The Real Time Market – RTM

Dr. S.K. Chatterjee
Chief (RA Wing), CERC

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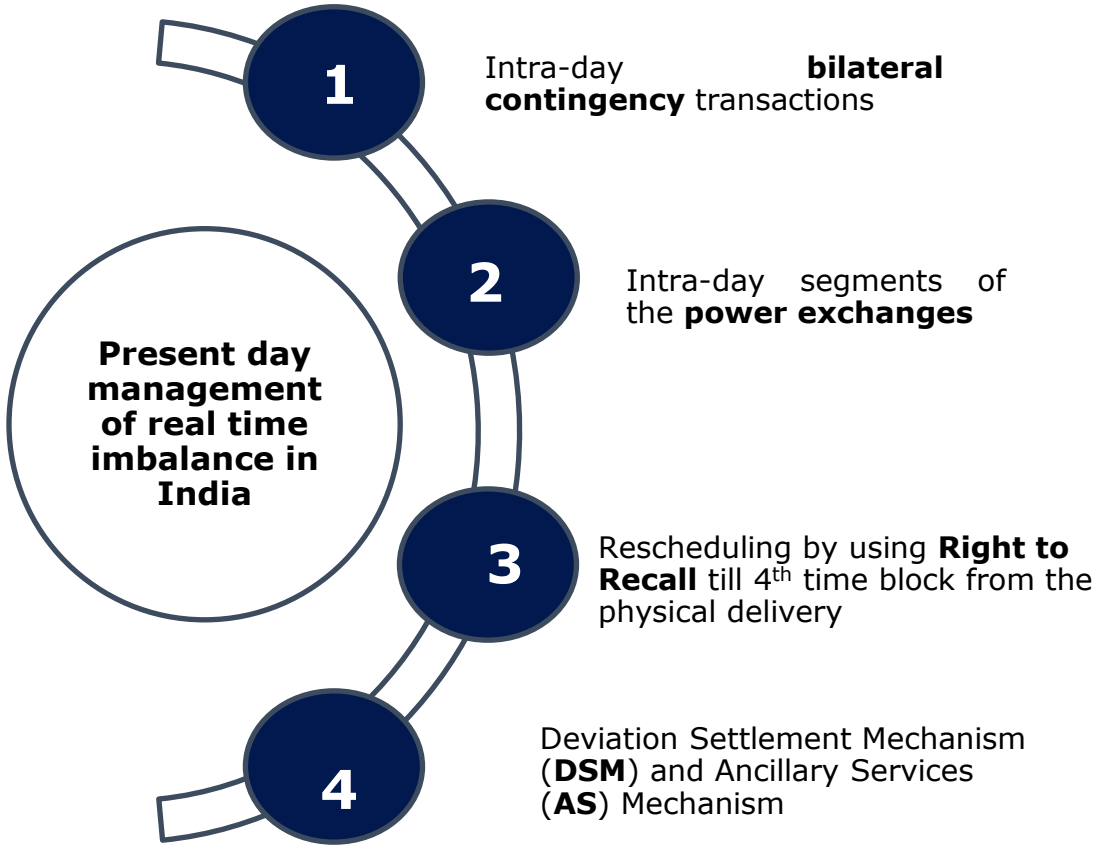
Real Time Market- Rationale and Benefits

Energy Imbalance Management at Real Time

Existing Mechanism and their Issues



1. Intra-day **bilateral contingency** transactions
2. Intra-day segments of the **power exchanges**
3. Rescheduling by using **Right to Recall** till 4th time block from the physical delivery
4. Deviation Settlement Mechanism (**DSM**) and Ancillary Services (**AS**) Mechanism

Treatment of DSM

DSM is meant for last mile imbalance management and frequency control.

DSM used as an avenue for real time energy procurement and sale;

Ancillary services have been used for a longer period

Liquidity in Power Exchanges

Volume traded under intra-day market approx. 0.1 % of total generation

Price discovery methodology of "Pay as you bid" instead of "Uniform Clearing price"

Absence of Gate Closure

- **Right to Recall**: Non participation of URS in intra day market due to right to recall prior to 4 time blocks .
- **Absence of gate closure** prevents firmness of schedule .

There is a need for real time market with Gate Closure

Rationale for RTM….1/2

Market Operation – Framework			
Categories of Market	**Day Ahead Market (DAM)**	**Real Time Market (RTM)**	**System Imbalance/Ancillary Services Market**
Purpose	Energy Trade	Energy Trade	Inadvertent deviation management
Market Operation – India			
Current	DA (self-scheduling + Power Exchange (PX))	Deviation settlement Mechanism (DSM) + Ancillary Services (AS) + Intra-Day (PX) + Re-Scheduling (4 time blocks prior to dispatch)+ Intra-day contingency	
Desirable	DA (self-scheduling + PX)	Real Time Market (Hourly), with gate closure	DSM + AS

Rationale for RTM….2/2

Larger Pool	• Organised platform with access to a larger pool for buyers and sellers
RE Integration	• Market mechanism closer to real time to handle RE variability
Avenue for Merchant plants	• Avenue for merchant / un-tied capacities to sell power
Managing demand in real time	• Option for managing real time load variation
Organized market vis-à-vis DSM	• RTM to induce generators / discoms to organized energy market and reduced dependence on DSM
Collective vs. Continuous bids	• Collective transaction expected to bring in confidence of stakeholders in RTM
Introduction of gate closure	• Need for firmness of schedules. Hence the need for Gate closure.

