

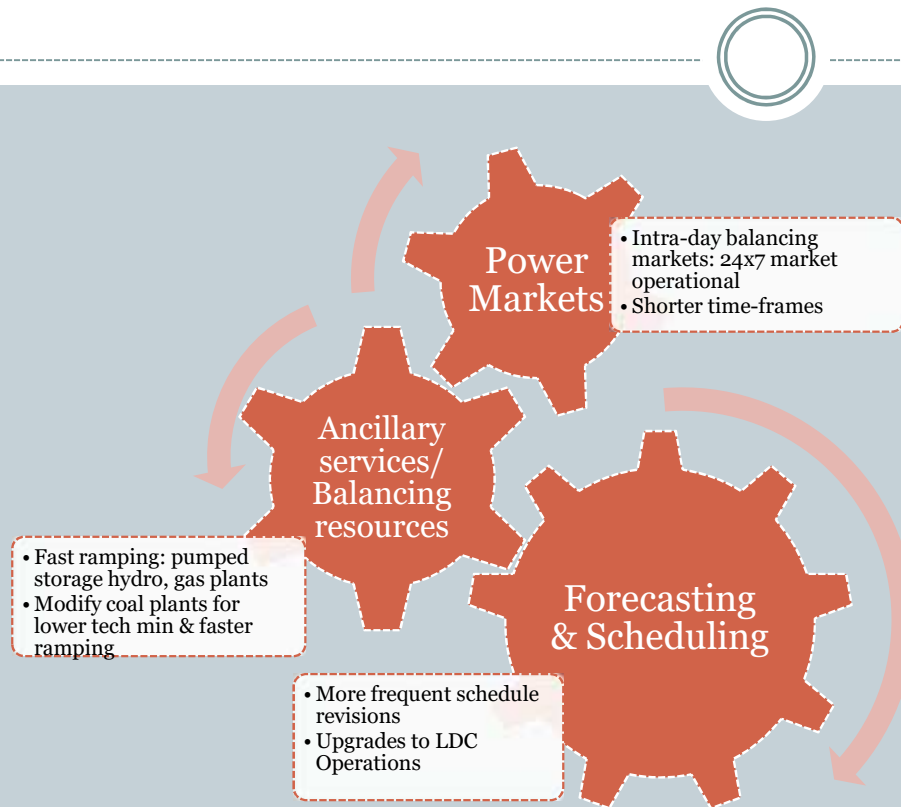
# Framework for Forecasting, Scheduling & Deviation Settlement for RE



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**COMMISSION**

# Integration of RE Sources into the Grid



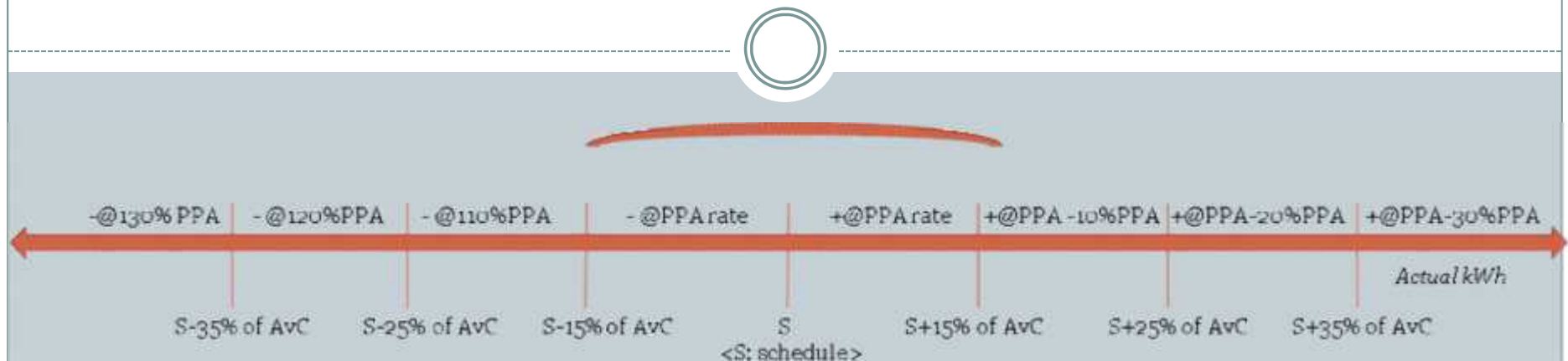
- CERC notified the Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar)- for Regional Entities- on 7/8/15
- CERC notified the Ancillary Services Operations Regulations, 2015, applicable on ISTS, on 19/8/15
- CERC/FOR agreed on draft Model Regulation on operational and commercial framework for intra-state wind & solar generators

