MINUTES OF THE 50TH MEETING

OF THE

FORUM OF REGULATORS (FOR) HELD AT PUNE

Venue	**:**	**Majestic Hall-I** **Le Meridien** **Pune (Maharashtra)**
Dates	**:**	**29th September, 2015 – 01st October, 2015**
List of Participants	**:**	**At Annexure-I (enclosed)**

The meeting was chaired by Shri Gireesh B. Pradhan, Chairperson, Central Electricity Regulatory Commission (CERC) and Forum of Regulators (FOR).

In his opening remarks, the Chairperson, CERC / FOR, while extending a warm welcome to all members of the Forum to the 50th meeting of the Forum, placed on record appreciation and gratitude for all the past and present Members of FOR for their invaluable contributions to the fruition of Forum, as a think tank on the policy and regulation of electricity sector.

Release of Compendium of "FOR" Reports, Compendium of Minutes of "FOR" Meetings and Study Report of "FOR" on Reduction of Cross Subsidies :

The FOR Secretariat compiled and printed 7 volumes of Compendium of FOR Study Reports (brought out since inception of FOR in 2005 and totalling to 50 reports on various subjects) and 7 volumes of minutes of FOR Meetings (held between 2005 and March 2015) and a separate FOR Study Report on Road Map for Reduction of Cross Subsidies. The Chairperson, CERC / FOR along with Chairperson, Maharashtra Electricity Regulatory Commission (MERC), and Chairperson, Punjab State Electricity Regulatory Commission (PSERC) released all volumes of the compendia and the study report. He thanked the FOR Secretariat for their arduous efforts in bringing out these editions.

The FOR thereafter took up the agenda items for consideration.

Agenda Item No. 1 : Confirmation of the Minutes of the 49th FOR Meeting held during 26th – 28th July, 2015 at Hotel Hyatt Regency, Ashram Road, Usmanpura, Ahmedabad (Gujarat).

The Forum noted and endorsed the minutes of the 49th Meeting of FOR held at Ahmedabad (Gujarat) during 26th – 28th July, 2015.

Agenda Item No. 2 : Model Regulations (State level) for Forecasting, Scheduling and Imbalance handling for variable RE Sources (Wind & Solar).

During the 49th meeting of FOR held at Ahmedabad (Gujarat), the Forum discussed the "Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar)" published by the CERC. The Forum, while appreciating the framework had directed the FOR Secretariat to evolve draft Model Regulations for SERCs / JERCs for implementation of the framework and place the same for further consideration by the Forum. In pursuance to these directions, the FOR Secretariat evolved Model Regulations (State level) for Forecasting, Scheduling and Imbalance handling for variable RE Sources (Wind & Solar).

A presentation was made by Dr. Sushanta K. Chatterjee, Joint Chief (Regulatory Affairs), CERC, on the proposed Model Regulations (enclosed as Annexure - II). The salient features of the Model Regulations are as under :

1. The Model Regulations aim to facilitate
    a. Grid operators to have day-ahead and hour-ahead visibility into how much renewable power is expected to be injected which allows them to forecast 'net load' and planning for up and down ramps of net load;

b. The generators to integrate with the grid in a sustainable way, without incurring backing-down losses, while addressing inherent variability and uncertainty of RE;

c. Providing incentives for accurate forecasting and minimizing MW deviations from schedule;

2. The Electricity Act, 2003 provides that State Grid Code shall be consistent with the Grid Code notified by CERC. Further, Tariff Policy also requires the State Commissions to implement the ABT mechanism in line with the framework specified by CERC.

3. Regulations provide for an aggregator / qualified coordinating agency (QCA) to facilitate the generators with the services related to forecasting / aggregate schedules / schedule revisions, metering, telemetry, communicating with SLDSs, de-Pool deviations etc.

4. Mandatory forecasting by SLDC as well as wind / solar generator / Aggregator / QCA (as the case may be). Commercial impact of deviation from forecast would have to be borne by the RE generator.

5. Flexibility in revision of schedule by allowing a maximum of 16 revisions, i.e., one revision in six time blocks and effective from the 4^{th} time block.

6. Zero Tolerance band of ± 15% for the existing wind/solar generators and ± 10% for the new wind/solar generators has been provided,

meaning thereby that there would be no commercial impact for deviation within this band. With revised definition of Error [Error defined with reference to available capacity, i.e., Error (%) = 100x(Actual – Schedule) / (Available Capacity)], this band gives wide amplitude to the wind and solar generators to manage their generation without adverse commercial impact.

7. Penalties are symmetrical for over-injection and under-injection. Hence, no perverse tendencies should exist for scheduling below or above forecast. Within the tolerance band where there is no penalty on the generator, the impact of deviation is being socialized completely.

8. The regulations provide for detailed energy accounting procedure for finalizing deviation charges and its settlement for distribution companies, open access consumers, conventional generators, RE generators. Separate accounting has been prescribed for “Schedule”, “Actual” and “Deviation”.

9. For RE generators connected to the State grid and selling power within the State, the payment by buyer can continue to be as per actual generation. Accordingly, REC adjustment will not be required.

10. For RE generators connected to the State grid but selling power outside the State boundary, commercial settlement has to be aligned with the regional framework. Thus, their payment shall be made as per schedule, and deviation settlement will follow a framework similar to the Regional Framework on Forecasting, Scheduling and Imbalance Handling as notified by CERC. The accounting shall be done by SLDC, and the settlement shall be done with the State DSM pool.

    For such generators, RPO balancing will be required to be undertaken by SLDC. For example, in case of under-injection, equivalent RECs from the exchange shall be procured by SLDC and extinguished, while for over-injection, RECs could be credited to State DSM pool as carry forward for next cycle.

11. Once energy accounting for all grid connected entities is put in place, all solar & wind generators can be treated together as a virtual pool within the State Pool. Deviations for and within this virtual pool could be settled first at the rates and methodology stipulated by Model Regulations.

12. In case there is deficit in the State DSM pool at the end of the year, due to mismatch between deviation charges paid by RE generators

and DSM charges payable at State boundary due to RE deviations, then the SLDC may approach National Funds such as PSDF or NCEF to cover such deficit.

Consensus:

The Forum endorsed the Model Regulations (State level) for Forecasting, Scheduling and Imbalance handling for variable RE Sources (Wind & Solar). The Forum appreciated the suggestion of support from PSDF/NCEF or some other Central Fund to the RE resource rich States as part of implementation of the aforesaid framework and reiterated that this should be available for a definite period, say of three years, to enable the States to adjust to the new regime seamlessly.

Agenda Item No. 3 : Presentation and Discussion on "UMPP for Poor : A step towards ensuring 24x7 power to all".

Representatives of Prayas Energy Group, Pune made a presentation on "UMPP for Poor: A step towards ensuring 24x7 power to all" (**enclosed** as **Annexure - III**). The presentation inter alia included

a. Present status of electrification, access and supply of electricity in the country.

b. Factors included in the current scheme of "24x7 Power for All" announced by the Government of India.

c. Challenges in providing 24x7 supply to all.

d. Cost components for electrification which include, network infrastructure, operations & maintenance and finally 24x7 supply of power.

e. Existing structural dis-incentives to provide supply to rural households.

f. Approaches for overcoming the structural dis-incentives, inter alia, include

- Allocation of low cost power to States facing access challenge
- GoI support under DDUGJY for network augmentation and subsidy for overcoming structural disincentive
- Strong accountability based on contractual arrangements
- Withdrawal of power allocation in case of non-compliance
- Time-bound reduction in fiscal impact.

The Forum appreciated the presentation.

Agenda Item No. 4 : Presentation and Discussion on the Report on "Current Worries – Ebbing Performance of India's Power Sector".

Representatives of CRISIL Ltd., made a presentation before the Forum on "Current Worries – Ebbing Performance of India's Power Sector" (**enclosed as <u>Annexure - IV</u>**). The issues brought out in the presentation included,

a. Viability risks of lower off take, fuel shortage and after-effects of aggressive bidding, being faced by the thermal generation capacities

b. Liquidity pressure faced by discoms of six States after financial restructuring package (FRP) moratorium.

c. Lack of inclination by discoms to sign PPAs

d. Short lived Relief from FRP in view of persistent gap between procurement costs and unit realization.

e. Key inefficiencies existing in the system.

f. Suggested way forward including

    1. Better demand forecasting by discoms to enter into medium term PPAs.

    2. Facilitation of Open Access

    3. Augmentation of domestic coal production through faster environmental clearances

    4. Targeting improvement in agricultural metering and feeder separation.

The Forum appreciated the presentation.

Agenda Item No. 5 : Presentation and Discussion on "Standard Offer Programme – Handbook July 2015".

Representatives of Shakti Sustainable Energy Foundation and MP EN Systems Advisory Private Ltd. together brought out a handbook on “Standard

Offer Programme". This Handbook is a "How-To" guide which captures details of DSM design and implementation approaches. A presentation (**enclosed** as **Annexure - V**) was also made in this context, which included

- Status of DSM Programs at a Glance
- Standard Offer Program as Feed-in-Tariff for Efficiency and Load Management
- Decision Framework to Determine SOP Price
- Structure of the Handbook (incl. How-to-do Guide, Contents & Formats etc.)
- Examples from Indian industry – "DSM based energy efficiency programme by EESL" and "Tata Power Commercial Standard Offer".

Chairperson, CERC on his behalf and on behalf of the Members of the Forum conveyed deep gratitude to Shri U.N. Panjiar, Chairperson, Bihar Electricity Regulatory Commission (BERC), who was due to retire on 1st October, 2015, for his outstanding contribution to the Forum.

Chairperson, CERC / FOR also thanked the Chairperson, Members and staff of the Maharashtra Electricity Regulatory Commission (MERC) for their painstaking efforts to host the 50th meeting of FOR at Pune (Maharashtra).

Smt. Shubha Sarma, Secretary, CERC/FOR, conveyed sincere thanks to all the dignitaries present in the meeting. She also thanked the staff of "FOR" Secretariat for their arduous efforts at 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 50TH MEETING

OF

FORUM OF REGULATORS (FOR)

HELD DURING 29TH SEPTEMBER, 2015 – 01ST OCTOBER, 2015 AT PUNE (MAHARASHTRA).

S. No.	NAME	ERC
01.	Shri Gireesh B. Pradhan Chairperson	CERC – in Chair.
02.	Shri Naba Kumar Das Chairperson	AERC
03.	Shri Digvijai Nath Chairperson	APSERC
04.	Shri Umesh Narayan Panjiar Chairperson	BERC
05.	Shri Narayan Singh Chairperson	CSERC
06.	Shri P.D. Sudhakar Chairperson	DERC
07.	Shri Jagjeet Singh Chairperson	HERC
08.	Shri Basharat Ahmed Dhar Chairperson	J&KERC
09.	Justice (Retd.) Shri N.N. Tiwari Chairperson	JSERC
10.	Shri S.K. Chaturvedi Chairperson	JERC for Goa & All UTs except Delhi
11.	Shri R.K. Kishore Interim Chairperson	JERC for Mizoram and Manipur
12.	Shri M.K. Shankaralinge Gowda Chairperson	KERC
13.	Shri T.M. Manoharan Chairperson	KSERC
14.	Dr. Dev Raj Birdi Chairperson	MPERC
15.	Ms. Chandra Iyengar Chairperson	MERC
16.	Shri Anand Kumar Chairperson	MSERC

17.	Shri Satya Prakash Nanda Chairperson	OERC
18.	Ms. Romila Dubey Chairperson	PSERC
19.	Shri Vishwanath Hiremath Chairperson	RERC
20.	Shri S. Akshayakumar Chairperson	TNERC
21.	Shri Niharendu Chakraborty Chairperson	TERC
22.	Shri Subhash Kumar Chairperson	UERC
23.	Shri Rabindra Nath Sen Chairperson	WBERC
24.	Shri K.M. Shringarpure Member	GERC
25.	Ms. Shubha Sarma Secretary	CERC
26.	Dr. Sushanta K. Chatterjee Joint Chief (RA)	CERC
SPECIAL INVITEES		
27.	Shri A.K. Singhal Member	CERC
28.	Shri A.S. Bakshi Member	CERC
29.	Dr. M.K. Iyer Member	CERC

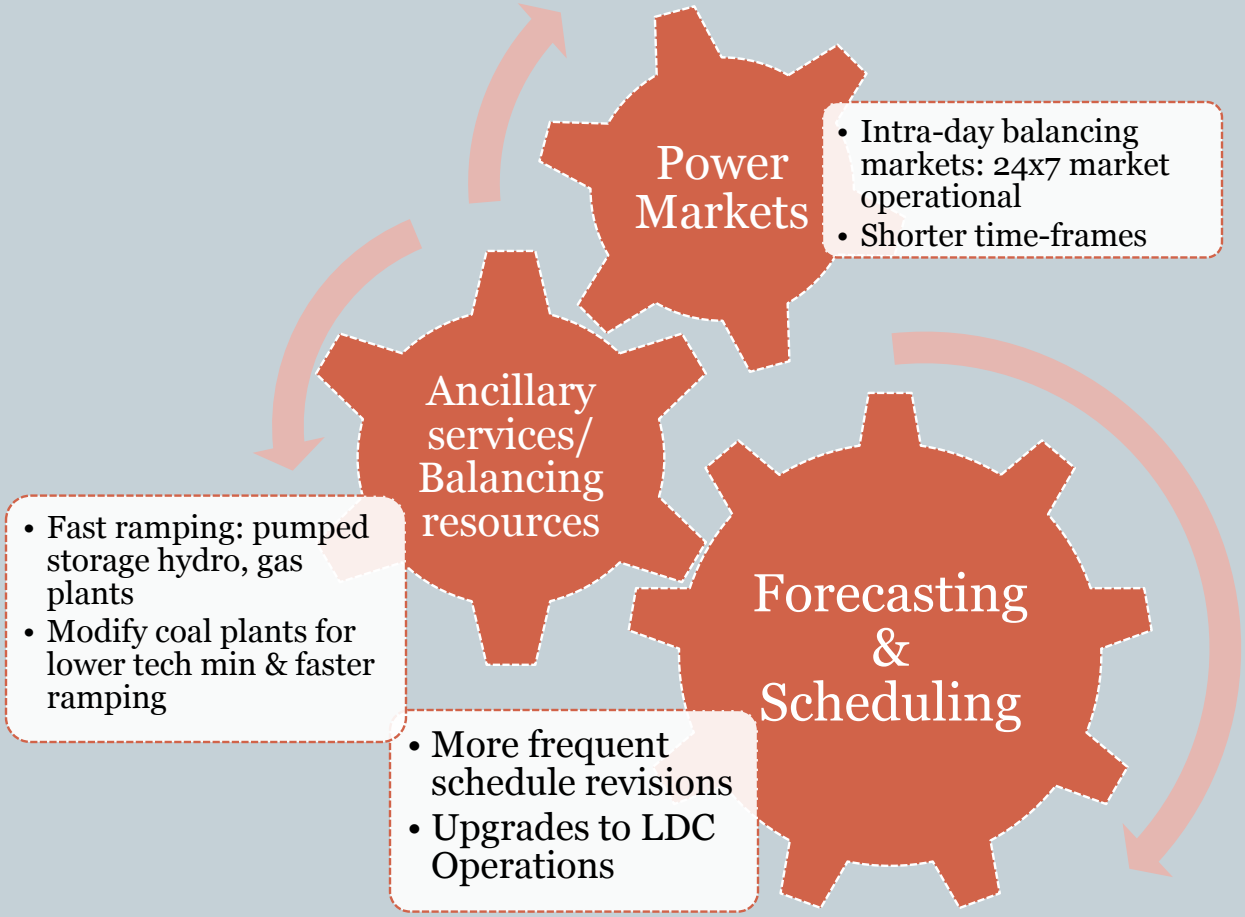
State Model Regulation for Solar & Wind Generators

SEPTEMBER 30TH 2015

50TH MEETING OF THE FORUM OF REGULATORS

PUNE

Integration of RE Sources into the Grid



Recent Progress on Grid-Integration of Variable Renewable Energy

- CERC notified the Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar)- for Regional Entities- on 7/8/15
- CERC notified the Ancillary Services Operations Regulations, 2015, applicable on ISTS, on 19/8/15
- At 49th FOR meeting in Ahmedabad, States requested CERC to frame a Model Regulation on operational and commercial framework for intra-state[1] wind & solar generators

[1] connected directly to the State grid

Scheduling & Deviation Settlement for States

Objectives of Model Framework for States

1) To roll out forecasting & scheduling for wind and solar generators so that Grid operators
   - have day-ahead and hour-ahead visibility into how much renewable power is expected to be injected
   - can forecast 'net load' (load – RE power)
   - can plan for up and down ramps of net load
   - can plan balancing resources for managing uncertainty
2) For generators to integrate with the grid in a sustainable way, so they do not have to incur backing-down losses, while addressing inherent variability & uncertainty of RE
3) To provide incentives for accurate forecasting & minimizing MW deviations from schedule

Challenges

- Few states have implemented Availability Based Tariff (ABT) mechanism as stipulated in IEGC:
  - Chhattisgarh, Delhi, Gujarat, Maharashtra, MP, West Bengal
- Nearly all states have unique methodology of intra-state commercial settlement
- Fragmented wind industry: 27,853 wind turbines owned by over 5,000 generators
- 3GW of solar capacity to be scaled to 100 GW, in various forms and different transaction types
- Commercial metering point varies across states

Aggregator: Qualified Coordinating Agency (QCA)

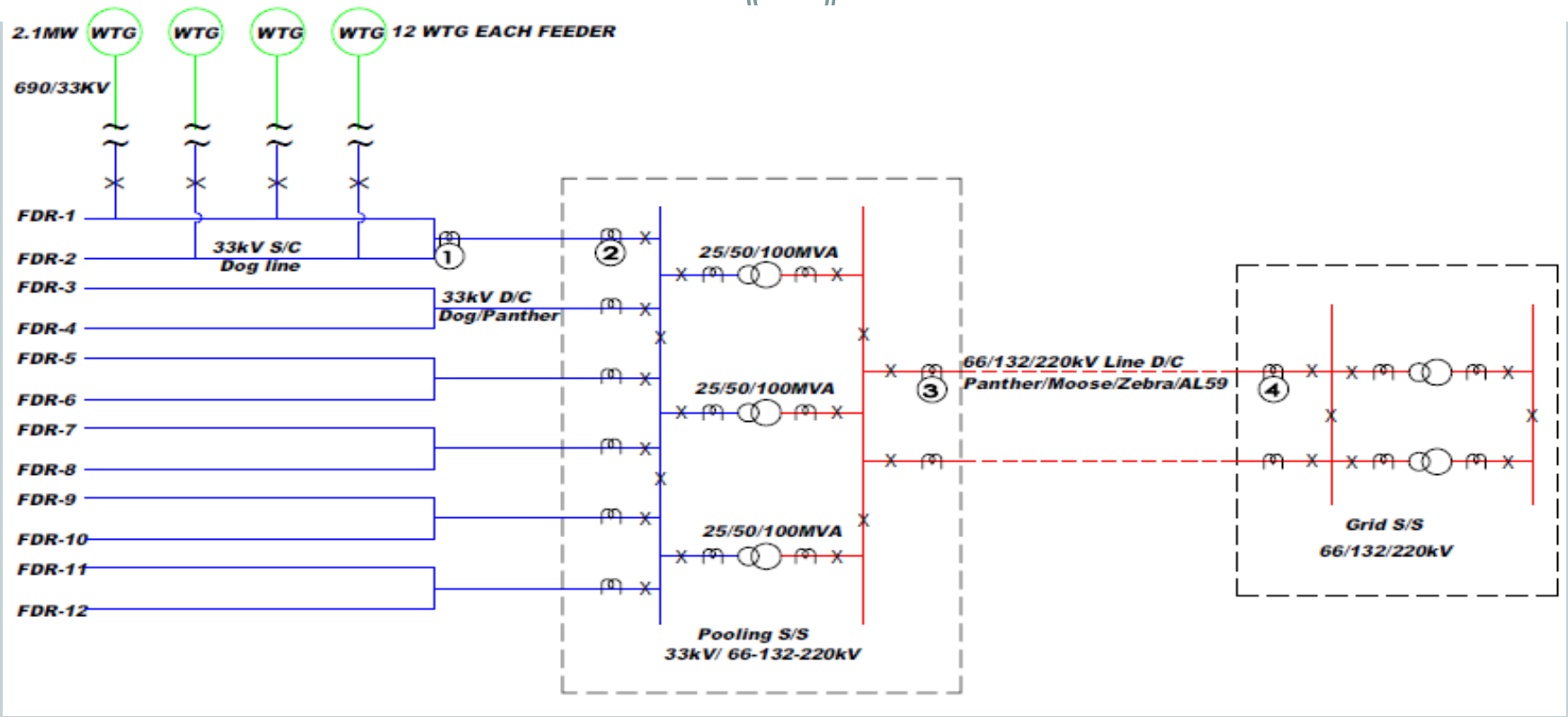
To coordinate at a pooling station level:

- Forecasting
- Aggregate schedules and schedule revisions
- Metering & telemetry
- Communicate with SLDC
- De-pool energy deviations
- De-pool deviation charges; o*n basis of actual generated units*

Advantages

- ✓ SLDCs do not need to interact with thousands of generators
- ✓ Small generators do not have to build capacity on forecasting & scheduling

Wind Rich States: Metering & Energy Accounting



State	AP	GJ	KN	MH	MP	RJ	TN
Billing Meters Position	3&4	3	4	2&3	1	2&4	0&1

Forecasting & Scheduling of RE generators

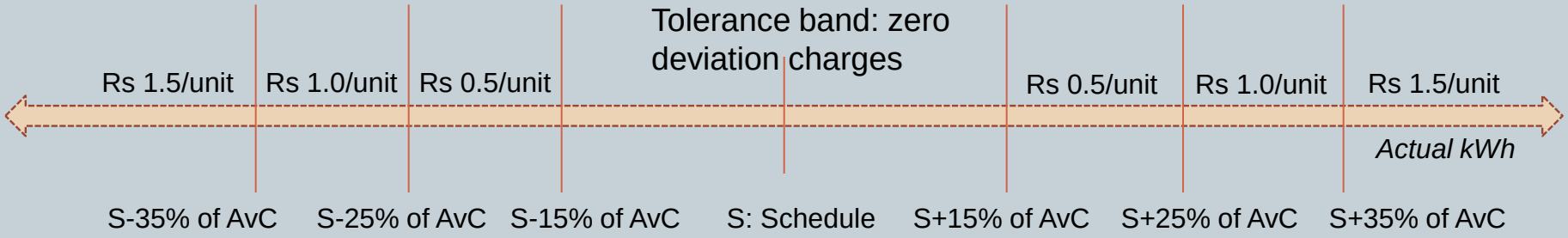
First and necessary step towards managing VRE on the grid

- Forecasting to be done both by QCA/generator as well as SLDC
- Day-ahead and week-ahead schedule on a time-block basis to be submitted to SLDC
- Up to 16 revisions allowed in a day, one per 6 time-blocks, effective from the 4th time-block
- Plan for data telemetry, process for submission and revisions to be outlined in Detailed Procedure to be prepared by SLDC
- Smart meters at pooling stations a must for SLDC; QCA to meter individual turbines

