MINUTES OF THE THIRTY FIRST MEETING

OF

FORUM OF REGULATORS (FOR)

VENUE : "LORDS" CONFERENCE HALL
WELCOM HOTEL GRAND BAY
VISHAKAPATNAM
(ANDHRA PRADESH).

DATES : 27TH – 28TH JULY, 2012

The meeting was chaired by Dr. Pramod Deo, Chairperson, CERC/FOR. The list of participants is at **Annexure-I**.

Shri Rajiv Bansal, Secretary, CERC/FOR extended a warm welcome to all members of the Forum.

The FOR thereafter took agenda items for consideration.

Agenda Item No. 1 : Confirmation of the Minutes of the 30th Meeting of "FOR" held on 06th June, 2012 at "India Habitat Centre", New Delhi.

The Forum noted and endorsed the minutes of the 30th Meeting of FOR held at New Delhi on 06th June, 2012 as circulated. The Forum also noted the Action

Taken Report as contained in Appendix-II of the Agenda Note. After discussion, the minutes were confirmed

Agenda Item No. 2 : Consideration of the Draft Report on "Study on Preparing Plan for Transmission Infrastructure Development for the likely Capacity Additions of RE based Power Plants in the States rich in the RE Potential".

Shri G.B. Pradhan, Secretary, Government of India, Ministry of New and Renewable Energy joined the meeting for interaction with the members of FOR on this agenda item. Shri Pradhan expressed his gratitude for inviting him for interaction with the Regulators. He appreciated the various initiatives taken by FOR for promotion of renewable energy sources.

A presentation was made by Executive Director, PGCIL highlighting the salient features of the draft report on "Study on Preparing Plan for Transmission Infrastructure Development for the likely Capacity Additions of RE based Power Plants in the States rich in the RE Potential" (copy **enclosed** at **Annexure – II)**. He informed that the report is being updated by incorporating the data and analysis on RE potential and evacuation of infrastructure requirement for the State of Jammu & Kashmir as well.

The Forum appreciated the efforts of the CTU in preparing the blue print for transmission infrastructure development for evacuation of power from renewable energy sources in the RE rich States. The Forum endorsed the report with the suggestion inter alia that an assessment should be carried out separately to study

the impact of the projected expenditure towards strengthening of intra-State/STU system on ARR/Tariff.

Agenda Item No. 3 : Issues relating to "Promotion of Renewables".

A presentation was made by Shri Tarun Kapoor, Joint Secretary, MNRE. A copy of the presentation is **enclosed** at **Annexure – III**. Shri Kapoor apprised the Forum about the status of implementation of National Solar Mission (NSM) as also the status of Solar Power Capacity Addition. He also highlighted the issues and constraints in the way of development of Solar Power Capacity Addition and requested for regulatory intervention to remove the constraints. Shri G.B. Pradhan, Secretary, MNRE also underscored the need for regulatory support in making the National Solar Mission a success. Shri Pradhan recognized the important role of Electricity Regulators in terms of setting, monitoring and enforcing Renewable Purchase Obligation (RPO). He shared the concerns of the solar power developers due to non-payment by the distribution companies and called upon intervention by the Regulators for ensuring payment on priority to all such RE generators.

The Forum appreciated the presentation and noted the issues raised.

Agenda Item No. 4 : Consideration/Adoption of the Report on "Standardization of Regulatory Accounts".

A presentation was made by the representatives of M/s. Sanjay Gupta & Associates and M/s. ABPS Infrastructure Advisory Private Limited highlighting the recommendations on the subject (copy **enclosed** at **Annexure – IV)**. The Forum discussed the contents of the proposed Regulatory Accounts and endorsed the report with the following suggestions :-

- ❖ The allocation percentages indicated in the context of separate accounting for network business and supply business should be indicative/illustrative in nature with the flexibility for the SERCs to adopt suitable allocation methodology/percentage based on the needs in the State.
- ❖ A separate provision should be made to indicate reporting of Regulatory Account in the Union Territories where they do not have the practice of statutory account.

Agenda Item No. 5 : Power Quality Issues.

A presentation was made by Shri Manas Kundu, India Co-Ordinator of M/s. Asia Power Quality Initiative (APQI). A copy of the presentation is **enclosed** at **Annexure – V**. Shri Kundu highlighted the need for greater regulatory intervention in ensuring quality of power supply. The Electricity Act, 2003 has several provisions relating to power quality. However, there is a need for more effective compliance of power quality standards. He argued that the benefits in most cases outweigh the costs involved in ensuring power quality. The Forum appreciated the presentation. After discussion, it was decided that a Working Group on "Power Quality" be constituted by the Chairperson of the Forum to examine the need for greater regulatory intervention in this respect.

Agenda Item No. 6 (A) : Discussion on Report of the Working Group on "Review of the Performance of the Regulators".

The recommendations were discussed. The Key Performance Indicators (KPIs) evolved by the Working Group as also the proposals of internal review of performance based on these parameters were endorsed. As regards the proposal

for amendment to the relevant provisions in this context, it was decided that this should be discussed along with the proposal for amendment to other provisions of the Act.

Agenda Item No. 6 (B) : Discussion on the Amendment to the Electricity Act, 2003.

It was decided to hold a separate meeting of the "FOR" to discuss the proposal for amendment to the Electricity Act, 2003.

The proposal on 'Single Buyer Model' should also be included as agenda for next FOR meeting.

The Forum appreciated the efforts of APERC for the arrangements made for the meeting.

A vote of thanks was extended by Shri Rajiv Bansal, Secretary, CERC/FOR. He conveyed his sincere thanks to all the dignitaries present in the meeting. He 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 THIRTY FIRST MEETING

OF

FORUM OF REGULATORS (FOR)

HELD DURING 27TH – 28TH JULY, 2012

AT "LORDS" CONFERENCE HALL, WELCOM HOTEL GRAND BAY, VISHAKAPATNAM, (ANDHRA PRADESH).

S. No.	NAME	ERC
01.	Dr. Pramod Deo Chairperson	CERC – in Chair.
02.	Shri A. Raghotham Rao Chairperson	APERC
03.	Shri Digvijai Nath Chairperson	APSERC
04.	Shri Jayanta Barkakati Chairperson	AERC
05.	Shri Manoj Dey Chairperson	CSERC
06.	Dr. P.K. Mishra Chairperson	GERC
07.	Shri R.N. Prasher Chairperson	HERC
08.	Shri Subhash Chander Negi Chairperson	HPERC
09.	Dr. V.K. Garg Chairperson	JERC for Goa & All UTs except Delhi
10.	Shri Himam Bihar Singh Chairperson	JERC for Manipur & Mizoram
11.	Shri K.J. Mathew Chairperson	KSERC
12.	Shri Anand Kumar Chairperson	MSERC
13.	Shri S.P. Nanda Chairperson	OERC

14.	Ms. Romila Dubey Chairperson	PSERC
15.	Shri D.C. Samant Chairperson	RERC
16.	Shri Manoranjan Karmarkar Chairperson	TERC
17.	Shri Jag Mohan Lal Chairperson	UERC
18.	Shri Prasad Ranjan Ray Chairperson	WBERC
19.	Shri S.C. Jha Member	BERC
20.	Shri T. Munikrishanaiah Member	JSERC
21.	Shri Vishwanath Hiremath Member	KERC
22.	Shri C.S. Sharma Member	MPERC
23.	Shri K. Venugopal Member	TNERC
24.	Shri Rajiv Bansal Secretary	CERC/FOR
25.	Shri Sushanta K. Chatterjee Deputy Chief (RA)	CERC
SPECIAL INVITEES		
01.	Shri G.B. Pradhan Secretary	MNRE
02.	Shri Tarun Kapoor Joint Secretary	MNRE
03.	Dr. Ashvini Kumar Director	MNRE

Scope & Objective

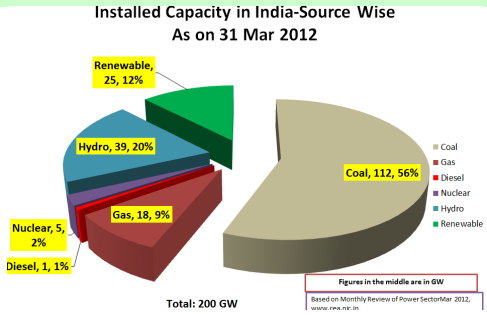
- MNRE and FOR/CERC have entrusted POWERGRID identify transmission infrastructure for Renewable capacity addition 12th Plan.
- Studies include:
  - Identification of transmission infrastructure for Renewable Capacity addition in 7 states: Tamil Nadu, Karnataka, A.P, Maharashtra, Gujarat, Himachal Pradesh and Rajasthan
  - Estimation of capex requirement
  - Strategy framework for funding and speedy renewable power development

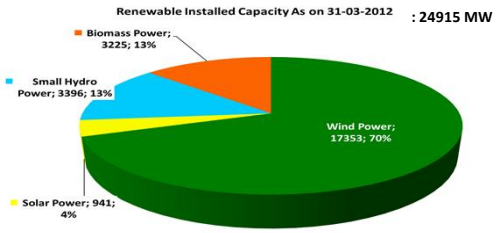
Approach

- On the advice of MNRE and CERC/FOR
  - POWERGRID visited SNA/STU in Tamil Nadu, Karnataka, A.P, Maharashtra, Gujarat and Rajasthan
  - Based on the series of the discussions held between POWERGRID and SNA/STUs, SNA/STUs have provided pocket wise envisaged capacity addition by Renewable sources coming up in 12th plan
  - Above capacity addition programme informed to MNRE/CERC/CEA & respective States/SNAs for their observations
- Raw data provided by STU/SNA processed and corroborated for Transmission study and network simulation
  - Pocket wise capacity addition information was sub-divided into various clusters based on the proximity of pooling stations, voltage level, short circuit level etc.
  - Information regarding network connectivity of RE generation based on the STU network data/maps
- Additional data collection
  - Transmission system for part capacity addition, proposed by above STUs provided by MNRE/STU
  - Raw data for wind/solar generation pattern in various States collected from SLDCs
  - Regional/State demand patterns from POSOCO/RLDC
  - RPO target of each State by 2016-17 provided by CERC/FOR

Report - Table of Contents

Existing Renewable Generation Capacity





Source: MNRE

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Envisaged Renewable Capacity in RE Rich States In 12Th Plan

State	Existing Capacity (MW)		Addition in 12th Plan (MW)		Total capacity (MW)	
	Wind	Solar	Wind	Solar	Wind	**Solar**
Tamil Nadu	6370	7	6000	3000	12370	**3007**
Karnataka	1783	6	3223	160	5006	**166**
A.P	392	92	5048	285	5440	**377**
Gujarat	2600	600	5083	1400	7683	**2000**
Maharashtra	2460	17	9016	905	11476	**922**
Rajasthan	2100	200	2000	3700	4100	**3900**
Total	15705	922	30370	9450	46075	**10372**
Total	***16627***		***39820***		***56447***	

Moreover, SHP addition: 1700 MW (H.P: 1000 MW; Karnataka: 700MW)

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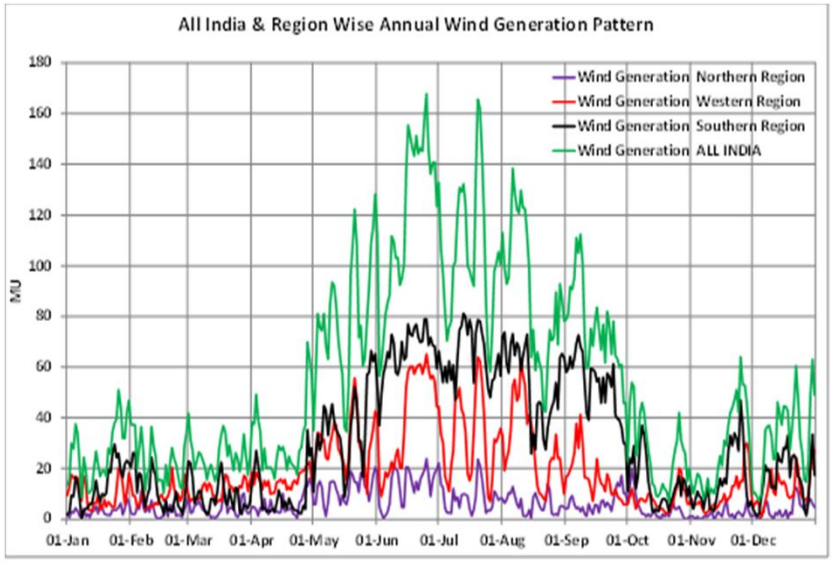
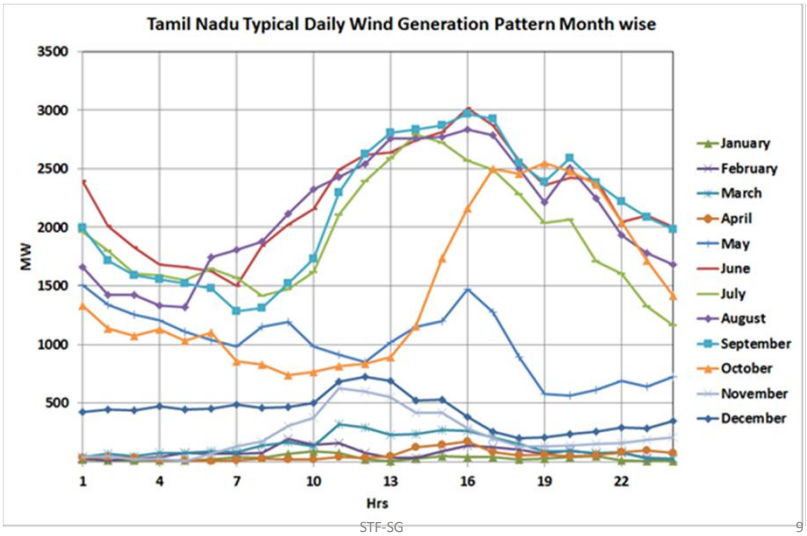
RENEWABLE GENERATION PATTERN (2011)

