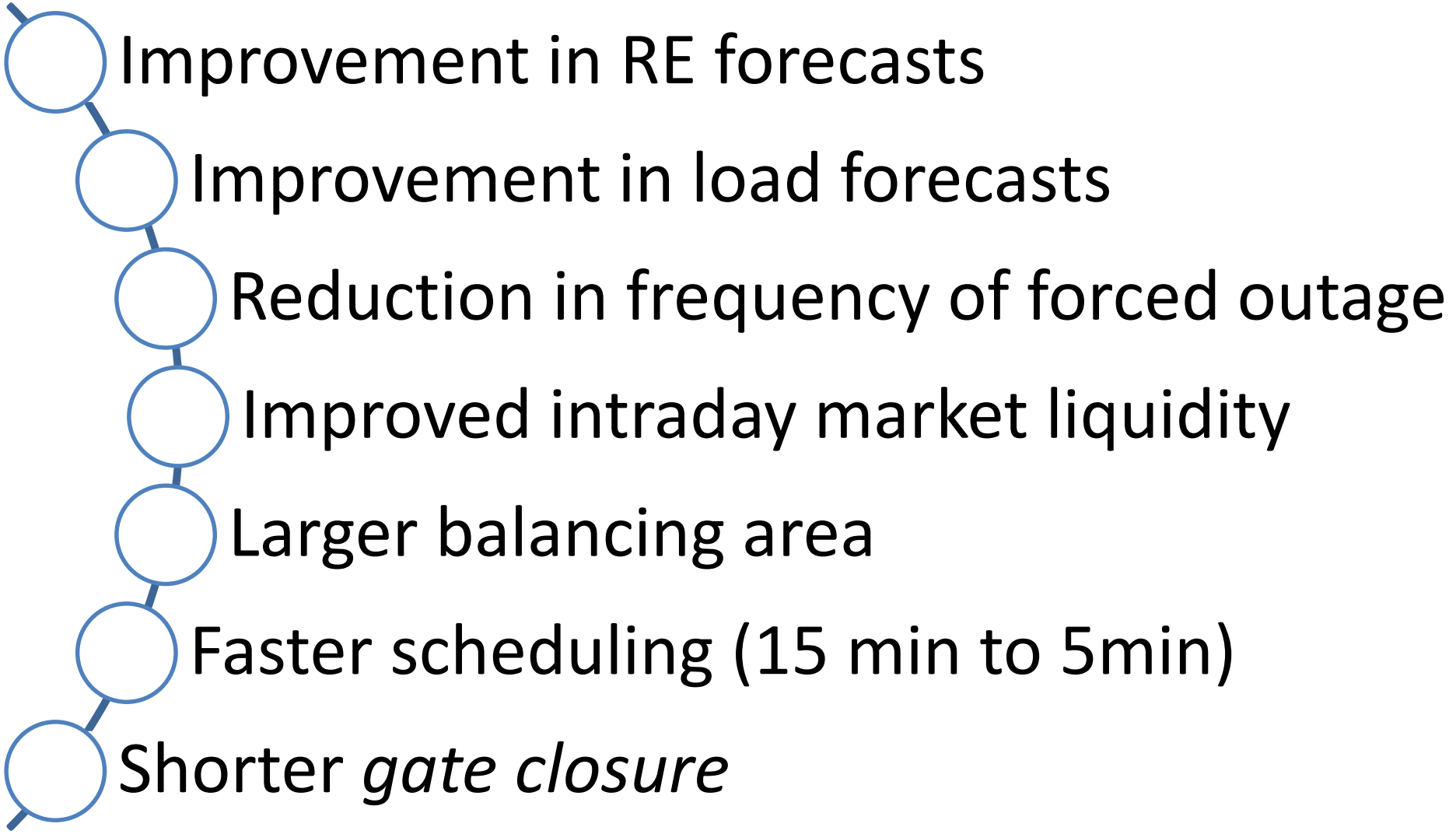
Tailor made by IIT-Delhi & NLDC Team

- **Basics of Optimization:**
- **Excel Solver for Optimization (Hands on)**
- **Economic Load Despatch (ELD)**
- **Unit Commitment (UC)**
- **General Algebraic Modelling System (GAMS)**
- **Hands on Session on GAMS**
- **Illustration - SCED Module being operated at NLDC**

Key take-aways:

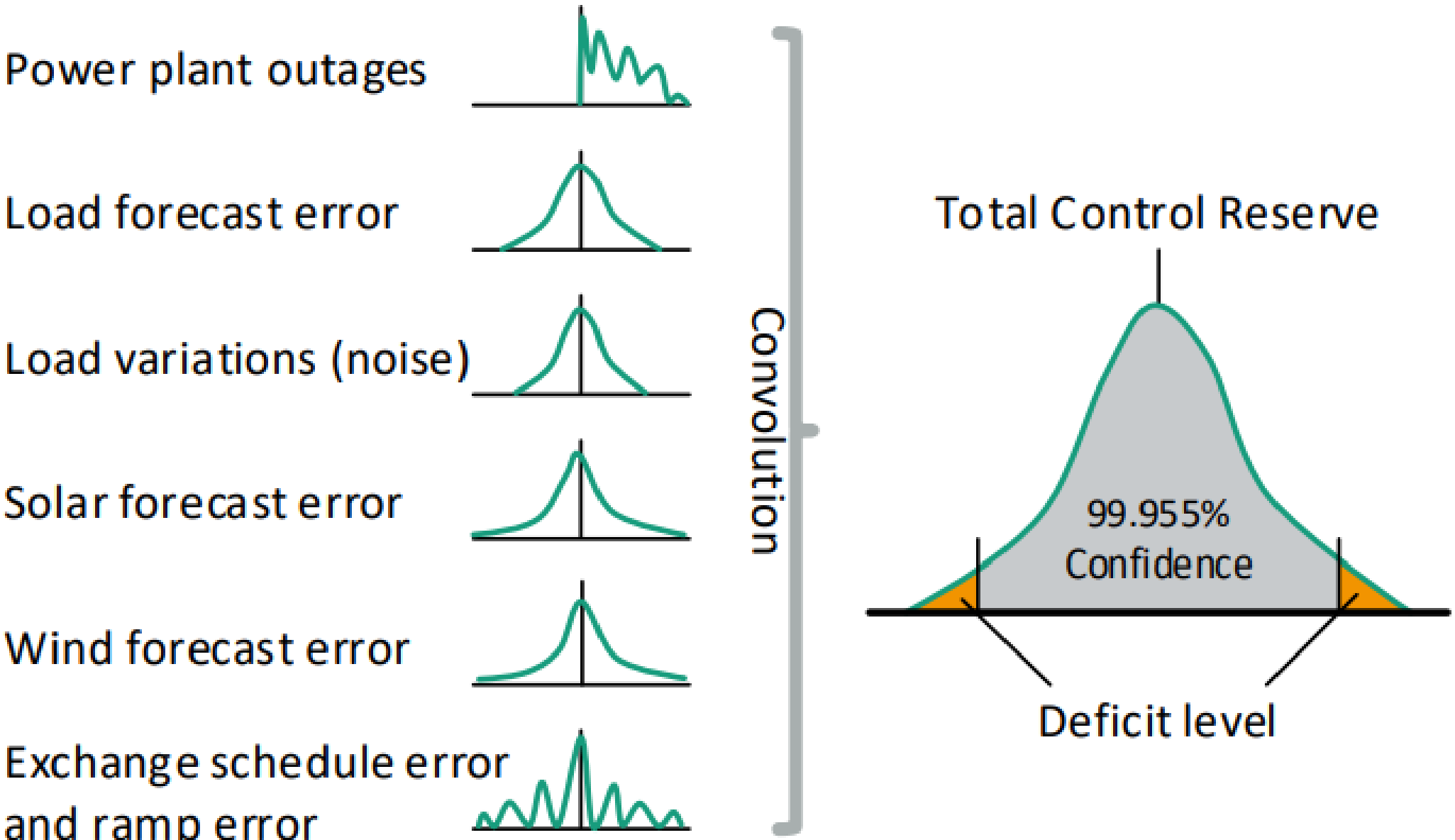
- Problem Formulation
- Tools – Solver/GAMS
- Co-optimization
- IT Infra specification
- Interfacing
- Visualization