Proposed Deviation Settlement for RE generators

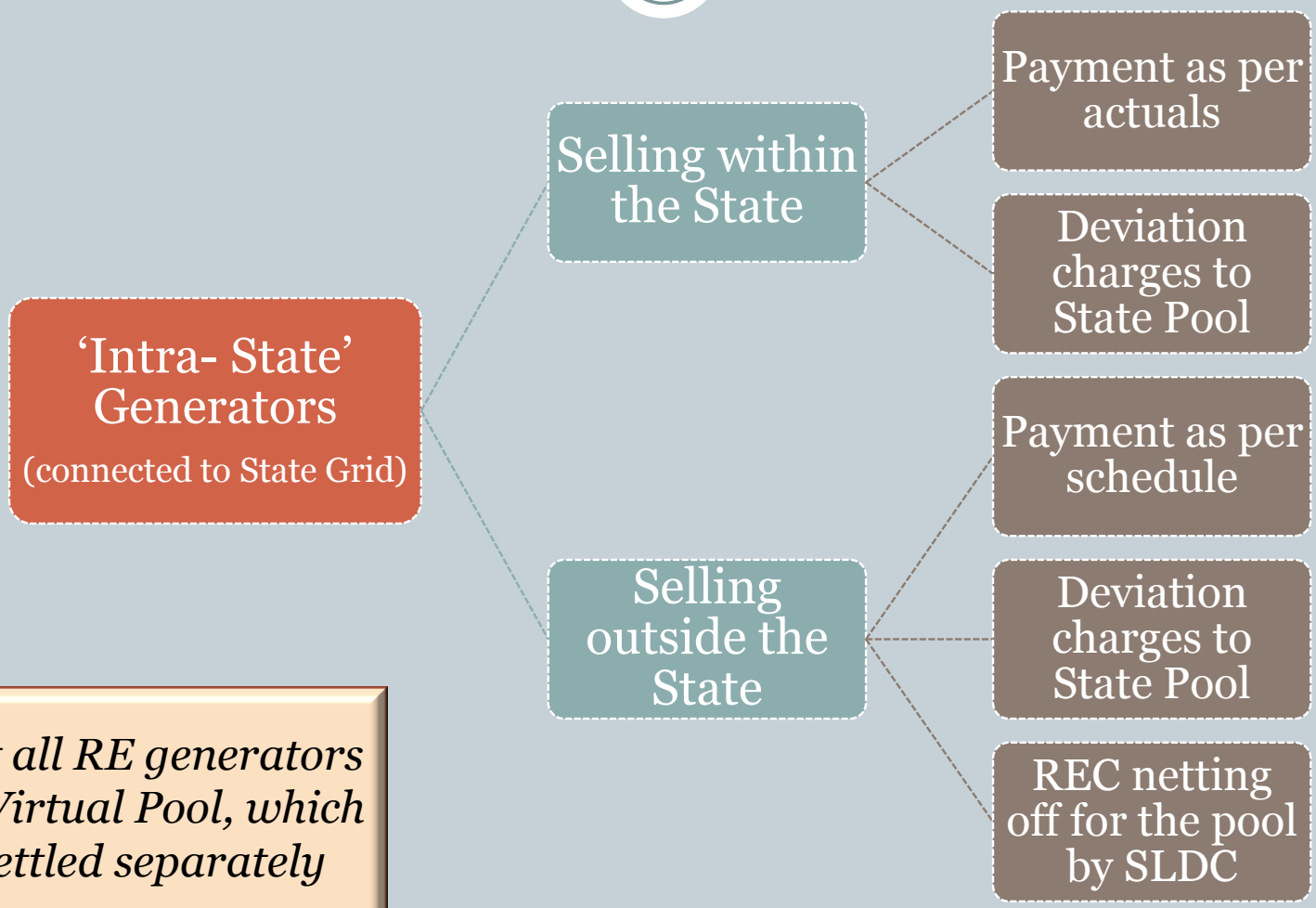
'Absolute Error' : absolute value of the error in actual generation w.r.t. scheduled generation and the 'Available Capacity' (AvC), for each time block: Error (%) = 100 X [Actual Generation– Scheduled Generation] / (AvC) ;

Deviation Charges:



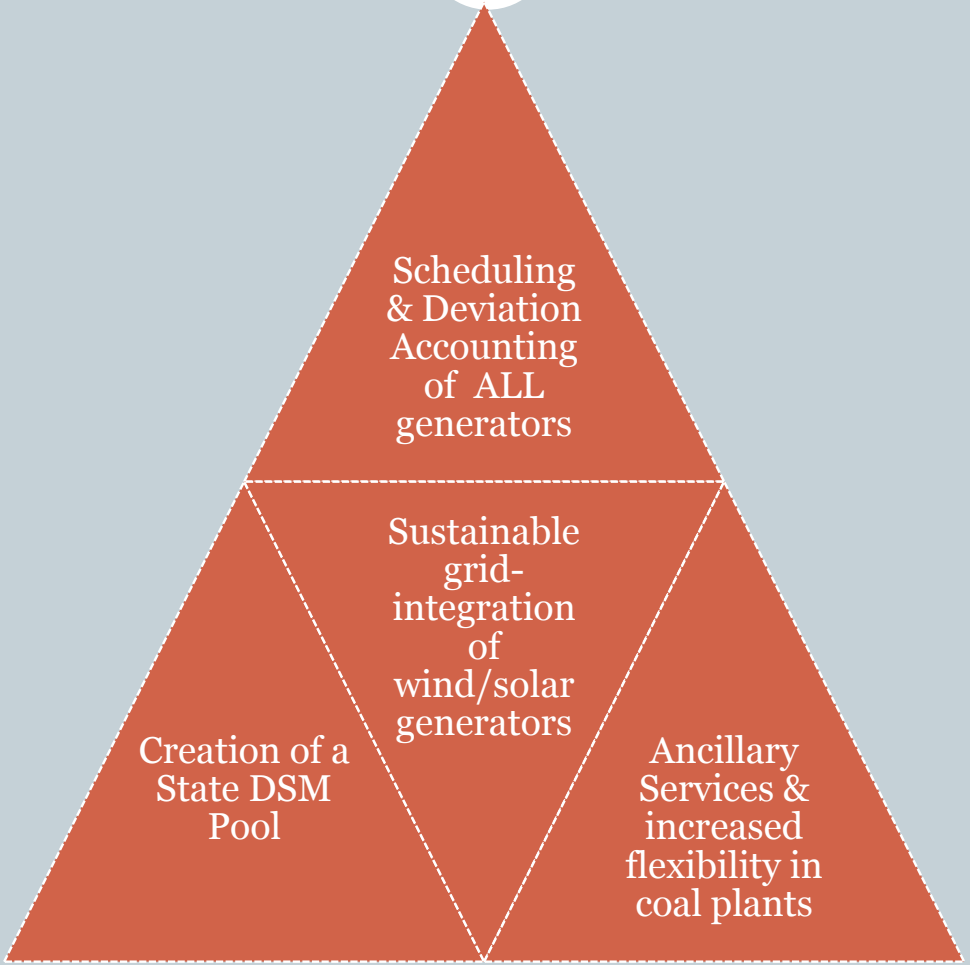
- **15% tolerance band for existing wind / solar generators**
- **10% tolerance band for new wind / solar generators**

Intra-state RE generators: 2 types of transactions



Treat all RE generators as a Virtual Pool, which is settled separately

Cornerstones of sustainable Regulatory Framework for grid-integration of Solar & Wind sources



Accounting Process

1. Metering (SEM) at interface point

Distribution companies	Open access consumers	Conventional generators	Renewable energy generators at pooling station level

2. Energy Accounting

Separate Energy Accounting of Schedule	Separate Energy Accounting of Actual	Separate Energy Accounting of Deviation

3. Deviation Charge and its Settlement

Computation of deviation charge	Allocation of deviation charge

2. Energy Accounting

A. Separate Energy Accounting of schedule

- (i) distribution companies (drawl)
- (ii) open access consumers (drawl)
- (iii) conventional generators (generation)
- (iv) renewable energy generators at pooling station level (generation)

B. Separate Energy Accounting of actual

- (i) distribution companies (drawl)
- (ii) open access consumers (drawl)
- (iii) conventional generators (generation)
- (iv) renewable energy generators at pooling station level (generation)

C. Separate Energy Accounting of deviation

- C1: A(i) - B(i) distribution companies (drawl)
- C2: A(ii) - B(ii) open access consumers (drawl)
- C3: A(iii) - B(iii) conventional generators (generation)
- C4: A(iv) - B(iv) renewable energy generators at pooling station level (generation)

3. Deviation Charge and its Settlement

Computation of Deviation Charge

- Compute Deviation Charge (D) payable/receivable for the State as a whole at the State periphery

- Implement DSM mechanism for RE generators on lines of model regulation and collect in the State DSM pool, deviation charge (R1) from the pooling stations/RE generators based on the said model

Settlement of deviation charge

- Allocate (D) amongst the distribution companies/OA consumers/conventional generators/RE generators in proportion to their respective deviation viz., C1/C2/C3/C4
- For RE generators, assuming (i) the share out of State level deviation charge as D4 and (ii) receipt of deviation charge from RE generators (Pooling station) based on the charges for deviation as per the model regulation, as R1 -
- actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

This amount (D4 - R1 if greater than zero) can be refunded to the State DSM pool from PSDF/NCEF

Another model

Step 1 & Step 2 : Same as in Model 1

Step 3: Deviation Charge and its Settlement

Computation of Deviation Charge

- Compute Deviation Charge (D) payable/receivable for the State as a whole at the State periphery
- Implement Deviation Settlement Mechanism(DSM) for conventional generators on lines of CERC DSM or any other variant, that is, determine in advance the deviation charge payable/receivable by all grid connected entities within the state
- Implement DSM mechanism for RE generators on lines of model regulation and collect in the State DSM pool, deviation charge (R1) from the pooling stations/RE generators based on the said model

Settlement of deviation charge

- Compute for the distribution companies/OA consumers/conventional generators, the deviation charges payable/receivable by them in proportion to their respective deviation viz., C1/C2/C3 (this should be as per State level DSM)….(assume net balance as D1)
- In respect of RE generators, collect deviation charge from the RE generators (Pooling station) based on the charges for deviation as per the model regulation (assume as R1)
- actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

If D is greater than (D1+R1), the differential be made good from the PSDF/NCEF

Deviation Accounting: Illustration

- State periphery UI Charge = Rs. 100 Cr.
- Deviation of Discom = 40 MW(h)
- Deviation of OA Consumer = 10 MW(h)
- Deviation of Conventional Generators = 30 MW(h)
- Deviation of RE Generators = 20 MW(h)

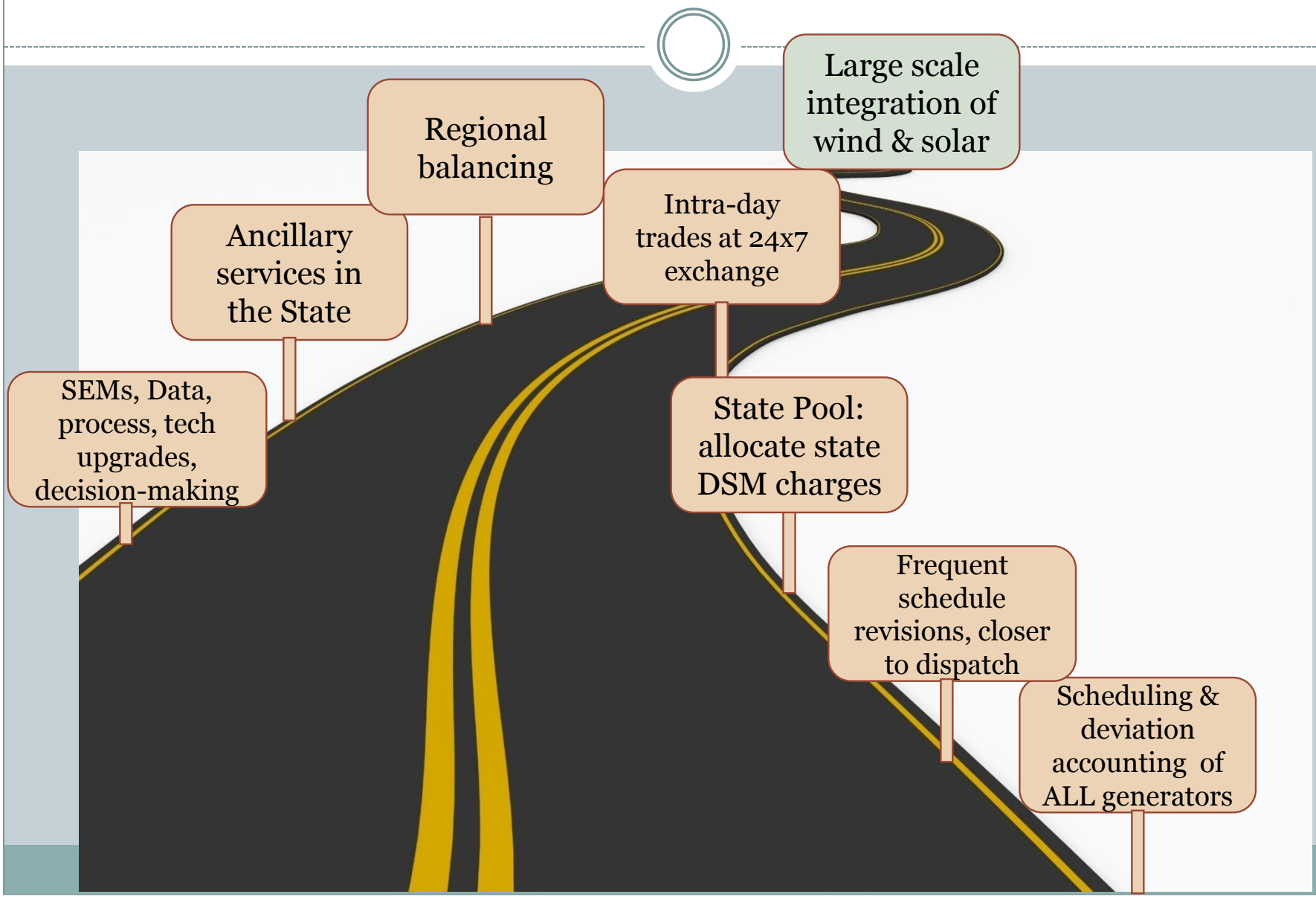
Deviation Settlement: Illustration				
For RE Generator	**(A)**	**(20/100)X100**	**=**	**Rs. 20 Cr.**
Receipt from RE Generator	**(B)**		**=**	**Rs. 12 Cr.**
Difference (to be funded from DSDF / NCEF)	**(A)-(B)**		**=**	**Rs. 8 Cr.**

- Settlement of other entities (OA, discoms, Conventional Generators) also on similar principles.

Implementing Intra-State Deviation Settlement

- Regulations by concerned SERC
- Procedures for Scheduling, Metering, Accounting, Settlement
- Interface Metering for intra-state entities
  - Multiple manufactures e.g., L&T, Secure Meters, Elster, etc.
  - Typical cost per meter as per CEA standard – Rs. 50,000
  - Estimated no. of meters in a state : 250
  - Total estimated cost: Rs. 2 Crores
- Software Requirement for scheduling, metering, accounting and settlement
  - Estimated cost Rs. 2 – 3 Crores
- Capacity building of stakeholders
- Total Estimated Timeframe for implementation: 3 - 6 months
- Past experience – Implemented in Gujarat, MP, Maharashtra, Chattisgarh, Delhi, West Bengal, etc.

The Roadmap


Large scale integration of wind & solar
Regional balancing
Intra-day trades at 24x7 exchange
Ancillary services in the State
SEMs, Data, process, tech upgrades, decision-making
State Pool: allocate state DSM charges
Frequent schedule revisions, closer to dispatch
Scheduling & deviation accounting of ALL generators

THANK YOU

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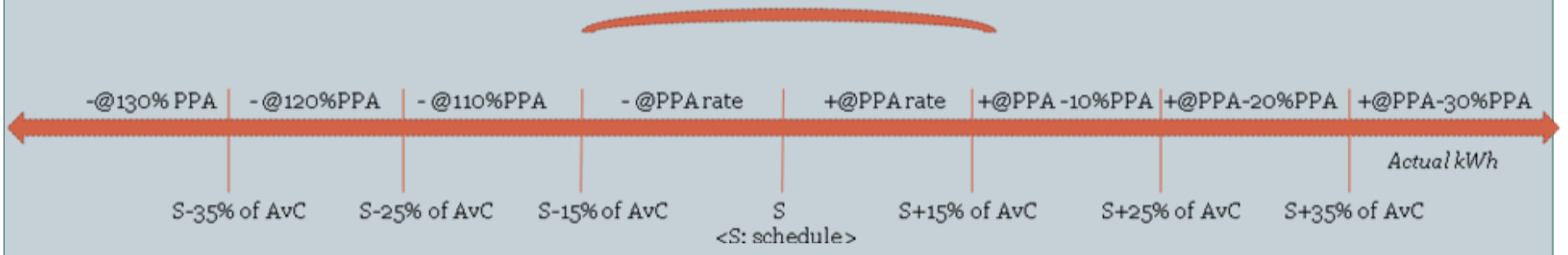
ANNEXURE

Deviation Settlement Framework for Regional Entities



- Error definition: [(Actual generation – Scheduled generation)/Available Capacity] x 100
- Payment as per schedule @PPA Rate
- Deviation Settlement within tolerance band (+/- 15%):
  - Receipt from/payment to pool @PPA rate (i.e. in effect, payment as per actuals)
- Beyond 15%, a gradient band for deviation charges is proposed as follows:

Abs Error (% of AvC)	*Deviation Charge*
15%-25%	10% of PPA rate
25%-35%	20% of PPA rate
>35%	30% of PPA rate

- 16 revisions allowed, one for every one-and-half-hour block, effective from 4th time-block.

Settlement of RPO under revised framework

- RPO deemed complied at scheduled generation
- In case of under-injection by RE generator, actual units to be balanced with RPO
  - Need for procurement of equivalent REC for shortfall in RE generation
- Similarly over-injection necessitates
  - crediting REC towards such excess generation

Instead of procuring or crediting REC for each case

- all RE under/over-injections can be netted off (on monthly basis) for the entire pool first

- RE shortfall: RECs will be purchased from exchange and extinguished
- RE surplus: notional RECs will be credited to DSM Pool as carry forward for next cycle

- **Example:**

Total RE Over-injections in pool = 10,090 MWh; Total Shortfall = 10,195 MWh
Net= Over-injections – Shortfalls = 10,090 -10,195= - 105 MWh

Central Agency (on behalf of DSM pool) purchases 105 RECs from market for shortfall at end of month

Settlement & Deviation Charges for Open Access and Captive Power Plants

- Settlement of OA and CPP poses challenge, particularly for CPP where there is no PPA rate
- Therefore a reference rate equal to APPC at National level that may be determined by CERC through order
- All deviations from schedule by these entities must be settled at APPC rates.

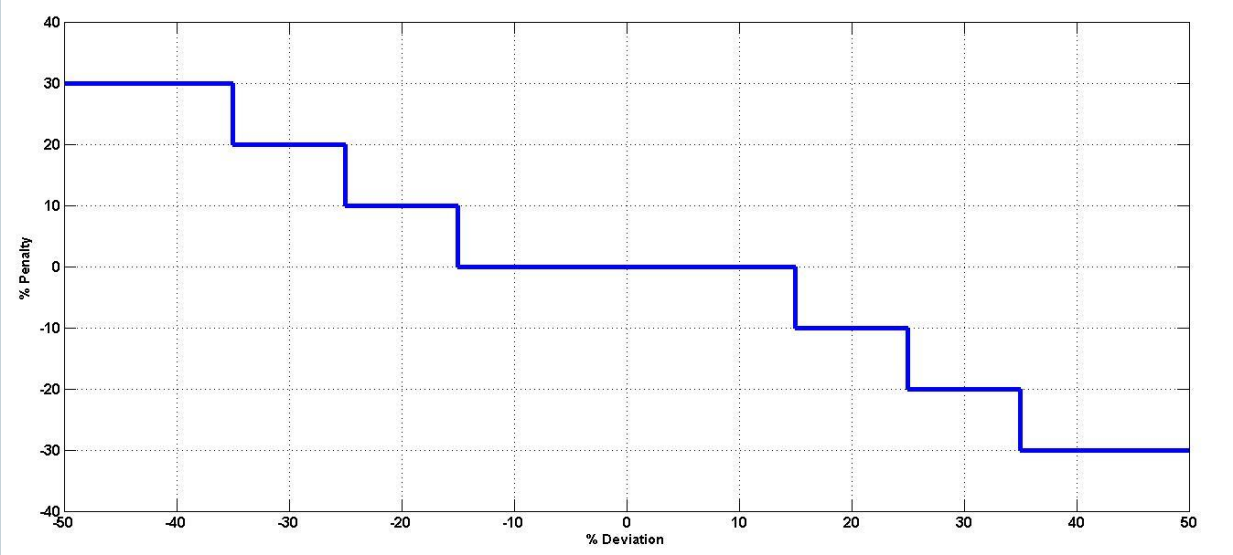
Example:

OA/CPP deviation from schedule = 20 MWh of shortfall; APPC = 3 Rs/kWh

OA/CPP pays = 20*3*1000 = Rs. 60,000 to DSM pool

Framework minimizes gaming

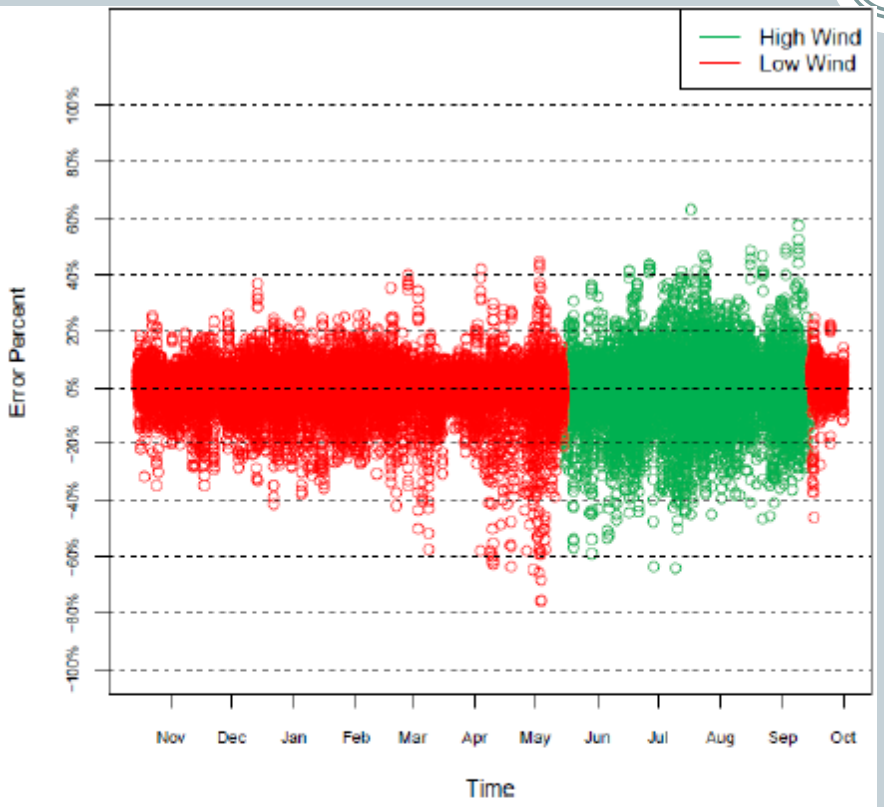
- Reference rate to be the PPA rate
  - deviation charges determined as a % of this rate
  - will ensure equitable burden for the same error among generators
- Symmetrical deviation charge for under and over-injection
  - ensures no perverse incentive to over-schedule or under-schedule vs forecast
  - charges for deviation symmetrical around zero