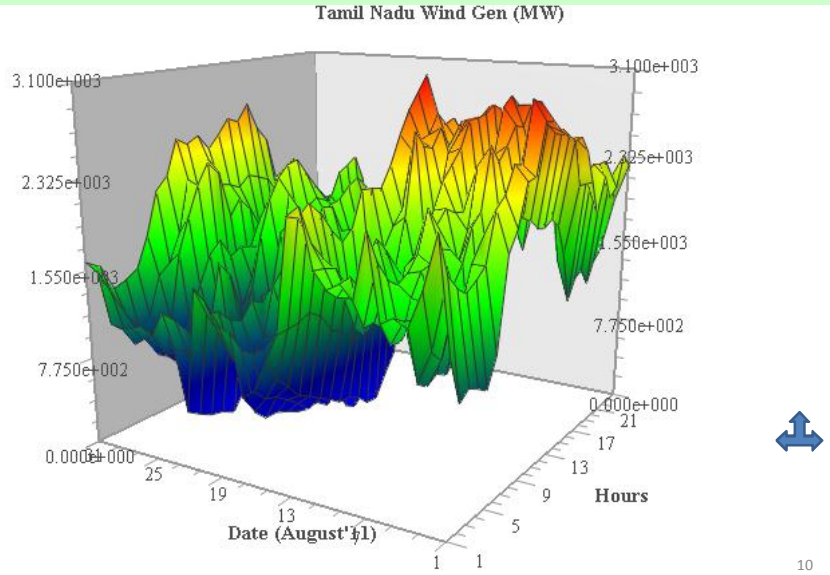
Annual Wind Energy Generation Pattern During 2011



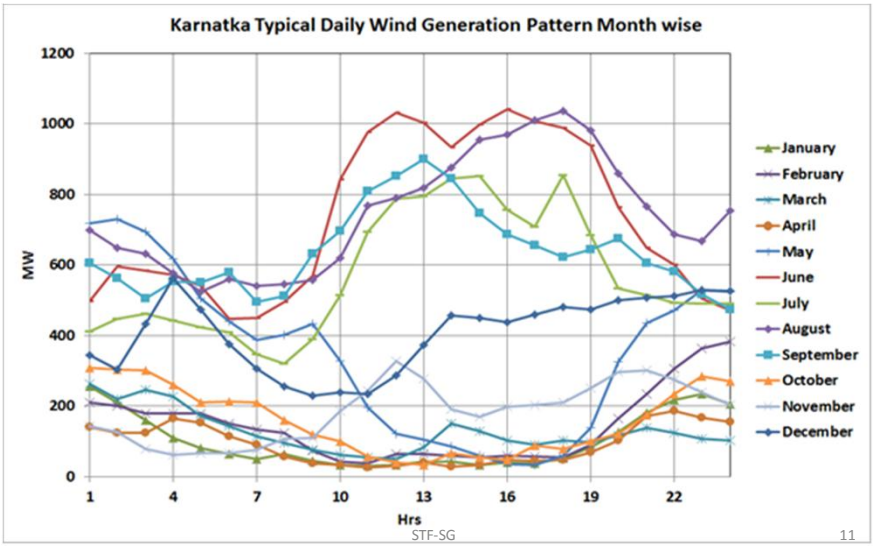
Wind Power Generation Pattern in Tamil Nadu During 2011



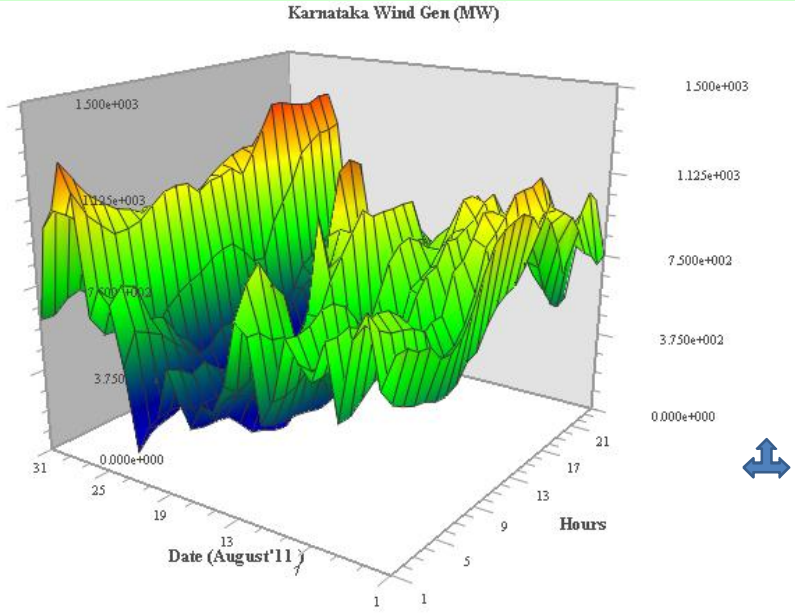
Wind Power Generation Pattern in Tamil Nadu During August 2011



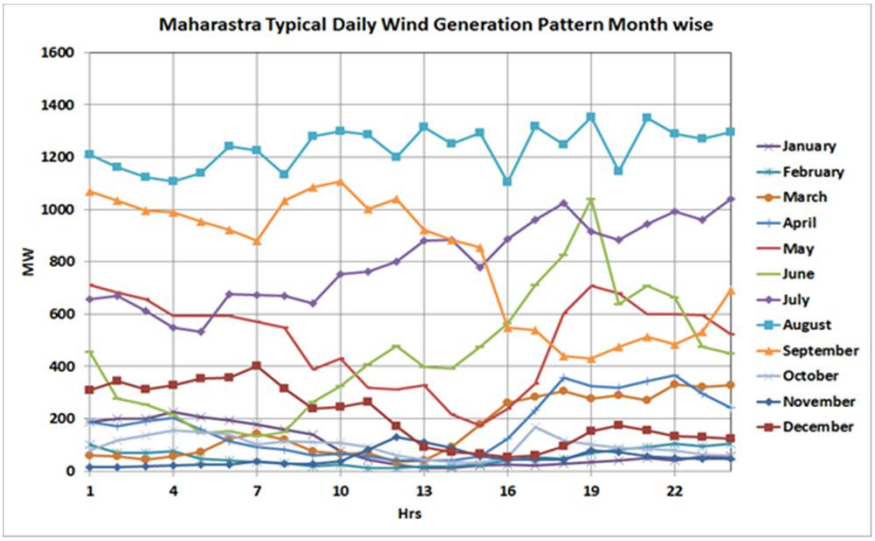
Wind Power Generation Pattern in Karnataka During 2011



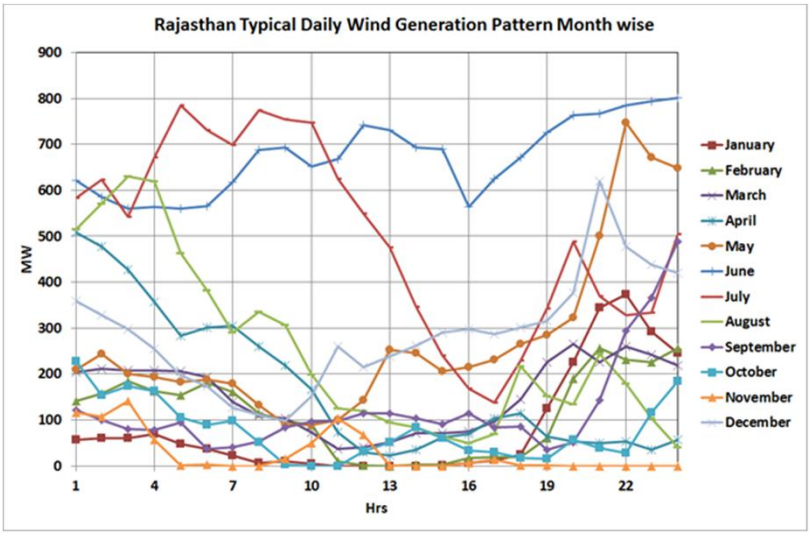
Wind Power Generation Pattern in Karnataka During August 2011



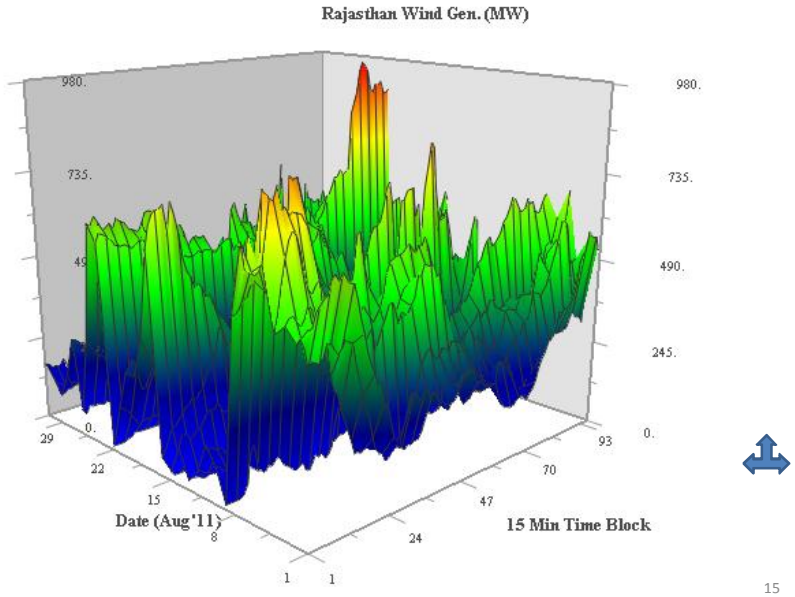
Wind Power Generation Pattern in Maharashtra During 2011



Wind Power Generation Pattern in Rajasthan During 2011



Wind Power Generation Pattern in Rajasthan During August 2011



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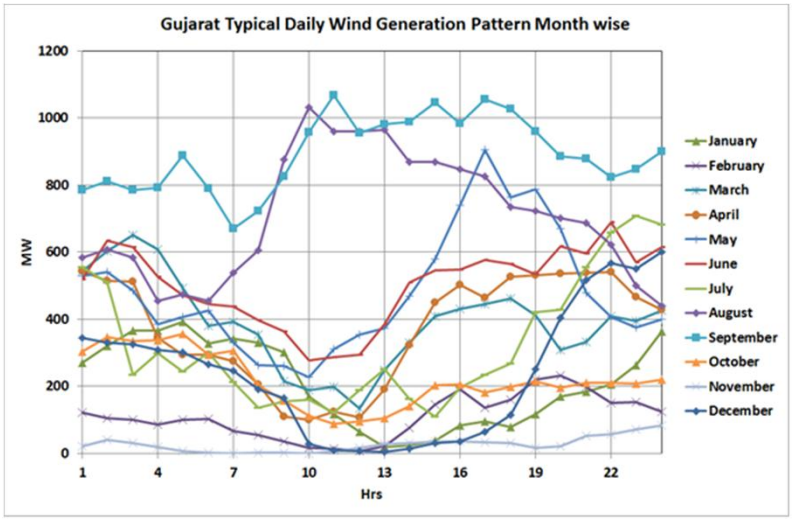
Wind Power Generation Pattern in Gujarat During 2011



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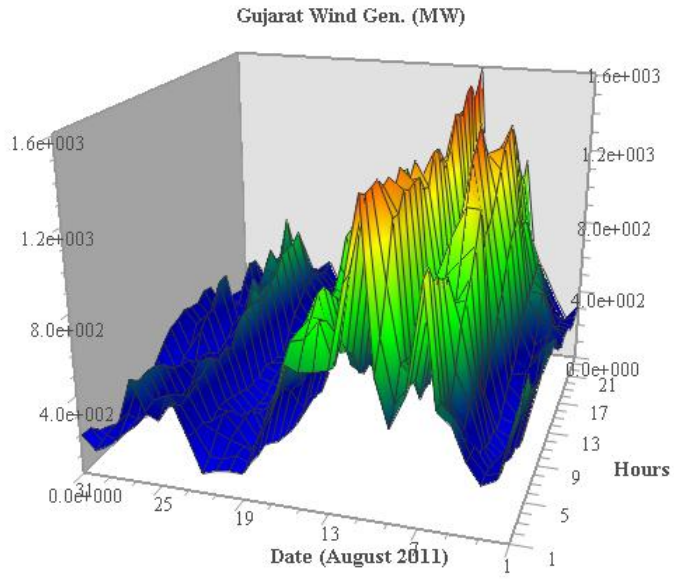
Wind Power Generation Pattern in Gujarat During August 2011



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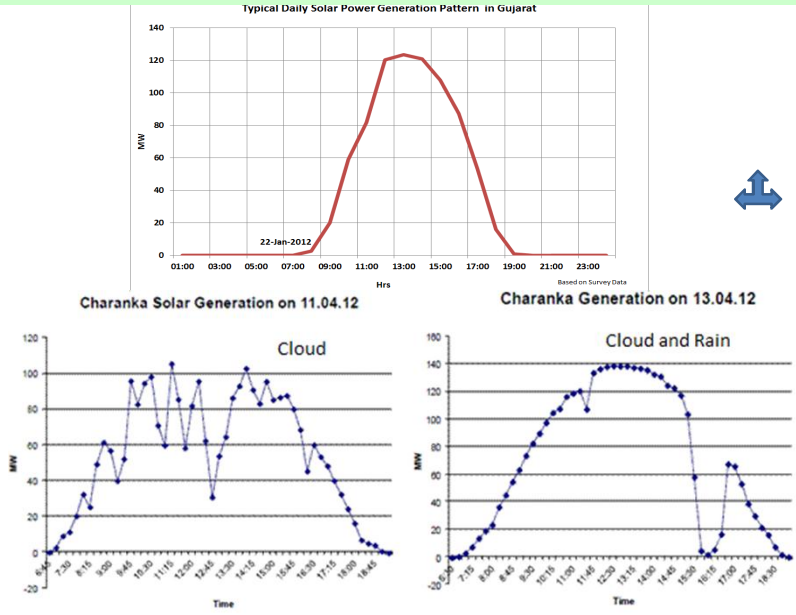
Typical Solar Power Generation Pattern in Gujarat