Reserve requirement would decrease with



- Improvement in RE forecasts
- Improvement in load forecasts
- Reduction in frequency of forced outage
- Improved intraday market liquidity
- Larger balancing area
- Faster scheduling (15 min to 5min)
- Shorter *gate closure*

Dimensioning of Reserve- Probabilistic approach

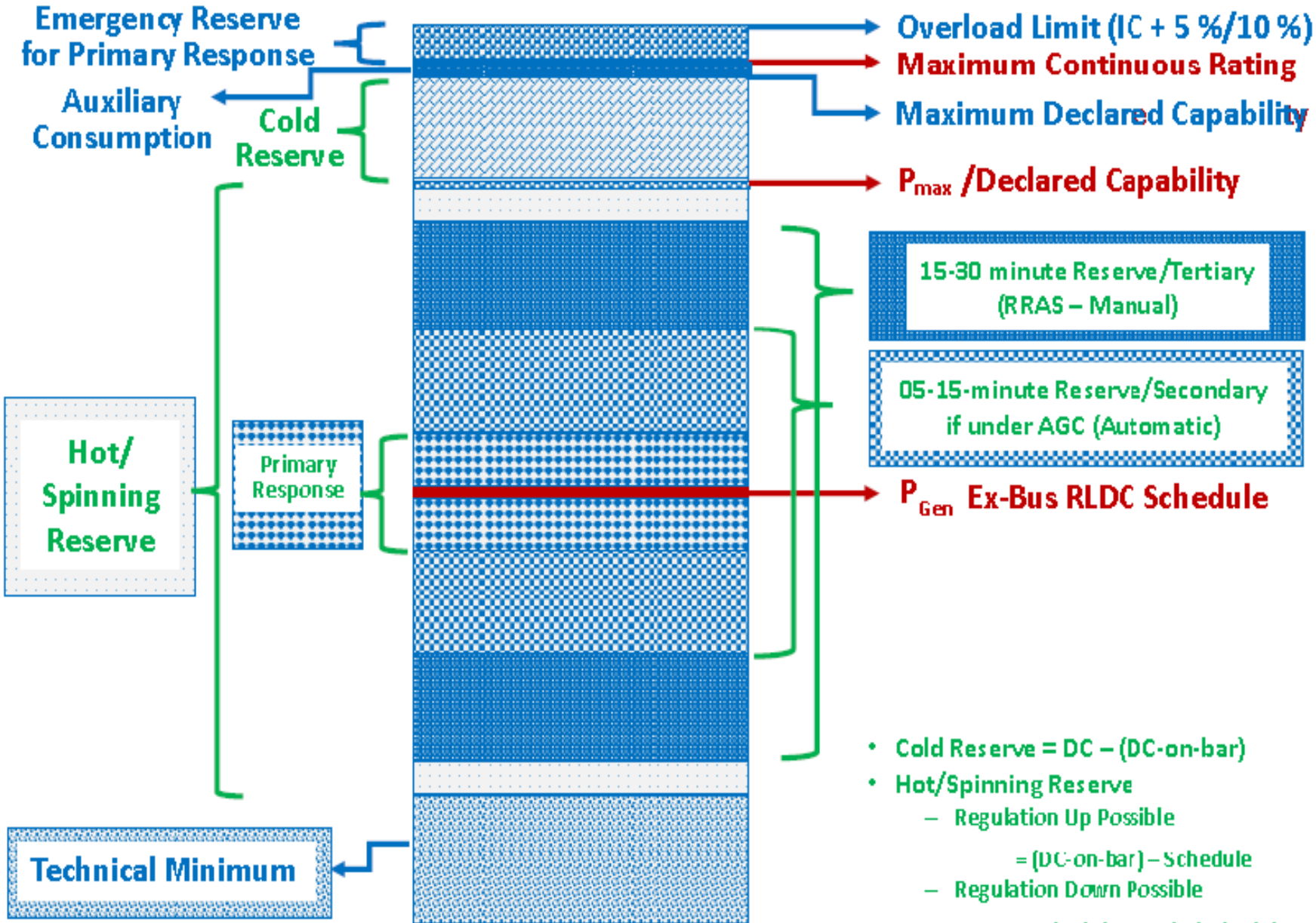


State	99 percentile	99 percentile
	Positive ACE (MW)	Negative ACE (MW)
Maharashtra	640	538
Gujarat	576	625
Madhya Pradesh	636	582
Andhra Pradesh	672	560
Telangana	620	595
Karnataka	638	768
Tamil Nadu	720	630
Rajasthan	718	788

Dimensioning - Reserve Assessment Methods

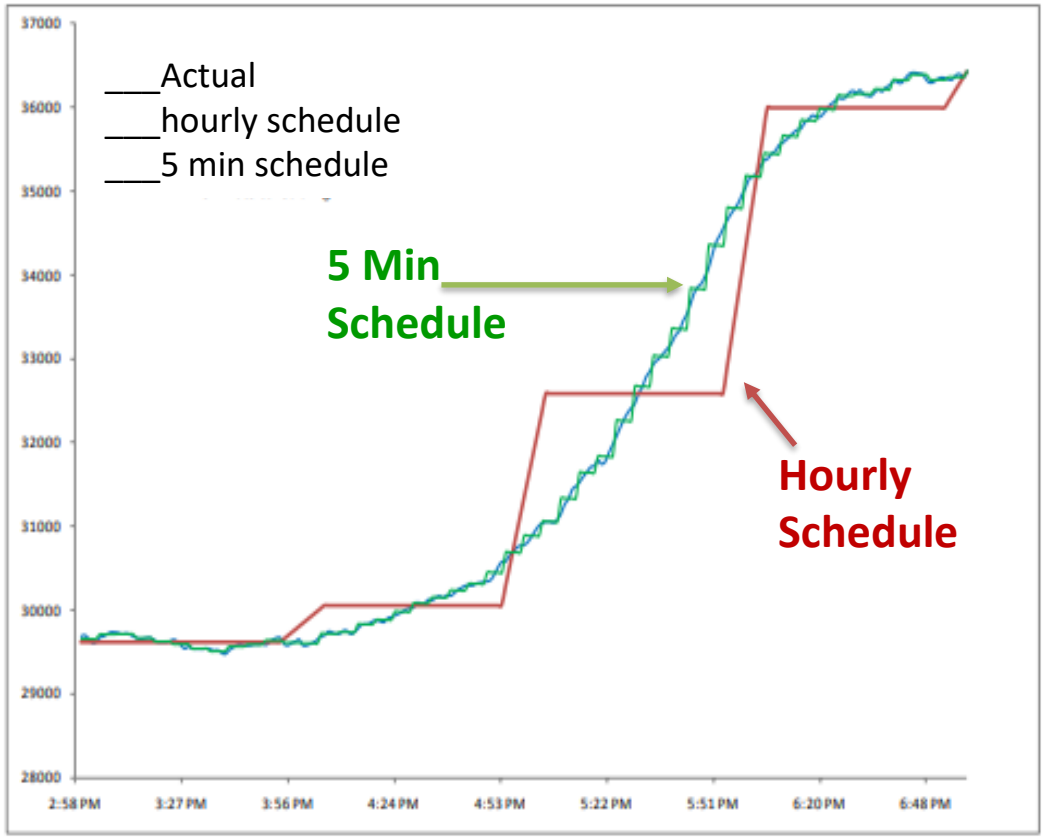
Region/State	Reserves required as per CERC road map (MW)	Reserves requrement @ 3 times of Standard Deviation (MW)*
Maharashtra	330	699
Gujarat	330	714
Madhya Pradesh	330	675
Chhattisgarh	250	372
Goa	-	81
UT DD	-	57
UT DNH	-	72
WR	800	2136
		* w.r.t. Jan-Aug 2019 Data