Future power markets would be characterized by huge demand-supply variability leading to grid reliability issues

There is a need for designing of organized real time market in the country

Benefits of Real time markets

SNo	Benefits	Entity concerned
1	Discoms would **procure power** for real time imbalances **from organized markets** instead of leaning onto DSM	Discom
2	Discoms will have **access to a larger pool of generation** for the procurement of the power	Discom
3	**Prices discovered** under Market environment are **likely to be more efficient / transparent**	Social welfare
4	Gains realized by sale of URS power would be shared in the ratio of 50:50 with contracted beneficiary	Generator / Discom
5	Alternatively, **DISCOM can directly participate in the market** and sell surplus power and retain 100% gains.	Discom
6	RTM **incentivizes cheaper generators** by increasing their visibility at a national level	Generator
7	RTM provides default payment security	-

There are benefits to all stakeholders with the introduction of real time markets

Introduction of Gate Closure

Integrated Market mechanism

- **Mostly followed in US markets**.
- System Operator centrally optimizes the scheduling and dispatch of resources
- The Unit Commitment along with Economic Dispatch is carried out by the SO

Exchange Based Market mechanism

- Mostly, **European and Australian markets follow Exchange based markets**
- Trading of energy in exchanges throughout the day and clearing of market is based on trade prices.
- Bidding process is carried at a market operator level, hence the MO is largely dependent upon the bidders for sanctity of bids.

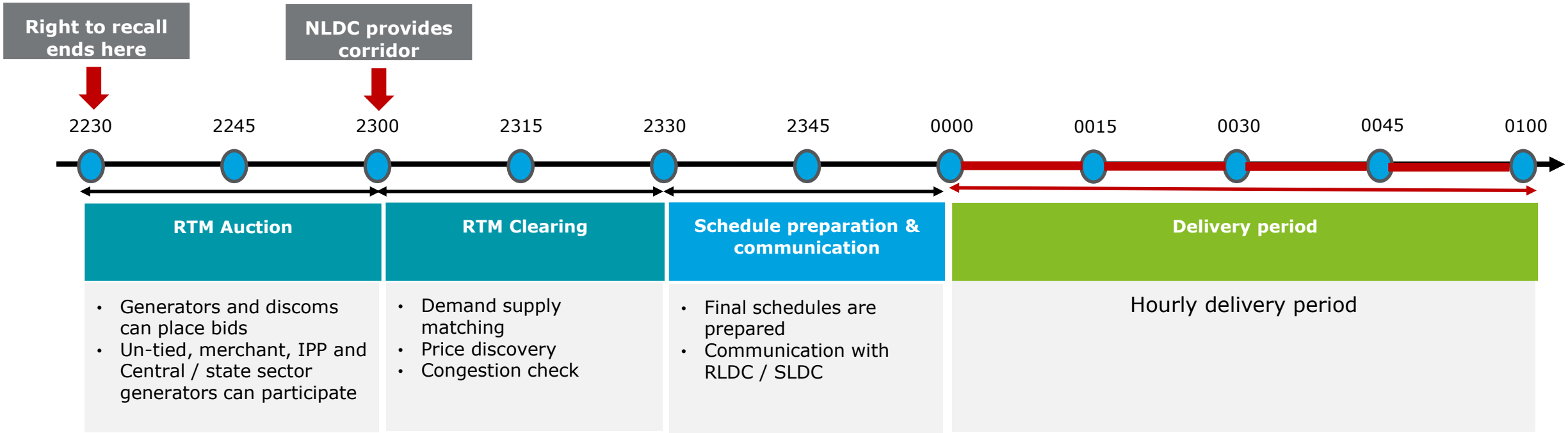
Concept of Gate Closure

In both types of Markets, at some point before physical delivery, schedules are frozen/finalized. This ensures clear knowledge of system imbalance to S/O.

System Operator then uses this information for maintaining reliability of the grid.

- Real Time Market Design – as suggested in Discussion Paper

Hourly Real time market as suggested in Discussion Paper



RTM auction start time	RTM auction end time	RTM clearing interval	Schedule prep and Communication	Delivery period (MCP and MCV will be discovered for each 15 minute block)
22:30 Hrs (of the previous day)	23:00 Hrs (of the previous day)	23:00-23:30 Hrs (of the previous day)	23:30-24:00 Hrs	00:00-01:00
23:30 Hrs (of the previous day)	00:00 Hrs (of the delivery day)	00:00-00:30 Hrs	00:30-01:00 Hrs	01:00-02:00
…				
21:30 Hrs	22:00 Hrs	22:00-22:30 Hrs	22:30-23:00 Hrs	23:00-00:00