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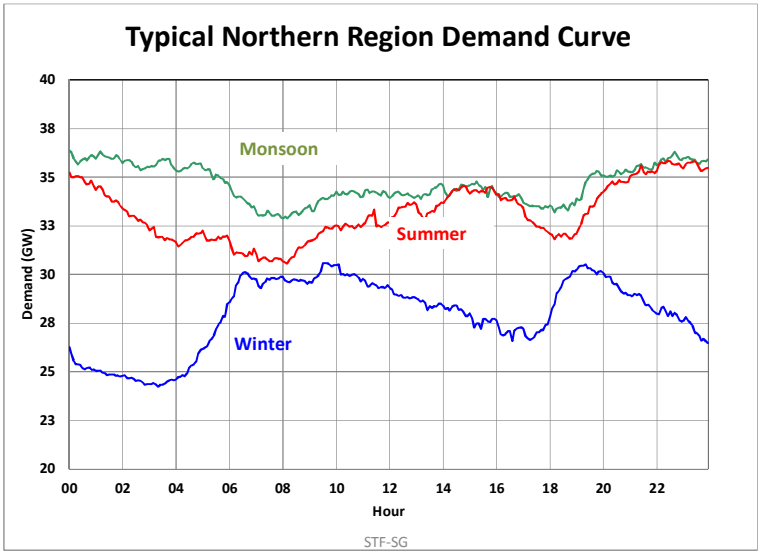
Typical Seasonal / Daily Demand Pattern of Northern Region



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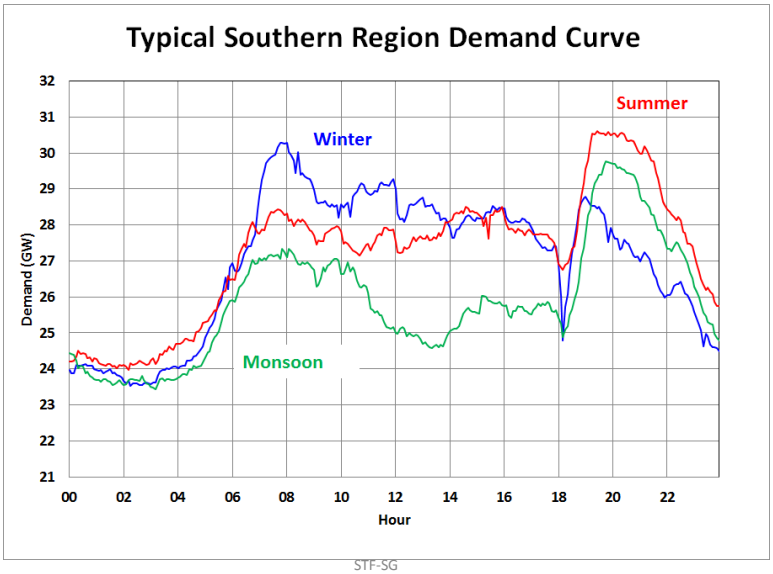
Typical Seasonal / Daily Demand Pattern of Southern Region



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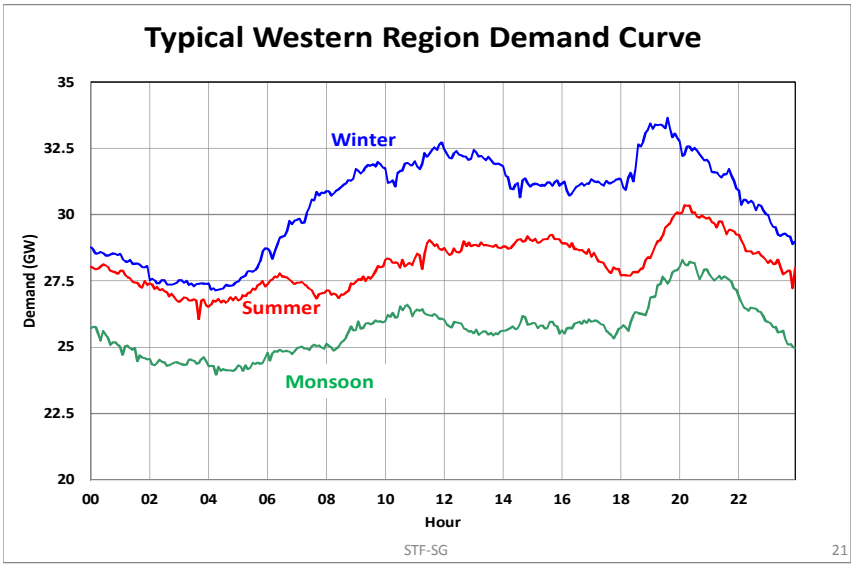
Typical Seasonal / Daily Demand Pattern of Western Region



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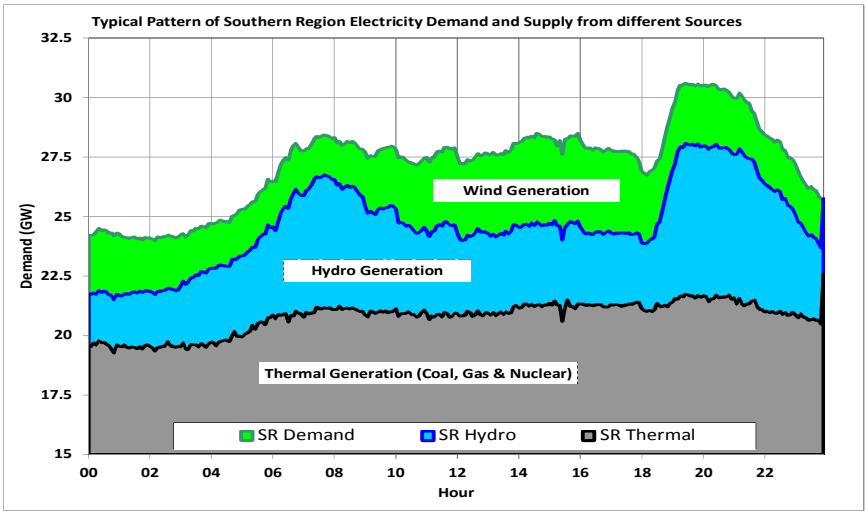
Typical Demand Profile and supply-Mix in Southern Region (July 2011)



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STUDY METHODOLOGY & ASSUMPTIONS

Load Generation Scenario

- Based on the inputs from various agencies, Load generation scenario was prepared for studies, which included:
  - Capacity addition form conventional as well as Renewble for 12th plan
  - Demand of States as per draft 18th EPS for different Scenarios
  - Dispatch/Availability factors of generation including Renewable for different Scenarios
  - Scenarios
- Load Generation Scenarios along with assumptions for Renewable Generation Dispatch in different scenarios discussed with CEA

Load Generation scenario

- RE Plants Considered “Must Run”
- RPO to be fulfilled by all entities
- About 35GW surplus capacity available in other than peak condition with RE + conventional capacity by 2016-17
- Conventional generation backed down as per merit order dispatch - high cost gas based plants are being first then high cost State thermal plants.
- Reservoir based hydro plants are also considered to be not dispatched in such scenarios whereas Run-off-the-River plants are dispatched as maximum RE generation being monsoon season.
- Condition A : Stats overall Surplus (Conventional) as well as RE Surplus
  - RE Surplus capacity (RE beyond RPO) dispatched outside for use by deficit states.
  - Surplus conventional may be backed down only up to the extent of its RPO surplus
- Condition B : Stats overall Surplus but RE deficit
  - State must import at least to the extent of its RPO targets and back down its conventional up to the extent of RE import
- Condition C : Stats overall Deficit as well as RE deficit
  - State must import at least to the extent of its RPO targets fulfillment

Study Methodology & Assumption

- Time Frame for Study -2016-17 (end of 12th plan)
- Studies carried out for two scenarios:
  - Demand other than Peak with High Wind/Solar
  - Peak Demand with Low Wind/Solar
- 18th EPS (Draft) Demand considered for 2016-17.
- Other than Peak Scenario Demand Considered : 75% of Peak (NR @ 90%)
- Renewable Generation Dispatch

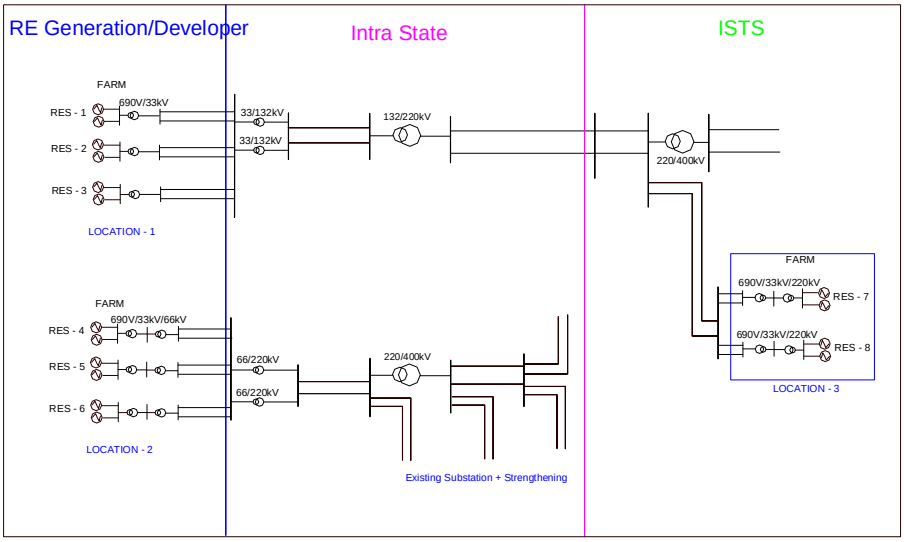
% Dispatch	Other than Peak Scenario	Peak Demand Scenario
Wind	70% 30%(Raj)	30% 70 %(Raj)
Solar	80%	10%
SHP	70%	70%

Thermal- 75%; Hydro-35% dispatch

Study Methodology & Assumption

- RE Generation Step up at 33kV or 66kV level
- Drawl from the RE plant depending upon the generation capacity
  - Further step up to next higher level i.e 132/220/400kV level
- Motoring load of Pumped storage plants are considered as load (20% more than its generating mode)-3400 MW PSP Capacity
- Transmission system including all 11 nos. High Capacity Tr. Corridors coming up by 2016-17 time frame considered
- IEGC Transmission Planning criterion considered for evolution of transmission system

Typical Transmission Arrangement of RE Generation Farm with Grid



Load Generation Scenario Considered

Sl no.	State	Existing RE (MW)	Future RE (MW)	RPO (MW) [32% CUF}	Demand (MW)	RE Generation Disaptch (MW)	RE surplus (MW)	Demand Met from Conventional Genration(State+Central+IPP) (MW)
					Other than peak			
1	Tamil Nadu	6377	9000	4720	14246	11064	6344	9312
2	Andhra Pradesh	484	5333	5028	18902	4110	-920	13236
3	Karnataka	2310	3945	3350	9577	4375	1025	6227
4	Gujrat	3200	6483	3600	13730	7000	3400	10130
5	Maharastra	2477	9921	5800	20962	8770	2970	15162
6	Rajasthan	2300	5700	2560	11511	4300	1740	8951
7	Himachal Pradesh	443	996	450	1599	1008	558	1149

SYSTEM STUDIES AND RESULTS

Intra State Strengthening

State	Transmission line	Sub Stations
Tamil Nadu	•1440 ckms 400 kV line •91 ckms 230 kV line •45 ckms 110 kV line	•1 no. of 400/230 kV S/s (830 MVA) •1 no. of 230/110 kV S/s (300MVA)
Andhra Pradesh	•460 ckms 400 kV line •582 ckms 220 kV line	•1 no. of 400/220 kV S/s (1260 MVA) •5 no. of 220/132 kV S/s (1120MVA)
Gujarat	•440 ckms 400 kV line •1192 ckms 220 kV line •40 ckms 132 kV line **For Solar Park –II** •200 ckms 400 kV line	•2 no. of 400/ 220 kV S/s (1260 MVA), •3 no. of 220/132/66 kV S/s (500MVA) **For Solar Park –II** •1 no. of 400/220/66 kV S/s (400/220 kV -630 MVA, 220/66 kV 500MVA)
Rajasthan	•2010 ckms 400 kV line •622 ckms 220 kV line •1114 ckms 132 kV line	•3 no. of 400/220 kV S/s (3945 MVA) •9 no. of 220/132 kV S/s (1760 MVA) •29 no. of 132/33 kV S/s (1025 MVA)
Himachal Pradesh	•282 ckms 132 kV line •134 ckms 66 kV line	•4 no. new S/s (556 MVA)