Advantages of the proposed framework

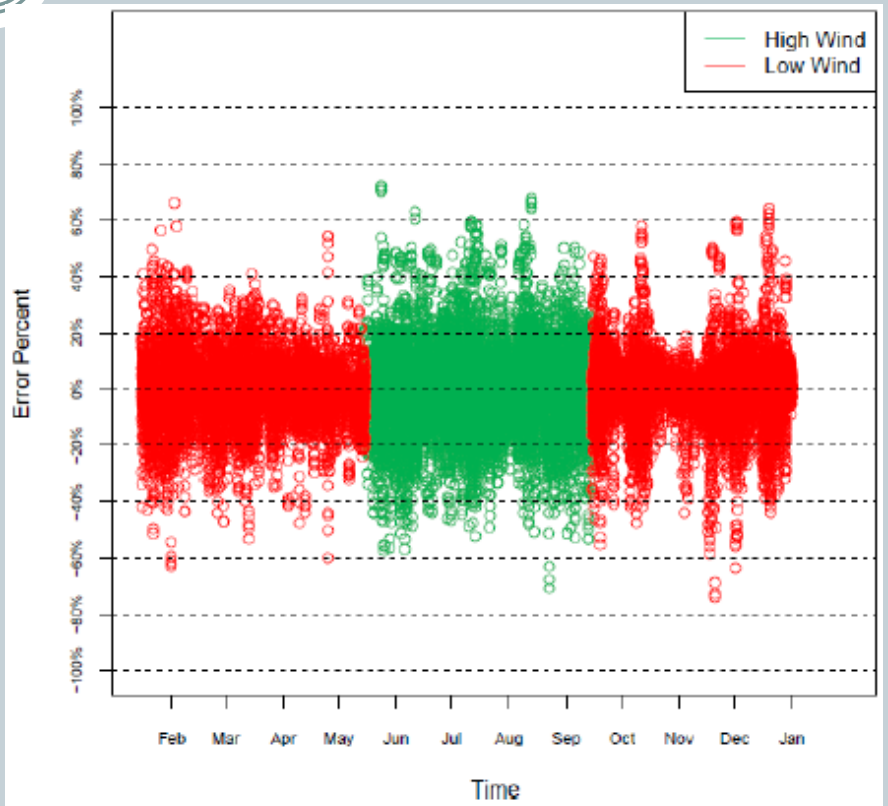
- In sync with conventional deviation and settlement framework
- Budgeting and matching easier
- Minimizes possibility of gaming
- Will give fillip to RPO compliance, while no risk of REC price on generator
- Risk shared between RE generator and buyer
- No impact on revenue for generators within the free & comfortable 15% band
- Band can be tightened later with more forecasting experience
- Will not result in windfall gain or loss to generators; generator equity

Error normalized to capacity: simulation studies by GE



Period	MAE
Overall	6.21%
High Wind	8.22%
Low Wind	5.12%

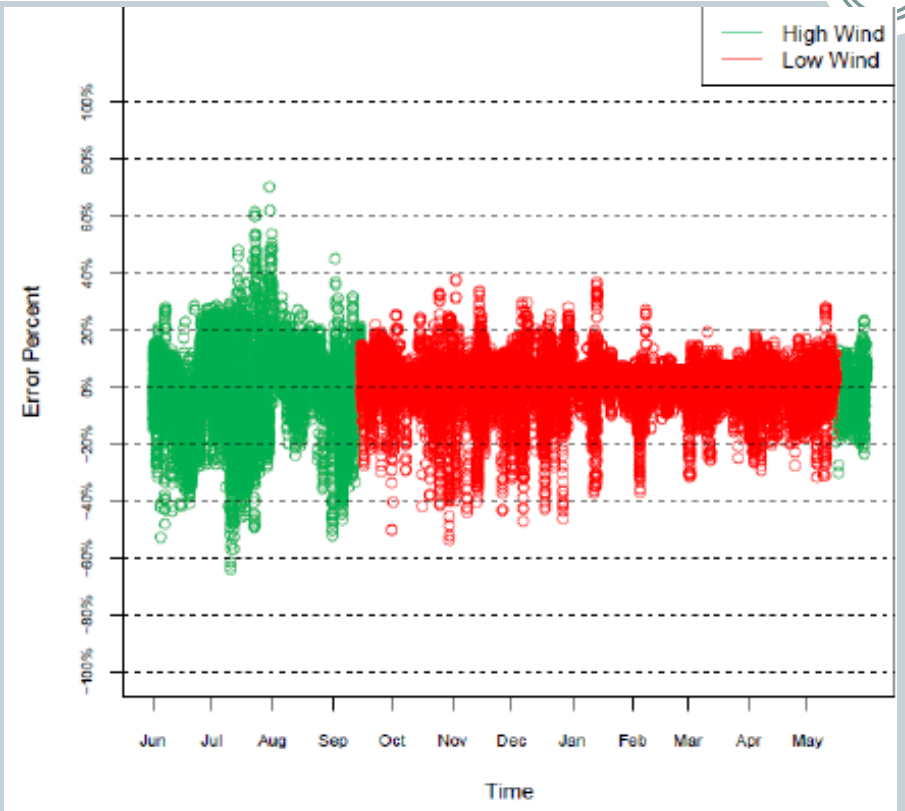
Site A: 25.5 MW



Period	MAE
Overall	8.62%
High Wind	10.84%
Low Wind	7.39%

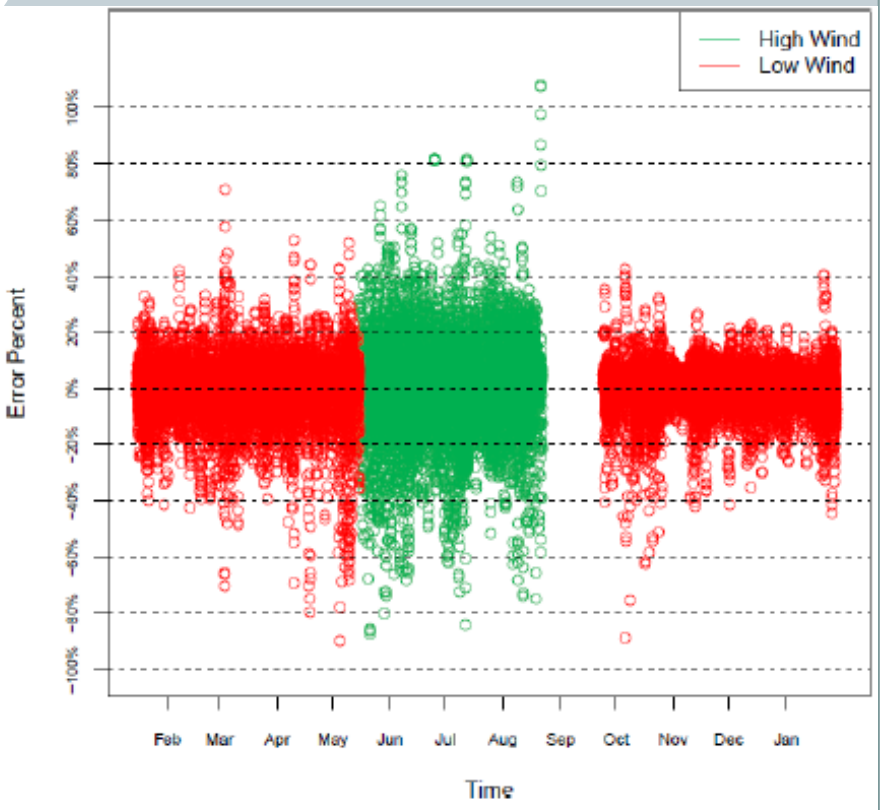
Site B: 24 MW

Error (normalized to capacity) distribution



Period	MAE
Overall	7.56%
High Wind	10.71%
Low Wind	5.97%

Site C: 72 MW

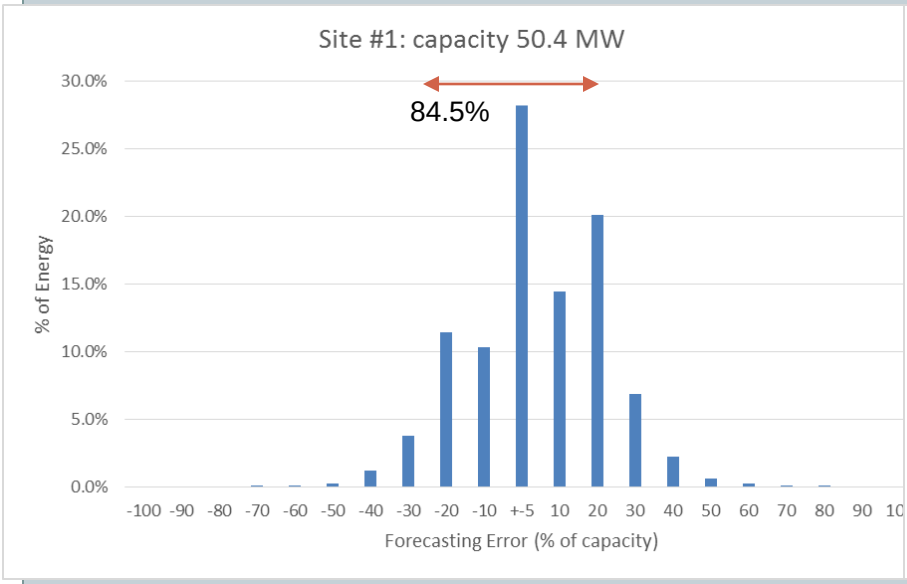


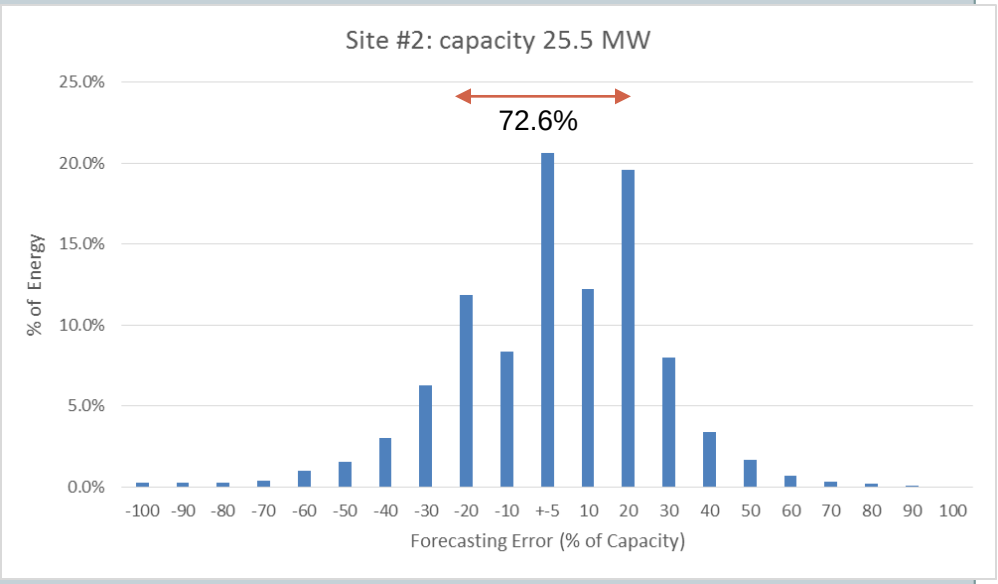
Period	MAE
Overall	7.78%
High Wind	12.12%
Low Wind	6.02%

Site D: 51.2 MW

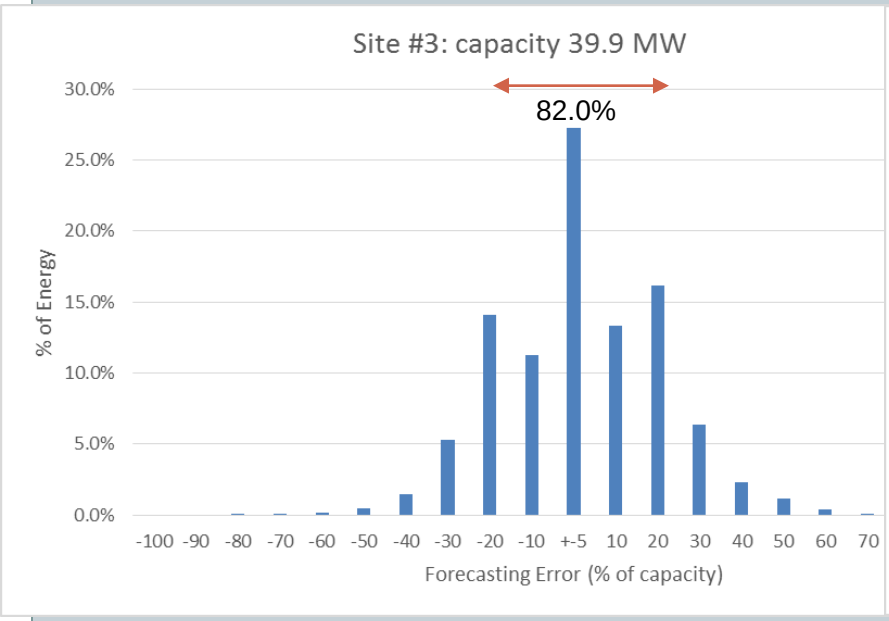
Forecasting Error analysis by Unilink

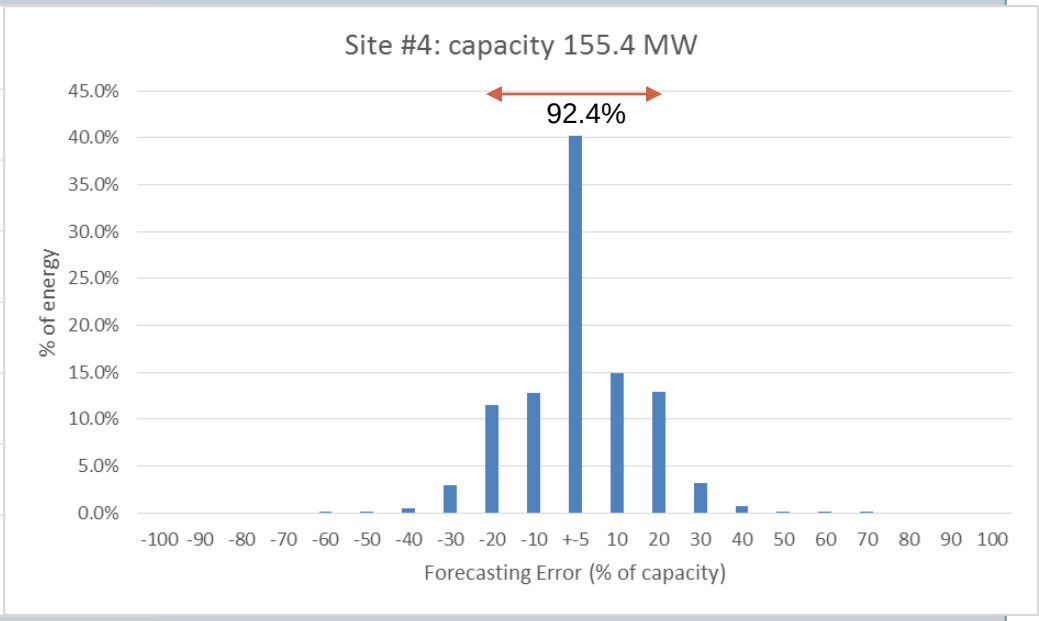
- Unilink Corp: aggregator & forecaster in Gujarat (covering 500 MW)
- Error observed based on actual data for year 2014
- Forecasting done with 8 revisions per day





Observations on new error definition (contd)





Presentation before the Forum of Regulators
on

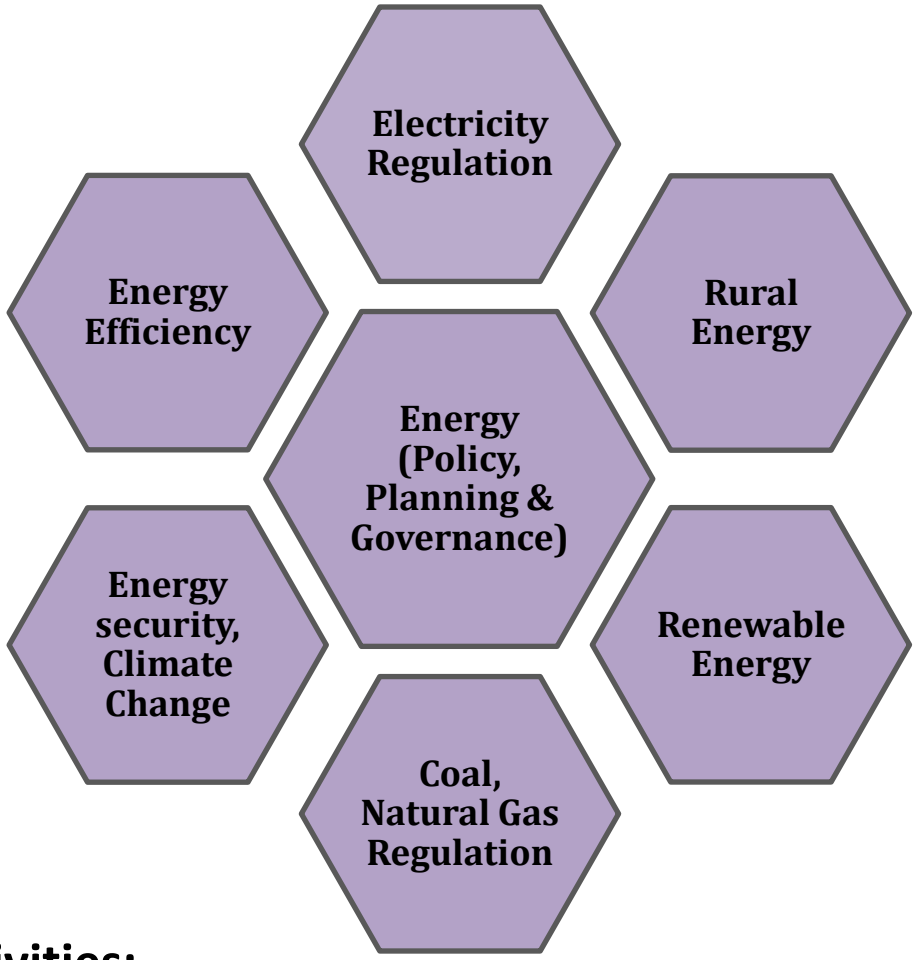
UMPP for the poor: a step towards ensuring '24 x 7 Power for All'

Prayas (Energy Group), Pune

30 September 2015

About Prayas …

www.prayaspune.org/peg



Activities:

- *Research & intervention (regulatory, policy)*
- *Civil Society training, awareness, and support*

Outline

- Household electrification
  - National commitment and challenge
- Structural disincentive for Discom
- Approach to overcome the disincentive

National commitment: 24 x 7 Power for all

- Government has announced '24 x 7 Power for all'
  - Reliable 24x7 power supply to domestic, industrial and commercial consumers by 2018-19
  - Reliable Agricultural Power supply for irrigation pump for 8 to 10 hours subject to agro climatic factors
  - Access to all unconnected households by 2018–19

- Plans to implement this scheme for various states
  - Andhra Pradesh and Rajasthan announced by December 2014
  - Uttrakhand, Goa and Meghalaya - September 2015
  - Plans for Bihar to be signed soon
  - Remaining plans expected by this year end

- Big step forward as the commitment is about 24 x 7 supply and not just access and electrification

Present status

- 8 Crore Households (i.e. ~40 Crore people) still lack access to electricity

- 6 States namely; UP, Bihar, MP, Rajasthan, West Bengal and Odisha, account for more than 75% of the total non-electrified Households

- No improvement in hours of supply
  - Average rural hours of supply reported in 2004-05 and 2011-12 were the same at 14.7 (IHDS-I and II)

Challenges

- Providing connections to all the remaining non-electrified households
  - More than half of un-electrified households are deemed APL
  - Non-BPL households need to pay ~Rs.3300 for connections, which can be significant upfront cost

- Significant investments for strengthening and augmenting grid will be necessary to cater to the demand that will pick up once supply is made available

- Ensuring reasonable quality of supply at affordable rates for all electrified households and productive loads in rural areas
  - Rising cost of power purchase
  - High levels of AT&C losses and financial losses of Discoms

DDUGJY

- Major GoI programme essential for rural grid extension:
  - Feeder Separation
  - Strengthening and metering of sub-transmission ,distribution systems
  - Rural electrification which subsumes completion of works under erstwhile RGGVY under 12th and 13th Plan. (**Budgetary support of 35447cr.)**

Budgetary support 33453 cr.

- Status
  - 10th & 11th Plan: Rs. 29,986 crores invested for electrification of over 1 lakh villages, intensive capital works in < 3 lakh villages and to provide free connections to over 2 crore BPL households
  - 12th Plan: 10% of sanctioned funds being released so far

- Key challenges:
  - How to ensure grid extension and network augmentation realise goal of Power for All?
  - How to ensure adequate hours of supply on these rural feeders?

Components of Electrification

1. Network infrastructure & providing connection*s*
   - *accounts for 7-10% of total cost*

2. Operations & Maintenance
   - accounts for 9-10% of total cost

3. Supply of power
   - accounts for 80% of total cost

Structural disincentive to supply to rural households

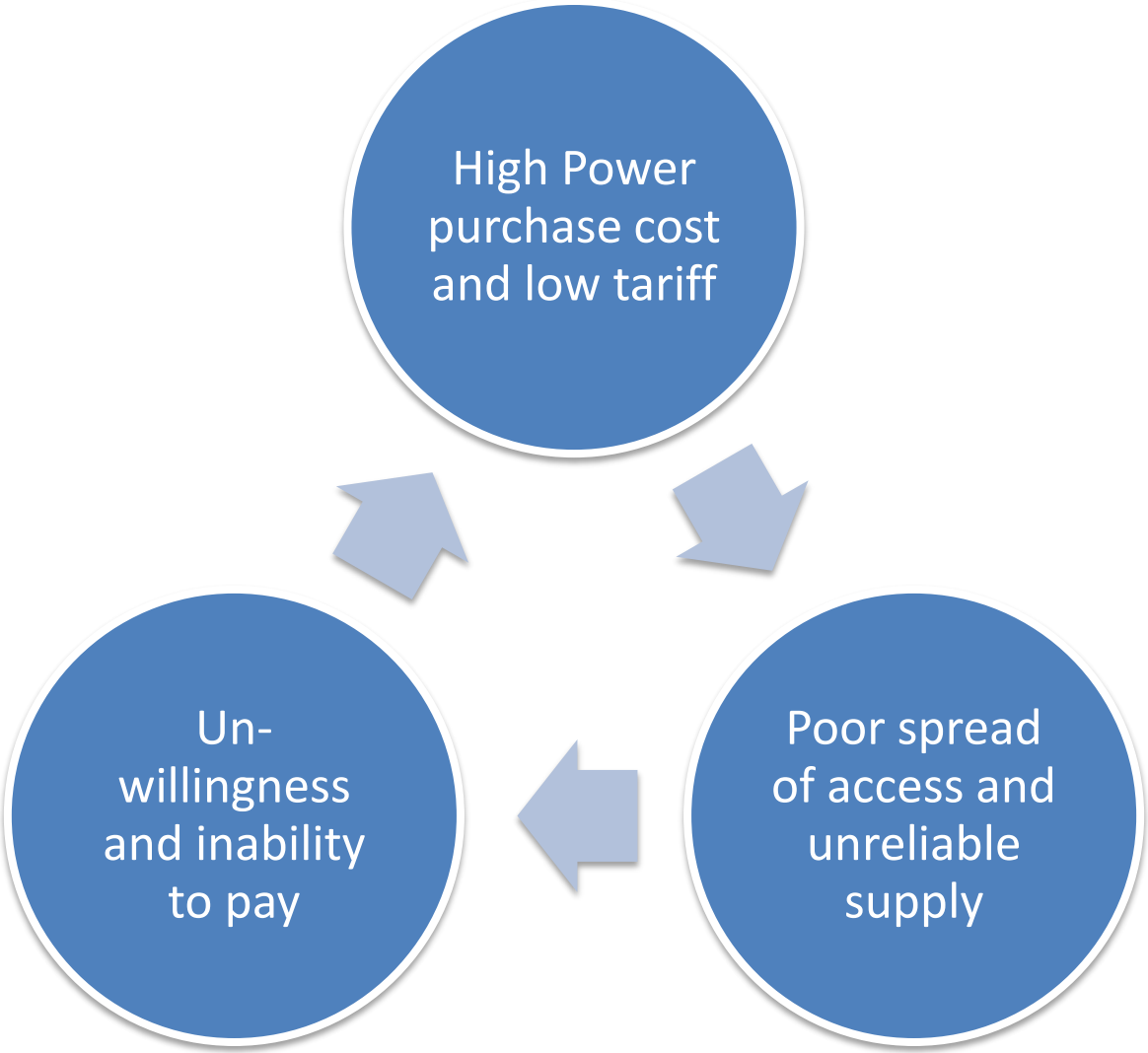
Marginal Power purchase cost in Rs/unit	5*
Power Purchase cost after accounting for Transmission and Distribution loss of ~20%	6
Distribution cost for units supplied to Households in Rs/unit	1.25
Total cost of supply in Rs/unit	7.25
Revenue from sale to electrified HH in Rs/unit	2.5
Loss per unit	***4.75***