## CERC's Framework for Scheduling, Forecasting & Deviation Settlement for RE Sources (solar & wind)



- Forecasting and scheduling must be done for both solar and wind regional entities
  - Can be done by generator and/or RLDC
  - Larger geographical area results in better forecasting accuracy
- Due to the infirm nature of these sources, more flexibility provided w.r.t schedule
- Incentive to improve forecasting- deviation charges outside a tolerance band, which could be tightened over time.
- Integration with existing grid-framework for long term sustainability of RE sources on the grid

# Deviation Settlement Framework for Regional Entities



- Error definition:  $[(\text{Actual generation} - \text{Scheduled generation}) / \text{Available Capacity}] \times 100$
- 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:

| <i>Abs Error (% of AvC)</i> | <i>Deviation Charge</i> |
|-----------------------------|-------------------------|
| 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 4<sup>th</sup> 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**

# Forecasting, Scheduling and Deviation at State Level



## Model Intra-State Framework

# 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) in States



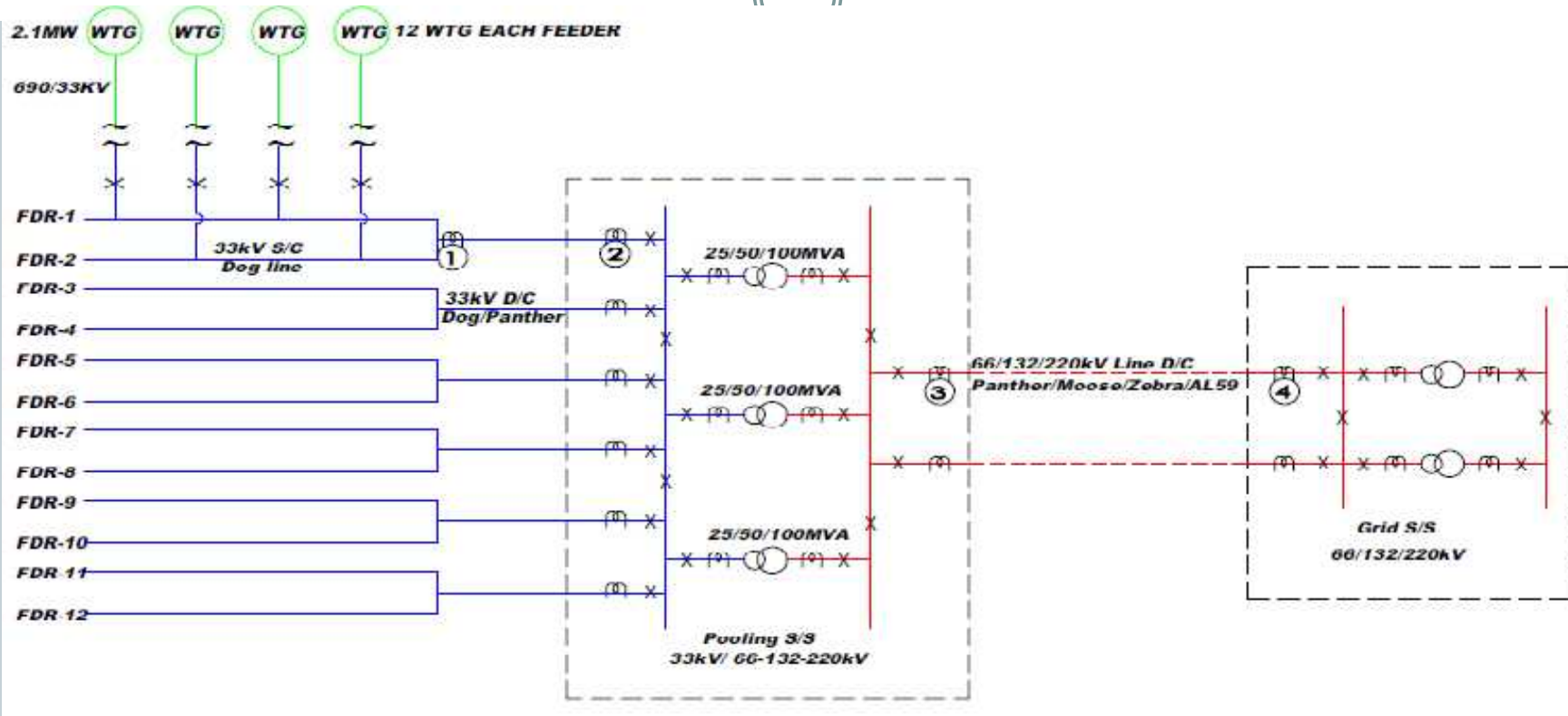
## To coordinate at a pooling station level:

- Forecasting
- Aggregate schedules and schedule revisions
- Metering & telemetry
- Communicate with SLDC
- De-pool energy deviations
- De-pool deviation charges; *on 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



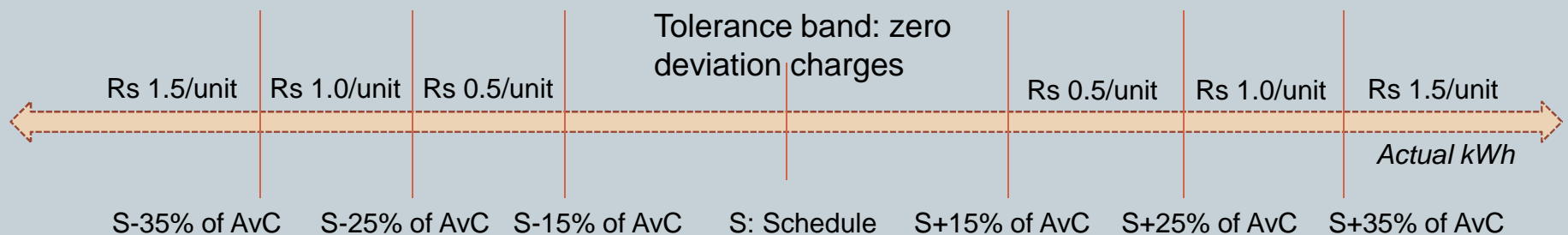
|                         |     |    |    |     |    |     |     |
|-------------------------|-----|----|----|-----|----|-----|-----|
| State                   | AP  | GJ | KN | MH  | MP | RJ  | TN  |
| Billing Meters Position | 3&4 | 3  | 4  | 2&3 | 1  | 2&4 | 0&1 |