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Intra State Strengthening

State	Transmission line	Sub Stations
Tamil Nadu	•1620 ckms of 230 kV line •2840 ckms of 110 kV line	•10 no. of 230/33 kV S/s (2900 MVA) •22 no. of 110/33 kV S/s (4400 MVA)
Karnataka	•630 ckms of 220 kV line •1160 ckms of 132 kV line	•4 no. of 220/33 kV S/s (1200 MVA) •9 no. of 132/33 kV S/s (1750 MVA)
Andhra Pradesh	•900 ckms of 220 kV line •1600 ckms of 132 kV line	•5 no. of 220/33 kV S/s (1600 MVA) •12 no. of 132/33 kV S/s (2450 MVA)
Gujarat	•1080 ckms of 220 kV line •2592 ckms of 66 kV line	•12 no. of 220/66 kV S/s (4800 MVA)
Maharashtra	•1800 ckms of 220 kV line •3120 ckms of 132 kV line	•11 no. of 220/33 kV S/s (3200 MVA) •24 no. of 132/33 kV S/s (4850 MVA)
Rajasthan	•990 ckms of 220 kV line •1680 ckms of 132 kV line	•6 no. of 220/33 kV S/s (1800 MVA) •13 no. of 132/33 kV S/s (2650 MVA)
Himachal Pradesh	•200 ckms of 132 kV line •540 ckms of 33 kV line	•6 no. of 132/33 kV S/s (550 MVA)

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ISTS Strengthening

State	Transmission line	Sub Stations
Northern	• 1480 ckms of 765 kV line • 580 ckms of 400 kV line	• 3 no. of 765/400kV S/s • Augmentation of transformation Capacity at Moga S/s
Western	• 1440 ckms of 400 kV line	• Up gradation of 400 kV Kolhapur S/s to 765kV level
Southern	• 60 ckms of 765 kV line • 620 ckms of 400 kV line • 1600 ckms of HVDC line	• 2 no. of +/- 500 kV HVDC terminal stations along with 400 kV S/S • Up gradation of 400 kV Narendra S/s to 765kV level

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System strengthening within state for conveyance of ISTS

Region	State	Transmission line	Sub Stations
Southern	Tamil Nadu, Karnataka, A. P.	•1500 ckms of 400kV line •1500 ckms of 230kV line •1898 ckms of 220 kV line	•6 no. of 400/230/110 kV S/s •4 no. of 230/110 kV S/s •2 no. of 400/220 kV S/s •4 no. of 220/132 kV S/s •400/220 kV S/s Augmentation •220/132 kV S/s Augmentation
Western	Gujarat, Maharastra	•1384 ckms of 220 kV line •235 ckms of 132 kV line	•400/230 kV S/s Augmentation •220/132 kV S/s Augmentation
Northern	Rajasthan, H. P.	•740 ckms of 400kV line •500 ckms of 220 kV line •310 ckms of 132 kV line	•220/132 kV S/s Augmentation •1 no. of 33/220 kV S/s •220/132 kV S/s Augmentation

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ISTS

State	Transmission line	Sub Stations
Tamil Nadu	•180 ckms of 230 kV line •240 ckms of 110 kV line	•1 no. of 230/33 kV S/s (300 MVA) •2 no. of 110/33 kV S/s (400 MVA)
Karnataka	•180 ckms of 220 kV line •240 ckms of 132 kV line	•1 no. of 220/33 kV S/s (300 MVA) •2 no. of 132/33 kV S/s (450 MVA)
Andhra Pradesh	•180 ckms of 220 kV line •240 ckms of 132 kV line	•1 no. of 220/33 kV S/s (300 MVA) •2 no. of 132/33 kV S/s (400 MVA)
Gujarat	•180 ckms of 220 kV line •512 ckms of 66 kV line	•3 no. of 220/66 kV S/s (1000 MVA)
Maharashtra	•180 ckms of 220 kV line •280 ckms of 132 kV line	•1 no. of 220/33 kV S/s (300 MVA) •3 no. of 132/33 kV S/s (450 MVA)
Rajasthan	•180 ckms of 220 kV line •280 ckms of 132 kV line	•1 no. of 220/33 kV S/s (200 MVA) •2 no. of 132/33 kV S/s (400 MVA)
Himachal Pradesh	•40 ckms of 132 kV line •120 ckms of 33 kV line	•1 no. of 132/33 kV S/s (125 MVA)

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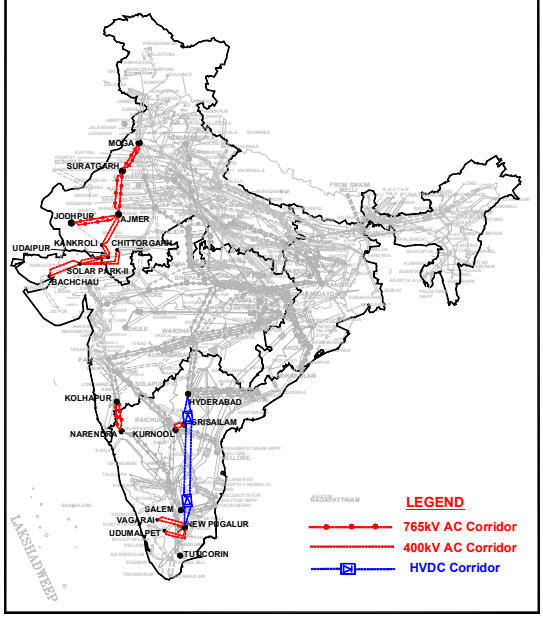
PROPOSED HIGH CAPACITY TRANSMISSION CORRIDORS FOR RE PROJECTS



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ISSUES & MITIGATING MEASURES IN RENEWABLES INTEGRATION

Issues in Large Scale Renewable Integration

- Intermittency
- Variability / Uncertainty
- Plants connected at remote/concentrated locations with weak transmission network
- RE plants providing lesser grid support during system disturbances/exigencies than the conventional in terms of MVAR/active Power regulation
- Most of the wind plants are not FRT capable, may lead to collapse of large chunk of RE generation at a time in grid fault situations

Mitigating Measures for Large Scale Renewable Integration

- Strong Grid interconnections
- Flexible generation, Ancillary Services, Reserves etc. for supply-balancing
- Demand Side management, Demand Response and Storage for load balancing
- Forecasting of Renewable generation & Forecasting of Demand
- Establishment of Renewable Energy Management Centers (REMC) equipped with advanced forecasting tools along with reliable communication infrastructure
- Deployment of Synchrophasor technology i.e. PMUs/WAMS on pooling stations and interconnection with centralized control centre through Fiber Optic Communication for real time information, monitoring and control
- Capacity building at respective LDC/PCC/Conventional/Non-Conventional Generator regarding RE handling
- Institutional Arrangements with defined roles & responsibilities of various agencies/generation developer
- Technical Standard Requirements (Grid code, Connectivity standards, Real time monitoring etc.)
- Policy advocacy for development of power-balance market and pricing mechanism

Roles & Responsibilities

S no.	Activities	Role
1	Strong Grid Interconnections (ISTS/Intra State) –Planning –Implementation	CEA/CTU/STU STU/Tr. Licensee
2	Regulation for Market design for Flexible Generation, Ancillary Services and Generation Reserves	CERC/SERC
3	Regulation for Demand Side Management / Demand Response including time-of-use tariff	CERC/SERC
4	Renewable Generation Forecasting - Policy formulation - Regulation - Implementation - Aggregation	MNRE CERC/ SERC Developer SLDC/RLDC
5	Demand Forecasting	SLDC/State DISCOM
6	Energy Storage Technology - selection, design & implementation	CTU/CEA/POSOCO
7	Establishment of Renewable Energy Management Centre - Policy formulation - Regulation - Implementation	MNRE CERC/SERC POSOCO/SLDC
8	Deployment/Approval of Real time monitoring system using Synchrophasor Technology	CTU/CEA
9	Formulation of technical Standards for Renewable Generation	CEA/CTU
10	Capacity Building ï Providing training	CTU/POSOCO/SLDC/STU
11	Institutional arrangement (Roles & Responsibilities of Developers /DISCOM/STU/SLDC etc.) ï incorporation in EA 2003	MOP/CEA
12	➢Assessment / Reassessment of onshore and offshore wind Energy Potential and update of Wind Atlas ➢Assessment / Reassessment of Solar Energy Potential and update of Solar Atlas	C-WET/IMD

RENEWABLE ENERGY MANAGEMENT CENTRE

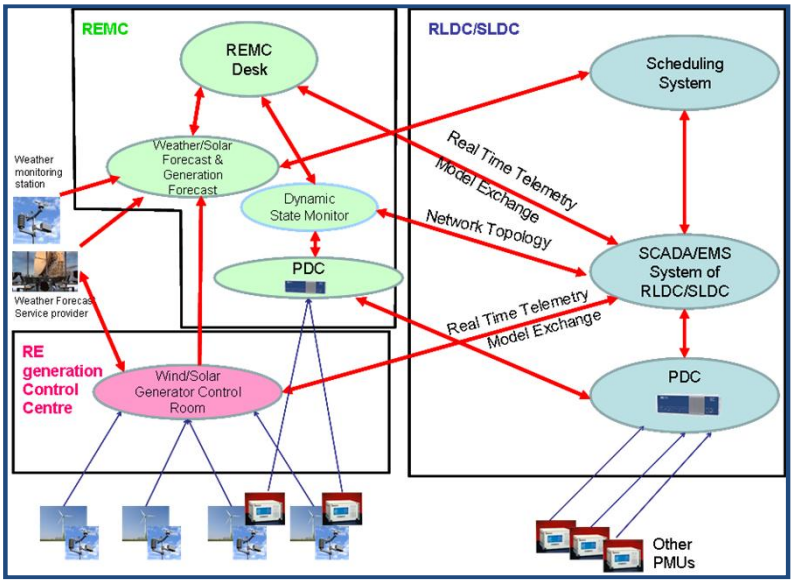
Renewable Energy Management Centre

- Large Scale Wind Generation Requires Wind/Solar Generation Forecast.
- To address the issue of uncertainty and intermittency with limited flexible resources
- Enable scheduling of RE power

Functionality of Renewable Energy Management Centre

- Forecasting of RE generation in jurisdiction area on day-ahead, hour-ahead, week-ahead, month-ahead basis.
- Real time tracking of generation from RE sources and its geo-spatial visualisation
- Close coordination with respective LDC for RE generation and control for smooth grid operation
- Single source information repository and coordination point for RE penetration
- On-line Dynamic security Assessment tool like Dynamic performance, Harmonic performance.

Proposed Hierarchical structure for Renewable Energy Management Centre



Locations of REMCs

S. No.	Co- Located With	Location
1	NLDC	New Delhi
2	NRLDC	New Delhi
3	WRLDC	Mumbai
4	SRLDC	Bangalore
5	SLDC-Rajasthan	Jaipur
6	SLDC-Gujarat	Vadodara
7	SLDC-Maharashtra	Mumbai
8	SLDC-Tamil Nadu	Chennai
9	SLDC- Andhra Pradesh	Hyderabad
10	SLDC- Karnataka	Bangalore

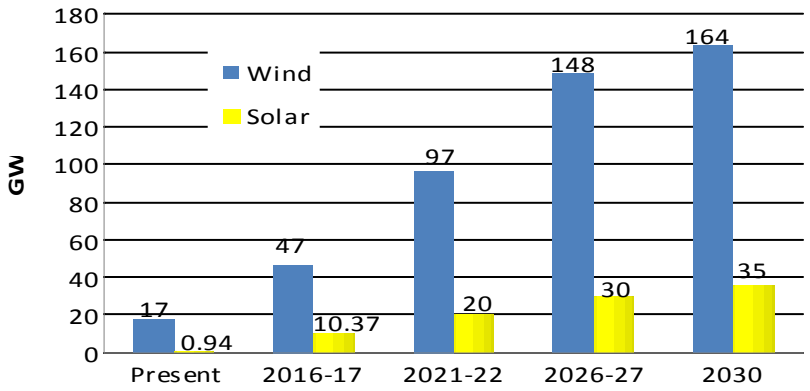
ESTIMATED COST OF THE SCHEME

Summary of Estimated cost

S.no	Particulars	Estimated Cost (Rs. Cr)
1.	**Intra State Transmission System Strengthening = (A)**	**20,466**
1A.	For absorption of power within the state	9,366
(i)	Tamil Nadu	2593
(ii)	Andhra Pradesh	1080
(iiii)	Gujarat	1500
(iv)	Rajasthan	3817
(v)	Himachal Pradesh	376
1B.	Other Intra State Strengthening	11,100
2.	**Inter State Transmission System**	18,848
2A.	ISTS Strengthening	17,267
2B.	Other ISTS Strengthening	1581
3.	**Dynamic Reactive Compensation**	568
4.	**Real Time Dynamic State Measurement Scheme as well as Communication Systems**	451
5.	**Energy Storage**	2000
	Total Inter State Strengthening (Sum of item 2 ,3 , 4, and 5)= (B)	**21867**
6.	**Cost of Establishment of RE management Center = (C)** *(6 RE rich state, one each for NLDC / 3 RLDC)*	**224**
	Grand Total (Sum of items A, B & C)	***42,557***

Envisaged Wind & Solar Capacity addition by 2030

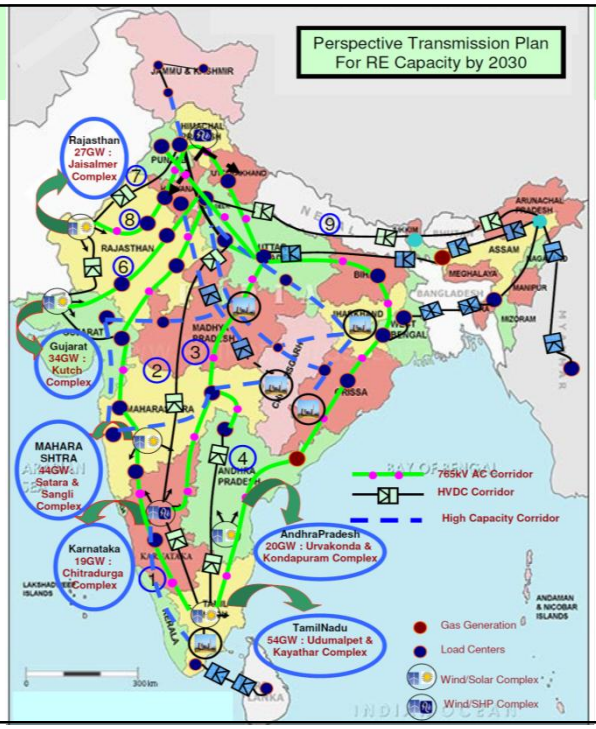
Resource	Present (GW)	2016-17 (12th plan) (GW)	2021-22 (13th Plan) (GW)	2026-27 (14th Plan) (GW)	2030 (mid 15th plan) (GW)
Wind	17	47	97	148	164
Solar	0.92	9.45	20	30	35



Increasing Renewable Penetration

Scenario	Energy Penetration(%)	Capacity Penetration(%)
Present	4	12
2016-17	13	21
2030	21	35
2050	33	>50

** Envisaged RE Capacity (2050) :775 GW (including hydro (57 GW)*



Implementation Strategy

- Low Gestation period for renewable project
- Development of last mile connection, system strengthening takes considerable time
- Transmission System works need to be started much before generation projects in a time bound manner

Intra State Strengthening:

- Implemented by respective STUs.
- Support may be provided by some expert agency having extensive experience in design, tendering, implementation etc. for common design, standards and speedy implementation.