**Without accounting for time of demand (evening peak hours), which can increase the cost by ~15%*

Additional challenges

- High level of accumulated financial losses
  - Likely to result in large regulatory assets and hence tariff increase
- Potential events which will worsen discom finances
  - Proposed Carriage and content separation
  - Renewable energy based open access and rooftop solar PV installations picking up at a fast rate
- Limited scope for support from state governments
  - Existing levels of revenue subsidy are already very high
  - Potential bailout requirement

Vicious cycle of structural disincentive



Implications

- In absence of specific interventions to deal with the structural disincentive:
  - Discoms will avoid impractical or unrealistic tariff increase
  - Solar rooftop prices will become a ceiling for tariff increase than can be imposed on high paying consumers
  - Increase in open access and rural demand (like agriculture) will worsen the structural disincentive

- Potential outcome
  - Proposed investments will not yield expected results
  - Reliable power supply will be unaffordable for many

➔ Need to address the structural disincentive

Breaking the vicious cycle

Principles:

- Tariff structure
  - Effective targeting of subsidy (to meet most basic needs of decent living)
  - Reflective of quality of supply (increase with rise in consumption)
  - Allow for timely variation (RPI-x)

- Structural disincentive
  - Rational power purchase planning and controlling losses and inefficiencies (takes time to implement and benefits to be realised)

→ Low cost power to be made available to overcome structural disincentive and to start breaking the vicious cycle

Overcoming Structural Disincentive

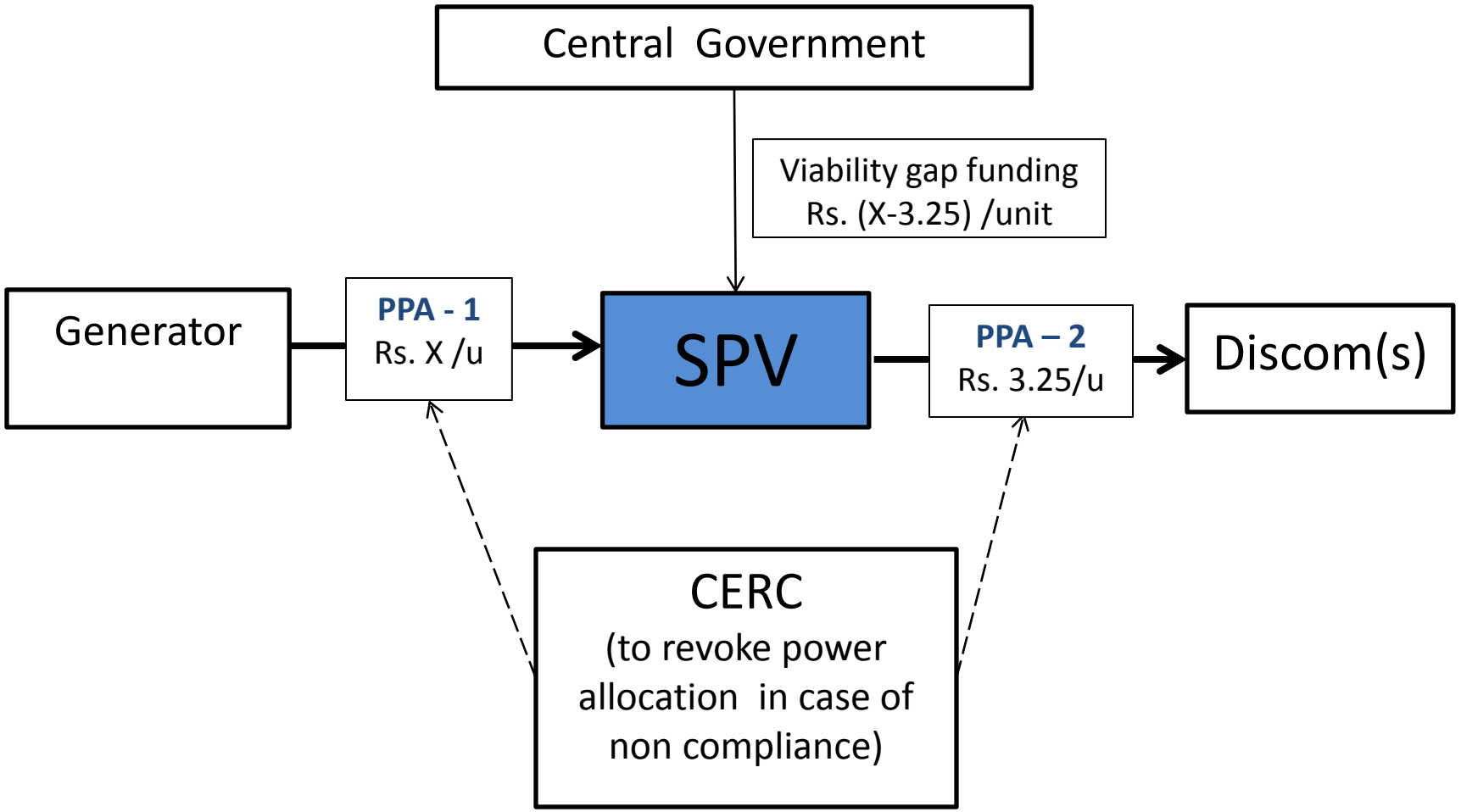
- For ensuring supply of *at least one unit per day* to every rural HH, make available 4 units of low cost power (say Rs. 3.25/u) to Discom
  - 1 Unit of power per day sufficient to meet modest standard of living
  - 3 extra units (during off-peak hours) can be used to supply to other consumers

- Ensure credible mechanisms for monitoring and implementation of:
  - 24 x 7 power supply to all rural and newly electrified HH
    - Electricity Supply Monitoring Initiative (ESMI) like measures can also be considered
  - Revocation of low cost power in case of non-compliance by Discoms

- Tariff
  - Only first 50 units of HH consumption to be subsidised (tariff of say Rs. 2.5/u)
  - Additional consumption to be charged appropriately high tariffs (with telescopic rate structure)

- Identify target areas (say, states, districts, feeders) and allocate power based on normative household consumption of 200 watt per HH

Schematic of proposed approach



Reduction in Structural Disincentive

Cost	Current Scenario	Proposed Scenario
Marginal Power Purchase Cost	5	3.25
Power Purchase Units (20% loss implies 1.2 units,200W capacity means 3.79 units per day at 85% PLF and 7% AuxC)	1.2	3.8
Power Purchase Cost of units @ Marginal Power Purchase Cost	6	12.35
Distribution cost for units supplied to Households	1.25	1.25
Total Cost of supply (Power Purchase+ Distribution Cost)	7.25	13.6
Per unit cost	7.25	3.58
Revenue	**Current Scenario**	**Proposed Scenario**
Revenue from Sale to Households @ 2.5/unit	2.5	2.5
Revenue from sale of additional 2.54 units @Rs.3.6/unit*	Not Applicable	9.14
Total Revenue	2.5	11.64
Per Unit Revenue	2.5	3.06
Net Loss per unit	*4.75*	*0.51*
**At transmission level and off-peak market prices (2014-15 average)*		

Power procurement options

Existing Capacity

- Option 1: Utilise NTPC unallocated share
  - ~4719 MW in FY 15
  - Can provide 24 x 7 supply to 27 of the most populated backward districts
- Option 2: Utilise stranded/surplus capacity
  - Capacity stranded on account of lack of demand or fuel or viability issues can be utilised
  - FY 15-16: 18 States/ UTs expected to have net surplus energy and 16 States/UTs to have peak surplus on annual basis
- Option 3: Depreciated units of central PSUs
  - Capacity with PPAs about to expire
  - No or low fixed cost (R&M), variable cost at actuals

New Capacity

- Option4: UMPP for the poor
  - Bidding based on captive coal mine
  - Tariff discovered can be ~Rs. 3-3.5/unit and hence low direct fiscal impact
- Option 5: Competitive bidding
  - Market based bidding (case-1 or case-2) and supply it to Discom at fixed rate (Rs. 3.25 per unit)
  - GoI to compensate for the gap between discovered rate and fixed tariff of Rs. 3.25 /u
  - PPA with Discom should have time-bound and gradual reduction in the gap

Capacity needed for '24 x 7 Power for All'

- ~10 GW of base load capacity needed for rural electrification
  - Considering normative load of 200 Watt per HH and demand of 1 unit per day
  - All non-electrified HH in the 6 states which account of <75% of the total non-electrified HH
- Some figures in this context

Particulars	Capacity in GW
All India installed capacity	Total – 262, coal based - 165
12th Plan capacity addition up to March 2015	61
Capacity added in FY 2014-15	22
Capacity addition in pipeline for FY 2015-16	20
Renewable capacity addition planned by 2022	175

Outcome of suggested approach

Key Steps

- Allocation of low cost (Rs. 3.25 per unit) power to states facing access challenge
- GoI support under DDUGJY for network augmentation and subsidy for overcoming structural disincentive
- Strong accountability based on contractual arrangements:
  - Withdrawal of power allocation in case of non-compliance
  - Time-bound reduction in fiscal impact

Benefits

- 70 million HHs-28% of population 24x7 supply
- Will incentivize supply to other productive load (LT industry, PHCs, small commercial etc.)
- Deepen national electricity market
- Realise the dream of 24 x 7 Power for all

Thank you

Prayas (Energy Group), Pune

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Indian power sector: Caution lights on!

Heightening risks for generators, discoms staring at liquidity stress

Sudip Sural
Senior Director
CRISIL Ratings

September 30,2015

Key messages

- **46,000 mw of thermal capacities face viability risks of lower offtake, fuel shortage and after-effects of aggressive bidding**
  - Lower energy requirement of discoms and their weak health impacting power procurement
    - 15% of private sector coal capacities to remain without PPA by fiscal 2016 end
  - Fuel shortage persists despite positive steps taken to address fuel availability issues
    - Coal capacities commissioned post 2009 to operate at sub optimal 45% PLF; sharper focus desirable
  - Significant capacities impacted by aggression – for tariff bids first, and then to bag coal blocks
- **Discoms of 6 states face liquidity pressure after Financial Restructuring Package (FRP) moratorium**
  - Discom debt-trap continues on account of inadequate tariff hikes and high AT&C losses
  - Annual tariff hikes of 10% with efficiency improvements can help discoms break-even by fiscal 2018
- **Critical measures needed going forward**
  - Distribution sector reforms, including their ability to procure power in the near term
  - Addressing generation side risks - augmenting domestic coal production

46,000 mw of capacities largely in private sector facing viability risk

1 36,000 MW – Coal-based capacities at risk

Capacity additions (Coal)	April 2009 to March 2015	April 2015 to March 2016
At risk (Coal)	33,000 MW 2010 to 2015	3,000 MW 2016

Key Risk Factors impacting Coal Based Capacities at Risk

a Offtake risks (3,000 MW)	b Fuel availability risk (13,000 MW)	c Tariff under-recovery (16,000 MW)	d Coal block winners (tariff under-recovery-4,000 MW)
a.) No PPA signed	a) Domestic coal shortage b) No pass through c) Coal block de-allocated	a) Imported coal-based b) Fixed costs under-recovery	a) Aggressive bidding for coal block auctions b) Capping of fixed costs to lead to under-recoveries

2 10,000 mw – Gas-based capacities at risk

At risk (Gas)	Successful bidders under e-RLNG import scheme 5,000 MW	Stranded gas-based plants 5,000 MW

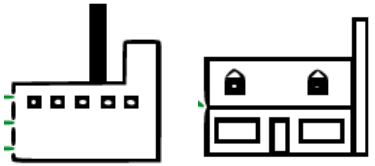
Source: CRISIL Ratings

Despite competitive cost of generation, huge latent demand for power, and high power outages….

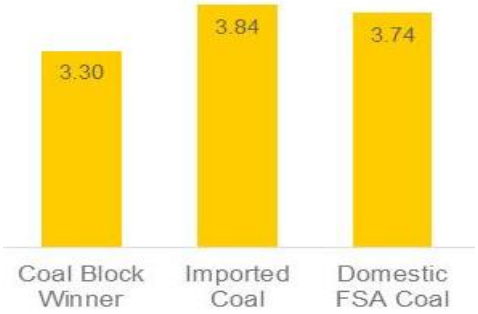
Genco

Discom

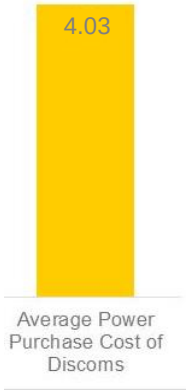
Consumer



Current Generation Cost + ROE*

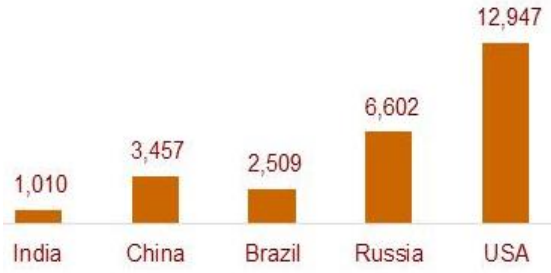


Power procurement cost



Un-served Latent demand

Per capita power consumption



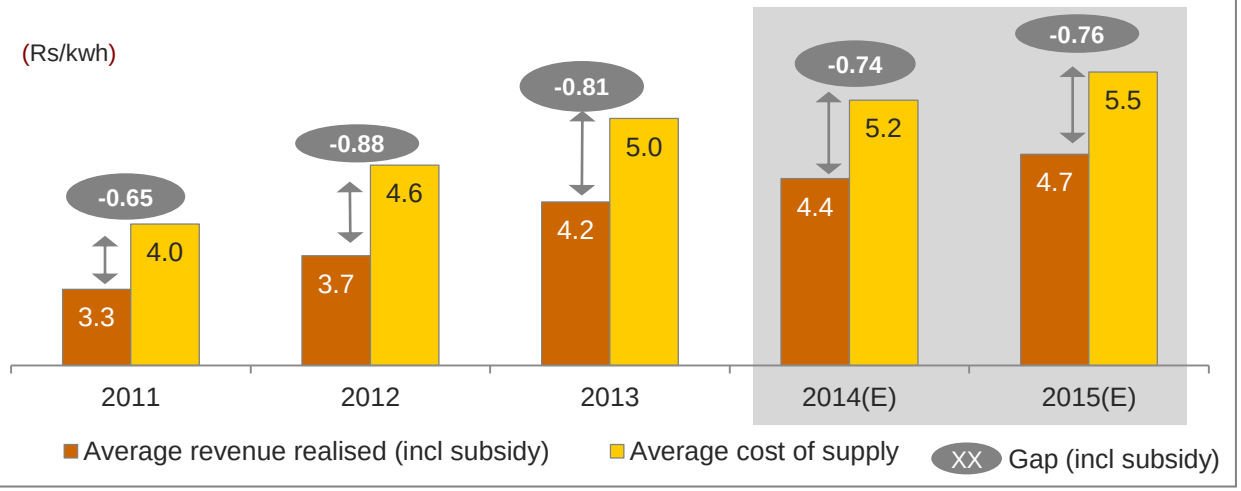
Why are discoms not signing the PPAs?

**Assumptions for generation cost: Capital Cost / MW=6.2Crore, ROE -15.5%*
Coal block winner: PLF-85%, Imported Coal: 35$ / tonne, PLF=85%, Domestic Coal: PLF-65%

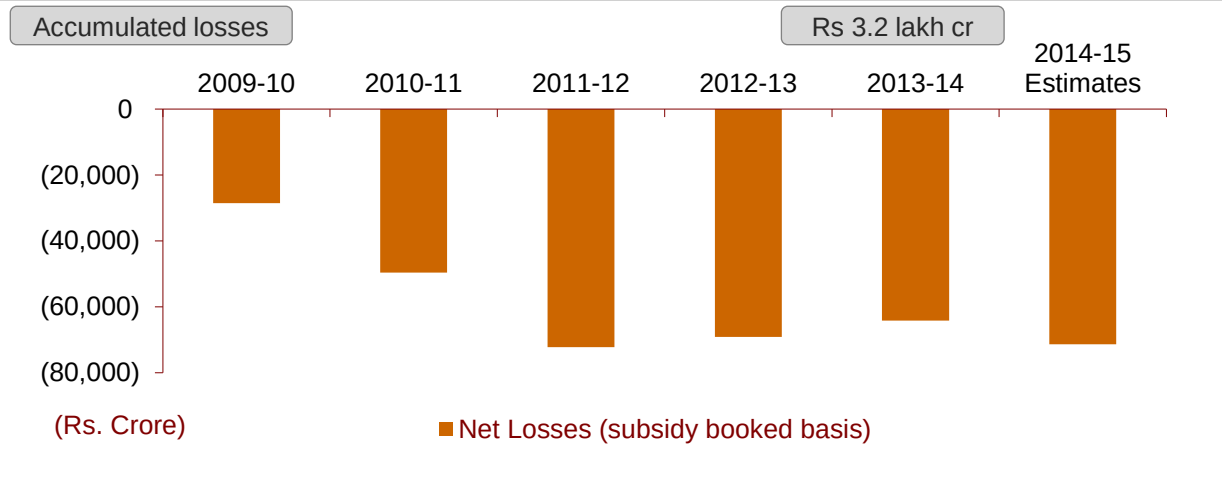
Short-lived relief from FRP for discoms

Gap per unit to persist due to insufficient tariff hikes

1 Gap per unit is estimated to have flattened



2 As a result, the increase in discom losses has been contained



Source: CRISIL Ratings, Power Finance Corporation

3 Ineffective implementation for FRP states

FRP implemented for AP, Bihar, Haryana, Jharkhand, Rajasthan, Tamil Nadu, Telangana and UP.

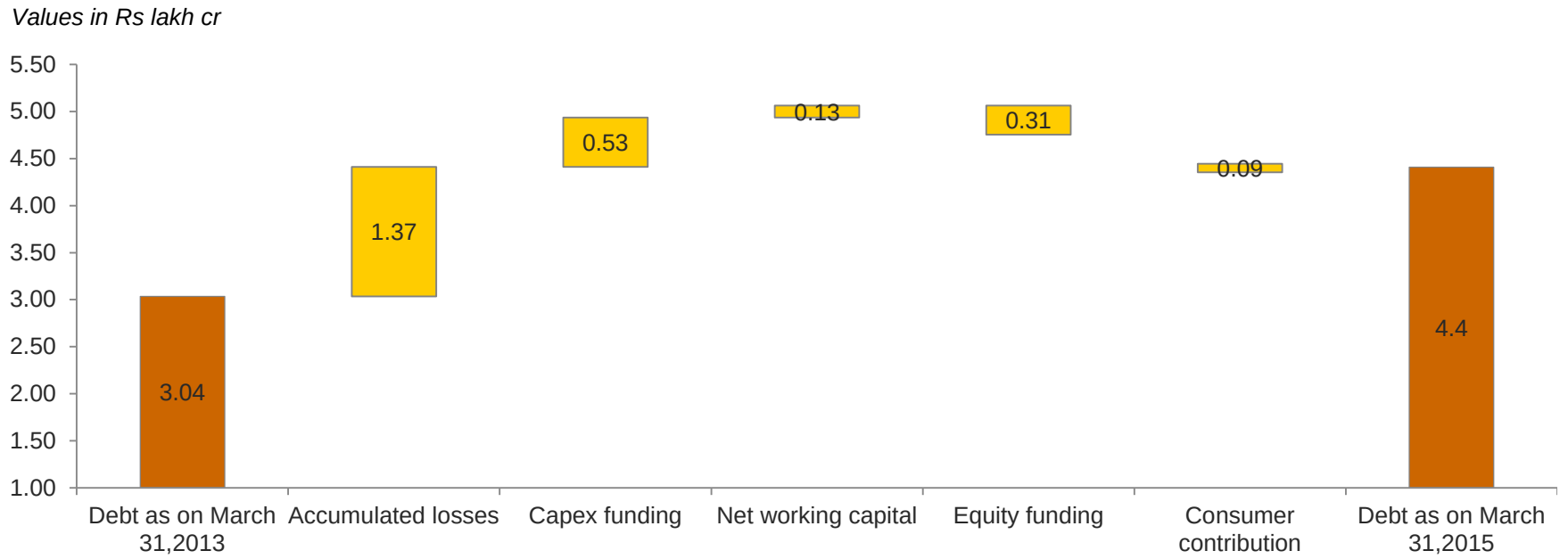
↑ Subsidy collections improved substantially

↓ AT&C losses witnessed no significant improvement except UP

↓ Tariff hikes reduced to 7.6% in fiscal 2015 from 20.9% in 2013 for FRP states

Discoms caught in debt trap

Mounting debt from funding accumulated losses and capex



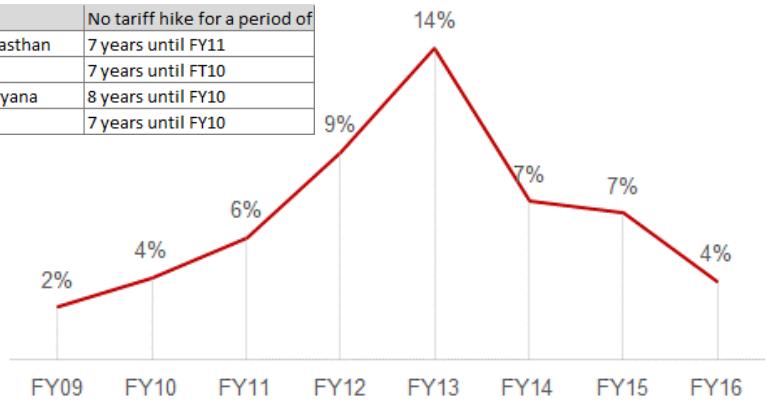
Source: CRISIL Ratings, Power Finance Corporation

Key inefficiencies in the system

1. Average tariff hikes for 18 major states

Average Tariff hikes

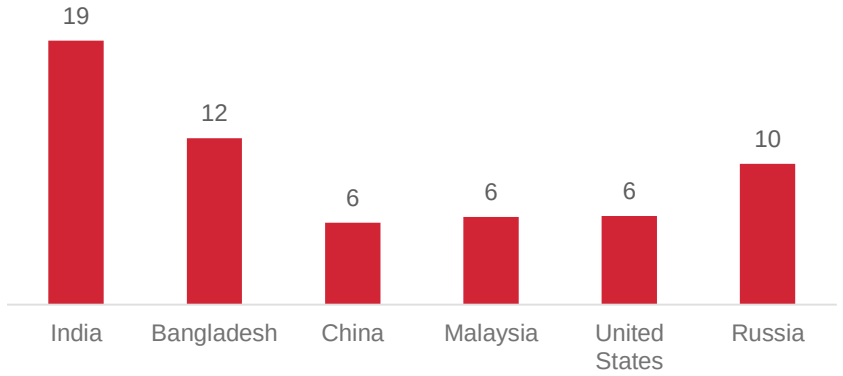
	No tariff hike for a period of
Rajasthan	7 years until FY11
AP	7 years until FT10
Haryana	8 years until FY10
TN	7 years until FY10



Note: Average tariff hike for 18 major states

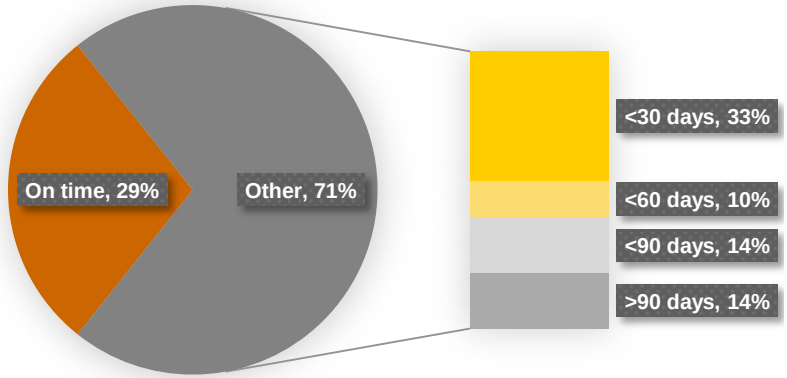
2. High T&D losses

T&D losses in %



3. Delays in Tariff Filings

70% of Tariff Filings for 2015-16 continues to be delayed



4. Other issues

- Buildup of regulatory asset without clear roadmap for dilution
- Delays in employing fuel cost adjustment mechanism
- High cross subsidization
- Unavailability of financial information from distribution utilities