Go to half hourly RTM

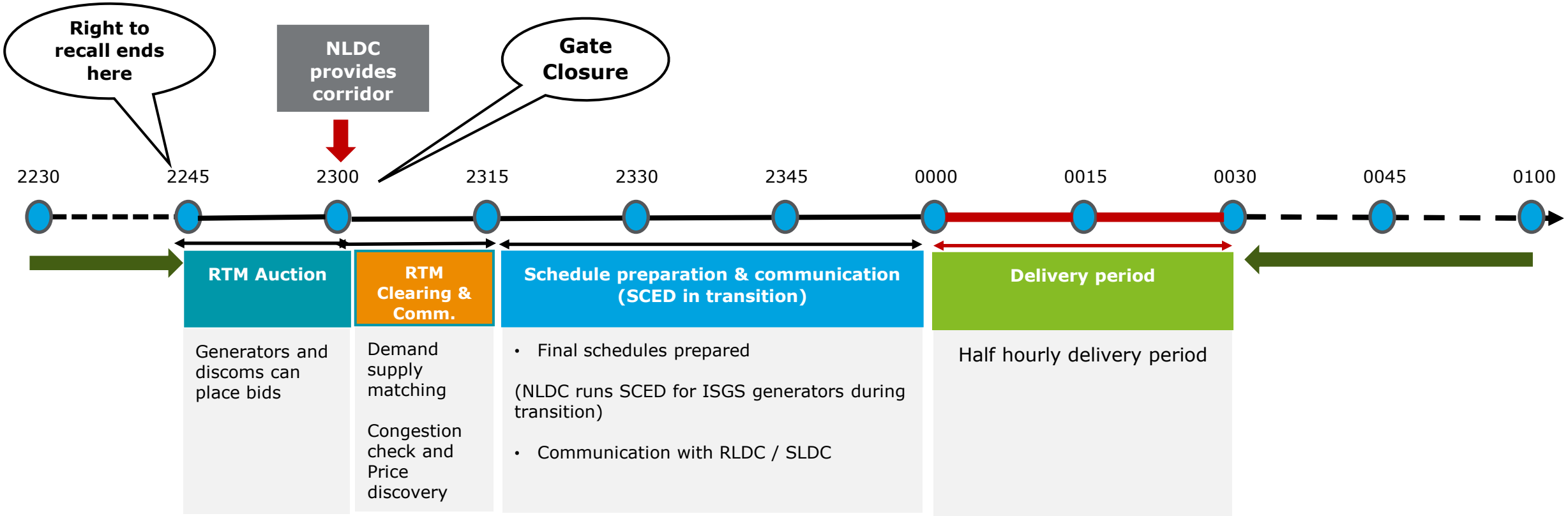
Comments Received by Stakeholders

Overview of key comments received by stakeholders

Issue	Overview of key comments		
	Generators	**Discoms**	**System operator**
Gate closure	NTPC and NLCIL also suggested to **reduce the gate closure time to one hour**	Gujarat / Maharashtra suggested to **exclude tied up generators** from RTM Suggested that **power procurement should be left to control of discoms**	POSOCO suggested a gate closure at **2 hours** before physical delivery considering operational complexities SLDC Gujarat suggested to exclude ISGS from concept of gate closure
Timelines, Operational procedure	**Bidding in Market should be open for all time blocks** at all times, however concerned bids may be considered for dispatch	MSEDCL suggested to **monitor the sanctity of bids** (Ramp check), Economic Dispatch of URS prior to RTM.	**Movement of Market towards 5-mins** from 15-mins, **allowance of one product** at a time, Proper Banking agreements as it's a 24*7 market mechanism, Formulation of Market rules to be left with exchanges
Transmission Corridor allocation and Congestion Management	**Transmission margins on key corridors** should be made available on RLDC website and may be updated on continuous basis, clarification for transmission charges and allotment priority for different products.	MSEDCL requested that the Transmission Corridor margin available for real time transaction should be declared by POSOCO accurately for optimum benefit of RTM. It also proposed that no additional transmission charges shall be levied to utility for transactions of power for PPAs having LTA/MTOA by utilities	POSOCO suggested that **declaring transmission corridor margin in advance of trading session would have impact on behavior of market participants and price discover in RTM.**
Other issues	• **Switching to 5-minute systems** in the future may also be kept in view. • **Clearing and settlement mechanism** to be worked out • Hourly market requires **substantial automation** • **Liquidity in the RTM** will be critical considering possible small volume of transactions in RTM. • **Pilot tests** could be conducted for gaining some experience before implementation • At least 5% of **quantum of demand from DISCOMs** should be made mandatory for procurement through RTM • SRPC argued hat URS left may be viewed as a need required for system operation by S/O		