ISTS strengthening :

Implementation of ISTS, by agency having sufficient experience in development of high end technologies in Transmission System with sound project management skills

Financing Strategy

- Capacity utilization Factor low , No ISTS charges for Solar Generation till 2014, RPO obligation of states, Promotion of renewable generation for clean development
- Rational Transmission Charges needs to be evolved.
- Intra State Strengthening -Grant may be provided for Intra State Project.
- ISTS Strengthening :
  - Cost may be pooled into the pool account, charges to be shared as per POC.
  - The debt Component may be provided as a grant / soft loan
- Setting up Renewable Energy Management Centre (REMC) - Capital Expenditure of respective RLDC charges recovered as per provision of Regulations.

Thank You

Promotion of Renewable Energy in India

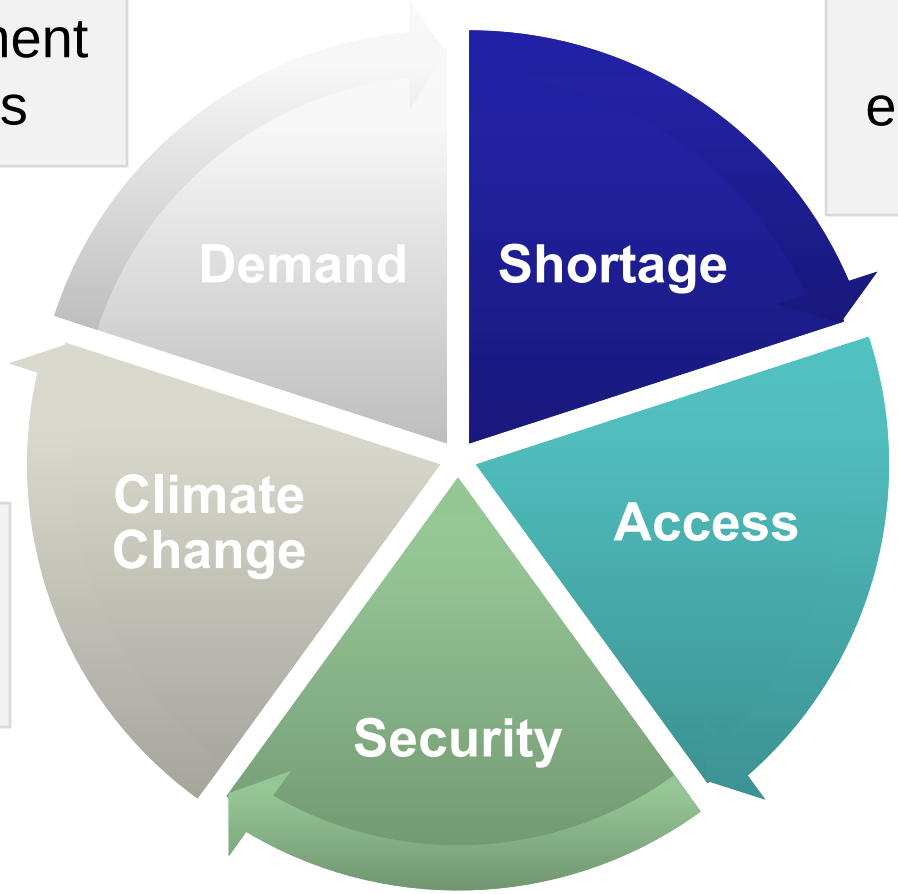
Ministry of New and Renewable Energy
Government of India

27 July 2012

India’s Energy Challenge

In next 12 years India’s electricity requirement to grow 2.5 times

Electricity shortage estimated at 25-35 GW

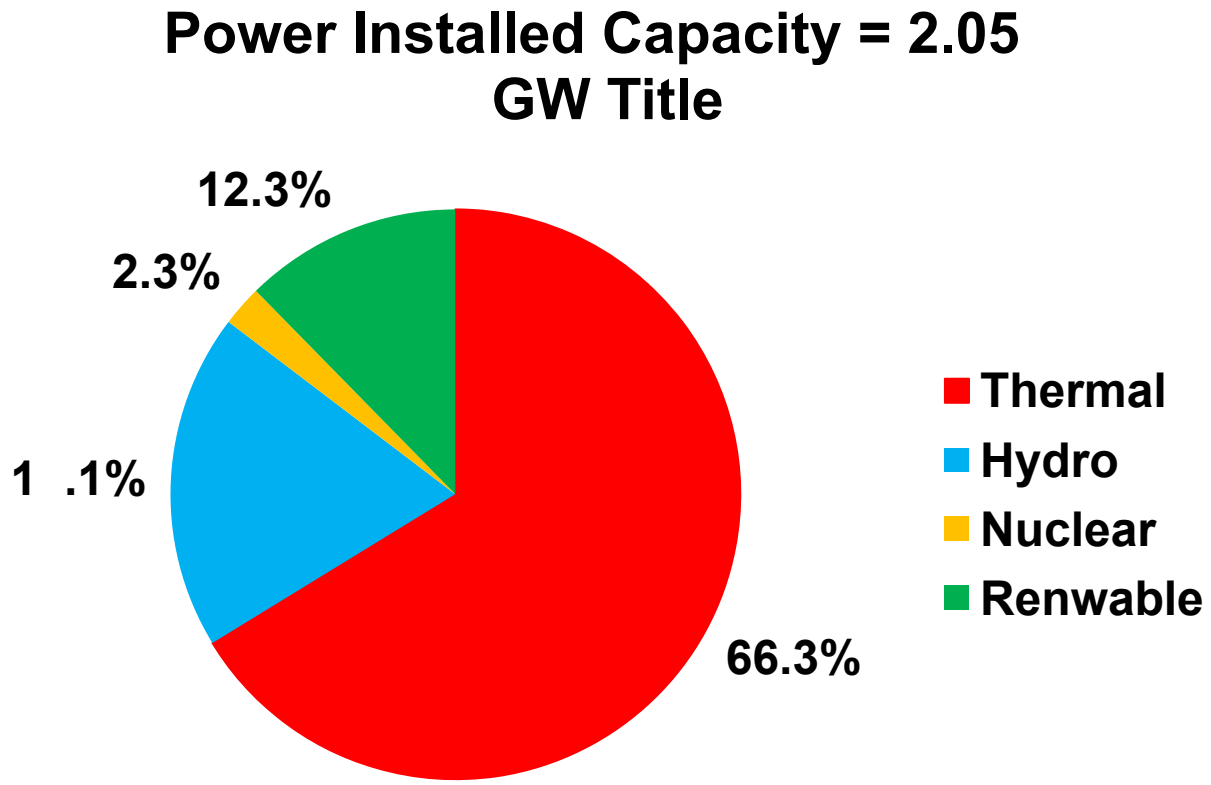


Climate Change is also an important issue

Around 400 Million people still without access to electricity

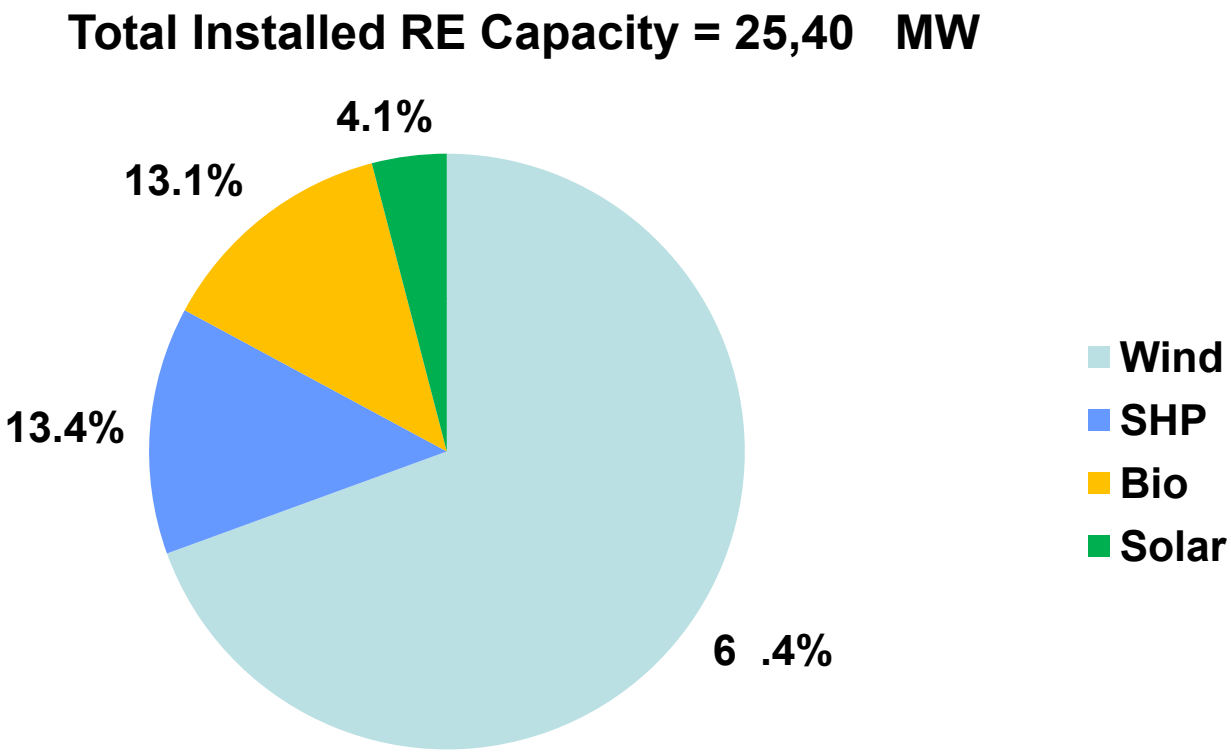
India is dependent on oil imports for 80% of its demand

Indian Power Sector (30 June 2012)



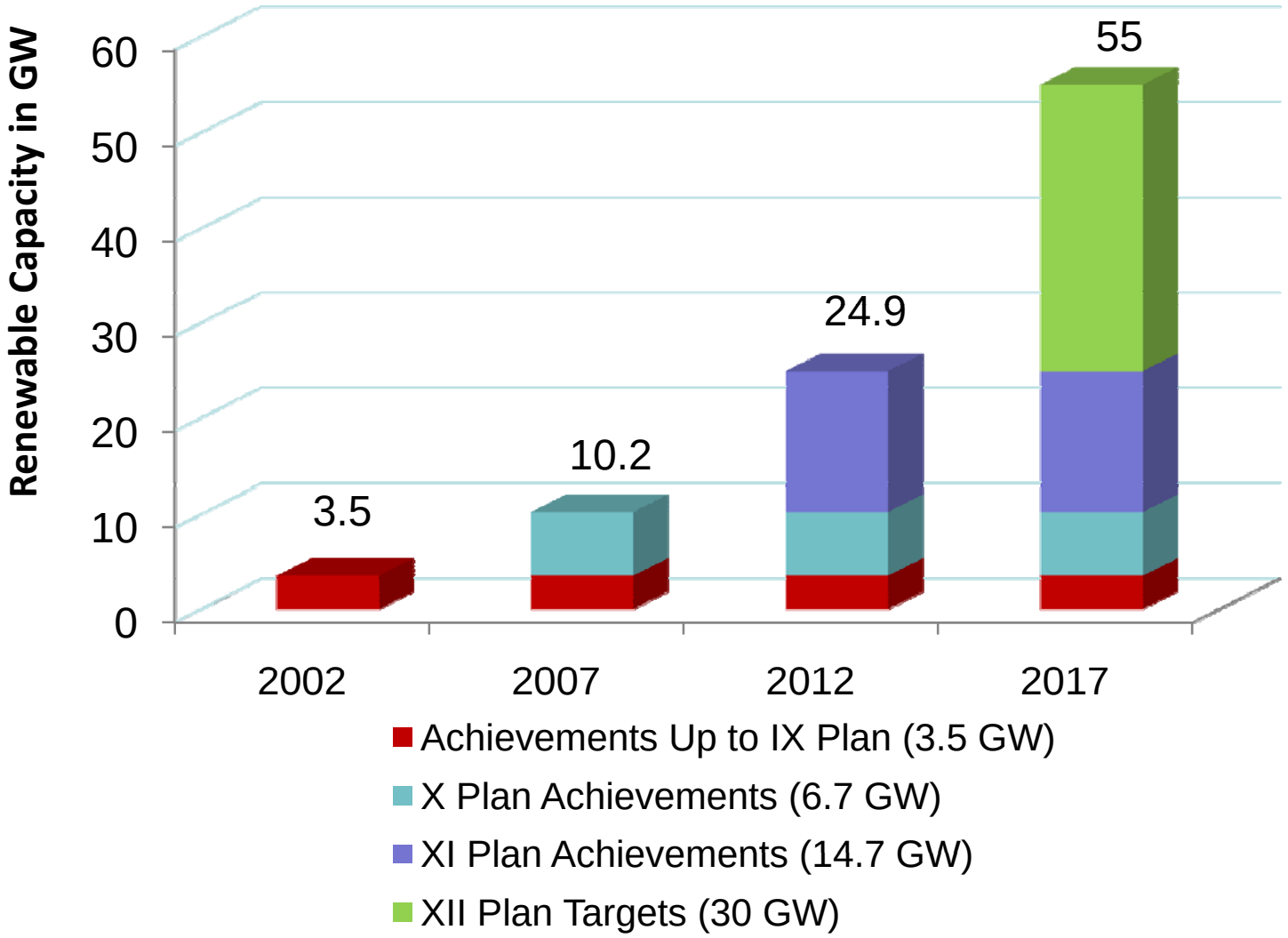
Thermal	Hydro	Nuclear	Renewable
1,36,436 MW	39,291 MW	4,780 MW	25,409 MW