Discoms of six out of eight states for which FRP was implemented will be under liquidity pressure

State government ability to support	Risk profile of state discoms: Low Risk	Moderate Risk	High Risk
Cluster I (Highest ability to support)	Karnataka, Chhattisgarh		
Cluster II	Goa Puducherry Gujarat Maharashtra		Telangana Madhya Pradesh Tamil Nadu
Cluster III	Kerala Uttarakhand	Assam, Odisha,	Jharkhand Haryana Rajasthan UP Andhra Pradesh
Cluster IV (Lowest ability to support)	Himachal Pradesh Sikkim	West Bengal	Bihar Punjab, J&K; North-eastern states (excluding Assam)

~50% of total discom borrowings

Note: Underlined states undertook FRP

Source: CRISIL Ratings

Way forward

	Issues	Solutions	Issues addressed by Electricity amendment bill 2014
Generation	Low demand	→ Better demand estimation by discoms to facilitate signing of medium term PPAs → Facilitation of open access	Facilitation of open access
	Fuel supply	→ Augument domestic coal production by Faster environmental clearances → Completion of rail links	
	Tariff issues for private players	→ Resolution of compensatory tariff isues	
Distribution	High AT& C losses	→ Higher Private participation → Targeting improvement in agricultural metering and feeder seperation	Separation of carriage and content
	Tariff under recovery	→ Higher autonomy for SERCs for elimination of revenue gap → Timely tariff filiings → Availability of timely and dependable financial information from discoms	Provisions relating to SERCs
	Accumulated losses and weak financial profile	→ One time resolution might be required	

Lending to Power Sector: Risks Rising Again

Key messages

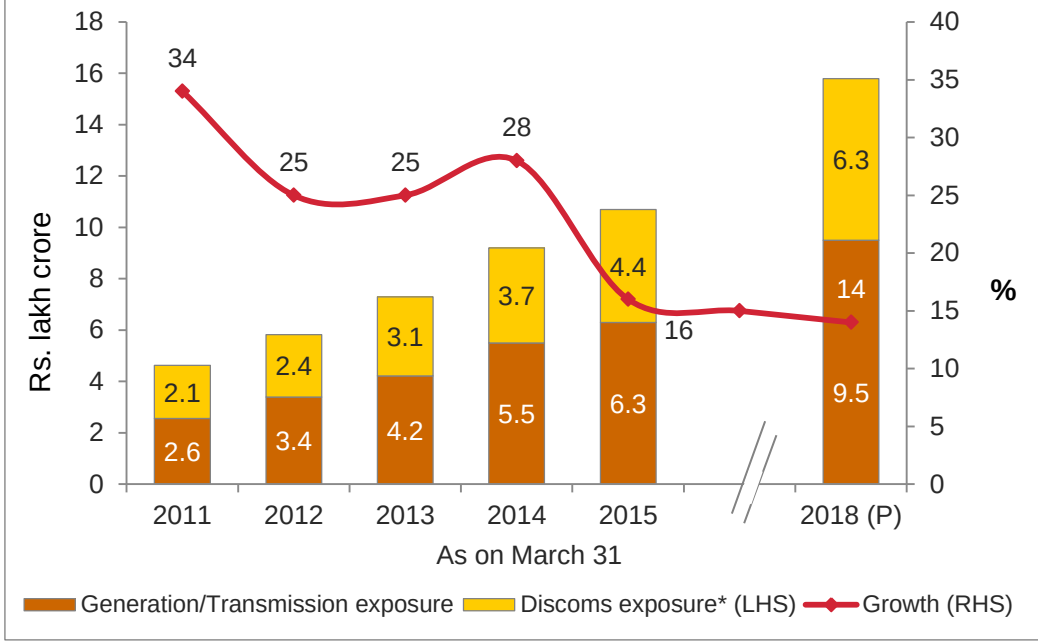
- **Growth in lending to power sector to decline over the medium term**
  - Exposure to reach ~Rs.16.0 lakh crore by Mar-18; growth to fall to 14% over 2015-18
  - Commissioning of capacities expected to be lower in the medium-term
  - Banks and FIs are becoming more cautious given increasing risks in power sector
- **Debt to weak power generation projects is at Rs.2.1 lakh crore (46,000 MW)**
  - Not entire debt at risk, promoter support and 5/25 structuring can provide some respite
  - Strong promoter support is available to projects amounting Rs.35,000 crore of debt
  - Likely 5/25 structuring of another Rs1.0 lakh crore debt, can make related projects viable
  - Consequently, weak projects aggregating Rs.75,000 crore of debt at risk
- **Outstanding debt to discoms has touched a high of Rs.4.4 lakh crore**
  - Till date, Central/State Government support has prevented discoms from turning weak
  - However, FRP commitments by discoms and State Governments yet to be fulfilled
  - Renewed stance of Government support needs to be made visible
  - In absence of any tangible progress, Rs.1.9 lakh crore of debt of weak discoms of 6 states at risk

* Financial Restructuring package

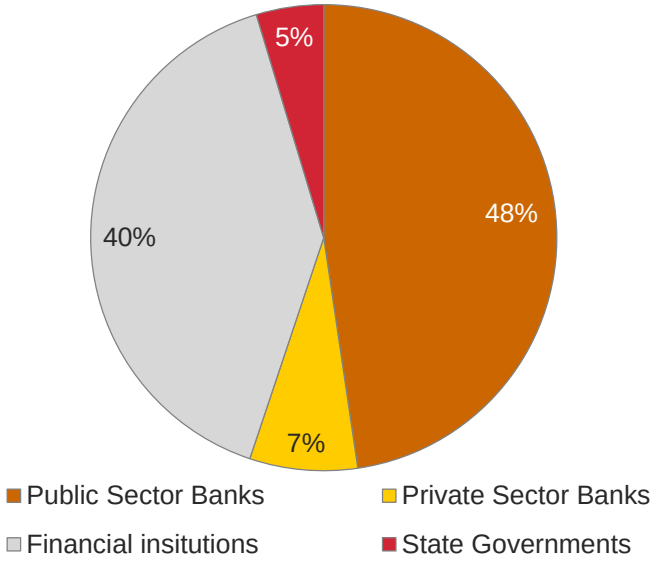
Growth in lending to power sector to moderate over 2015-18

Cautious lending to result in moderation in growth

Power sector credit ~ Rs.16.0 lakh crore by March 2018*



PSBs & FIs remain primary lenders



- **Power sector lending growth to dip to ~14% in 2015-18**
  - Incremental sanctions by banks and FIs have been trending lower in the past few years
    - Lenders are turning cautious given the increasing challenges faced by the sector
  - Expectation of lower commissioning of capacities
- **Banks credit to the sector will, however, remain high at ~9% of total advances**

* Includes bonds issued by discoms

Debt at Risk: Power generation projects

Debt to weak power generation projects: Rs.2.1 lakh crore

Particulars	Debt (Rs. crore)
1. Coal based capacities	**1,60,000**
(a) Off-take risk	12,000
(b) Aggressive pricing	81,000
(c) Fuel shortage	66,000
2. Gas based capacities (Due to lack of availability of gas)	**50,000**
Total	**2,10,000**

46,000 MW of stressed power projects form ~20% of total debt to power sector

Parent support & 5/25 scheme to provide some respite

2.1 lakh crore debt towards 46,000 MW of stressed projects

Strong parent support

Rs.35,000 crore (10,000 MW)

- Strong operational and financial link with parent
- Past demonstrated support
- Fungibility of cash flows within the parent group

Structuring under 5/25

Rs.1.0 lakh crore (20,000 MW)

- Coal based projects expecting increased fuel availability/ PPA agreements in near-term can be structured
- In gas based-capacities, auction winners can turn viable when gas production improves

Debt at Risk

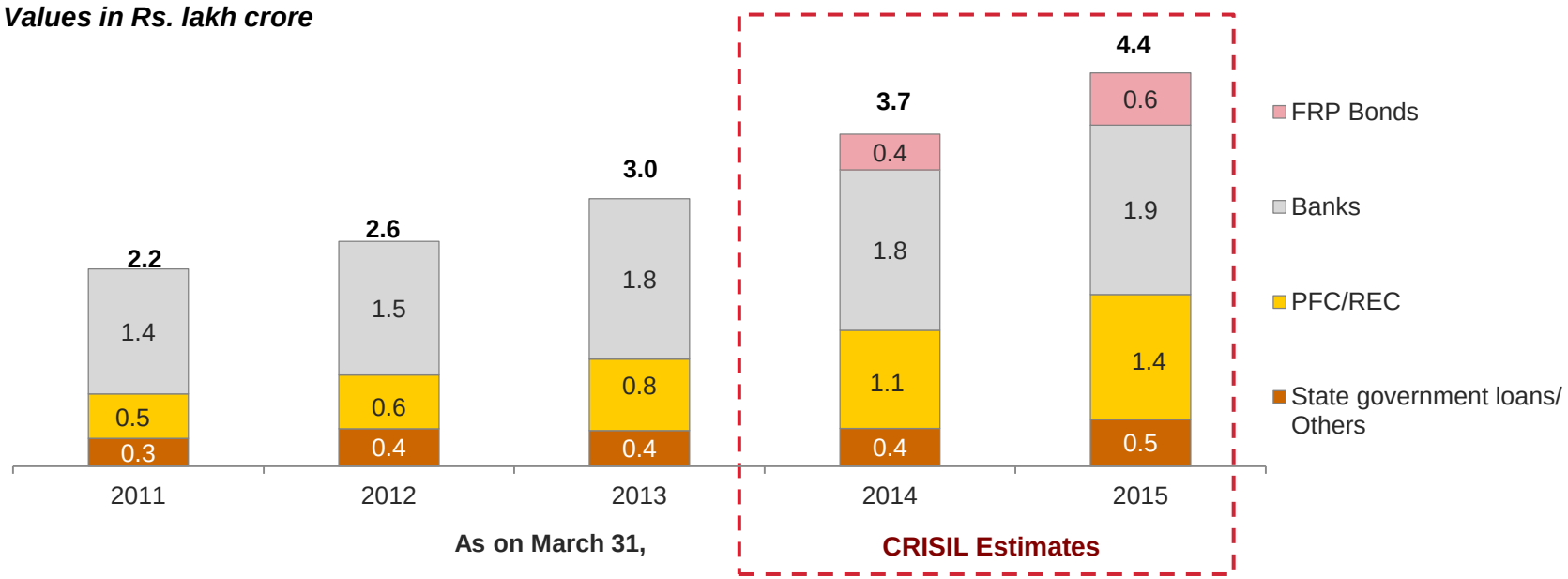
Rs.75,000 crore (16,000 MW)

- Aggressive bidding on tariffs
- Huge fixed cost overruns including stranded gas-based capacities

Debt at Risk : Discoms

Debt of discoms touches a high of Rs.4.4 lakh crore

Total debt of discoms has doubled between 2011 and 2015



- **Till date, Government support has prevented discoms from turning weak**
- **However, discoms and State Government FRP commitment yet to be fulfilled**
  - Insufficient tariff increases, limited reduction in Transmission & Distribution losses
  - State government takeover of Bonds issued by discoms remains a monitorable
- **Moratorium granted under FRP for the 8 states, ending over 2015-17**
  - 6 of these 8 states have a low ability to support their discoms

Debt of weak discoms of 6 states under FRP is Rs.1.9 lakh crore at risk

Weak Discoms	Moratorium ending in	Debt at risk (Rs.crore)
Haryana, Rajasthan, Uttar Pradesh, Andhra Pradesh, Bihar and Jharkhand	2015-17	1,90,000

- **Financial health of 6 discoms is weak as accumulated losses remain high**
- **Renewed stance of Government support needs to be visible**
- **Absence of tangible progress on support could result in debt turning weak**

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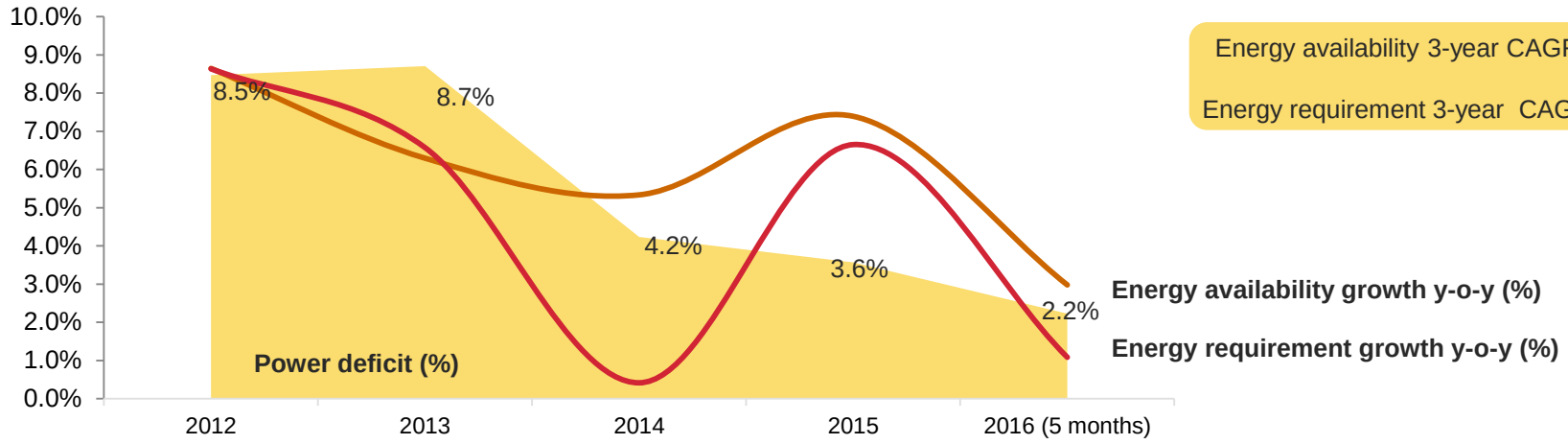
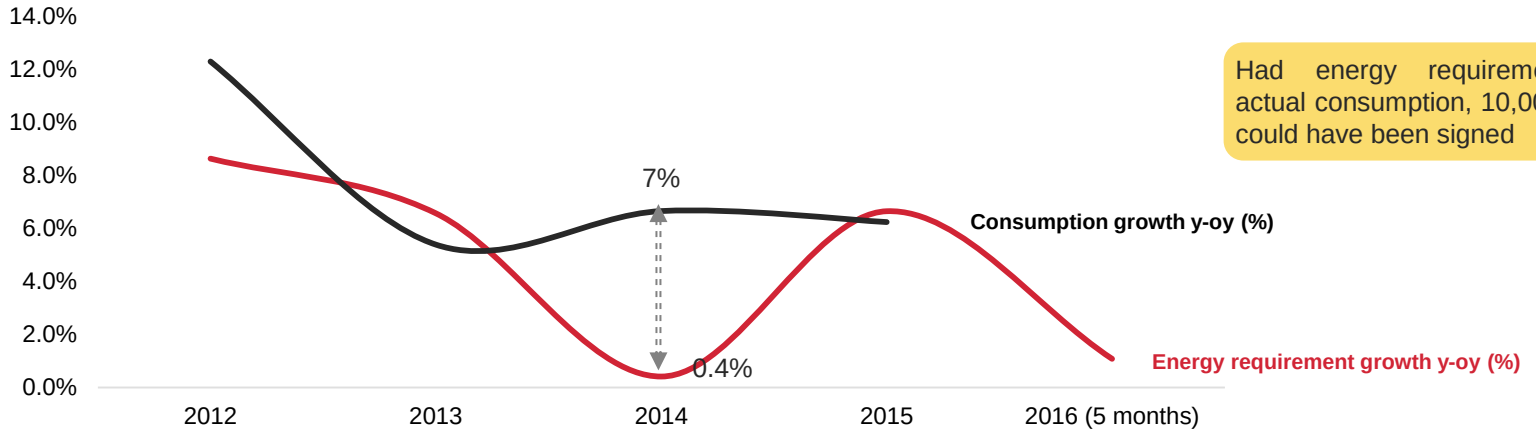
Lower energy requirement of discoms impacting fresh PPA bidding

Growth in energy availability has outpaced energy requirement of discoms, thereby reducing power deficit

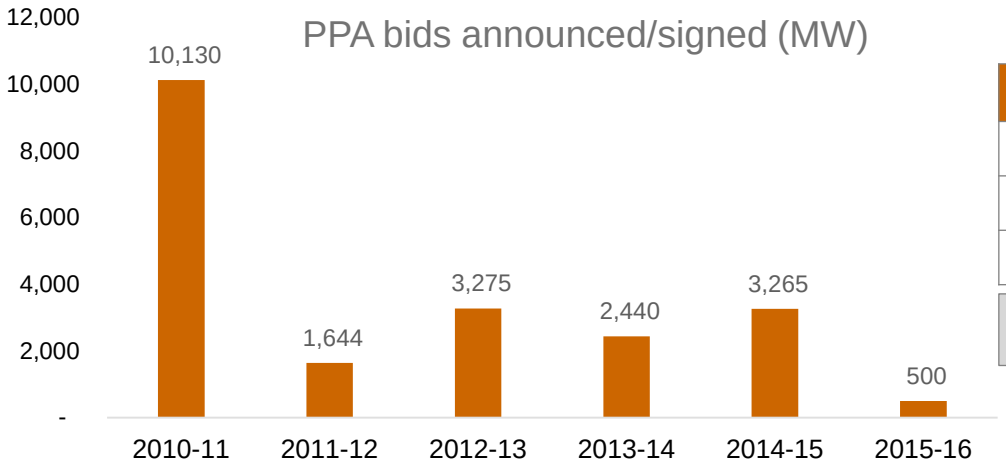


Energy requirements have been driven by consumption growth, except in fiscal 2014



1a Sans PPA, 15% of private coal capacities exposed to price volatility

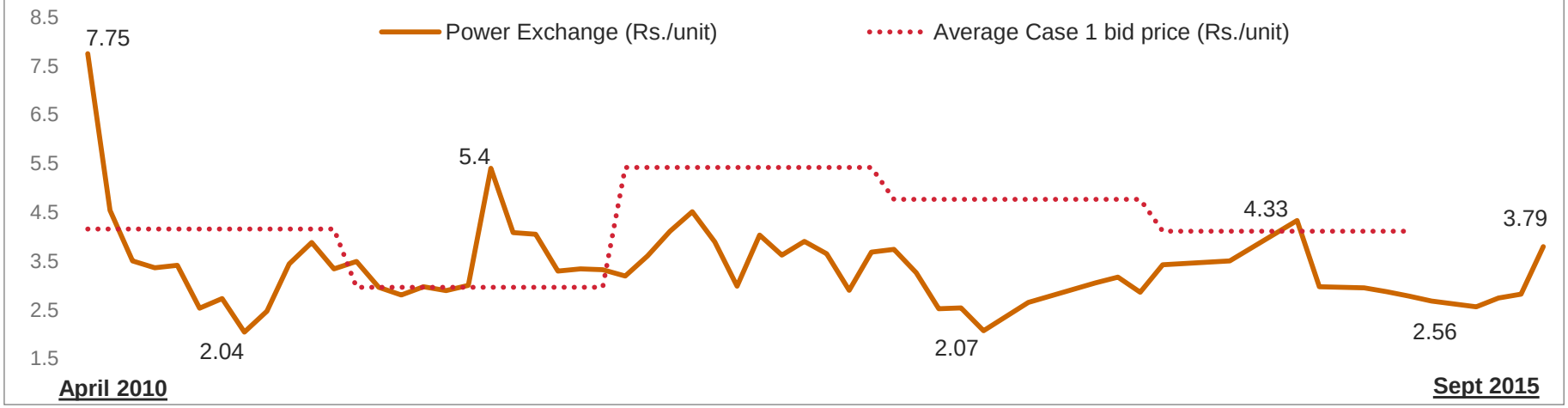
Private sector capacities without PPAs are increasing



GW	2015	2016-E
Pvt sector capacity commissioned	58	66
Capacity without PPA	8	10
%	14%	15%

Increased participation at exchanges in FY16

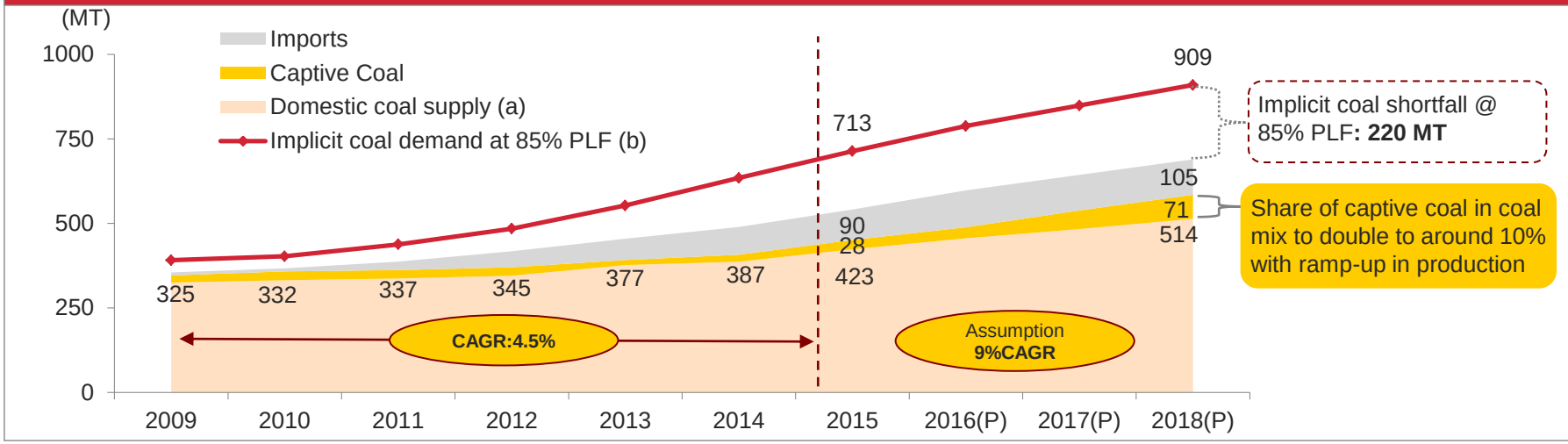
Merchant risk: Volatile short-term prices are enhancing pricing risk



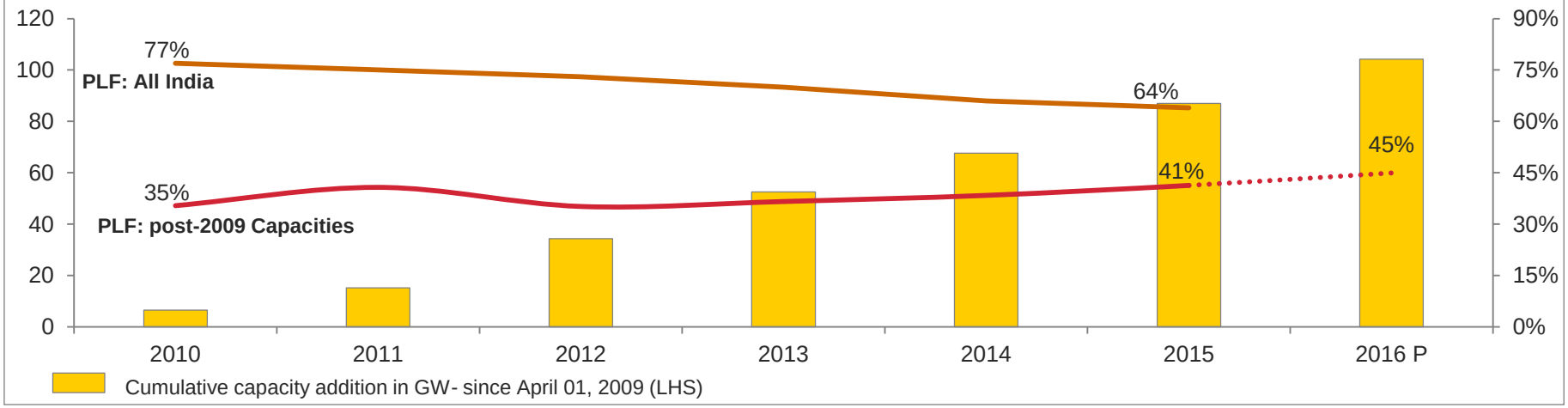
Source: CRISIL Ratings, Central Electricity Authority, CERC

1b Rising coal output to lift PLF of post-fiscal 2009 capacities to 45%

Improving production from Coal India and captive blocks...