Proposed Real Time Market Design

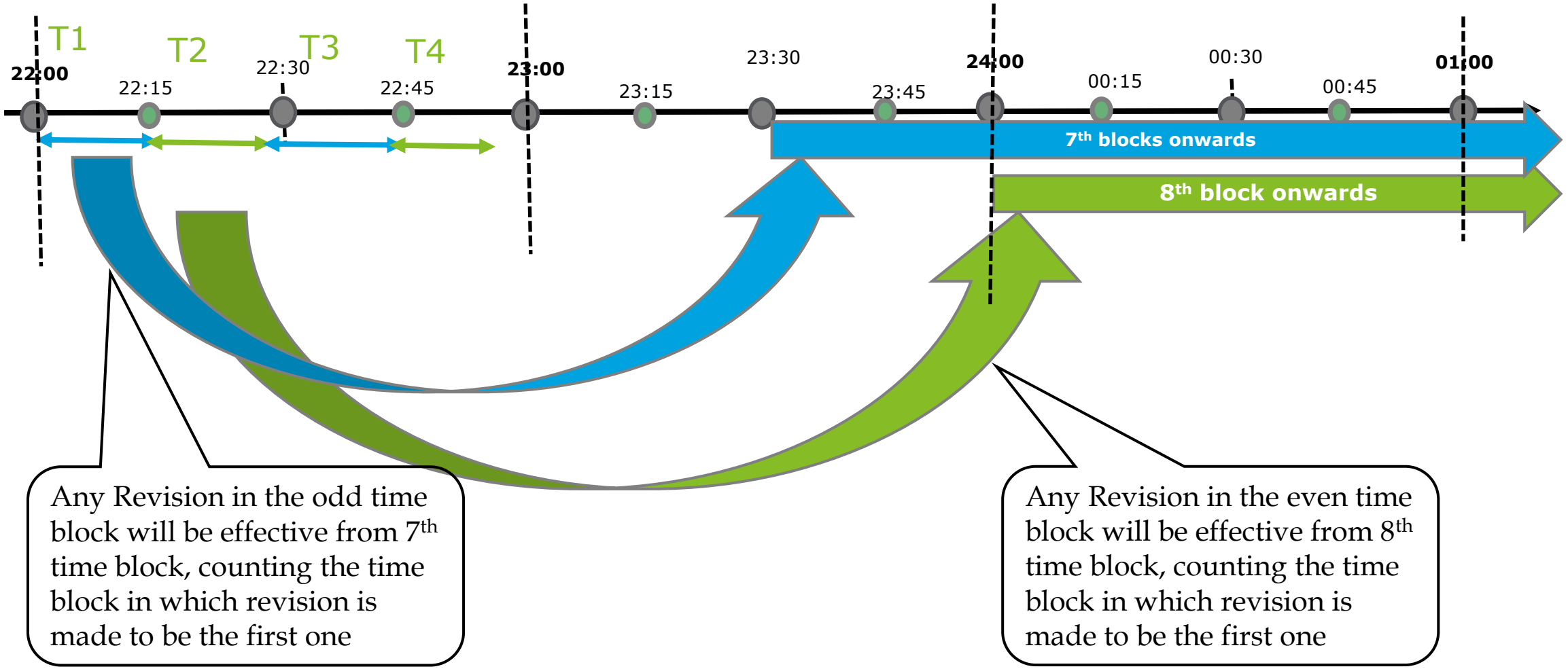
Half hourly Real Time Market



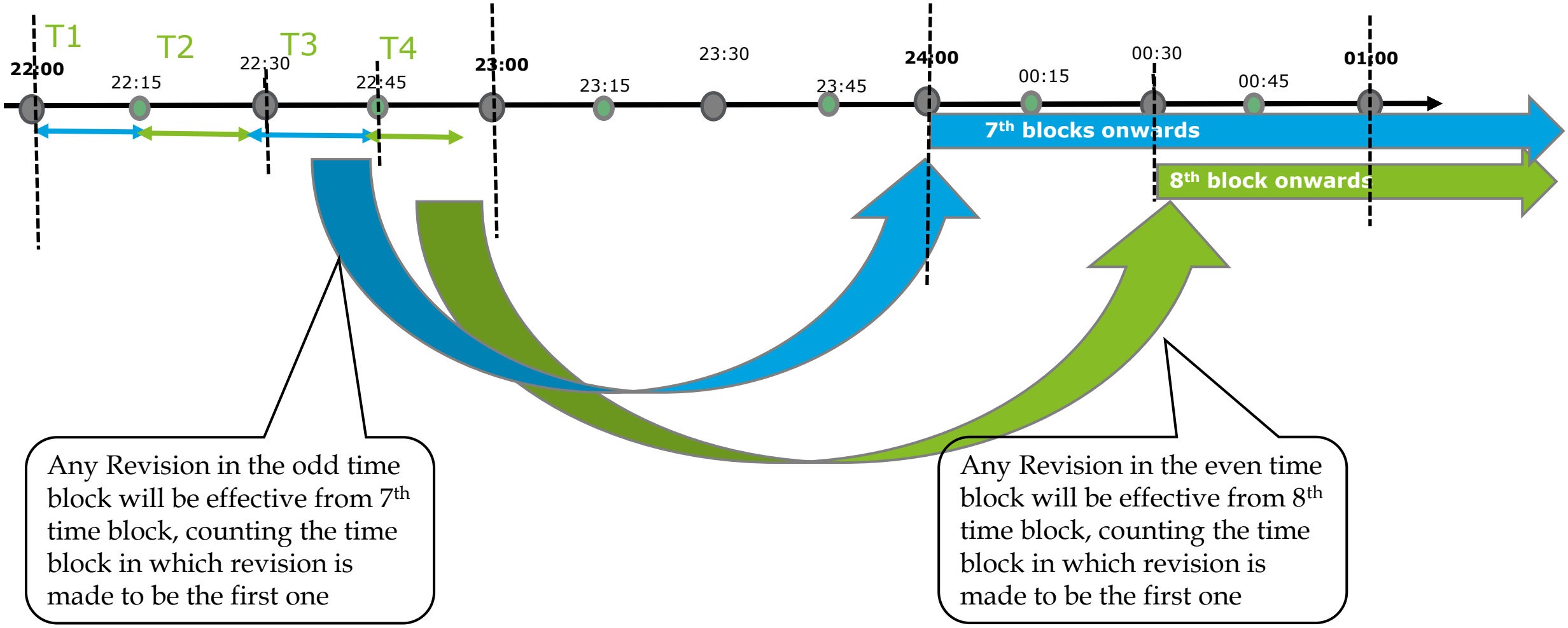
RTM auction start time	RTM auction end time	RTM clearing interval	Schedule prep and Communication	Delivery period (MCP and MCV will be discovered for each 15 minute block)
22:45 Hrs (of the previous day)	23:00 Hrs (of the previous day)	23:00-23:15 Hrs (of the previous day)	23:15-24:00 Hrs	00:00-00:30
23:15 Hrs (of the previous day)	23:30 Hrs (of the previous day)	23:30-23:45 Hrs	23:45-00:30 Hrs	00:30-01:00
…				
22:15 Hrs	22:30 Hrs	22:30-22:45 Hrs	22:45-23:30 Hrs	23:30-00:00