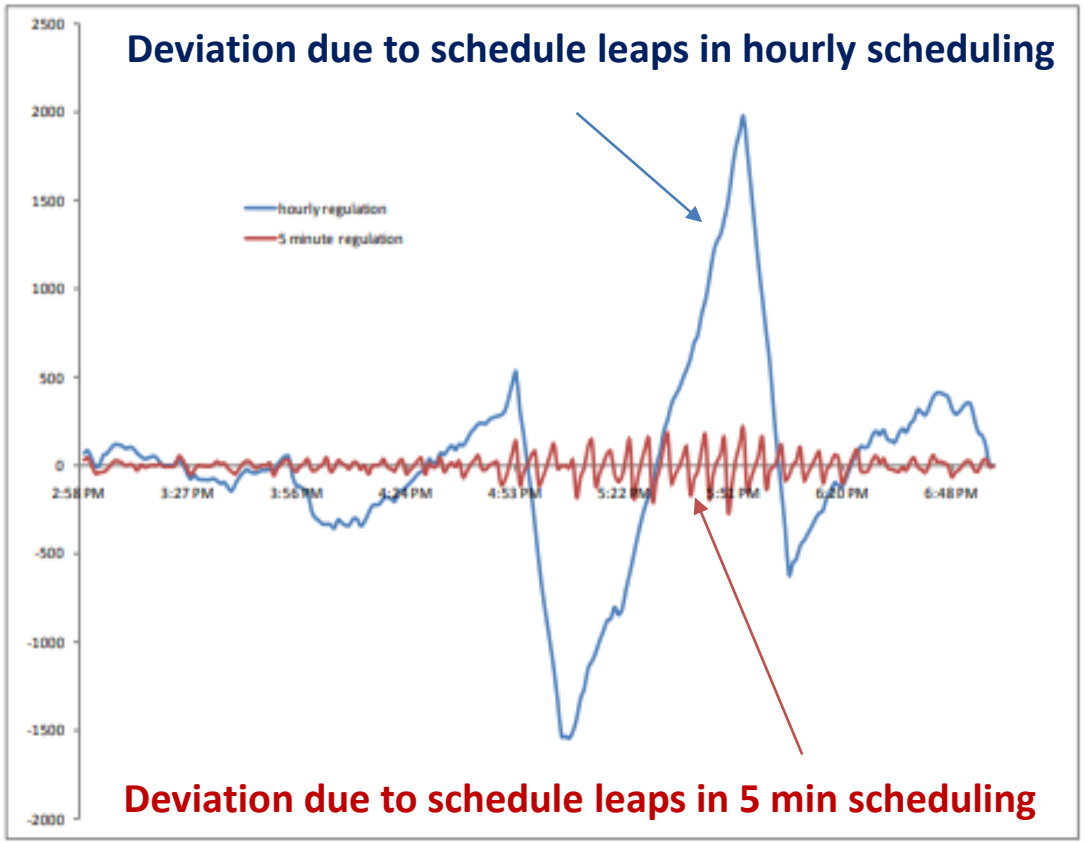
Schematic of Services from a Generating Station



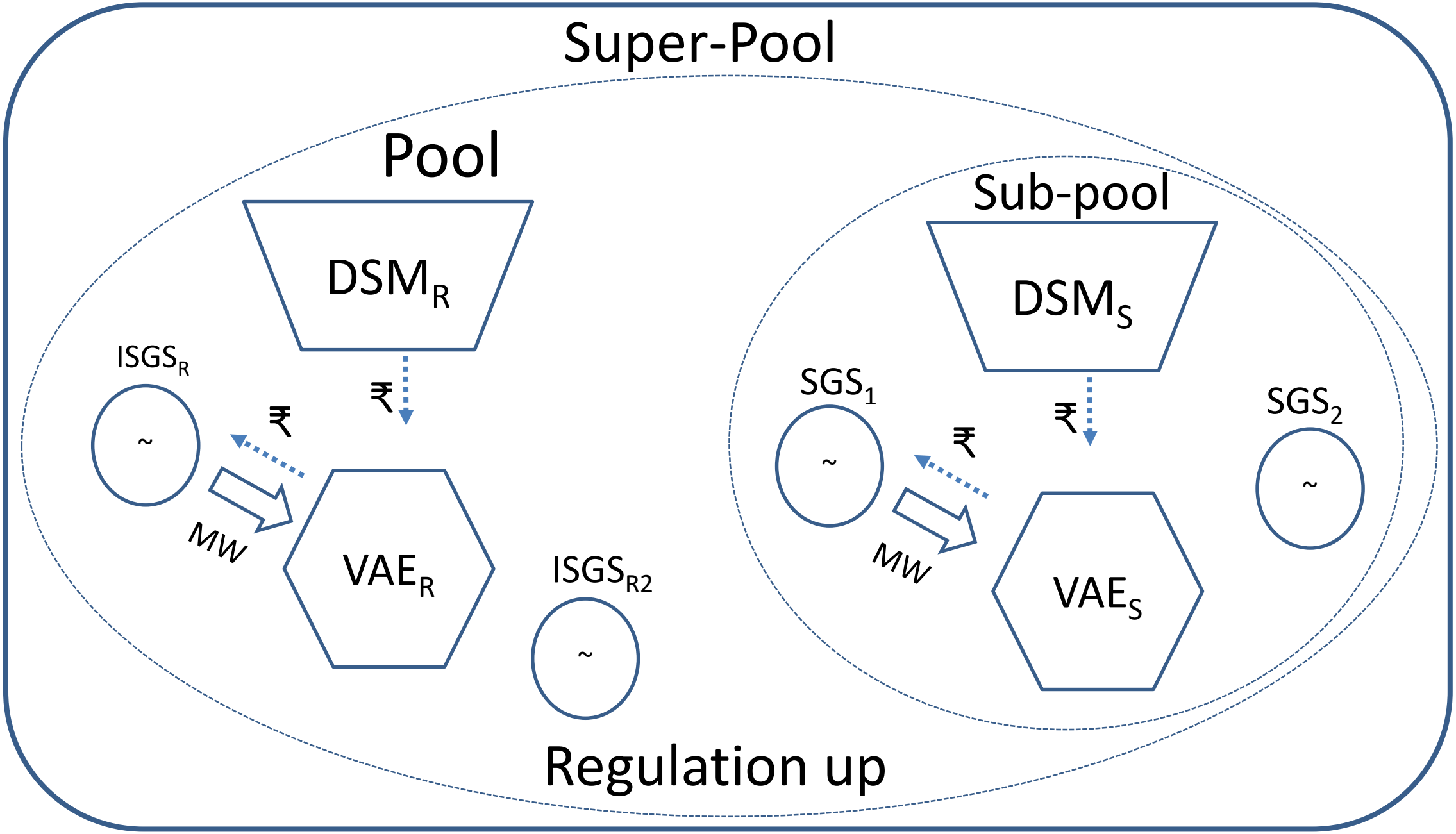
- Cold Reserve = DC – (DC-on-bar)
- Hot/Spinning Reserve
  - Regulation Up Possible
    = (DC-on-bar) – Schedule
  - Regulation Down Possible
    = Schedule – Technical Minimum