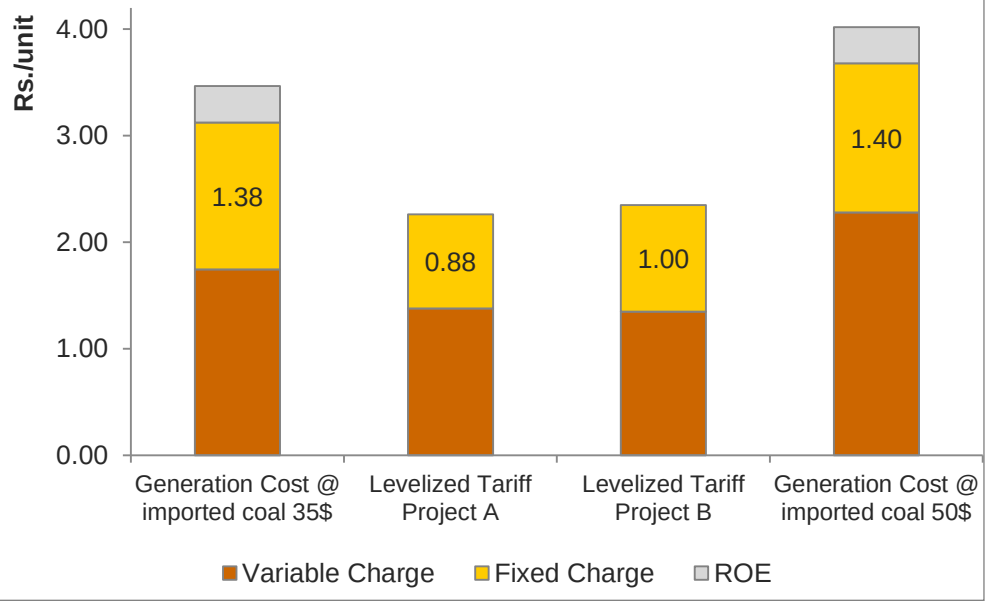


..leading to improvement in average PLF of post-fiscal 2009 capacities; yet PLFs remain sub-optimal

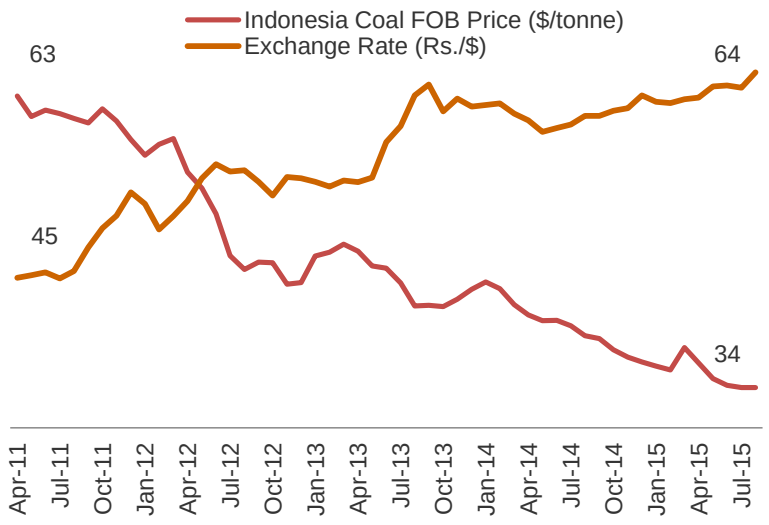


1c Aggressive bids & weaker rupee offset lower global coal prices

Fixed cost under-recovery will continue even if compensatory tariff is awarded



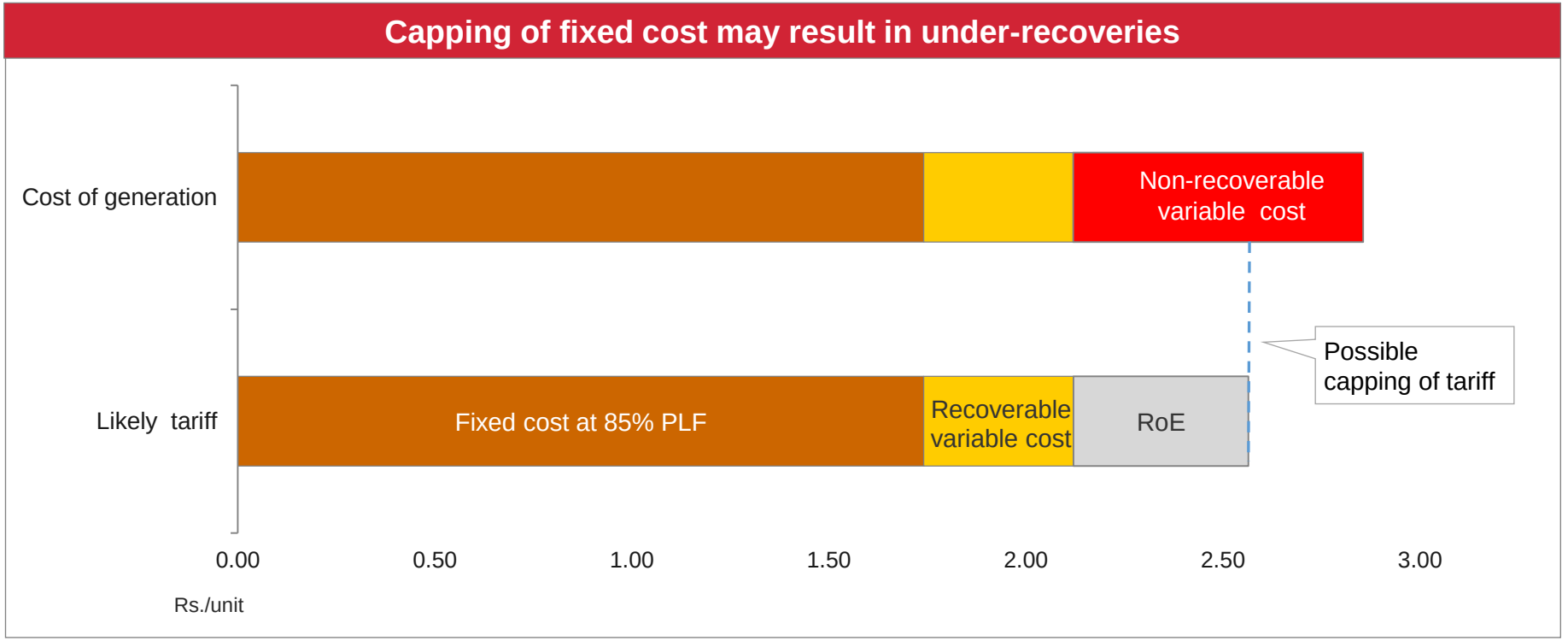
Weaker rupee offsets lower coal prices



- Aggressive bidding, cost over-runs and rupee depreciation resulting in tariff under-recoveries
- Final decision on compensatory tariff can provide relief on variable cost under-recovery
  - However, fixed cost under-recovery to continue

1d Private sector aggression = winner's curse in coal blocks

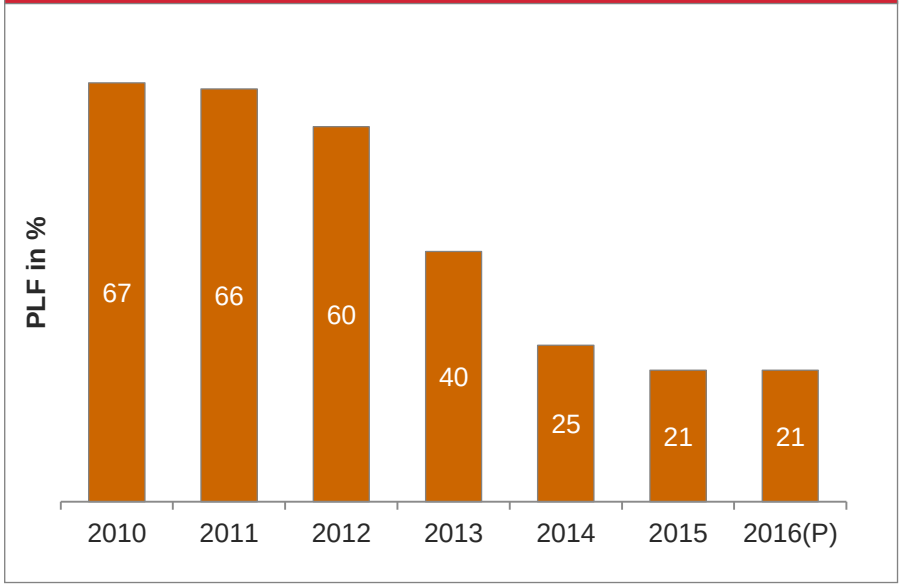
Capping of fixed cost may result in under-recoveries



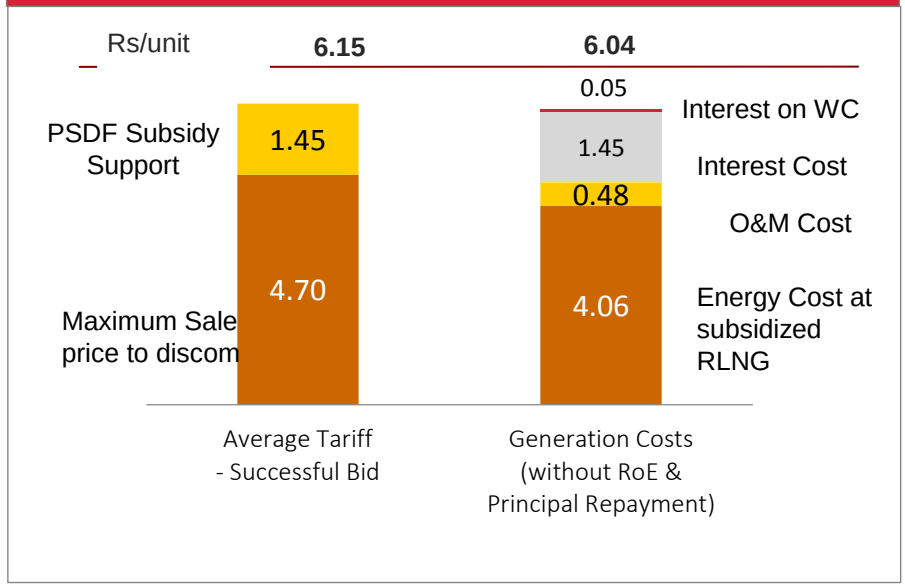
- Bidders forego mining costs and also pay non-recoverable forward premium of Rs 100–1,100 per tonne
- Case-1 PPA bid guidelines recommend power purchasers to cap fixed charges in consultation with state regulators
- Depending on where the tariff is capped, there could be under-recoveries for these players

2 Dwindling domestic gas supplies impacting gas units, RLNG auction provides interim relief

Sharply reducing PLF of gas-based capacities

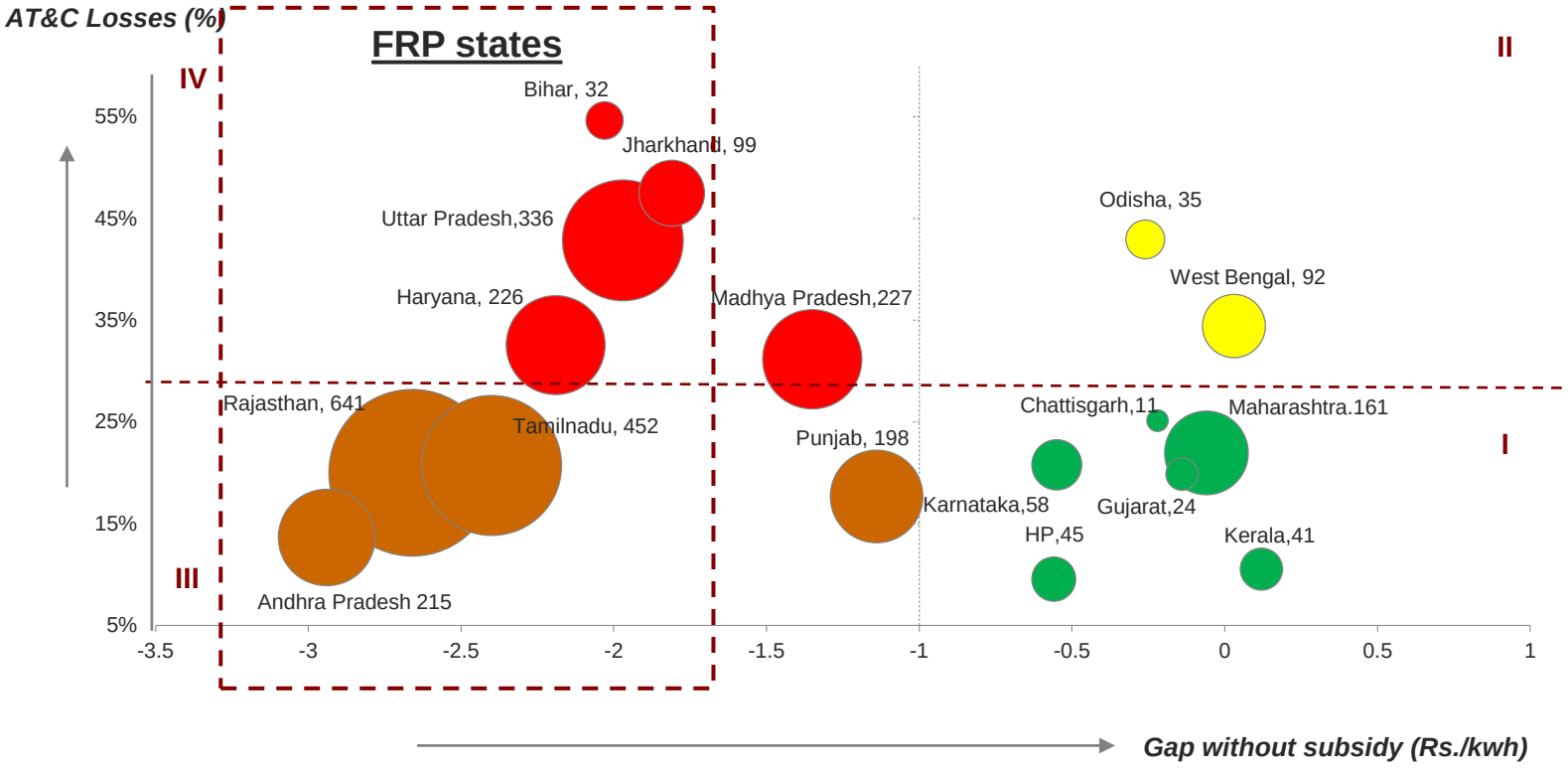


Tariff under RLNG import scheme adequate to service interest



- Scheme enables 8,000 mw (out of 14,000 mw stranded capacity) to operate at 31% PLF and at least service interest obligations
- Success however will depend on
  - Availability of moratorium from lenders and
  - Ability of power plants to find buyers of electricity at Rs 4.7/unit

Risk profiling of state discoms



Outstanding Debt as on March 31, 2013 in Rs. Billion

Quadrant I (Lowest Risk)

Quadrant II

Quadrant III

Quadrant IV (Highest Risk)

FRP states are estimated to continue to remain weak due to slow pace of tariff hikes and high AT&C losses

Source: CRISIL Ratings, Power Finance Corporation

Separation of carriage and content to bring in efficiency but marred with challenges

Key provisions	Key challenges in implementation
Separation of carriage and content business → Introducing multiple supply licensees,along with a state licensee, to promote competition → Wire business will remain with state discoms → Setting up of intermediary company to hold existing PPAs	→ Cherry picking of consumers will impact viability of state licensee → Seggregation of AT&C losses → Allocation of existing PPAs across licensees
Faciliation of open access → All 1MW+ consumers have choice to select supplier under mutually agreed tariffs → SERC to decide wheeling and surcharge	→ Given high cross-subsidy charges, the implementation may be difficult

Key Solutions

→ Gradual reduction in cross-subsidy
→ Upgradation of metering infrastructure

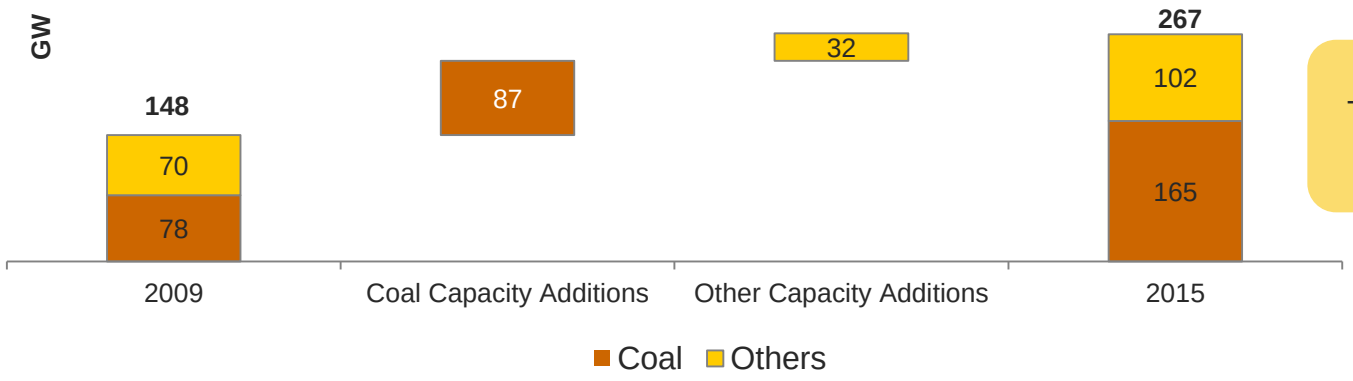
Provisions related to SERCs in Electricity Amendment bill 2014 promotes autonomy; challenges remain

- SERC's autonomy and powers have already been devised under Act 2003 but Act 2014 sets to strengthen these powers.

Key provisions	Key challenges in implementation
SERC's will regulate tariffs and power purchase costs such that → Elimination of revenue gap → Pass through of fuel purchase costs → Specification of category wise ceiling tariff	Higher autonomy coupled with private licensees can bring in more efficiency in tariff determination. Political interferences could still remain a challenge.
SERCs to undertake suo-moto tariff revision in case of delays in filing	Although APTEL order of 2011 already upholds this provision, lack of information makes it difficult for SERCs to undertake tariff hikes. Strengthening financial systems of discoms for quarterly reporting is necessary
Independent committee to review the performance of SERCs and CERC	
To ensure independence, no officer of a regulated entity or state govt should be considered for the post of member or chariperson for atleast 2 yrs	

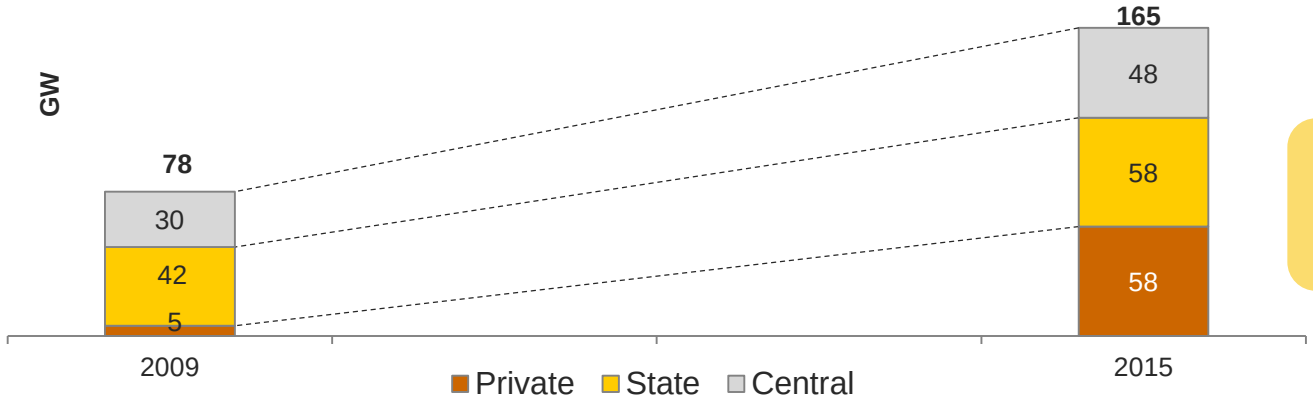
Private sector coal plants dominate new capacity additions

75% of capacities installed after fiscal 2009 are coal-fired



Coal dominates
Total capacity adds: 119 gw
Coal capacity adds: 87 gw

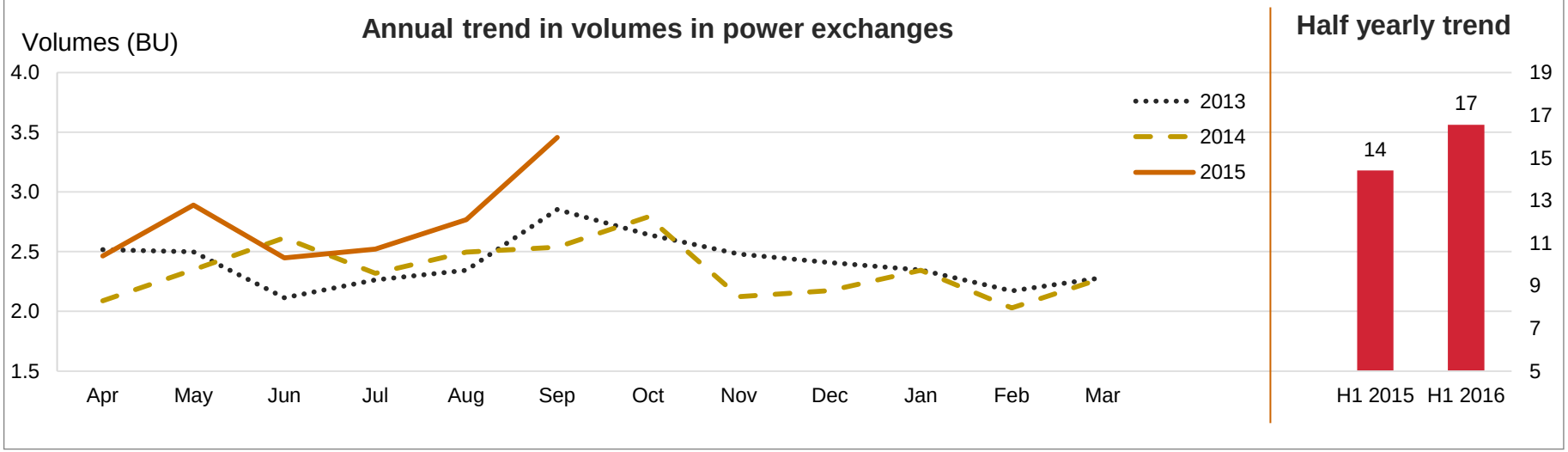
Coal capacity additions driven largely by the private sector



Private sector capacity share
2009: 7%
2015: 35%

Increased participation at power exchanges

Volumes in power exchange increased by 15% in 1H2015-16



Tariff hikes by key states

		Tariff hike (%)			
	State	2012-13	2013-14	2014-15	2015-16
1&2	AP& Telangana	27.0%	15.0%	0.0%	5%
3	Bihar	12.1%	6.9%	0.0%	2%
4	Haryana	18.7%	13.0%	0.0%	8%
5	Rajasthan	12.1%	10.6%	8.9%	na
6	Tamil Nadu	37.0%	3.5%	15.0%	na
7	Uttar Pradesh	8.8%	5.4%	8.9%	5.47%
8	Jharkhand	6.0%	0.0%	0.0%	
9	Madhya Pradesh	7.1%	0.8%	0.0%	10%
10	Punjab	12.1%	8.9%	2.7%	0%
11	Chhattisgarh	17.5%	0.0%	15.0%	14%
12	Delhi	21.0%	5.0%	8.3%	6%
13	Karnataka	3.5%	6.1%	8.0%	2%
14	Kerala	30.2%	7.9%	24.0%	0%
15	Maharashtra	16.5%	0.0%	10.0%	-6%
16	West Bengal				3%
17	Gujarat				3%
18&19	Arunachal &Himachal Prad				0%
20	Odisha				1%
21	Goa				14%
22	Assam				
23	Uttarakhand				7%
	All India weighted average	**13.00%**	**6.50%**	**5.50%**	**4%**