Renewable Power Capacity (30 June 2012)



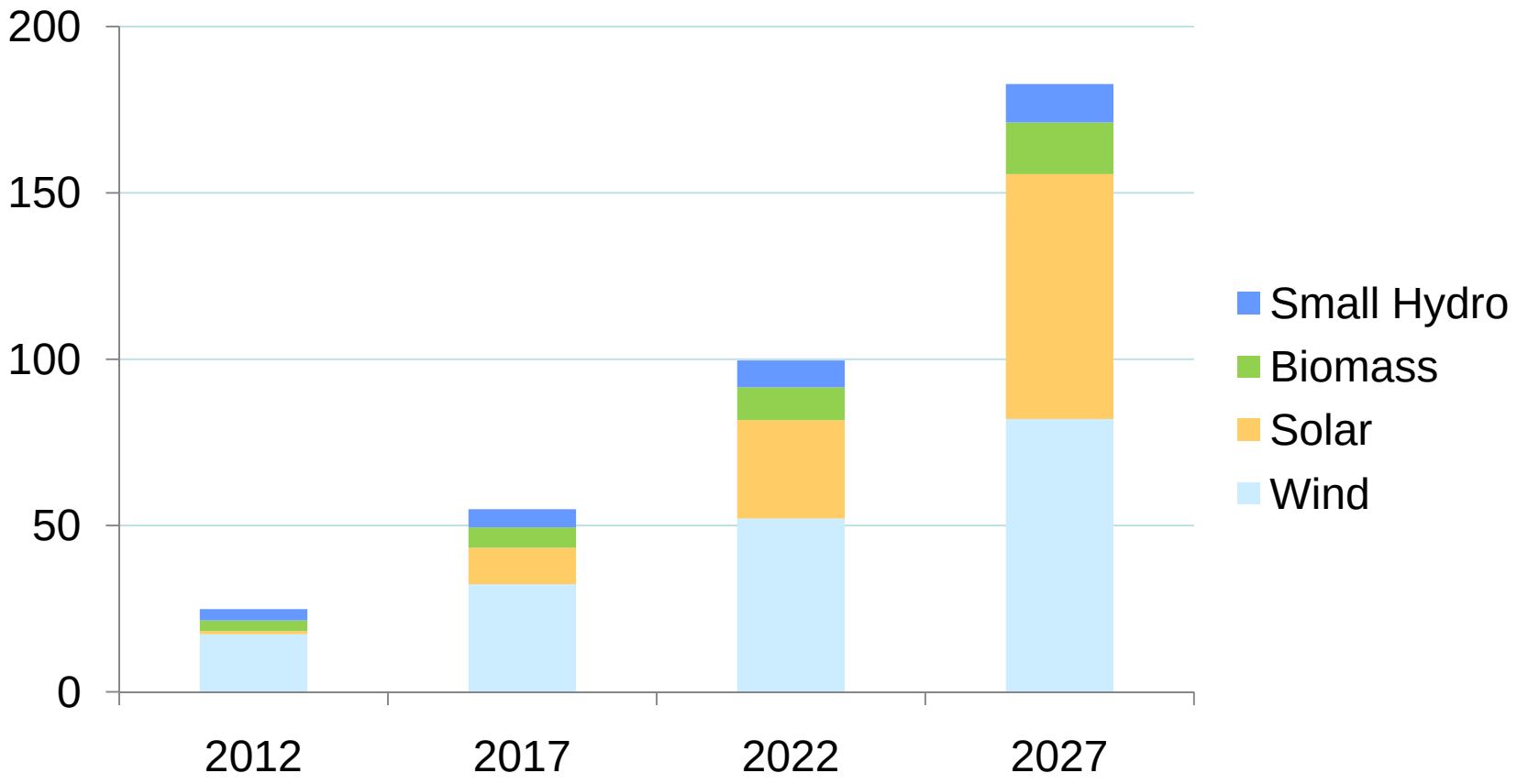
Wind	Small Hydro	Bio	Solar
17,644 MW	3,412 MW	3323 MW	1,031 MW

Plan-wise Renewable Capacity Addition



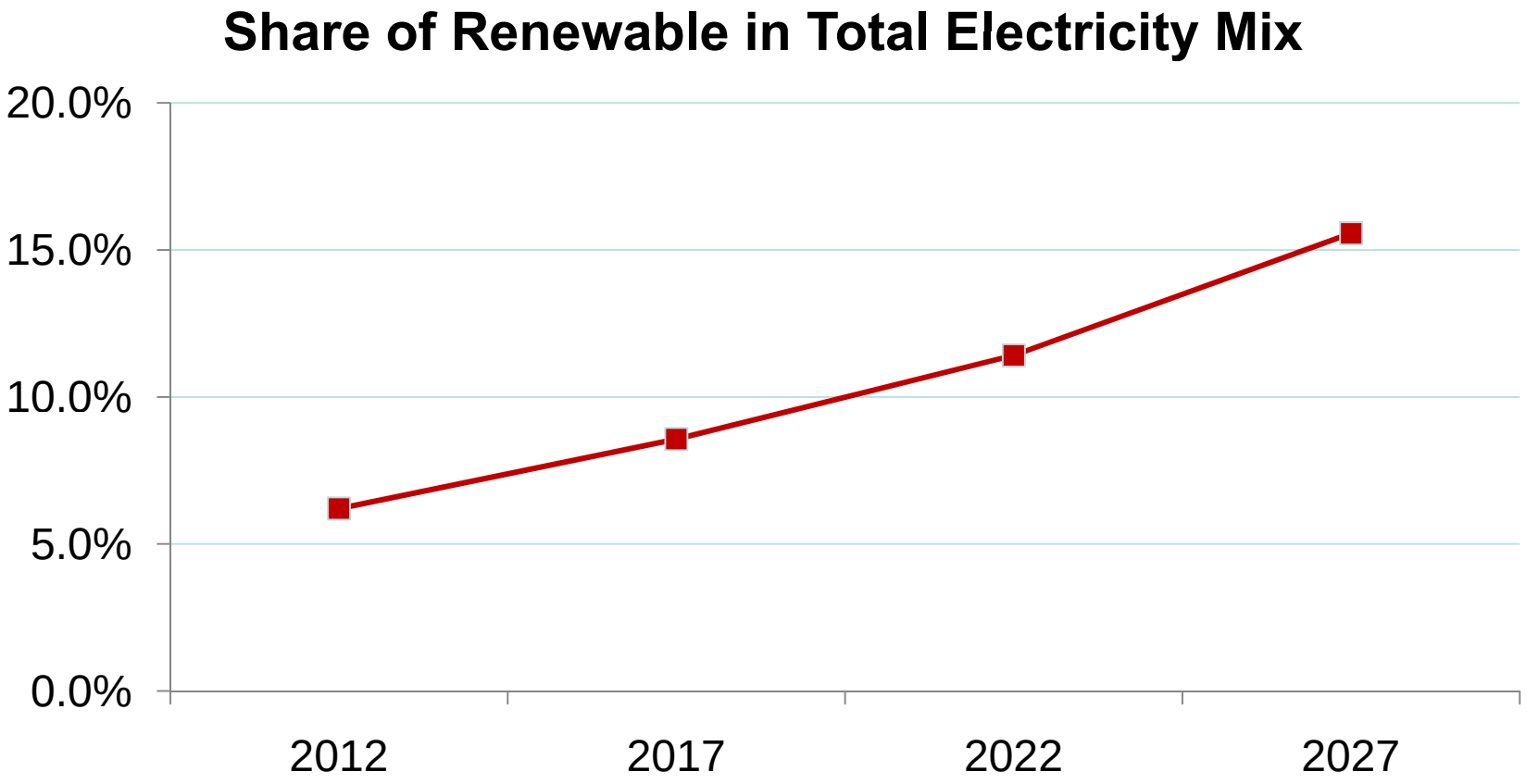
Renewable Energy Projections for 2027

Cumulative Installed Capacities in GW



Renewable Energy Projections for 2027

Share of Renewable in Total Electricity Mix in %



Renewable Resources in India

I. Solar Power

Estimated Potential	***30-50 MW/ sq. km,***
	5,000 trillion KWh/year
High Potential States	***Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, and Rajasthan***
Tapped Potential (Grid Power)	***1 GW***
	Projected 10 GW by 2017
Solar Radiation Resource Assessment:	• ***IMD has 45 stations***
	• ***51 Solar radiation monitoring stations set up in high potential states through CWET***
	• ***60 additional stations are planned in rest of the country.***

Network of Solar Radiation Monitoring Stations in India

Mission Road Map

Application Segment	Target for Phase I (2010-13)	Cumulative Target for Phase 2 (2013-17)	Cumulative Target for Phase 3 (2017-22)
Grid solar power (large plants, roof top & distribution grid plants)	1,100 MW	4,000 - 10,000 MW	20,000 MW
Off-grid solar applications	200 MW	1,000 MW	2,000 MW
Solar Thermal Collectors (SWHs, solar cooking/cooling, Industrial process heat applications etc.)	7 million sq meters	15 million sq meters	20 million sq meters
Solar Lighting System	5 million	10 million	20 million

JNNSM Phase-I, Batch-I

Scheme		Pro ects allotted		Pro ects Commissioned		Weighted Average bid tariff	% Reduction in tariff
		No.	MW	No.	MW		
Large PV pro ects through NVVN		30	150	26	130	12.16 Rs. / Unit	32 %
				2 Pro ects Cancelled			
Migration Scheme	SPV	13	54	11	48		
	ST	3	30	1	2.5		
RPSSGP Scheme (PV)		78	98	64	80.6		
Solar Thermal pro ects through NVVN		7	470	Scheduled for commissioning by May 2013		11.48 Rs. / Unit	25 %
Total		**131**	**802**	**102**	**261.1**	-	-

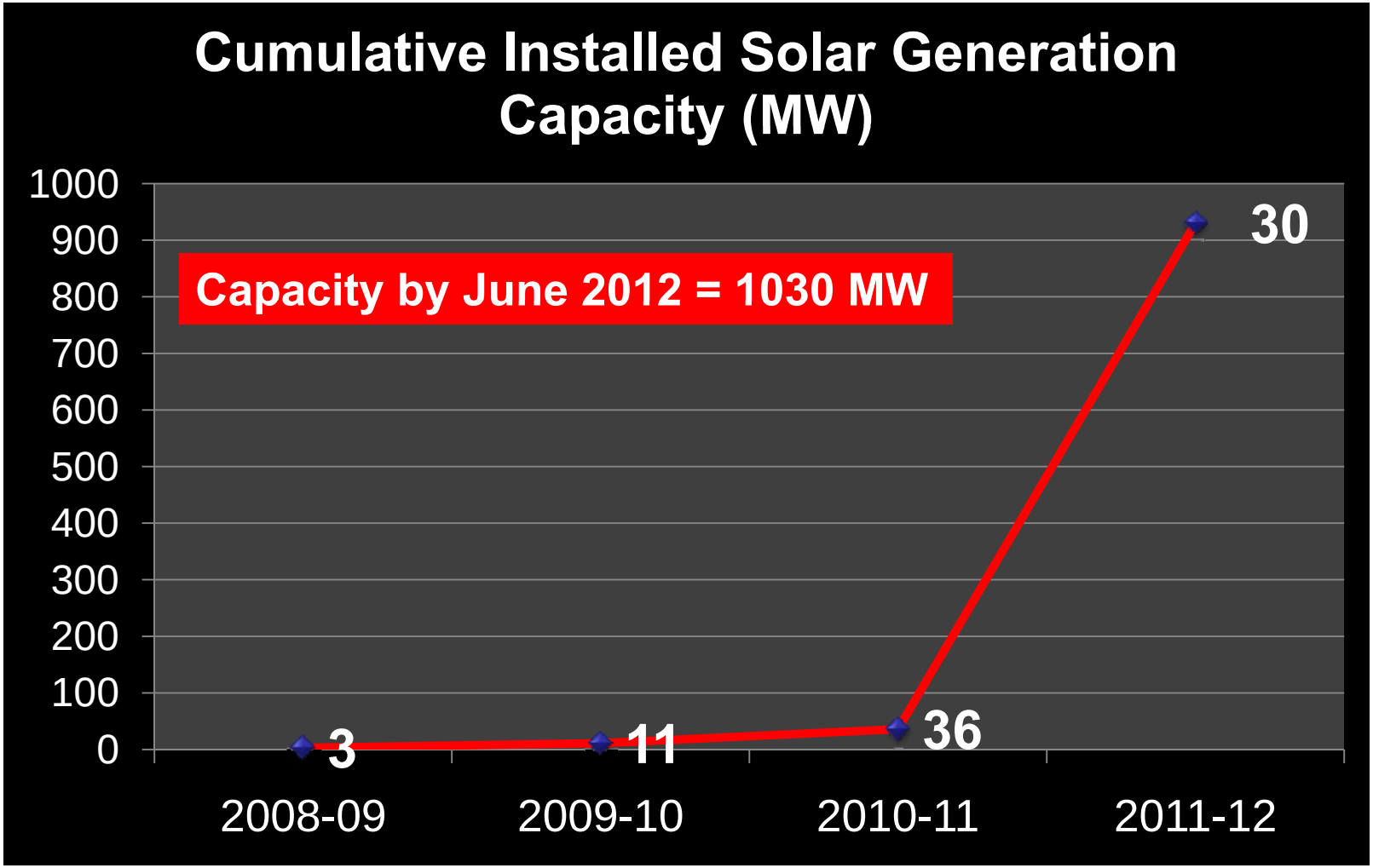
JNNSM Phase-I, Batch-II

Scheme	Pro ects allotted		Pro ects Commissioned		Minimum bid tariff	Maximum bid tariff	Weighted Average bid tariff	% Reduct ion in tariff
	No.	MW	No.	MW				
Large PV pro ects through NVVN	28	350	Scheduled for commissioning by Feb. 2013		7.4 Rs. Unit	.44 Rs. Unit	8.77 Rs. Unit	43 %