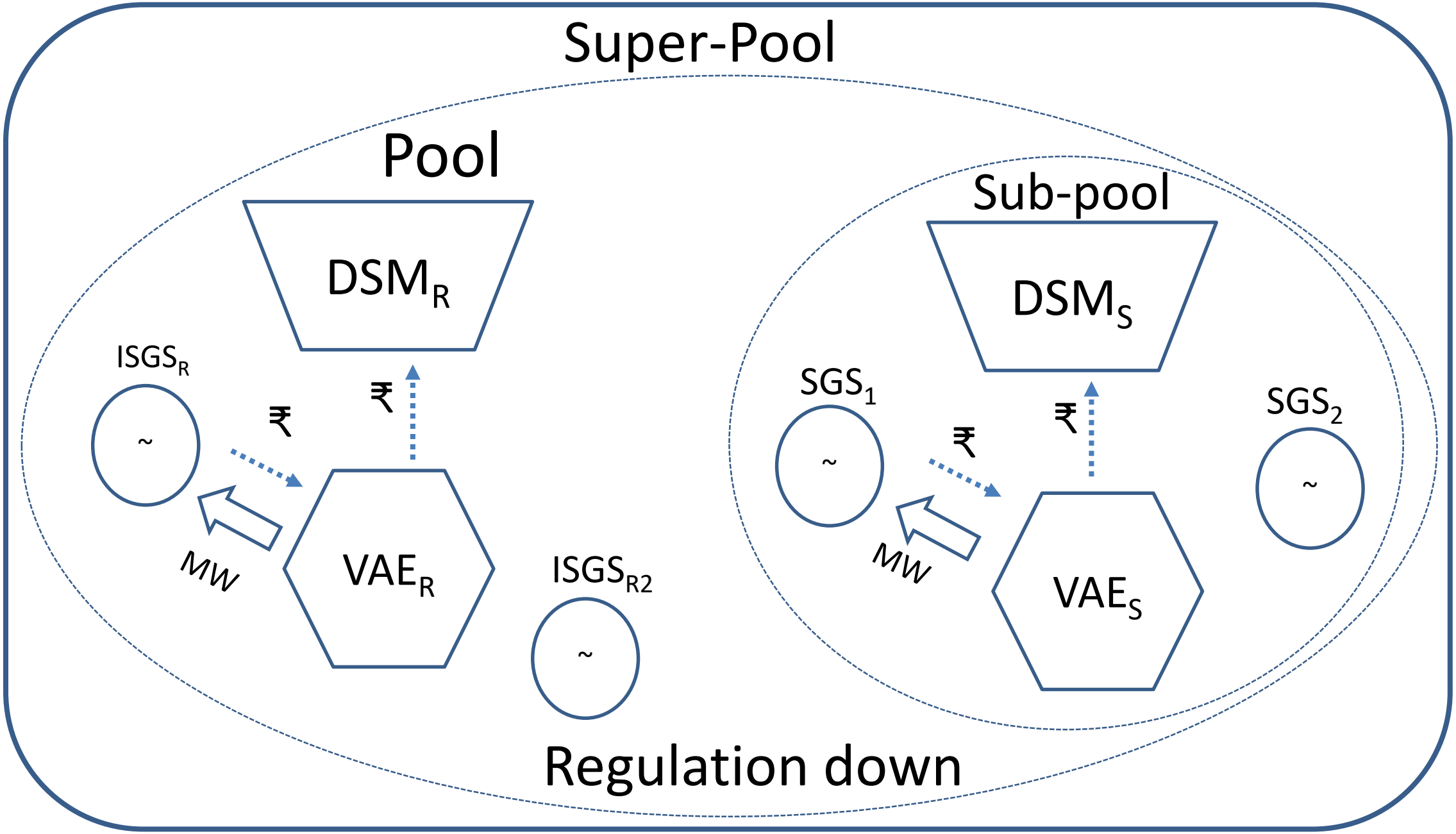
Schedule leaps at time block boundary





Regulation required for handling deviation
in 60-min scheduling is much higher than 5-min scheduling


Super-Pool
Pool
DSM$_R$
ISGS$_R$
₹
₹
~
MW
VAE$_R$
ISGS$_{R2}$
~
Sub-pool
DSM$_S$
SGS$_1$
₹
₹
~
MW
VAE$_S$
SGS$_2$
~
Regulation up


Super-Pool
Pool
DSM$_R$
ISGS$_R$
₹
₹
MW
VAE$_R$
ISGS$_{R2}$
Sub-pool
DSM$_S$
SGS$_1$
₹
₹
SGS$_2$
MW
VAE$_S$
Regulation down

On-line Survey of States – 22 responses

- Highlights -

- ✓ Grid Code in all states
- ✓ 7 states have ABT
- ✓ 1 State having URS mechanism (Delhi)
- ✓ 13 states-Multiple discoms , 5 -single discom
- ✓ Most SLDCs - Scheduling as per MOD
- ✓ MOD Preparation
  - 17 states use Variable Charge
  - Kerala, Himachal use (VC+FC)
  - Telangana & UP use Composite Tariff

On-line Survey of States – 22 responses

- Highlights -

- ✓4 SLDCs do not despatch private discoms (AP, GJ, HY, DVC)
- ✓4 Zero-sum DSM Pools: GJ/MP/MH/RJ
- ✓3 Non-zero DSM Pools: CG, WB, Delhi
- ✓1 state -Technical Min – 55% (MP),
- ✓DC & Ramp info. Availability – Most SLDCs
- ✓4 states with FSPs for RE (GJ,MP,MH,RJ)
- ✓Most SLDCs appreciated the need for Optimized dispatch

Solver Module for Economic Despatch Incorporating Reserves

	A	B	C	D	E	F	G	H	I
1	Reserves / Ancillary Services		Despatch Model :	Madhya Pradesh		Total Schdl	Total Cost (Rs.Lac per hour)	Average Rate (Rs./unit)	Net UP Reserve Avail
2			Forecast Demand	4363			83	1.77	1313
3			Reserve	330			Total Cost (Rs./hour)	SMP	Net Down Reserve Avail
4	17.06.19	50 block	Total Demand	4693		4693	8283965	3.33	1238
5			Tech. Min (%)	0.70					
6	Column Name -->		A	B	C	D	E=C*D	F	G=D-F
7	Column Totals -->		7964	3004		4693		4758	-65
8	S No	Station Name	P Max	Pmin	Variable Charge	Schedule for Block 'T'	Production Cost	Schedule for Block 'T-1'	Difference in Schedule of Blocks T & T-1
9	1	JP Nigrie	417.28	277.20	64	417.28	267075	417.28	0
10	2	Rihand III (NR)	2.36	0.00	132	2.36	3113	2.36	0
11	3	SIPAT I	105.48	0.00	133	105.48	140149	105.48	0
12	4	Rihand II (NR)	1.08	0.00	134	1.08	1451	1.08	0
13	5	Rihand I (NR)	1.94	0.00	134	1.94	2600	1.94	0
14	6	SIPAT II	158.02	0.00	137	158.02	216346	158.02	0
15	7	KSTPS-III	71.51	0.00	139	71.51	99751	71.51	0
16	8	KSTPS	405.31	0.00	142	405.31	573850	405.31	0
17	9	Sasan	1366.88	956.81	145	1366.88	1986890	1366.88	0
18	10	Singrauli (NR)	3.59	0.00	150	3.59	5371	3.59	0
19	11	ATPS (210MW) Chachai	193.00	135.00	160	193.00	308800	193.00	0
20	12	VSTPS-IV	266.21	0.00	175	56.21	98095	126.21	-70
21	13	VSTPS-V	131.37	0.00	176	0.00	0	0.00	0
22	14	VSTPS-III	211.93	0.00	177	0.00	0	0.00	0
23	15	VSTPS-II	138.99	0.00	179	0.00	0	0.00	0
24	16	VSTPS-I	355.45	0.00	184	0.00	0	0.00	0
25	17	SGTPS -1x500	470.00	350.00	197	350.00	689850	350.00	0
26	18	SGTPS -4x210	445.00	405.00	216	405.00	875610	405.00	0