Go to Hourly RTM
Go to SCED Timeline

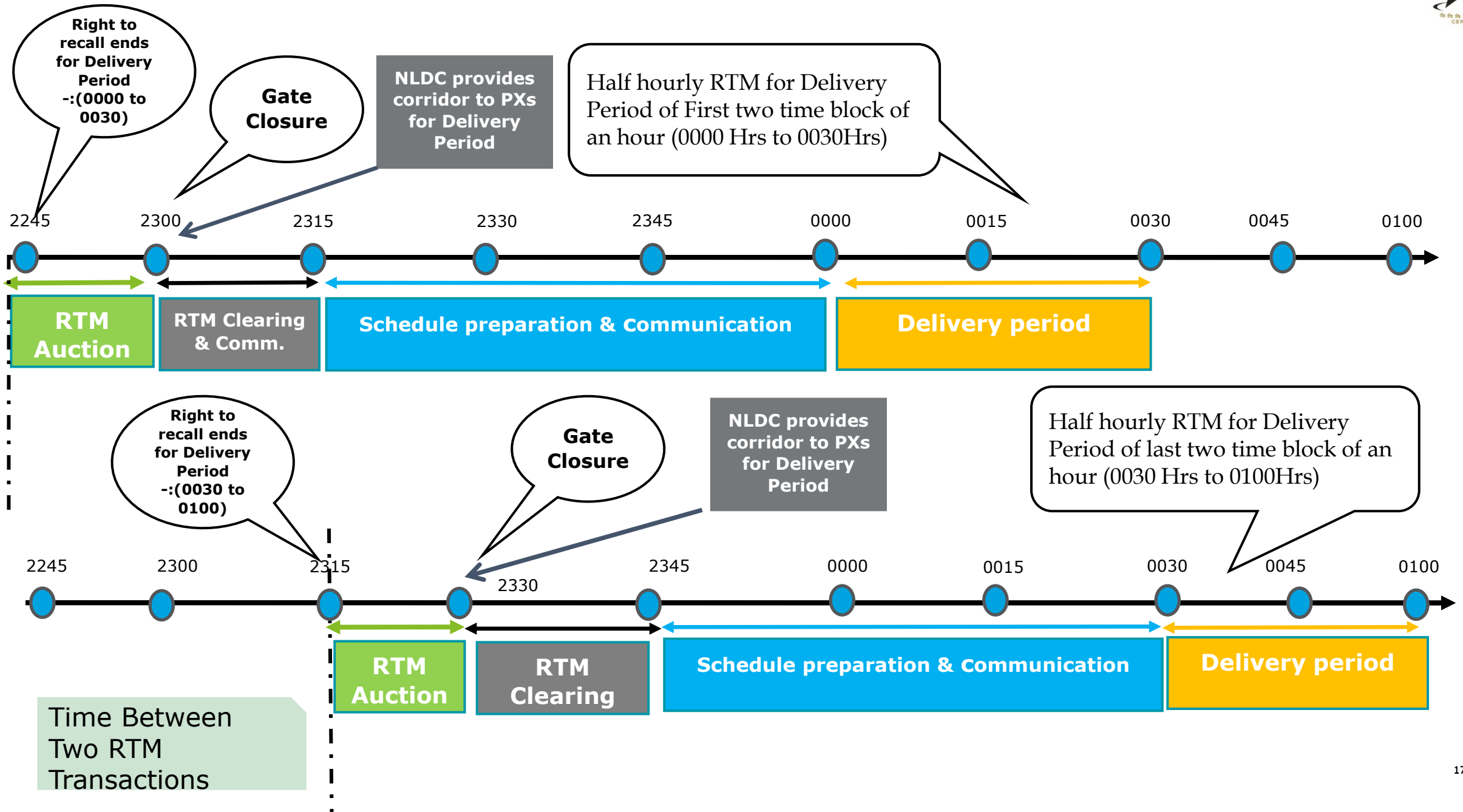
Timeline for Right to revise the schedule



Timeline for Right to revise the schedule



Timeline for Two Half hourly RTM



Proposed RTM Market – Features

- Delivery Period- Half hourly market – 48 Markets Run in a day
- Price Discovery mechanism – double sided closed auction with uniform price – same a day ahead market
- Introduction of Gate Closure - Gate closure implies the closure of the gate for trading in real-time market after which the bids submitted to the Power Exchange cannot be modified for a specified delivery period.
- Right To recall - shall end seven /eight time block prior to the delivery period
- Generator having long term contract and participating in RTM will be required to share net gains (after accounting for energy charge)
- RTM would be financially and physically bidding market
- Any deviation would attract charges as per DSM Regulations

Comparison of Hourly and Half-hourly markets

Parameter	Hourly	Half Hourly
Timeframe between Right to recall and delivery of power	• Available till **1.5 hours** before delivery period • For **last slot of delivery period –** available **11 time blocks prior**	• Available till **1 hour** before delivery period • For **last slot of delivery period –** available **7 time blocks prior**
Market engine runs	• **once every hour – Total 24 auction runs** • Runs after right to recall for ISGS has ended	• **twice every hour – Total 48 auction runs** • Runs after right to recall for ISGS has ended
Bidding window	**30 mins** (two time blocks)	**15 mins** (one time block)
Delivery of power	**60 mins** (four time blocks)	**30 mins** (two time blocks)
RTM clearing window	**30 mins** (two time blocks)	**15 mins** (one time block)
Schedule preparation and communication window	**30 mins** (two time blocks)	**30 mins** (two time blocks)
Timeframe for right to recall	Discoms have lesser timeframe to exercise right to recall.	Discoms have more timeframe to exercise right to recall.