# 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:

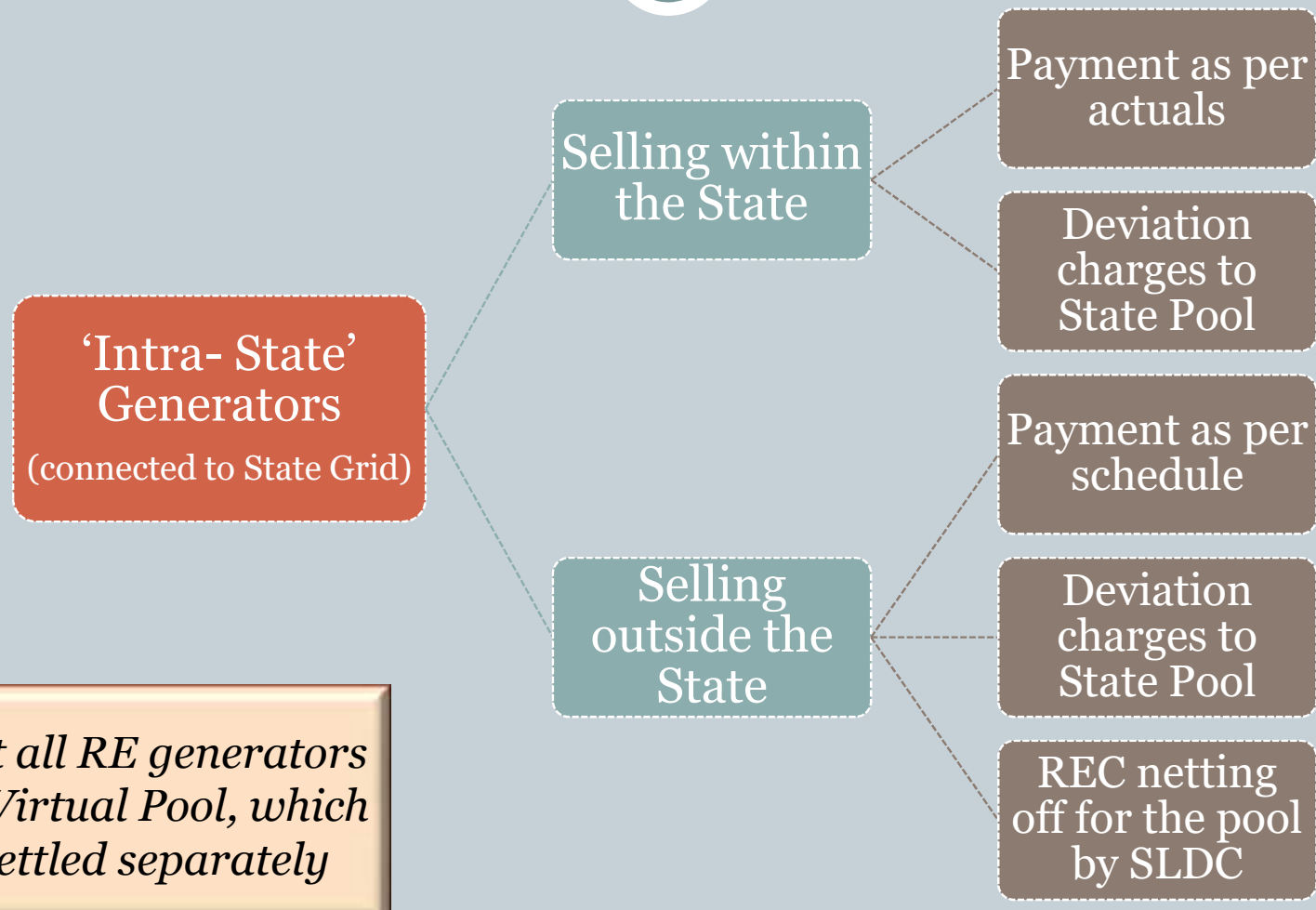


•**15% tolerance band for existing wind / solar generators**

•**10% tolerance band for new wind / solar generators**

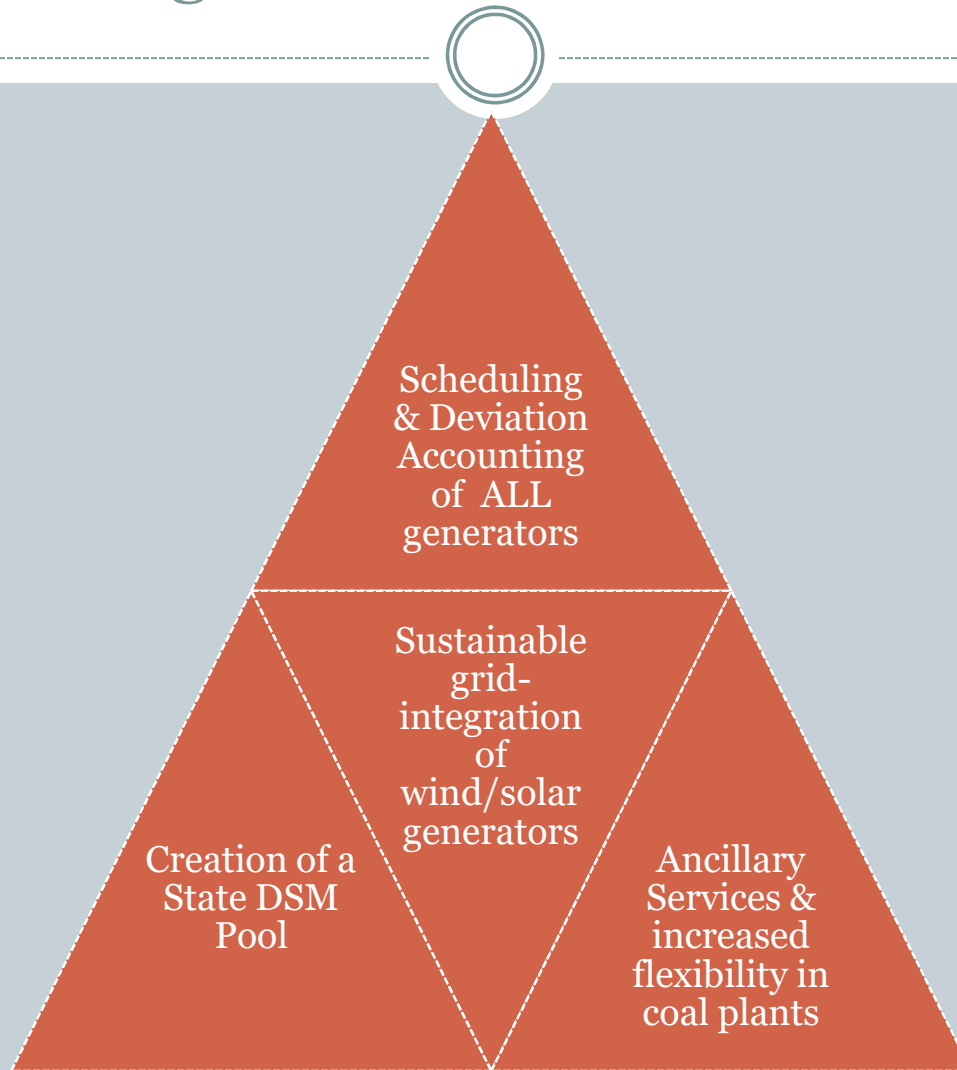


# Intra-state RE generators: 2 types of transactions



*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)