Instructions | State_Details | +

Madhya Pradesh Optimization Exercise July 2019

(Each case refers to a time block)

Cases	Production cost before Optimization (Rs Lakhs)	Production cost After Optimization (Rs Lakhs)	Total Saving (Rs Lakhs)	Average Cost before Optimization (Rs/Unit)	Average Cost After Optimization (Rs/Unit)	SMP rate (Rs/Unit)
Case 1: Maximum Demand (Morning)	159.2	157.9	1.3	2.12	2.10	3.93
Case 2: Minimum Demand (Morning)	104.8	102.6	2.2	1.78	1.74	2.57
Case 3: Maximum Demand (Evening)	152	152	0	2.04	2.04	5.92
Case 4: Minimum Demand (Evening)	103.5	100	3.5	1.78	1.72	2.57
Case 5: Maximum Surrender day	82.8	80.6	2.2	1.77	1.72	1.76
Case 6: Minimum Surrender day	146.9	146.9	0	1.98	1.98	5.92
Case-7: Max RE Gen.	86	84	2	1.76	1.72	1.77

Maharashtra Optimization Exercise Aug 2019

(Each case refers to a time block)

Cases	Production cost before Optimization	Production cost After Optimization	Total Saving	Average Cost before Optimization	Average Cost After Optimization	SMP rate
	(Rs Lakhs)	(Rs Lakhs)	(Rs Lakhs)	(Rs/Unit)	(Rs/Unit)	(Rs/Unit)
Case 1: Maximum Demand	515	484	31	2.54	2.49	3.29
Case 2: Minimum Demand	366	320	46	2.45	2.27	2.81
Case 3: Maximum Wind	375	350	25	2.47	2.31	2.96
Case 4: Minimum Wind	361	349	12	2.3	2.26	3.69
Case 5: Maximum Surrender	284	276	8	2.54	2.51	2.52
Case 6: Minimum Surrender	507	483	24	2.59	2.41	2.82

Gujarat Optimization Exercise July 2019

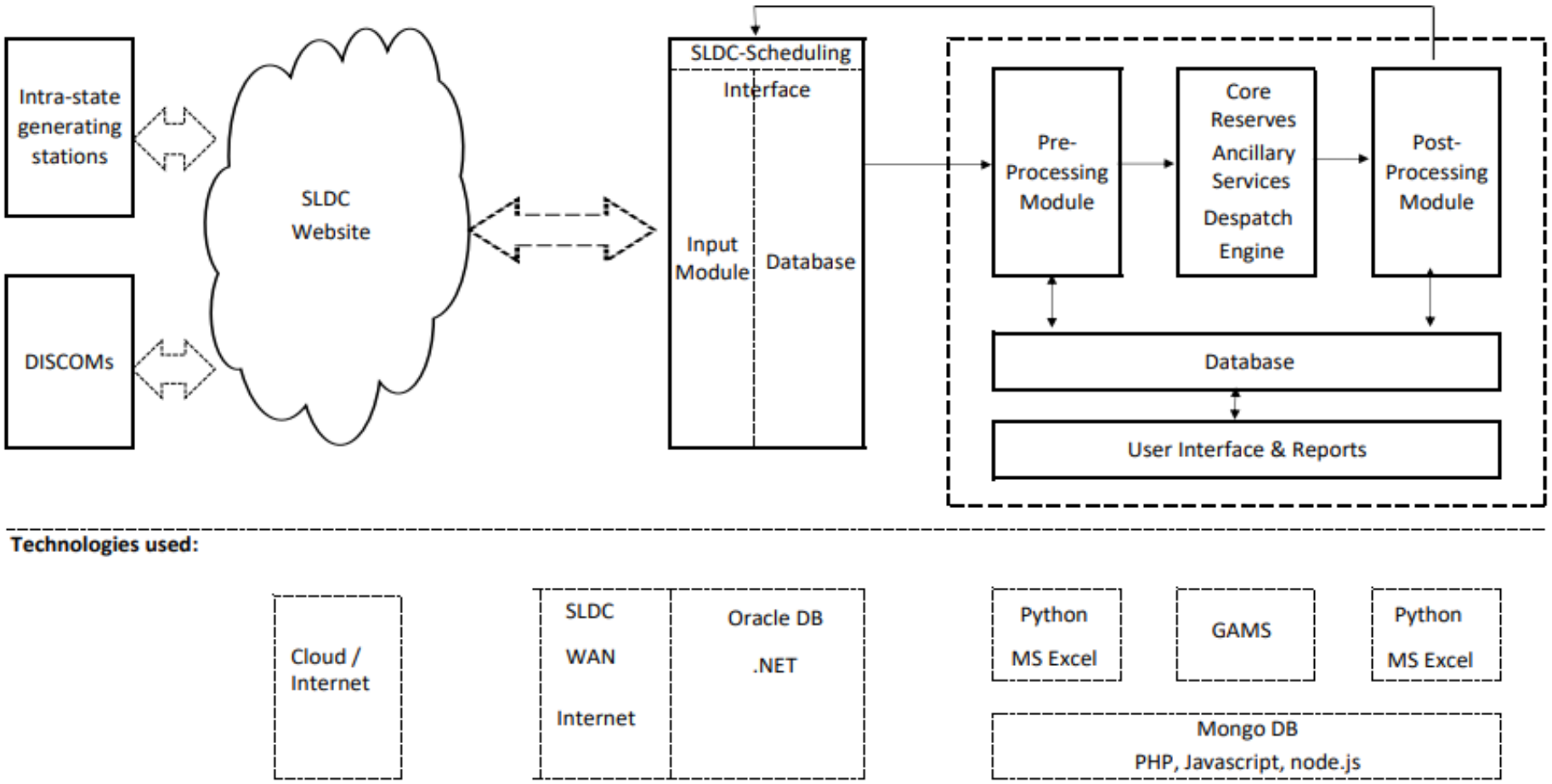
Scenarios used for optimization (each case ref to a time block)		Total production cost in Rs lakh		Average Production cost (Rs/Unit)		System Marginal Price (Rs/Unit)
Day	Block	Pre	Post	Pre	Post	
20-Jun-19	89	347	340	2.97	2.94	1.99
21-Jul-19	61	400	392	3.16	3.11	3.67
21-Jul-19	80	321	318	2.94	2.94	3.67
22-Jul-19	21	411	387	3.17	3.11	3.33
22-Jul-19	61	386	386	3.15	3.13	3.84

Regulatory Intervention for Pilot Implementation

Need for Regulatory Provisions by SERC:

1. Declaration of FC, VC, Technical Minimum, Ramp by state generators
2. Provision for linking FC recovery to machine availability (DC)
3. Adopting the CERC road-map for reserves
4. Mandating '*Essential Reliability Services*' – viz. Fast / Slow Tertiary (RRAS, FRAS)
5. Settlement Mechanism, Incentives, Mark-up