Date of tariff filing and tariff orders for 2015-16

	Tariff filing date	Tariff order date
Cut off date	Nov 30,2014	Apr 1,2015
Chhattisgarh	Nov 14,2014	May 12,2015
Bihar	Nov 15,2014	Mar 16, 2015
Punjab	Nov 27,2014	May 5,2015
Odisha	Nov 28,2014	Mar 23,2015
Uttarakhand	Nov 29,2014	Apr 11,2015
Haryana	Dec 1, 2014	7th May 2015
Gujarat	Dec 1,2014	Mar 31,2015
Uttar Pradesh	8th Dec 2014	Jun 18,2015
Karnataka	Dec 8,2014	Mar 2,2015
Delhi	Dec 12,2014	Sep 28,2015
Maharashtra	Dec 15,2014	Jun 26,2015
Madhya Pradesh	Dec 19,2014	Apr 17,2015
Arunachal &Himachal Prad	Jan 9,2015	Apr 21,2015
Goa	Jan 14,2015	Apr 6,2015
Assam	Jan 31,2015	Jul 24,2015
AP& Telangana	Feb 5, 2015	Mar 27,2015
West Bengal	Feb 24,2015	Aug ,2015
Rajasthan	na	na
Tamil Nadu	na	na
Kerala	na	na

Gray shaded cells are in which there are delays beyond the cut off date

Standard Offer Program and Handbook

September 2015

Deepak Gupta, Shakti Sustainable Energy Foundation
Mahesh Patankar, MP Ensystems Advisory Private Limited

Structure

- Status of DSM Programs at a Glance
- Standard Offer Program as Feed-in-Tariff for Efficiency and Load Management
- Decision Framework to Determine SOP Price
- Structure of the Handbook
  - How-to-do Guide
  - Contents;
  - Formats
- Next Steps

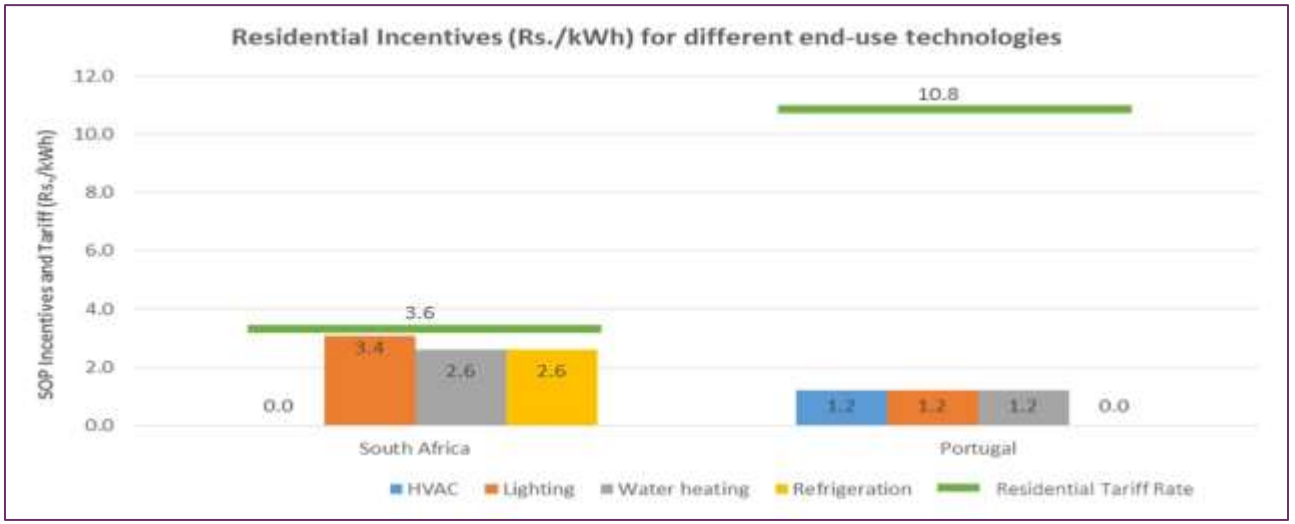
Status of DSM Programs at a Glance

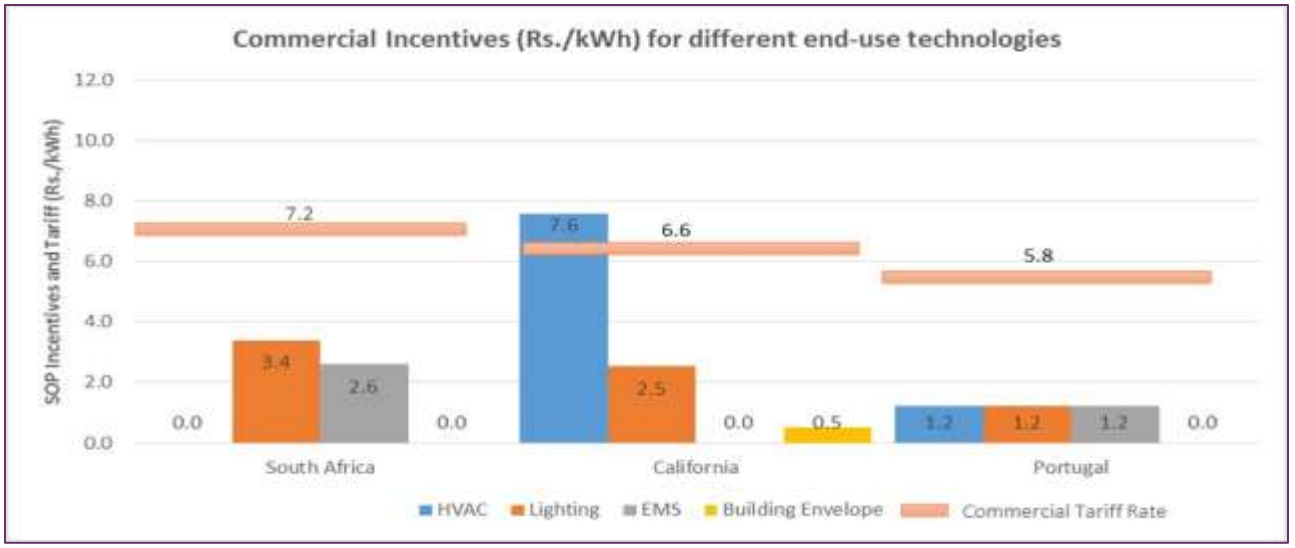
- 16 states have notified regulations
- Several states such as Maharashtra and Gujarat have launched DSM programs
- Prevalence of a combination of strategic conservation and load management (Demand Response, Thermal Storage) programs
- Scale-up of programs not yet achieved except for large lighting initiatives of EESL

Standard Offer Program as Feed-in-Tariff for Efficiency and Load Management

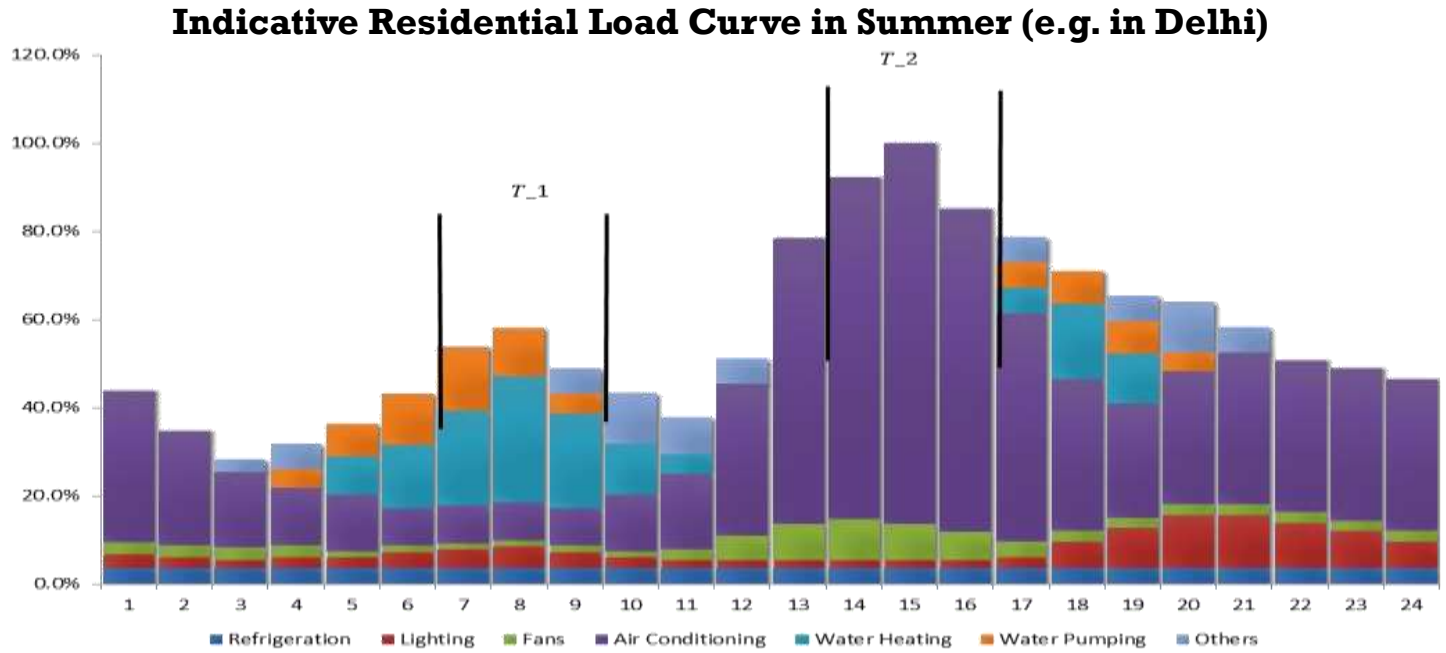
- **Purchase** of energy and/or demand savings by utility **from consumers**
- SOP Price **(Rs/kW and/or Rs/kWh)** based on 'value' of savings to utility → differs based on time of use; standard rate agreed upon at start of programme
- Provides end-use based and **technology agnostic** solutions
- Standard Product Offer (SPO): Variation of SOP → standardized product is offered by utilities to their consumers with incentive on initial cost

Internationally, SOP is used widely and is lesser than consumer tariff





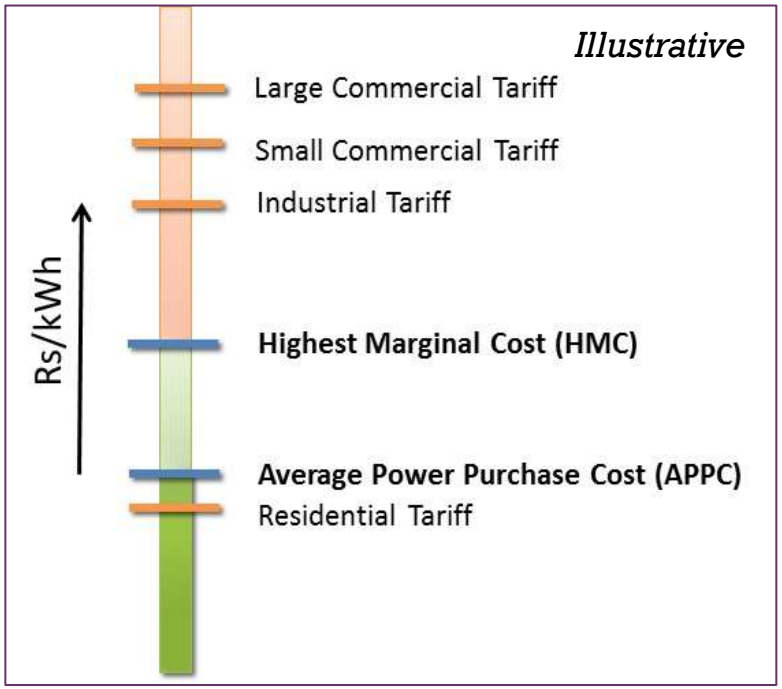
Savings in some time slots have higher value to the utility than savings in other time slots

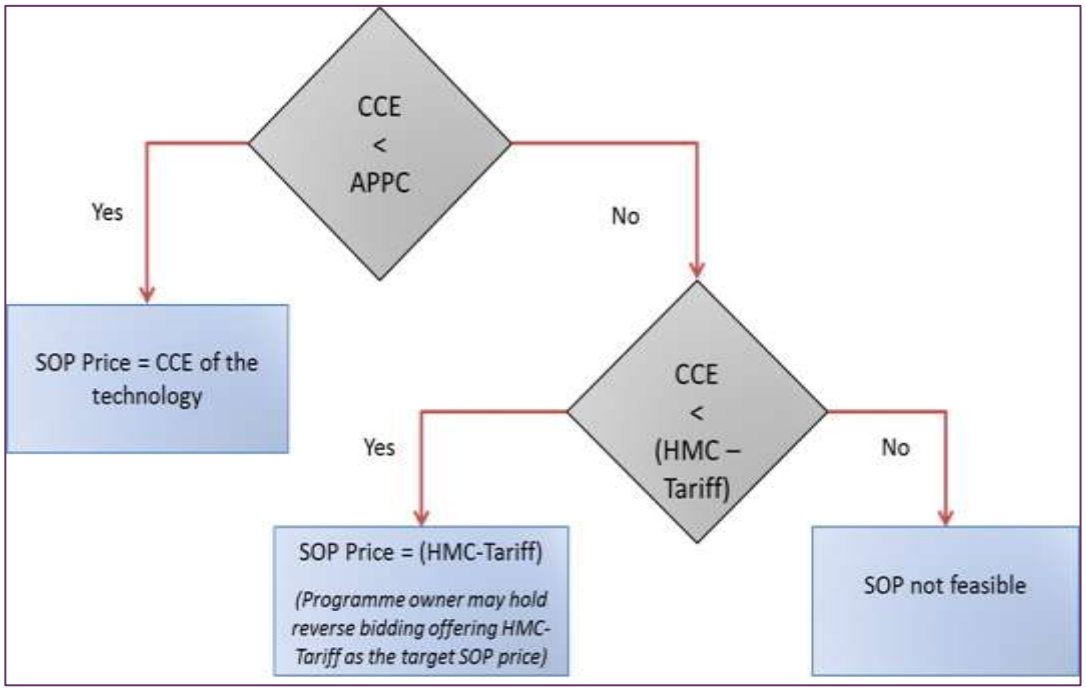


1. Price of electricity at time T1 lesser than at time T2
2. **Savings achieved in T2 have higher 'value' to the utility** – in this case, interventions for the air-conditioning end-use will benefit the utility system

SOP Price can be different in different time periods, or a single price

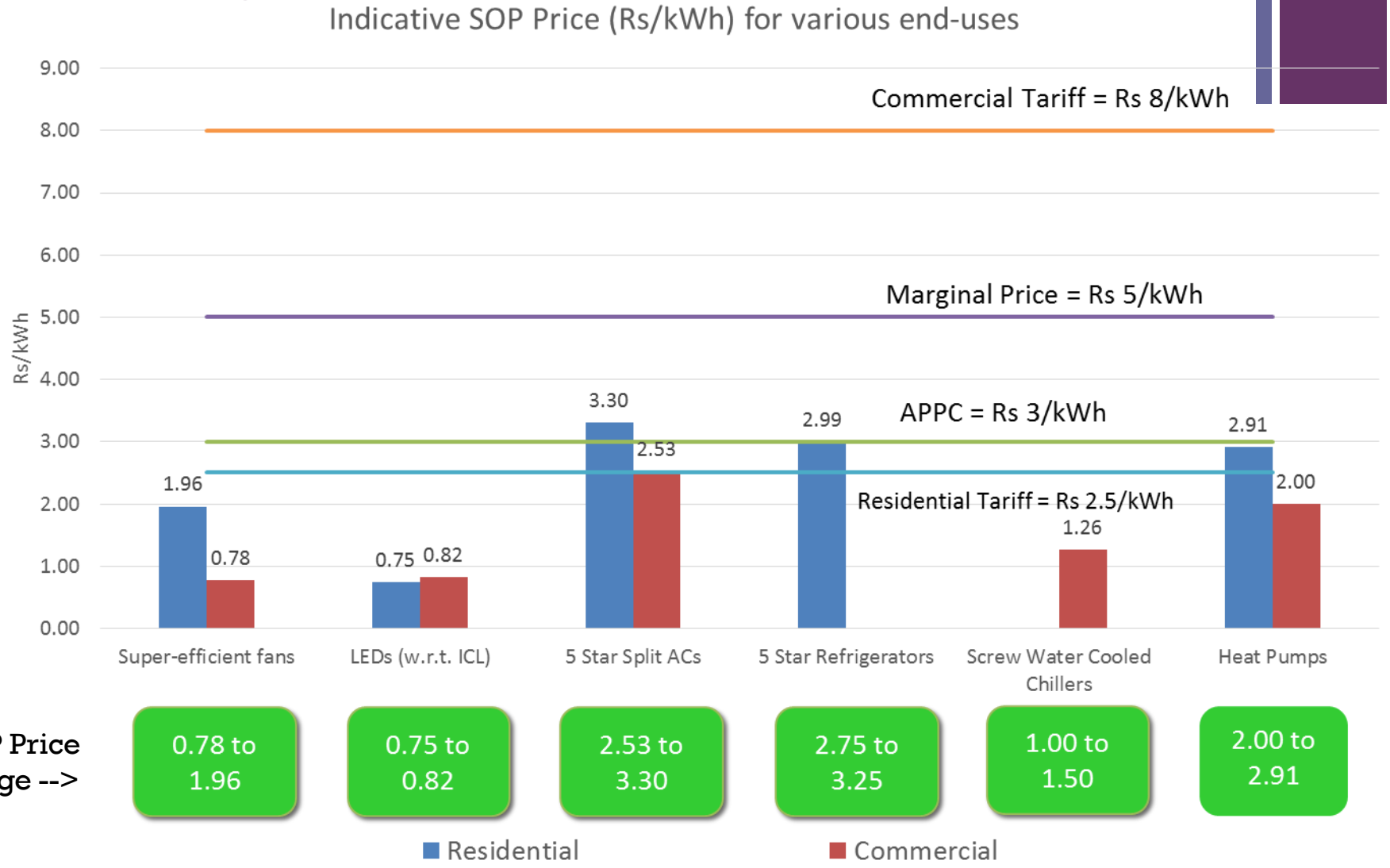
Decision framework to determine SOP price





- Cost of Conserved Energy (CCE) is used here as a simple metric to assist in buy or save decisions
- CCE is calculated as an annualized cost with specific discount rates (Handbook contains a detailed calculation procedure of CCE)

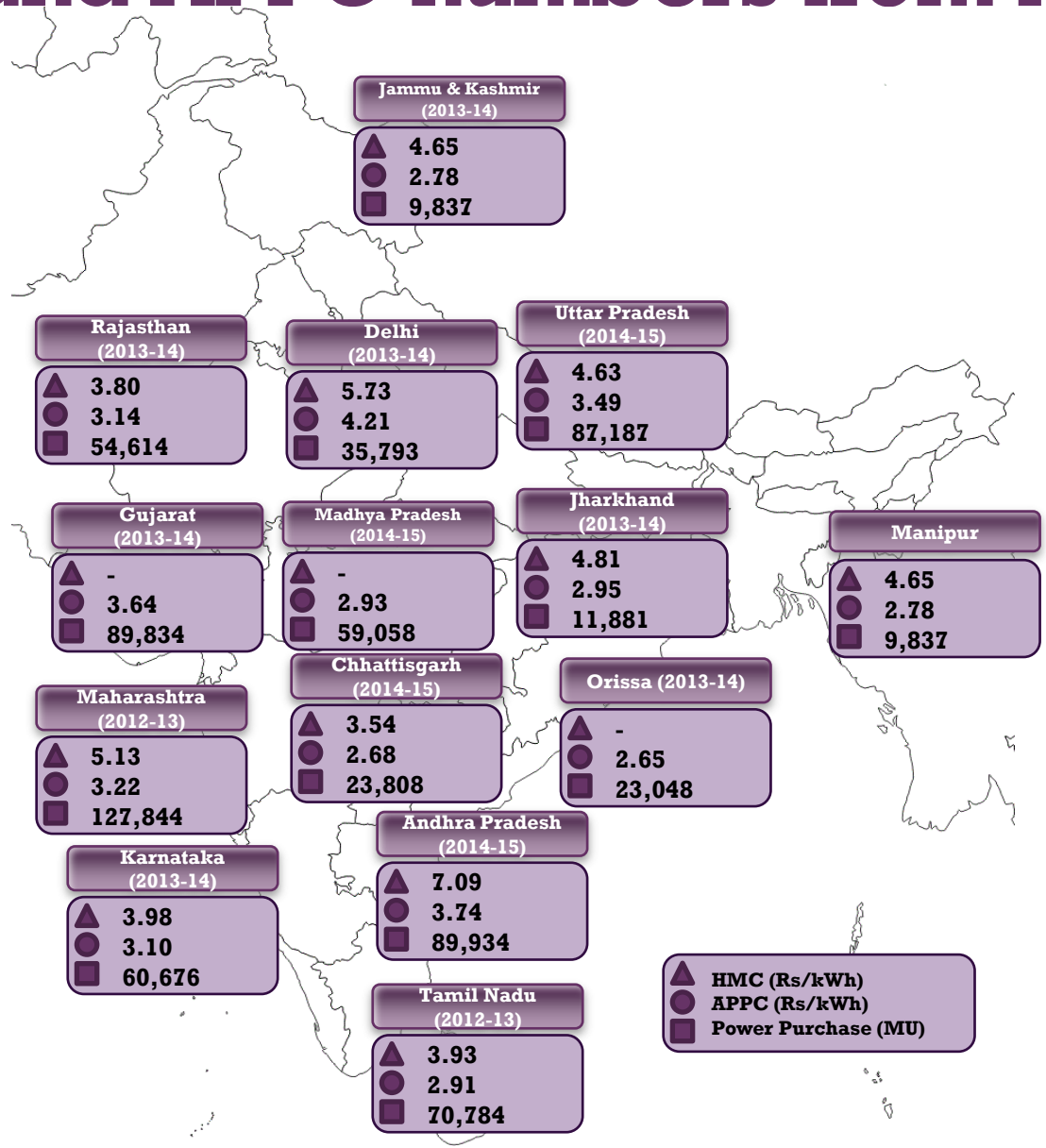
Most of the DSM measures are known to be below the Average Cost of Power Procurement