Proposed Regulatory Amendment

Regulations	Provisions
Indian Electricity Grid Code Regulations, 2010	• Provision for Right to recall • Scheduling for RTM Transactions • Settlement under RTM
Power Market Regulations, 2010	• Definition of Gate Closure, Real-time contracts etc. • Price Discovery Mechanism
Open Access Regulations, 2010	• Definition of Real time transaction • Procedure for Scheduling the RTM transactions • UI charges

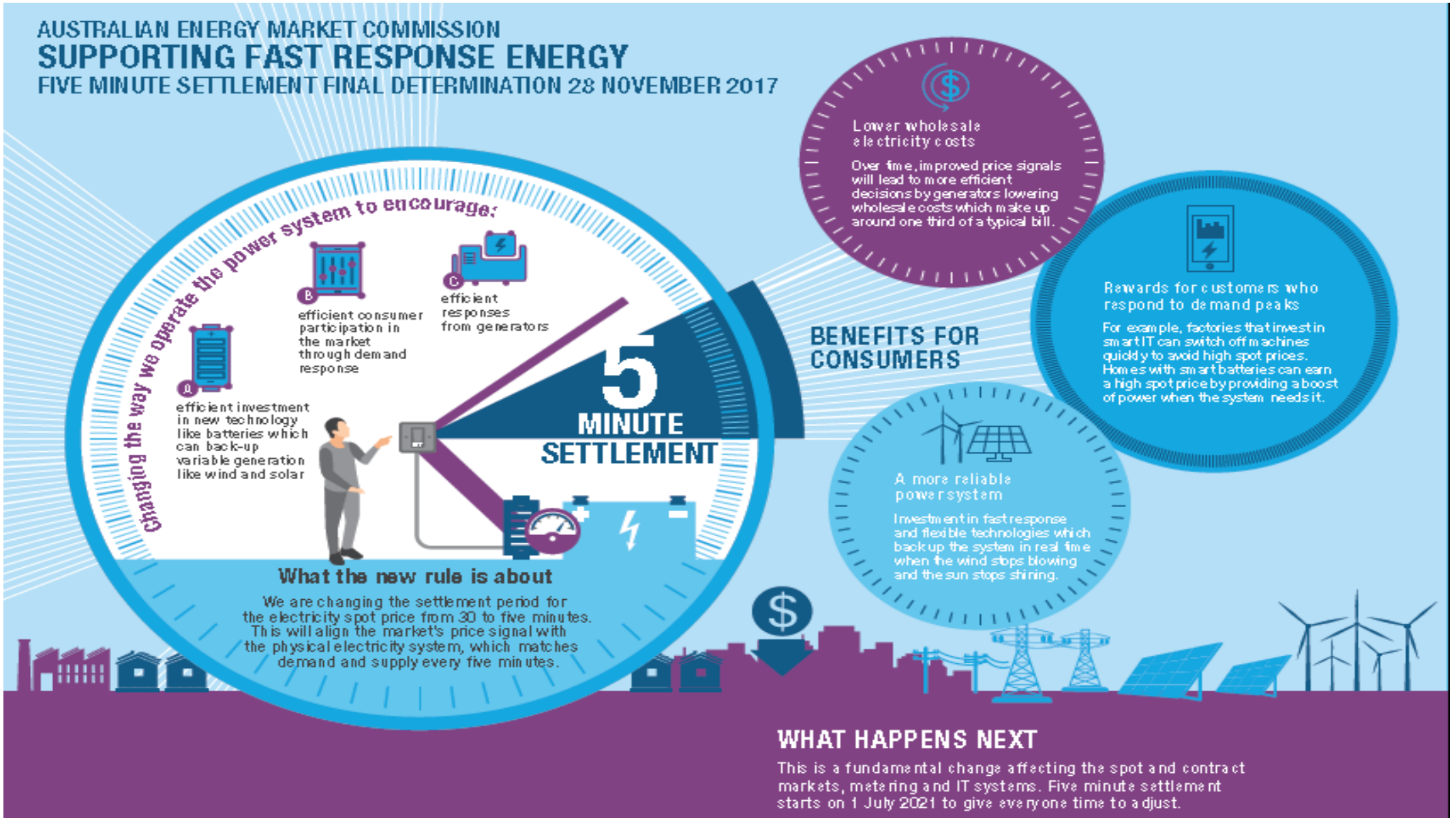
Future Regulatory Interventions

- Ancillary Services Market
- Co-optimisation of Energy and Ancillary Services
- Market Based Economic Dispatch on Day Ahead
- Following complimentary Mechanism at State Level
  - Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST)
  - Forecasting Scheduling and Deviation Settlement of RE
  - Reserves / Ancillary Services