Typical Schematic for IT Infrastructure



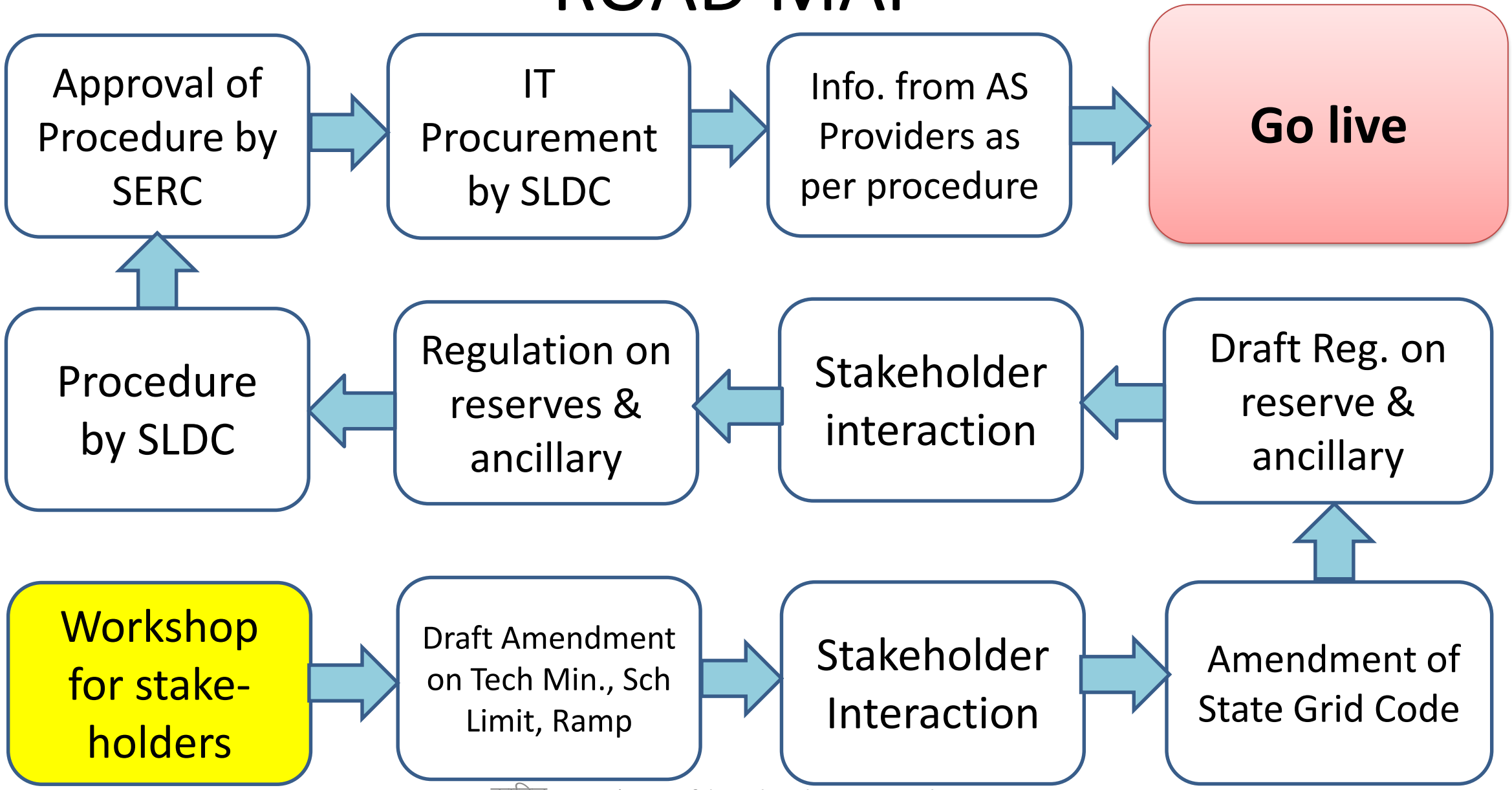
Typical Cost estimate (55 lakh) has been provided as reference (might vary subject to actual market conditions)

- Recommendations -

Gen. Margin as Reserve	Distributed primary reserve	Secondary Control	Pre-requisites for intra-state ERS	Information on scheduling limits
Dimensioning of reserve	Sanctity of VC, Ex-ante DC & schedule	Reserve Computation	Monitoring of reserves	Gate closure for reserve
Unit Commitment	Reserve Dispatch	VAE creation	Info & Communication infrastructure	Settlement

Transmission loss administration	Regulation on reserves & ancillary services

- ROAD MAP -


Approval of Procedure by SERC
IT Procurement by SLDC
Info. from AS Providers as per procedure
Go live
Procedure by SLDC
Regulation on reserves & ancillary
Stakeholder interaction
Draft Reg. on reserve & ancillary
Workshop for stake-holders
Draft Amendment on Tech Min., Sch Limit, Ramp
Stakeholder Interaction
Amendment of State Grid Code

THANK YOU!

Reserve Provisions mandated/envisaged by CERC

	Primary Response by all generators in MW (Distributed)	Secondary Reserve at regional level (MW)	Aggregate tertiary reserves at the state level (MW)
NR	Coal ≥ 200 MW Gas ≥ 50 MW Hydro ≥ 25 MW Gov. Droop: 3-6% Avoid VWO	800	1658
ER		660	857
WR		800	1353
SR		1000	1343
NER		363	65
Total	**4000**	**3623**	5218

Ref. IEGC & CERC Order of Oct 2015 in 11/SM/2015

Reserves- Definition

- 1. General: Funds or material set aside or saved for future use.

- 2. Accounting:
  - (1) Net worth of a firm over the amount realized from issuance of stock (shares) and arising from retained profits, revaluation of assets, and other surplus sums.
  - (2) Part of retained earnings set aside for a specified purpose and, hence, unavailable for disbursement as dividends.

- 3. Banking: Funds set aside for
  - (1) day to day operations (called primary reserves)
  - (2) meeting emergency liquidity requirements (called secondary reserves).

- 4. Energy industries: Computed or estimated quantity of hydrocarbons or minerals that can be extracted from known fields at an economical cost. The major classifications of reserves according to the level of confidence in the estimate are:
  - (1) Proven: Extensively sampled reserved estimated from seismic data and exploratory holes drilled
  - (2) Recoverable: Estimated from reservoir pressure and density of strata
  - (3) Probable: Rough estimate of quantity and quality of the item. Also called indicated reserves.
  - (4) Possible: Estimate based on unverified existence. Also called inferred reserves.

Read more: http://www.businessdictionary.com/definition/reserves.html

Basic Steps of the Pilot Exercise

Input Parameters from each Generator

(1) Declared capability in MW

(2) Declared capability on-bar (in MW)

(3) Schedule in MW

(4) Pmax = On bar IC – Normative Aux. Consumption (MW)

(5) Pmin = Technical Minimum generation (in MW)

(6) Variable charge (VC) in Rs/Kwh

(7) Ramp-Up rate in (%age of on-bar Capacity) per minute

(8) Ramp-down rate in (%age of on-bar Capacity) per minute

Derivable Parameters for each Generator

(1) Regulation Up-reserve = On bar IC – Schedule (MW)

(2) Regulation Down-reserve = Schedule – Tech. Min. (MW)