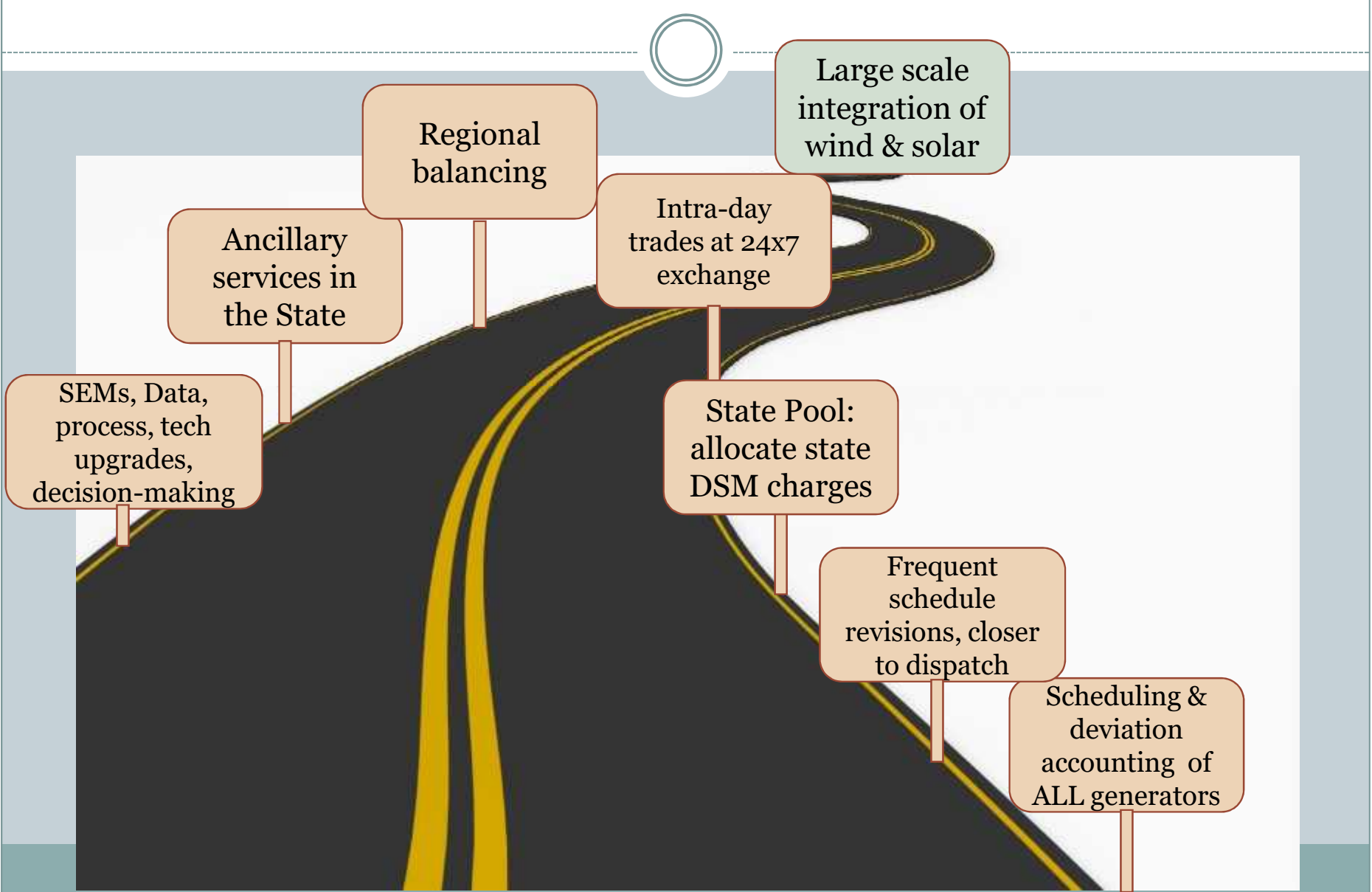
# Implementing Intra-State Deviation Settlement



- 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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