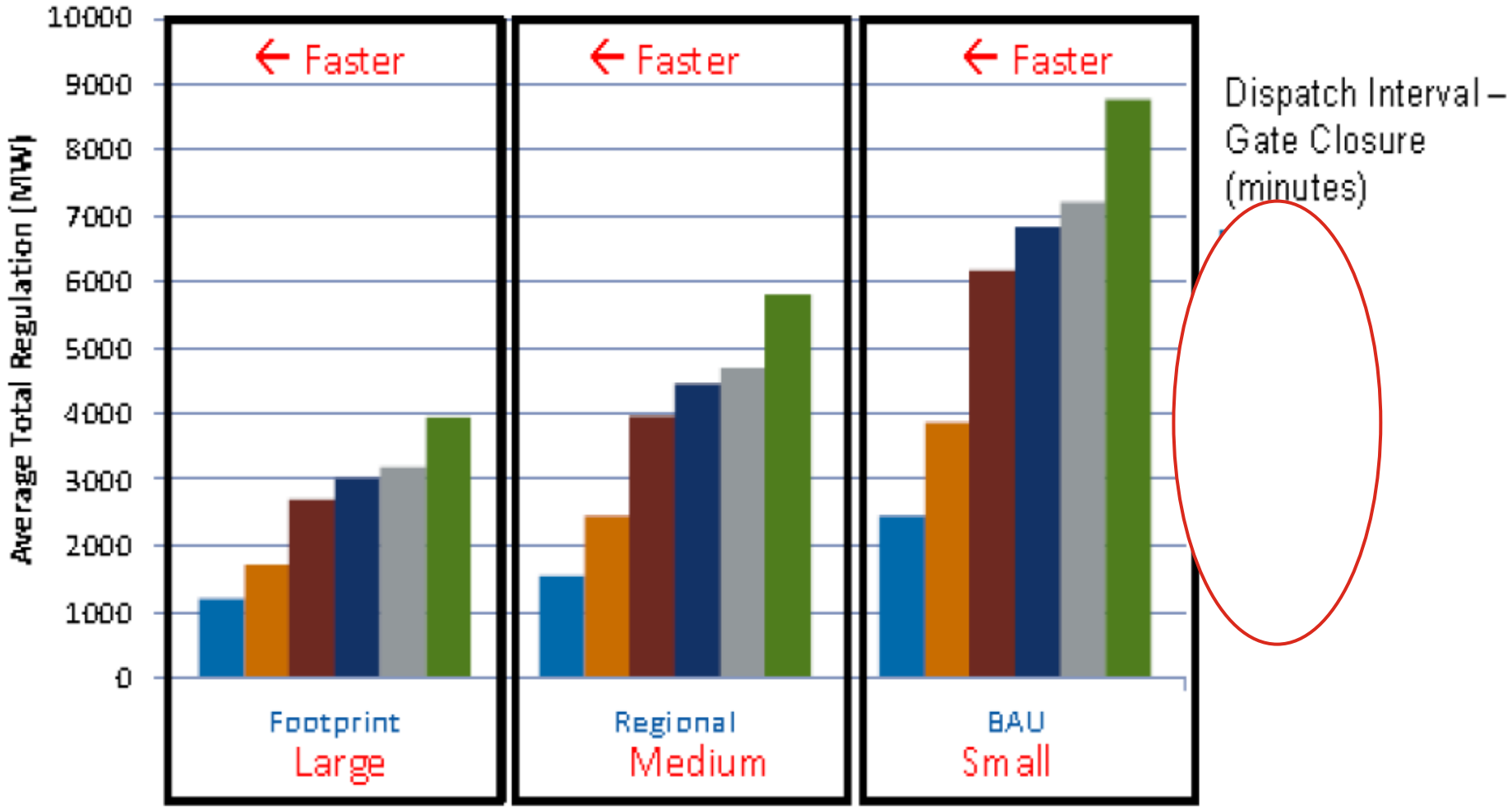
Thank you

Dr. S. K. Chatterjee
Chief of RA, CERC
skchatterjee@cercind.gov.in

International Experience – Australia



Dispatch Interval and Regulations



Milligan, Kirby, King, Beuning (2011), The Impact of Alternative Dispatch Intervals on Operating Reserve Requirements for Variable Generation. Presented at 10th International Workshop on Large-Scale Integration of Wind (and Solar) Power into Power Systems, Aarhus, Denmark. October

International Experience – USA

Table i. ISO's intraday timeline summary[4]

ISO	Procedure	Frequency	Look-ahead	Commitment	Dispatc	Prices[5]
CAISO	Residual unit commitment (RUC)	Daily	24-168 h	Long start units		Availability[6]
	Short-term unit commitment (STUC)	1 h	4 h	Medium/short		
	Real-time unit commitment and FMM	15 min	60-105 min	Fast start units	✓	✓
	Real-time economic dispatch	5 min	Up to 60 min		✓	✓
ISO-NE	Resource Adequacy Analysis (RAA)	Daily	Oper. day	Non-fast start		
	Additional RAAs	As needed	Oper. day	✓		
	Unit dispatch software	5 min	60 min		✓	Ex-post
MISO	Reliability Assessment Commitment	Daily	Oper. day	✓		
	Intraday RAC	As needed	Oper. day	✓		
	Look-ahead commitment (LAC)	15 min	3 h	✓		
	Real-time SCED	5 min	N/A		✓	Ex-post
NYISO	Supplemental resource evaluation	As needed	Oper. day	✓		
	Real-time commitment (RTC)	15 min	150 min	✓		
	Real-time dispatch (RTD)	5 min	60 min		✓	✓
PJM	Reliability Assessment Commitment	Daily	Oper. day	✓		
	Combustion Turbine Optimizer (CTO)	As needed	Oper. day	✓		
	Ancillary Service Optimizer (ASO)	1 h	60 min	✓		
	Intermediate-term SCED	15 min	60-120 min	✓		
	Real-time SCED	5 min	15 min		✓	✓
ERCOT	Day-ahead Reliability Unit	Daily	Oper. day	✓		
	Hourly RUC	1 h	Oper. day	✓		
	SCED	5 min	N/A		✓	✓

USA ISOs Intraday Timeline Summary (Source: MIT Energy Initiative)