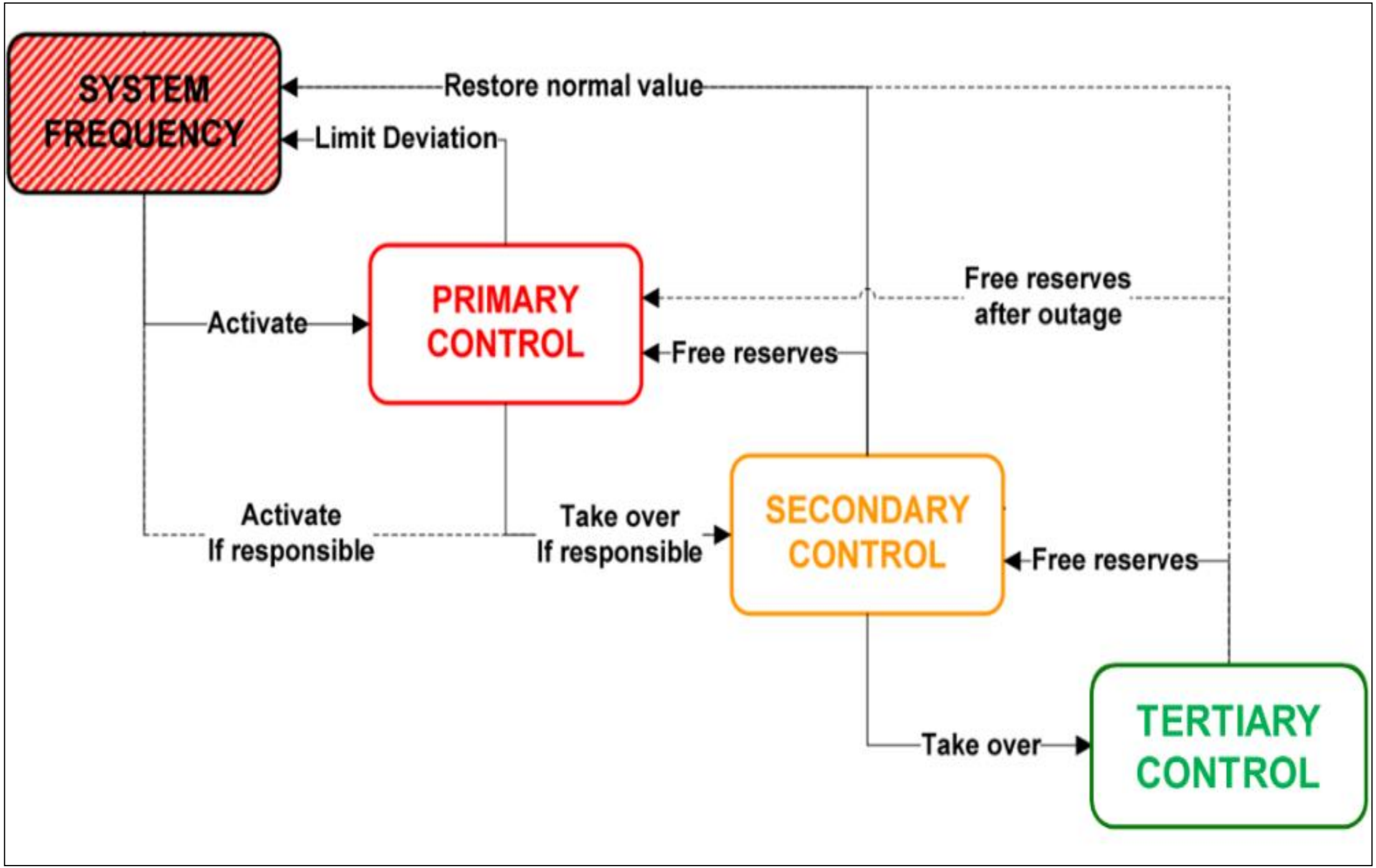
(3) Cold reserve = DC – DC on bar …. (MW)

(4) Hot spinning reserve = DC on bar – Schedule (MW)

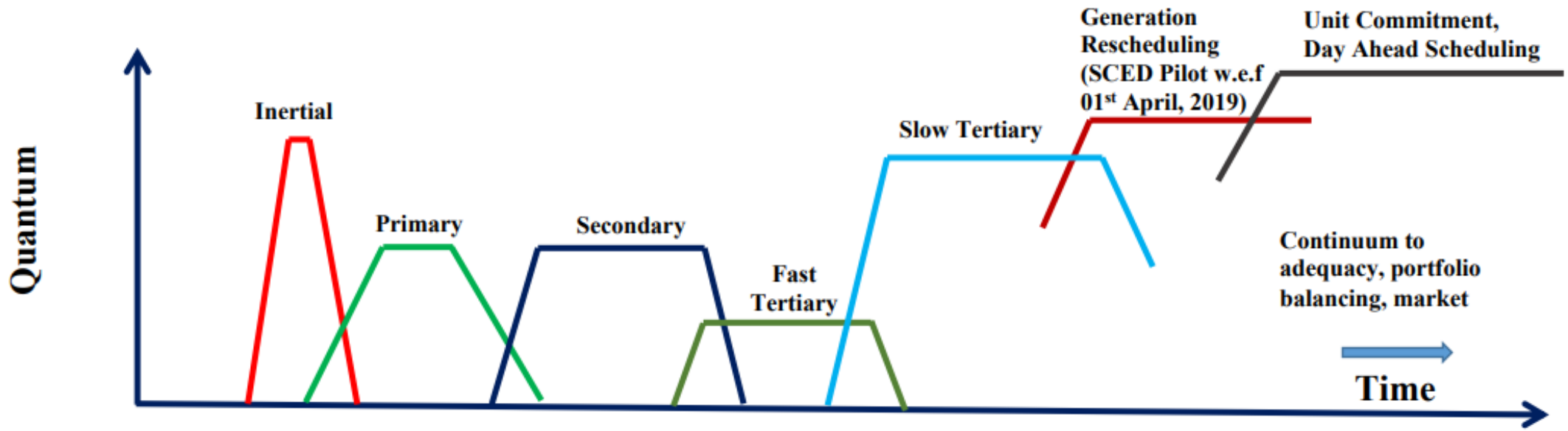
(5) Dispatchable reserve = Min of (Hot spinning & Reg-Up Reserve)

Optimization Formulation & Output

- To minimize the Objective Function: $\sum \boldsymbol{Schedule} * \boldsymbol{VC} = \boldsymbol{Minimum}$
- Equality Constraint(s): *Total schedule = Total demand of the state + Reserve*
- Inequality constraint(s): *Pmin ≤ Station schedule ≤ Pmax;*
- Decision Variables: Schedule of each power plant to be despatched

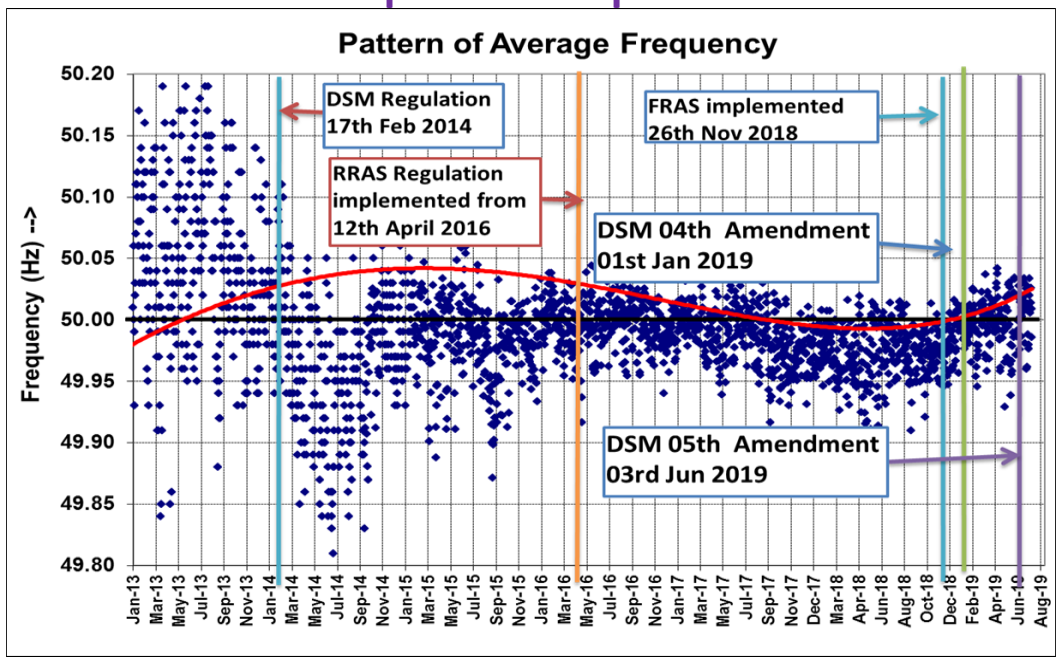

SYSTEM FREQUENCY
Restore normal value
Limit Deviation
PRIMARY CONTROL
Activate
Free reserves
Free reserves after outage
Activate If responsible
Take over If responsible
SECONDARY CONTROL
Free reserves
Take over
TERTIARY CONTROL