State-wise Capacity

State UT	MW	State UT	MW
Andhra Pradesh	21.8	Punjab	.3
Chhattisgarh	4.0	Rajasthan	1 8.7
Gujarat	680.0	Tamil Nadu	15.1
Haryana	7.8	Uttar Pradesh	12.4
Jharkhand	16.0	Uttarakhand	5.1
Karnataka	14.0	West Bengal	2.1
Madhya Pradesh	7.4	Andaman & Nicobar	0.1
Maharashtra	20.0	Delhi	2.5
Orissa	13.0	Lakshadweep	0.8
TOTAL			1030.66

Growth in Solar Power Installations



Off Grid SPV and Solar Thermal Physical Targets and Achievements

Solar PV

Year	Target in MW	Pro ect Sanctioned (MW)	Pro ects Installed (MW)
Till March 2010			59.00
2010-11	32	40.65	10.79
2011-12	58	77.40	20.20
2012-13	100	-	-

Solar Thermal

- 5.57 million square meter of solar thermal collector area installed so far cumulatively

Renewable Resources in India

II. Wind Power

So far main driver of RE in India contributes over 70% of total RE capacity

Assessed Potential	***49 GW (at 50 meter hub height)*** ***Actual potential is much higher***
Potential confined in 6 States	***Tamil Nadu, Andhra Pradesh, Karnataka in South*** ***Maharastra Gujarat and Rajasthan***
Tapped Potential	***17 + GW*** ***Current rate of deployment is > 3 GW per year*** ***India fifth in the World***
Wind Resource Assessment :	▪ ***Over 1100 wind monitoring stations in 31 States/UTs*** ▪ ***Seven handbooks on Wind Energy Resource published*** ▪ ***Wind Atlas for the country has been prepared***

State-wise Capacity

Sl. No.	States	Capacity (MW) (Upto June, 2012)
1.	Andhra Pradesh	263
2.	Gujarat	3016
3.	Karnataka	2025
4.	Kerala	35
5.	Madhya Pradesh	376
6.	Maharashtra	2772
7.	Rajasthan	2079
8.	Tamil Nadu	7073
9.	Others	4
	Total	**17644**

Renewable Resources in India

III. Biomass Power

Assessed Potential	**17 GW** **(As per present estimate-from surplus agro biomass)**
Tapped Potential	**2.3 GW** ***Projected 5 GW by 2017***

Biomass through dedicated energy plantation

2500 MW require 0.5 million hectare land with fast growing species and some agro practices. Green Mission aims at 5-10 million hectare land

- These will be small 1-2 MW tail end plants
- Save transmission losses by 7% better power factor
- Facilitate electricity supply to rural areas
- Bamboo forests regularly harvested would capture carbon efficiently (12 tonne/ha/yr against 0.5 to 1.5 tonne/ha/yr for other species)

Renewable Resources in India

IV. Hydro Power

Assessed Potential	***15 GW***
Potential mainly in Hilly states	***J&K, Uttarakhand, Himachal Pradesh, NE States***
Tapped Potential	***3.4 GW*** ***Projected 5.5 GW by 2017***
Strategy:	▪ ***Private sector participation*** ▪ ***Performance based incentivisation***

Promotion of Renewable Energy

- Policy and Regulatory Measures
- Infrastructural Support
- Availability of Finance

Mandatory Solar RPO Mechanism

- State Electricity Regulators to fix a percentage of energy purchased from Solar Power under RPO.
- The Solar RPO has to begin with 0.25 % of the energy procured reaching 3% by 2022.

Solar Power re uired to meet Solar RPOs (MW)					
2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1465	3018	465	6387	8204	1010

- This requirement likely to go up to 30,000 MW by 2022.

Current state-wise Solar RPO targets

State	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Andhra Pradesh	0.25%	0.25%	0.25%			
Arunachal Pradesh						
Assam	0.10%	0.15%	0.20%	0.25%		
Bihar	0.50%	0.75%	1.00%	1.25%		
Chhattisgarh	0.25%	0.50%				
Delhi	0.10%	0.15%	0.20%	0.25%	0.30%	0.35%
JERC (Goa & UT)	0.30%	0.40%				
Gujarat	0.50%	1.00%				
Haryana	0.00%	0.05%	0.10%			
Himachal Pradesh	0.01%	0.25%	0.25%	0.25%	0.25%	0.25%
Jammu and Kashmir	0.10%	0.25%				
Jharkhand	0.50%	1.00%				
Karnataka	0.25%					
Kerala	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%

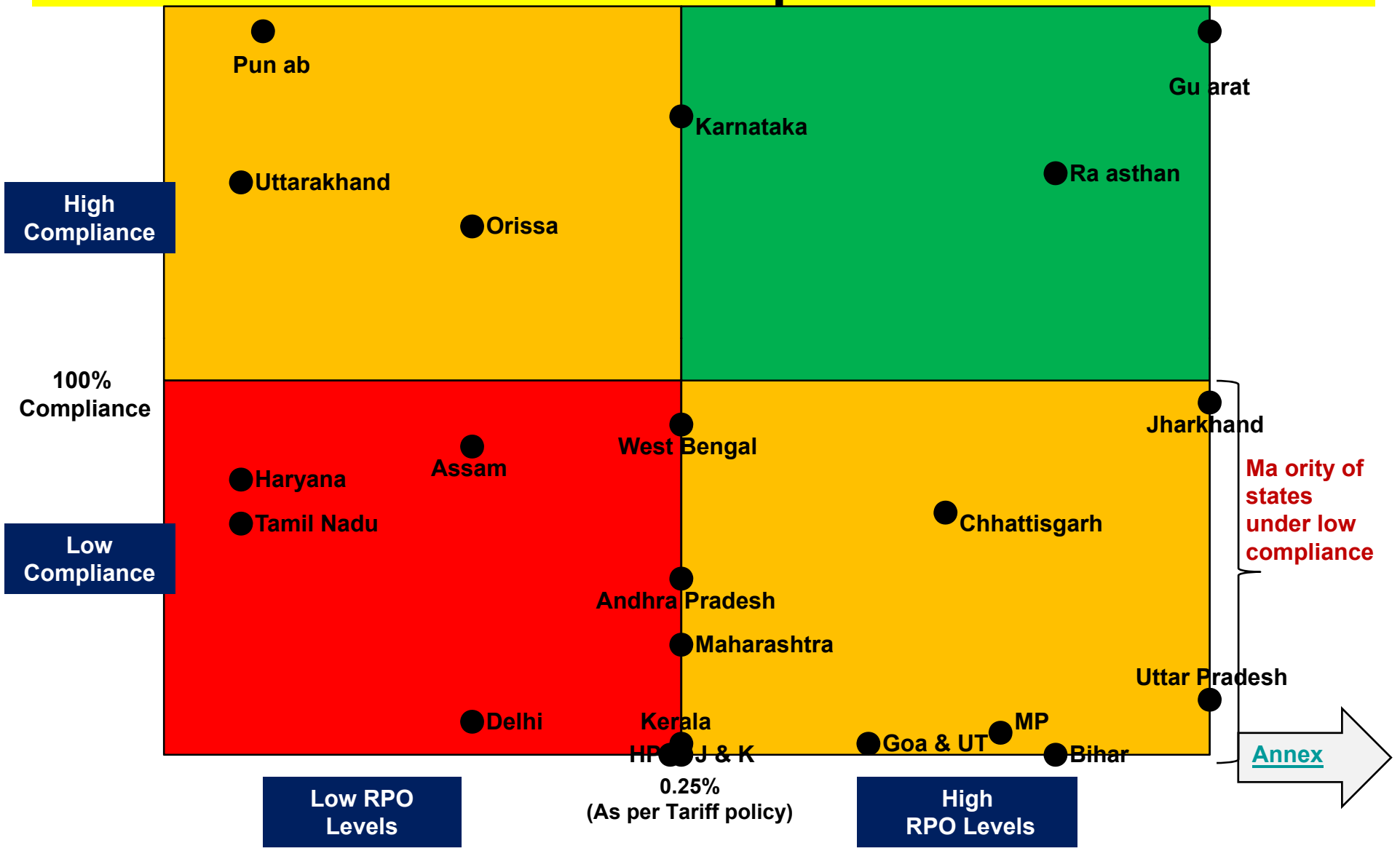
Source: RPO regulations of the respective states

Current state-wise Solar RPO targets

State	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Madhya Pradesh	0.40%	0.60%	0.80%	1.00%		
Maharashtra	0.25%	0.25%	0.50%	0.50%	0.50%	
Manipur	0.25%	0.25%				
Mizoram	0.25%	0.25%				
Meghalaya	0.30%	0.40%				
Nagaland	0.25%	0.25%				
Orissa	0.10%	0.15%	0.20%	0.25%	0.30%	
Punjab	0.03%	0.07%	0.13%	0.19%		
Rajasthan	0.50%	0.75%	1.00%			
Sikkim						
Tamil Nadu	0.05%					
Tripura	0.10%	0.10%				
Uttarakhand	0.03%	0.05%				
Uttar Pradesh	0.50%	1.00%				
West Bengal						