Required Regulatory Amendments…….1/5

Regulations	Provisions	Relevant Clause
Indian Electricity Grid Code Regulations, 2010	• Provision for Right to recall	**6.5.18.** [Revision of declared capability by the ISGS(s) having two part tariff with capacity charge and energy charge [ ] and requisition by beneficiary (ies) for the remaining period of the day shall also be permitted with advance notice. ~~Revised schedules/declared capability in such cases shall become effective from 4th time block and counting the time block in which the request for revision has been received in the RLDC to be the first one.~~] Any revision in schedule made in odd time blocks shall become effective from 7th time block and any revision in schedule made in even time blocks shall become effective from 8th time block, counting the time block in which the request for revision has been received by the RLDCs to be the first one. **Note:** Odd Time blocks referred in this clause, are the Time blocks 00:00 to 00:15, 00:30 to 00:45, 01:00 to 01:15 and so on. Even Time blocks referred in this clause, are the Time blocks 00:15 to 00:30, 00:45: 01:00, and 01:15 to 01:30 and so on. Illustration: If a request for revision in schedule or declared capability has been made in Time block 17:00 to 17:15 (odd Time block) of a day D, it shall be effective from Time block 18:30 to 18:45 of the day D (7th Time block from the Time block in which the request for revision was made). Similarly, if a request for revision in schedule or declared capability has been made in Time block 17:15 to 17:30 (even Time block) of a day D, it shall be effective from Time block 19:00 to 19:15 of the day (D) (8th Time block from the Time block in which request of revision was made). [**18(a)** ~~Notwithstanding anything contained in Regulation 6.5.18, in~~ In case of forced outages of a unit, for those stations who have a two part tariff based on capacity charge and energy charge for long term and medium term contracts, the RLDC shall revise the schedule on the basis of revised declared capability. The revised declared capability and the revised schedules shall become effective from the ~~4th~~ time block and in the manner as specified in Regulation 6.5.18., ~~counting the time block in which the revision is advised by the ISGS to be the first one.~~]

Required Regulatory Amendments…….2/5

Regulations	Provisions	Relevant Clause
Indian Electricity Grid Code Regulations, 2010	• Provision for Right to recall	***19.*** ~~*Notwithstanding anything contained in Regulation 6.5.18, I*~~ *In case of forced outage of a unit of a generating station (having generating capacity of 100 MW or more) and selling power under Short Term bilateral transaction (excluding collective transactions through power exchange), the generator or electricity trader or any other agency selling power from the unit of the generating station shall immediately intimate the outage of the unit along with the requisition for revision of schedule and estimated time of restoration of the unit, to SLDC/RLDC, as the case may be. The schedule of beneficiaries, sellers and buyers of power from this generating unit shall be revised accordingly. The revised schedules shall become effective*~~*from 4th time block*~~ from the time block and in the manner as specified in Regulation6.5.18.~~*, counting the time block in which the forced outage is declared to be the first one.*~~ *The SLDC/RLDC as the case may be shall inform the revised schedule to the seller and the buyer. The original schedule shall become effective from the estimated time of restoration of the unit. However, the transmission charges as per original schedule shall continue to be paid for two days.* *Provided that the schedule of the buyers and sellers shall be revised after forced outage of a unit, only if the source of power for a particular transaction has clearly been indicated during short-term open access application and the said unit of that generating station goes under forced outage.* ~~*Provided also that the provisions of this sub-regulation in respect of revision of schedule by electricity traders and any other agency (except the generating station) shall be operative with effect from 1st July 2012.]*~~

Required Regulatory Amendments……3/5

Regulations	Provisions	Relevant Clause
Indian Electricity Grid Code Regulations, 2010	• Scheduling for RTM Transactions	**6.5 Scheduling and Despatch procedure for long-term access, Medium – term and short-term open access** **5. Scheduling of Day-Ahead collective transaction:** **Inserting a new clause 6.5.5(aa)** **6.5.5 (aa) Scheduling of Real-time collective transaction:** NLDC shall indicate to Power Exchange(s), margin available in each of the transmission corridors before the gate closure, i.e. before the window for trade closes for a specified duration. Power Exchange(s) shall clear the buy and sell bids for the said duration under consideration on various interfaces or control areas or regional transmission systems as intimated by NLDC. The limit for scheduling of collective transaction during real time for respective Power Exchanges shall be worked out in accordance with the directives of the Commission. NLDC shall furnish the available transmission corridors to the Power Exchange(s) before the trading for real time market or a specified duration closes. Based on the information furnished by NLDC, Power Exchange shall clear the RTM bids and announce the Market Clearing price and volume. Based on the volume cleared by the Power Exchanges, NLDC shall communicate the schedules to the respective RLDCs. After getting confirmation from RLDCs, NLDC shall convey the acceptance of scheduling of collective transaction to Power Exchange(s). RLDCs shall schedule the Collective Transaction at the respective periphery of the Regional Entities.

Required Regulatory Amendments……4/5

Regulations	Provisions	Relevant Clause
Indian Electricity Grid Code Regulations, 2010	• Settlement under RTM	**6.5 (A) Scheduling and commercial settlement of energy exchanged under Ancillary services, Spinning Reserves, URS and Real-time transactions:** (c) In case of sale of share of original beneficiaries in market by ISGS in case of day ahead transactions, for which consent has been given, and in case of real-time transactions, for which consent is not required after the gate closure, the realized gains shall be shared between the ISGS and the concerned beneficiary in the ratio of 50:50 or as mutually agreed by the ISGS and concerned beneficiary in the billing of the following month. This gain shall be calculated as the difference between selling price of such power and fuel charge including incidental expenses. Provided that such sale of power by ISGS shall not result in any adverse impact on the original beneficiary(ies) including in the form of higher average energy charge vis-à-vis the energy charge payable without such sale: Provided further that there shall be no sharing of loss between the ISGS and the beneficiary(ies):