HMC and APPC numbers from few states

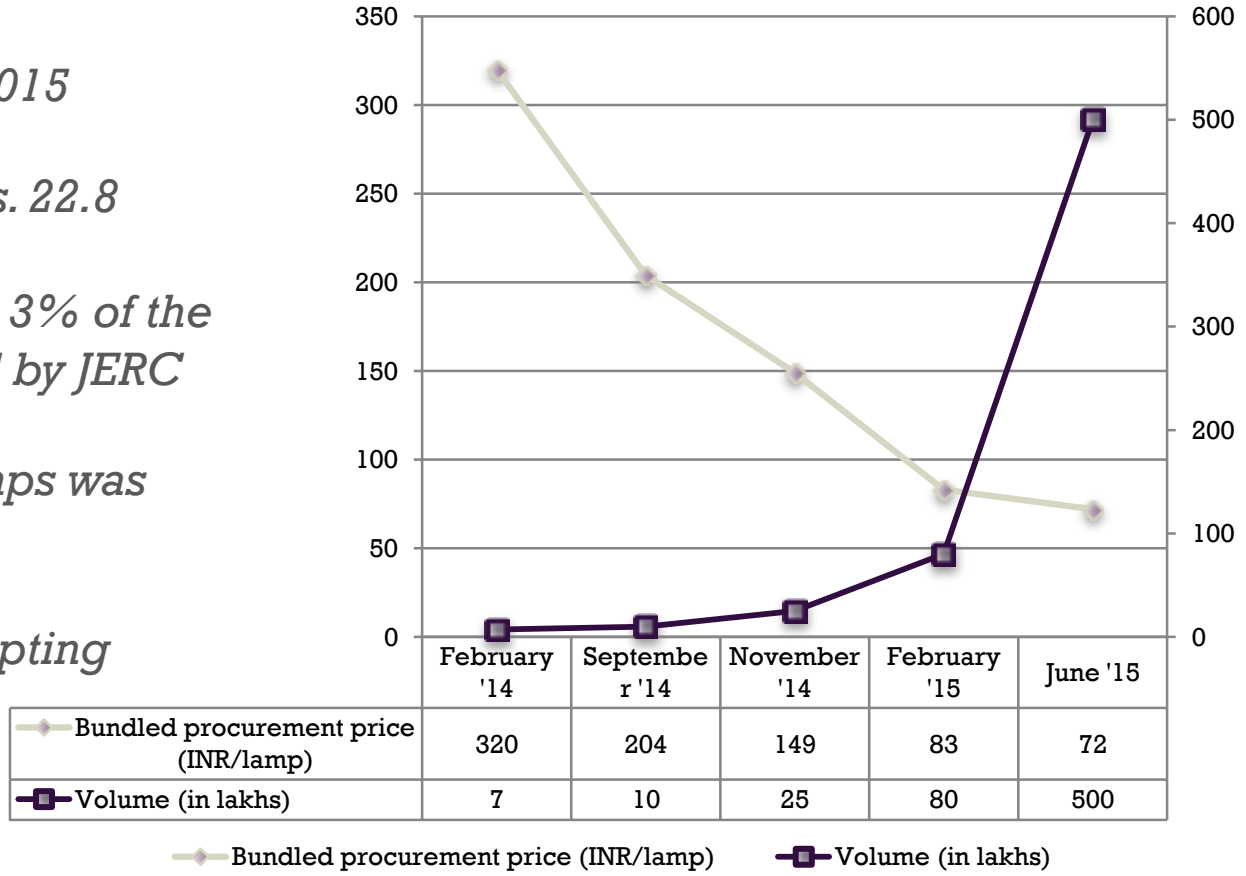
Average Power Procurement Costs vary from Rs. 2.90/kWh to Rs. 3.75/kWh

Highest Marginal Costs vary fromRs. 3.9/kWh to Rs. 7/kWh



Indian example – "DSM based Energy Efficiency Lighting Program of EESL"

- *First-ever program - Puducherry in 2014-2015*
- *Program outlay was Rs. 22.8 crore and the annual maintenance cost was 3% of the initial cost – approved by JERC*
- *SOP price for LED lamps was Rs. 2.5/kWh*
- *Other utilities are adopting alternate LED lighting structures*



Indian examples - Tata Power Commercial Standard Offer"

- *Implementation directly by utility, without aggregator.*
- *Eligible interventions - HVAC, Lighting, motive power, control systems, etc.*
- *Measurement and verification (M&V) procedure:*
  - *Defined by Tata Power and approved by MERC*
  - *Carried out by a third party agency*
- *Approved SOP price Rs 1 / kWh for verified saving during 8am to 8pm excluding Sundays and holidays.*

SOP Handbook developed to provide implementation support

- Intense handholding of utilities and regulatory staff, professionals is essential to develop somewhat standardized scalable results
- Combined team had several formats ready and it was important to put those out in the public domain so everyone benefits
- Entire value chain of design, stakeholder engagement and program M&V is important instead of a seemingly piecemeal approach currently taken

Process of Handbook development

- Developed by project team comprising of Shakti Sustainable Energy Foundation and MP Ensystems
- Peer review process involved several experts – Mr. V. L. Sonavane, Ex-member, MERC, Industry and Academic Experts, Mr. U. N. Panjiar, BERC, experts at UPERC, HERC, MERC DSM Consultation Committee
- Specific comments from Central Electricity Regulatory Commission (Hon'able Chairperson Shri Pradhan), Bureau of Energy Efficiency (Dr. Ajay Mathur, Ms. Pravatanalini Samal), EESL (Mr. Saurabh Kumar) guided the process substantially
- Developed as a "How-to-do" Guide for practitioners, utilities, regulators

Structure of the Handbook

- Identifies Roles and Responsibilities of the stakeholders
- Suggests two implementation models (national level and state-specific utility-driven)
- Presents SOP pricing for end-uses and technologies
- Includes detailed Annexures as formats:
  - Load Research,
  - Program Design Documents,
  - Regulatory Approval Process,
  - Measurement & Verification process
  - Approach for Consumer Outreach

Handbook Contents

S.No	Section	Description
1	SOP Implementation Framework	The Implementation Framework that can be adopted for an SOP to be offered at the national level, or, at the utility level.
2	Implementation process	Step-by-step process for the design and roll-out of an SOP
3	Design of an SOP	Detailed guidelines on designing an SOP, including, guidelines to select which SOP to offer, guidelines to perform benefit-cost analysis, guidelines on determining the SOP price and contents of a typical Program Design Document
4	Measurement and Verification (M&V) options	Possible M&V options for an SOP
5	Roles and responsibilities of various stakeholders	Identification of stakeholders and defining specific responsibilities at various stages in an SOP design and roll-out
6	Proposed structure of an "SOP Roll-out Manual"	Table of contents of a typical Program Roll-out Manual that would be released by the Program Owner when announcing an SOP

Annex	Title
I	Abbreviations
II	Glossary
III	International Examples of Successful SOPs
IV	Typical Terms of Reference for Load Research Activities
V	Sample Questions for Consumer Survey – Residential and Commercial Categories
VI	Sample Questions for Vendor Survey
VII	Representative Load Curves
VIII	Template for Regulatory Filing (Program Design Document (PDD)) – with Aggregator
IX	Template for Regulatory Filing (Program Design Document (PDD)) – without Aggregator
X	Types of Meters, Available Makes, M&V Applicability, Indicative Costs
XI	Brief Description of Energy Efficient Technologies
XII	Details of Energy Efficient Technologies
XIII	Annual Energy Savings from Energy Efficient Technologies
XIV	Average Power Procurement Cost (APPC), Highest Marginal Cost (HMC) and Units Purchased
XV	Capital Recovery Factor
XVI	Table of Contents of Program Roll-out Manual
XVII	Summary of Agreements and Contractual Documents
XVIII	Consumer Outreach Material
XIX	Communication and Marketing Approaches
XX	DSM Initiatives Undertaken by Utilities in India

Handbook covers "Standardized" and "Comprehensive" Measurement & Verification Protocols

Approach	Applicability	Description
Standardized M&V	Non-complex projects – e.g. lighting retrofits and unitary AC retrofits	Savings can be estimated at the program design stage and verified at the implementation stage. Savings can be computed as a combination of (i) sampling of savings through actual measurements of baseline and post-implementation energy usage at a certain pre-defined confidence interval and pre-defined margin of error (using statistically significant sample), and, (ii) extrapolating the savings to the population
Comprehensive M&V	Complex projects – e.g. chiller replacements, heat pump installations, etc.	Savings computed through actual measurements of baseline and post-implementation energy usage

Next steps

- SERCs requested to incorporate SOP (DSM and EE) in power procurement planning
- We intend to carry out wider dissemination of the Handbook in workshops, webinars, websites
- Current thinking is to develop SOP for Load Management and Strategic Conservation in the following end-uses:
  - Commercial – HVAC – a nation-wide SOP to seek peak-demand relief
  - Industrial (small and large) – motors/motors-driven systems
  - All of above programs would lead to reduced costly power purchase

Contacts

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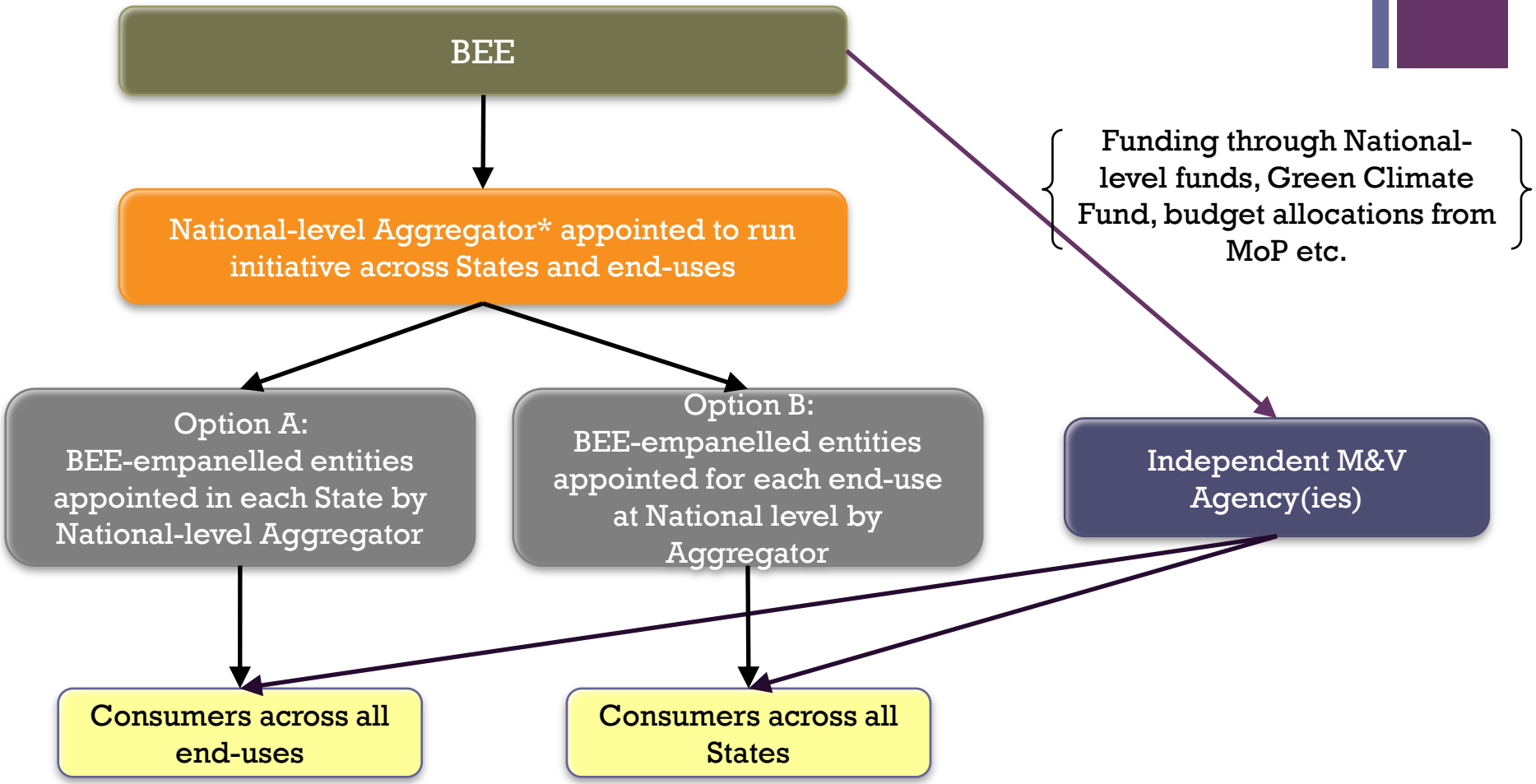
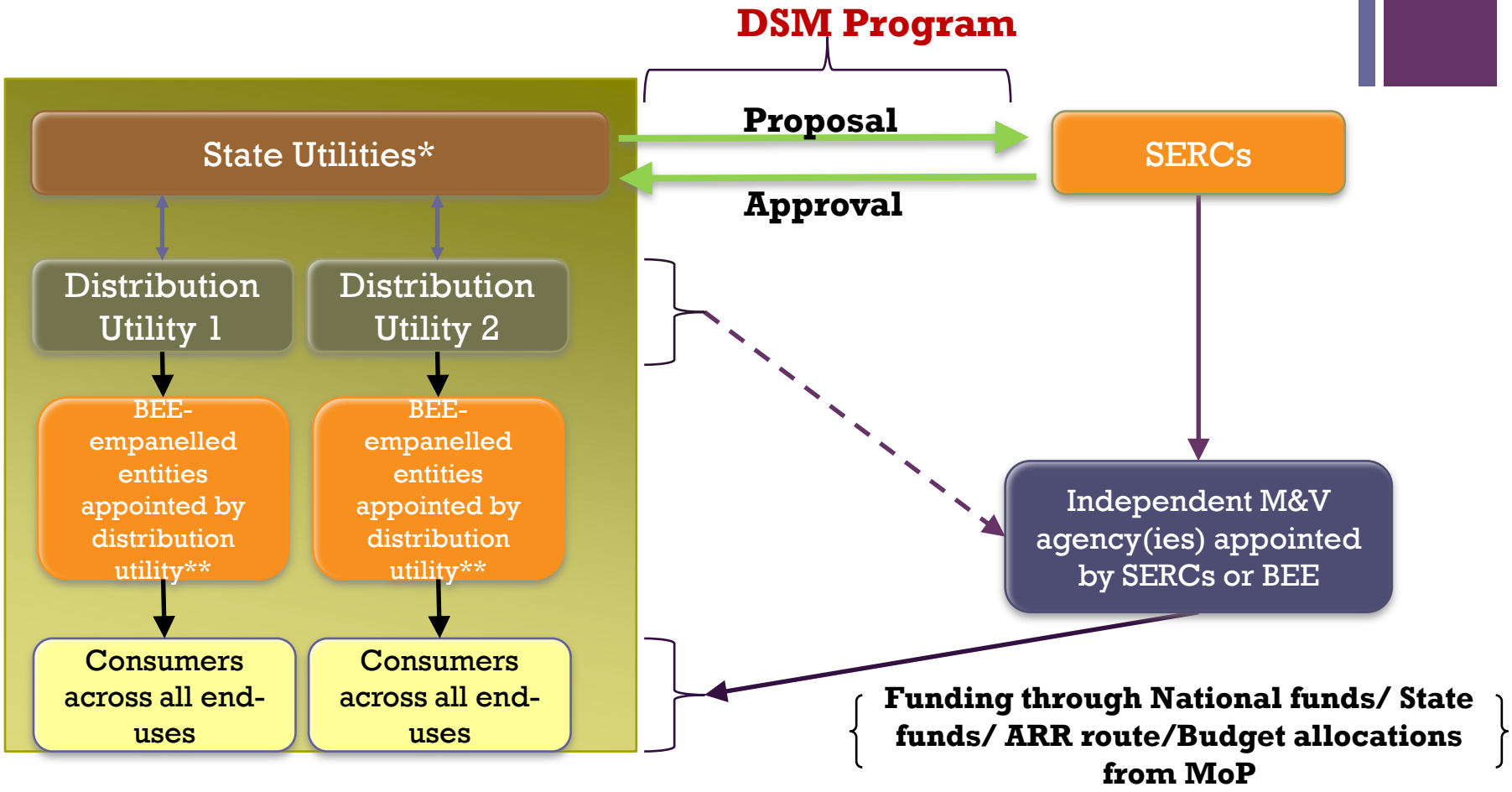
  - Mahesh Patankar, PhD (mahesh@mpensystems.com)
  - Sonia Shukla (sonia@mpensystems.com)

Possible implementation model 1: BEE Implemented National Level Program



** National level Public Sector Undertakings such as PTC India, NTPC, EESL, IREDA etc.) or private companies can run this program through subcontracted entities, if needed*

Possible implementation model 2: Individual Utility Driven Implementation



**State Utilities can develop DSM proposals to be approved by respective SERCs*

*** National level Public Sector Undertakings such as PTC India, EESL, NTPC, IREDA etc.) or private companies can run this program through subcontracting Energy Service Providers.*

Sample Questions for Consumer Survey

- General information

Name	
Location	
Contact number	
Email ID	
Area of the house/ apartment/ commercial establishment	
Energy Consumption in the last month (kWh) – From the electricity bill	
Average electricity bill (Rs.)	
Working hours/ time that people are in the house	
Average money spent on communication per month (mobiles/landlines/ Wi-Fi etc.)	

- Please list the details of appliances available in your house, their year of purchase, and usage timings:

Appliance	Type	No. of appliances	No. of appliances typically used at a time	Year of last purchase	Size	Hours of usage <tick mark where applicable>																								Is there any seasonal variation in usage? If yes, please elaborate.	Are you planning to purchase/ replace in the next 1-2 years
						12am to 1am	1am to 2am	2am to 3am	3am to 4am	4am to 5am	5am to 6am	6am to 7am	7am to 8am	8am to 9am	9am to 10am	10am to 11am	11am to 12noon	12noon to 1pm	1pm to 2pm	2pm to 3pm	3pm to 4pm	4pm to 5pm	5pm to 6pm	6pm to 7pm	7pm to 8pm	8pm to 9pm	9pm to 10pm	10pm to 11pm	11pm to 12am		
Tube light	☐ Regular ☐ T5 ☐ LED				-																										
Bulb	☐ Regular ☐ CFL ☐ LED				-																										

Contd…

- If you are aware of energy efficient appliances, please rank the most important reason(s) for not replacing the existing inefficient appliances?
  - ☐ High initial cost
  - ☐ Not sure about the savings
  - ☐ Existing appliance is working well
  - ☐ Existing appliance is recently bought
  - ☐ Time constraints
  - ☐ Planning to replace in the near future
  - ☐ Energy expenses are a small part of total monthly household expenses

- Are you aware of energy efficiency programs undertaken by your utility? ☐ Yes ☐ No
  - a. If yes, have you participated in any of those programs? ☐ Yes ☐ No If no, why so? _____
- If incentivized, are you willing to switch off/ reduce your loads if required by the utility at specific times in the day? ☐ Yes ☐ No
  1. If yes, at what incentive level (Rs/kWh)? ☐ 0.5 ☐ 1.0 ☐ 1.5 ☐ 2.0 ☐ 2.5 ☐ 3.0
  2. What kind of loads are you willing to reduce? ☐ Lighting ☐ HVAC ☐ Others _____ (please specify)
  3. How will you reduce loads? ☐ Switch off ☐ Modulate ☐ Change of operation timings ☐ Others _____(please specify)
- Are you aware of technologies such as heat pumps that reduce electricity consumption for heating requirements of the whole building? ☐ Yes ☐ No
- How much are you willing to pay for efficient appliances, based on the expected savings you will get?

Sample Questions for Vendor Survey

1. End use technology/products you provide:

   ☐ Fan ☐ Air Conditioner ☐ Lighting ☐ Water Heating
   ☐ Water Pump ☐ Thermal Energy Storage ☐ Others (please specify) _____

2. Are you a manufacturer or distributor of technology: ☐ Manufacturer ☐ Distributor

   a) If manufacturer, how do you get the raw materials/parts for the manufacturing of the product? _____
   b) If distributor, how do you import the products for distribution? _____

3. How many manufacturing and distribution units do you have in India?

   ☐ 1 ☐ less than 5 ☐ 5 to 10 ☐ more than 10

4. Where are they located?

S. No.	Best Technology	Annual Sales (Number of Pieces per annum)	Production/Distribution quantum (Number of Pieces per annum)	Final cost with discount (Rs. Per piece)
1				
2				
3				

Contd…

1. Cost range of the product:-
   a) Cost of the product _____
   b) Cost of the peripherals _____
   c) Cost of installation _____

2. Do you have any past experience in thermal storage, heat pumps?
   a. How many installations have you done before in India?

   ☐ Less than 5 ☐ 5 to 10 ☐ more than 10

   b. Where are they located? Specify the sector and city;

   ☐ Residential Building _____ ☐ Commercial Building_____
   ☐ Industry_____ ☐ Hotel_____ ☐ Hospital _____

   c. What were the key issues faced during the installations? _____
   d. Any new upcoming projects if you have in Mumbai or other cities? _____

3. What are the finance options you provide to the customers?
   ☐ EMI ☐ Finance Institutions ☐ others (specify) _____

4. How the agreements are made with the financiers? _____

5. Have you worked with energy service providers or Discoms?
   ☐ Yes ☐ No

6. How do you market your products? _____

7. What are the market barriers? _____

8. Do you meet with similar technology providers at any forum?
   ☐ Yes ☐ No

Brief Description of Energy Efficient Technologies

Unitary AC:

Unitary ACs (window ACs, Split ACs and Split + Inverter ACs) are small air-conditioning systems that typically use vapour compression cycles. The entire system uses a circulating liquid refrigerant which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. The vapour compression system has four components (i) compressor, (ii) condenser, (iii) expansion valve and (iv) evaporator.

Energy Efficient Chillers:

Chillers are used to remove heat from a liquid. In most of the medium and large air conditioning systems, chilled water is typically circulated through heat exchangers or coils in air handling units or other types of devices close to the load centers. This cools the air in the respective space(s), after which the water is re-circulated back to the chiller to be cooled again. The cooling coils transfer sensible heat and latent heat from the air to the chilled water, thus cooling and usually, dehumidifying the air. A typical chiller for air conditioning applications is rated between 15 and 1,500 tons (180,000 to or 53 to 5,300 kW) in cooling capacity. Chilled water temperatures can range from 35 to 45 degrees Fahrenheit (1.5 to 7 degrees Celsius), depending upon application requirements.

Refrigerators:

A refrigerator transfers heat from the refrigerator to the environment and hence cools the food stored inside the refrigerator. It also has a freezer, which maintains the temperature in the compartment below the freezing point of water to make ice and store frozen food. A refrigerator has (i) evaporator, (ii) compressor, (iii) condenser and an (iv) expansion device. Refrigerator also has a refrigerant, which is vaporized in the evaporator through the heat from inside the refrigerator followed by raise in pressure and temperature of the refrigerant through the compressor. The high pressure vapor is then condensed into high pressure liquid through the condenser and the heat is absorbed by the outside air the flows across the condenser. The resultant high pressure high temperature liquid refrigerant is turned to low pressure low temperature mixture of refrigerant liquid and vapor through the expansion device. The refrigerant goes to the evaporator, and the cooling cycle continues.

Contd.

Ceiling Fans:

Ceiling fans are the most commonly used electrical appliances for space conditioning in residential, commercial and industrial spaces in India. Several ceiling fans currently in use in various types of buildings are inefficient and there exists large potential to achieve energy efficiency by replacement of these energy inefficient fans with BEE five star rated efficient ones. Development of super-efficient fans is also being undertaken in India and these fans will be even more efficient than the 5 star rated fans.

Heat Pumps:

Heat Pumps use electricity to move heat from one place to another instead of generating heat directly. To move the heat, heat pumps work like a refrigerator in reverse. While a refrigerator pulls heat from inside a box and transfers it into the surrounding room, a HPWH pulls heat from the surrounding and transfers it at a higher temperature into a tank to heat water. Based on their input source, there are three basic types of heat pumps available in the market viz. Air-To-Water System (also referred to as an “air-source” heat pump) and the Water-To-Water System (or “water source” heat pump) and ground-source heat pumps. Heat pumps consist of a refrigerant, reversing valve, coil, evaporator, compressor, condenser, expansion equipment and plenum.

Thermal Energy Storage (TES):

The primary principal of a thermal storage unit is to shift the peak demand resulting from an air-conditioning system to the off-peak period by storing thermal energy (cooling in the form of ice) developed during the night-time. Small thermal storage systems have the capability to cater to 4 TR to 40 TR packaged systems by integrating a separate unit coupled with the packaged air-conditioning systems. Two primary technologies are used to store the “cooling”, namely, using ice-on-coil units and nodules-based techniques. In both the cases, use of phase change fluids such as glycol solutions is essential to store the “ice” in separate units, which is then thawed during the day-time peak to generate chilled water. In smaller systems the refrigerant can directly be cooled in a small heat transfer unit to generate the required cooling effect.

Induction Motors:

An induction motor is an AC electric motor. In this motor, the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. Energy efficient three phase squirrel cage induction motors are included under BEE’s voluntary labeling scheme. Squirrel cage induction motors are widely used in industrial applications due to their ruggedness.