1 Schematic of Reserves, Balancing and Frequency Control Continuum in India

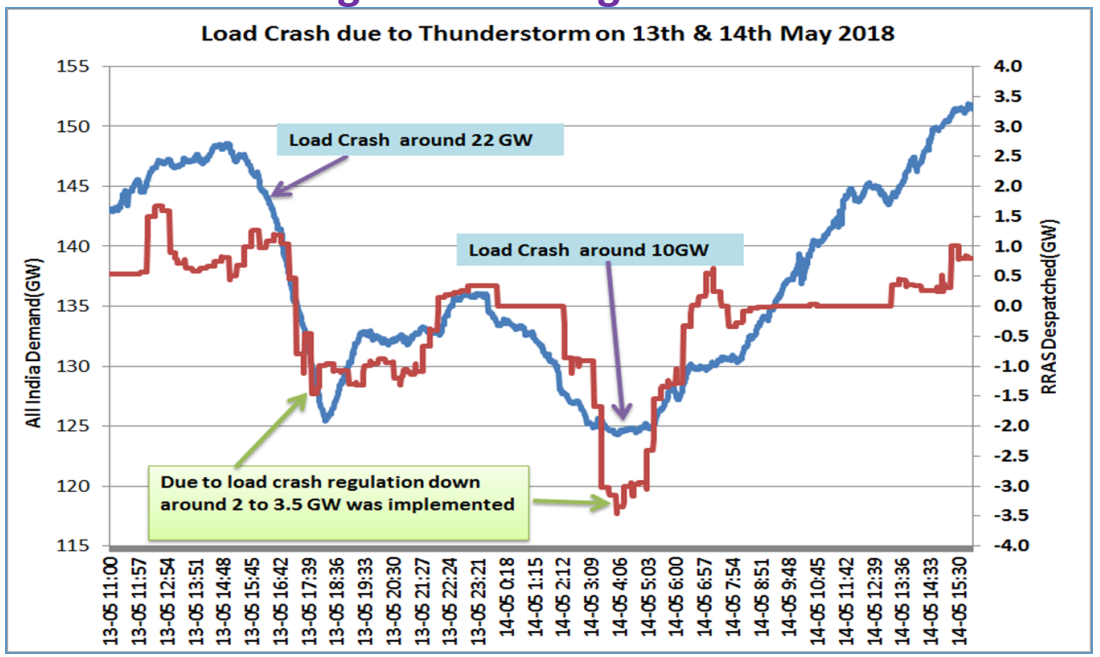


Response → / ↓ Attribute	Inertial	Primary	Secondary	Fast Tertiary	Slow Tertiary	Generation Rescheduling/Market	Unit Commitment
Time	First few secs	Few sec - 5 min	30 s – 15 min	5 - 30 min	> 15 – 60 min	> 60 min	Hours/ day-ahead
Quantum	~ 10000 MW/Hz	~ 4000 MW	~ 4000 MW	~ 1000 MW	~ 8000-9000 MW	Load Generation Balance	Load Generation Balance
Local / LDC	Local	Local	NLDC/RLDC	NLDC	NLDC/SLDC	RLDC / SLDC	RLDC / SLDC
Manual /Automatic	Automatic	Automatic	Automatic	Manual	Manual	Manual	Manual
Centralized / Decentralized	Decentralized	Decentralized	Centralized	Centralized	Centralized/ Decentralized	Decentralized	Decentralized
Code / Order	IEGC / CEA Standard (?)	IEGC / CEA Standard	CERC Order Pan-India AGC	CERC Order on FRAS Pilot	RRAS Regulations	IEGC; CERC Order Pilot on SCED upto 31st March, 2020	IEGC
Paid / Mandated	Mandated	Mandated	Paid	Paid	Paid	Paid	Paid
Regulated / Market	Regulated	Regulated	Regulated	Regulated	Regulated / Market	Regulated / Market	Regulated / Market
Implementation	Existing	Partly Existing	Pilot 5 plants	Pilot 19 plants	Existing	Existing	Existing

Freq. Profile improvement

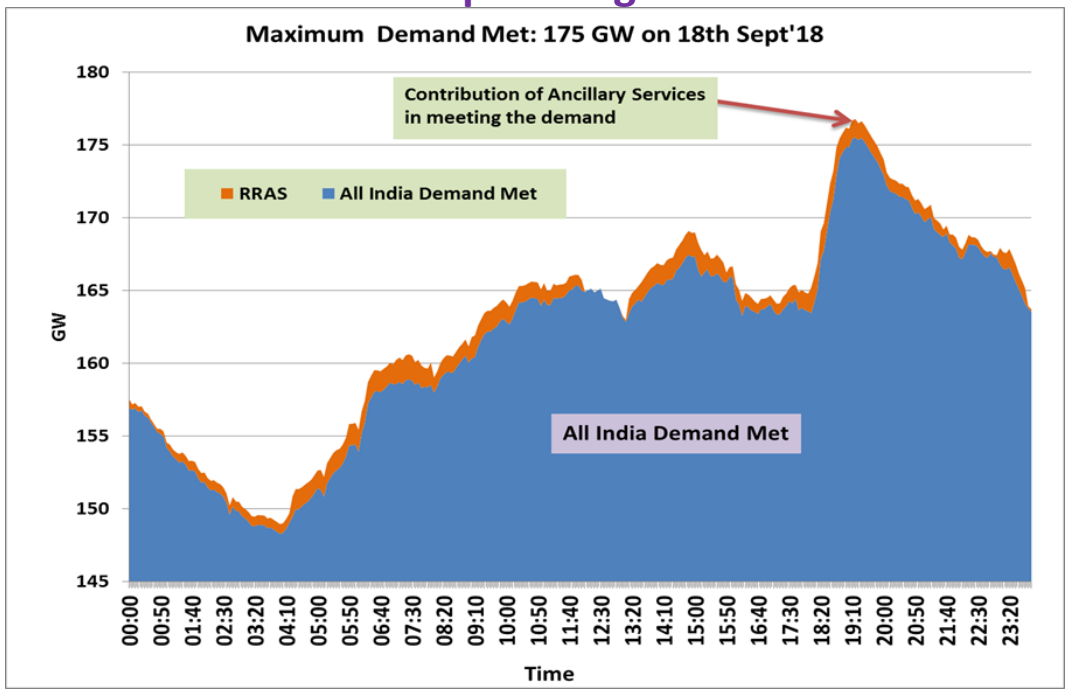


Handling Grid Contingencies



ASO Experience at ISTS level

Ramp Management



Facilitating RE absorption