Source: RPO regulations of the respective states

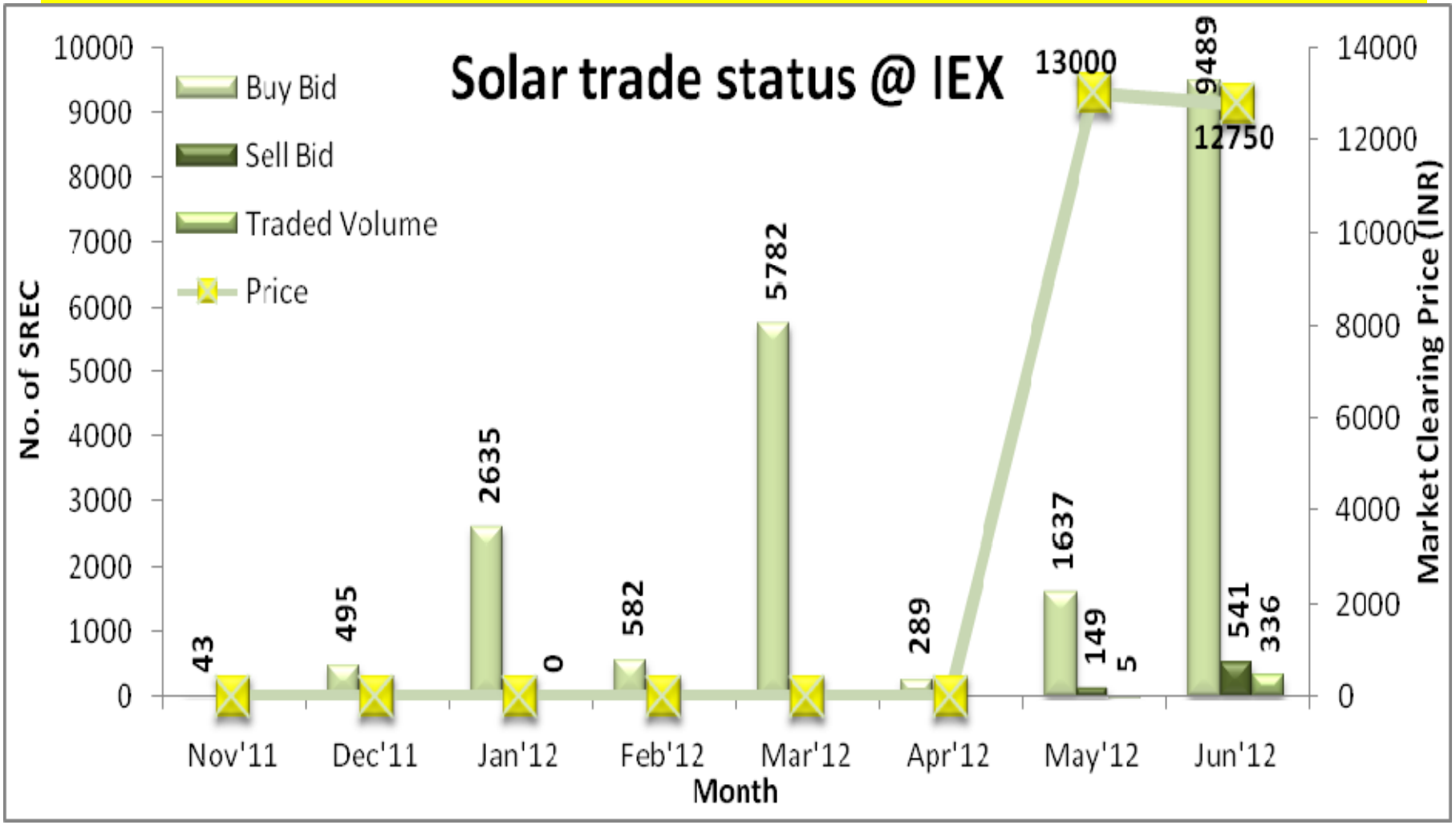
State Compliance



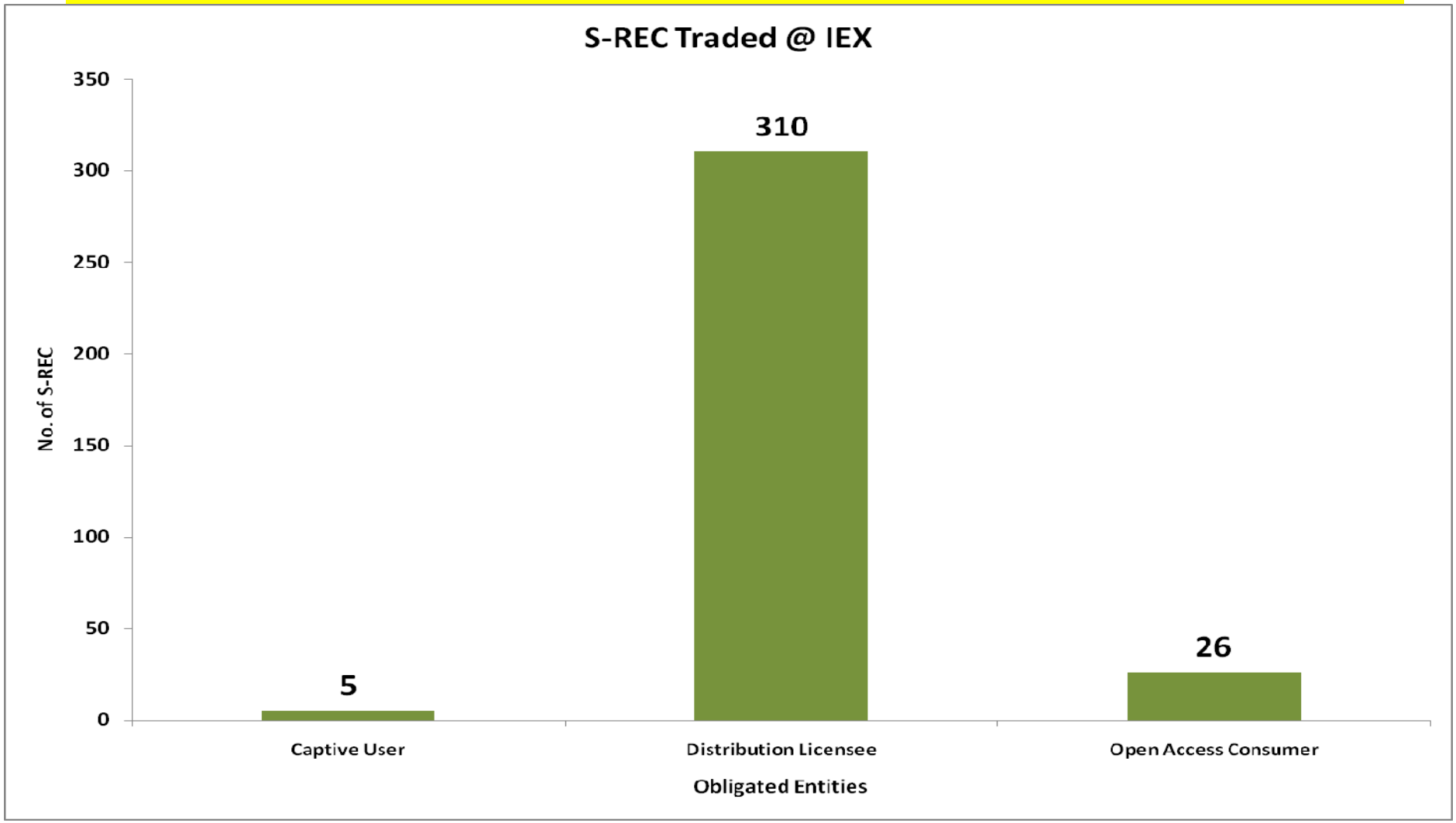
Captive Compliance Re uirement

Company Name	Captive Power Capacity (MW)	Solar Capacity Re uired for solar RPO compliance (MW) in 2012-13
J.K. Lakshmi Cement Ltd.	3.00	3.00
Indian Petrochemical Company Ltd.	257.00	3.40
Bharat Petroleum Corporation Ltd.	18 .00	4.00
Wardha Power Company Ltd.	405.00	4.20
Ultratech Cement Ltd.	12 .00	5.00
KSK Energy Ventures Limited	540.00	5.57
J.S.W. Steel Limited.	600.00	6.20
Prakash Industries Ltd.	300.00	6.20
Vedanta Ltd.	1215.00	7.52
National Aluminium Company Ltd.	1255.00	7.80
Visa Steel Ltd.	405.00	8.40
Gu arat Alkalies and Chemicals Ltd.	247.00	8.70
Ambu a Cement Ltd.	2 0.00	10.00
Steel Authority of India(SAIL)	578.00	12.00
Bokaro Power Supply Company Pvt. Ltd.	302.00	12.50
Ba a Hindustan Ltd.	323.00	13.50
Essar Group	367.00	14.27
Hindustan Zinc Ltd.	474.00	14.70
Jindal Steel and Power Ltd.	873.00	15.00
Sterlite Industries India Ltd.	675.00	16.80
Hindalco Ltd.	1358.00	41.70
Tata Steel Ltd.	1882.50	77.60
Reliance Industries Ltd.	208 .00	81.00
	Total	37 .06

Solar REC trade @ IEX



S-REC Traded @ IEX



State Solar Compliance FY 2012-13

State	Pro ected Demand (MU)	Solar RPO Target (2012-13)		Capacity for meeting Solar RPO	Capacity Tied Up 20.07.2012	Gap to be fulfilled in 2012-13
	2012-13	%	(MU)	(MW)	(MW)	(MW)
Andhra Pradesh	98,956	0.25%	247.39	148.6	75.5	**73.14**
Arunachal Pradesh	631	0.00%	-	-	0.025	**-0.03**
Assam	6,810	0.15%	10.21	6.1	5	**1.14**
Bihar	15,272	0.75%	114.54	68.8	0	**68.82**
Chhattisgarh	15,889	0.50%	79.45	47.7	29	**18.73**
Delhi	28,598	0.15%	42.90	25.8	2.552	**23.22**
JERC (Goa & UT)	12,860	0.40%	51.44	30.9	1.7	**2 .21**
Gu arat	79,919	1.00%	799.19	480.2	968.5	**-488.33**
Haryana	40,167	0.05%	20.08	12.1	8.8	**3.27**
Himachal Pradesh	8,647	0.25%	21.62	13.0	0	**12.**
Jammu & Kashmir	14,573	0.25%	36.43	21.9	0	**21.8**
Jharkhand	6,696	1.00%	66.96	40.2	36	**4.23**
Karnataka	65,152	0.25%	162.88	97.9	164	**-66.14**
Kerala	21,060	0.25%	52.65	31.6	0.025	**31.61**

State	Projected Demand (MU)	Solar RPO Target (2012-13)		Capacity for meeting Solar RPO	Capacity Tied Up 20.07.2012	Gap to be fulfilled in 2012-13
	2012-13	%	(MU)	(MW)	(MW)	(MW)
Madhya Pradesh	53,358	0.60%	320.15	192.3	13.205	**179.14**
Maharashtra	150,987	0.25%	377.47	226.8	75.5	**151.29**
Manipur	608	0.25%	1.52	0.9	0	**0.91**
Mizoram	418	0.25%	1.04	0.6	0	**0.63**
Meghalaya	2,154	0.40%	8.62	5.2	0	**5.18**
Nagaland	596	0.25%	1.49	0.9	0	**0.90**
Orissa	24,284	0.15%	36.43	21.9	29	**-7.11**
Punjab	48,089	0.07%	33.66	20.2	46.825	**-26.60**
Rajasthan	55,057	0.75%	412.93	248.1	329.9	**-81.80**
Sikkim	436	0.01%	0.04	0.0	0	**0.03**
Tamil Nadu	91,441	0.05%	45.72	27.5	18.055	**9.41**
Tripura	1,010	0.10%	1.01	0.6	0	**0.61**
Uttarakhand	11,541	0.05%	5.77	3.5	5.05	**-1.58**
Uttar Pradesh	85,902	1.00%	859.02	516.1	95.375	**420.74**
West Bengal	41,896	0.25%	104.74	62.9	52.05	**10.88**
			Total	**2,352.4**	**1,956.06**	**396.35**

Promotion of RE Issues

- ✓ **Payment from Discoms Priority to Renewables.**
- ✓ **Enforcement of RPOs**
  - ✓ Orders for RPOs
  - ✓ Monitoring for compliance
  - ✓ Action for non-compliance
  - ✓ Quarterly targets
- ✓ **Issues regarding RECs**
  - ✓ Clarity on issue of Discoms buying RECs more than mandatory RPOs
  - ✓ Bilateral purchase
  - ✓ Vintage based multiplier
  - ✓ Voluntary purchases
  - ✓ Validity period

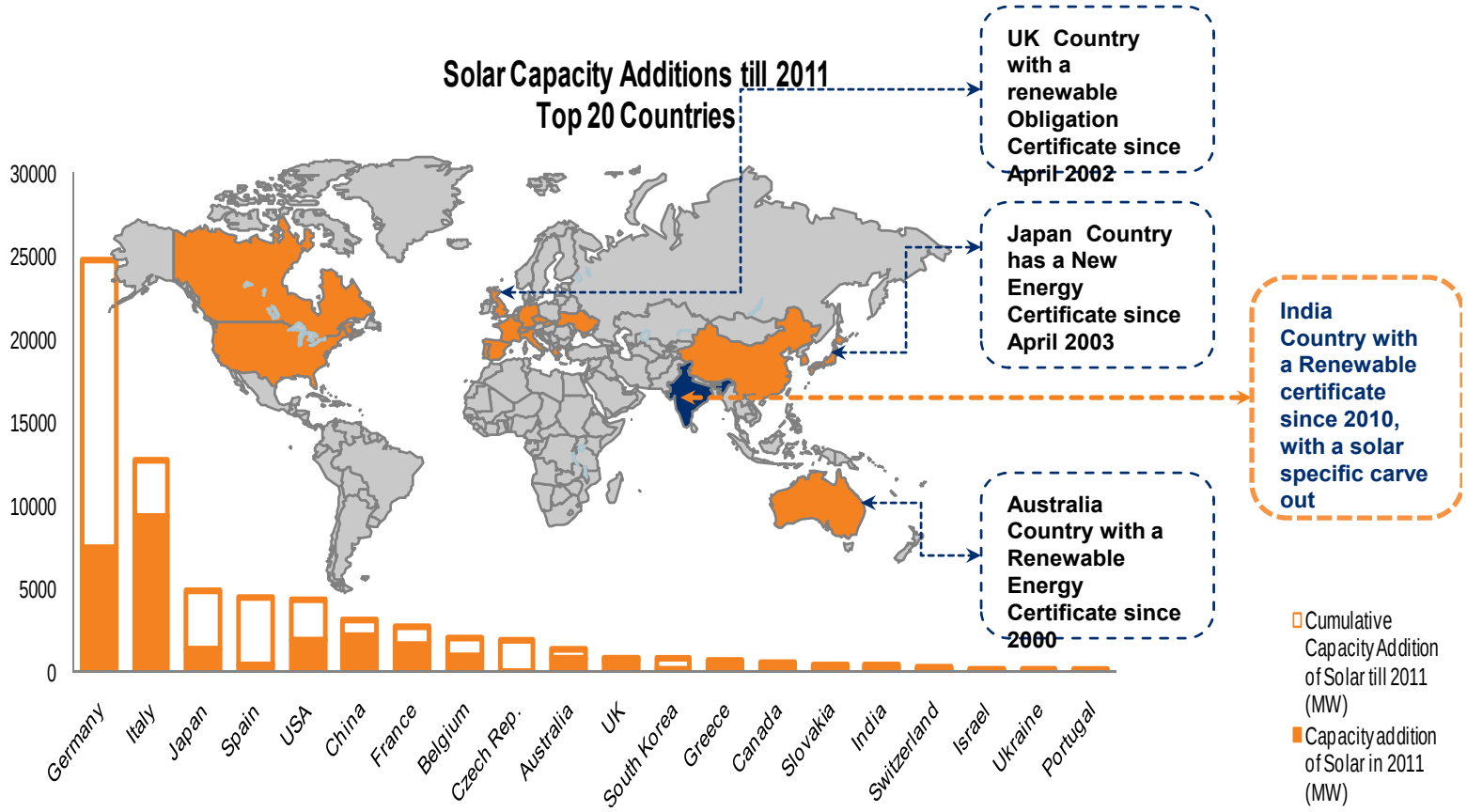
Promotion of RE Other Issues

- ✓ In case of subsidy by MNRE, RPOs are still met
- ✓ Off-grid RPOs/ RECs
- ✓ Grid connected Roof top RPOs/RECs
- ✓ Tariff for roof top with net metering and subsidy
- ✓ Long term visibility for RPOs and RECs

Japan, Australia and UK are countries with the most robust REC mechanisms globally

Global Overview

- **Total number of countries with an RPS uota policies 71**
- **Total Number of countries with a tradable REC 6**
- **Apart from Ghana India is the only developing country to have a tradable REC Ghana does not have an RPS**
- **India unlike Japan, Italy, UK and most American states has a solar carve out**



Source: BRIDGE TO INDIA market analysis
EPIA; "Global Market Outlook for Photovoltaics till 2016"; May 2012

UK has a two year validity of Renewable Obligation Certificates (ROCs) and a penalty re-cycling mechanism

RPO implementation	**RPO obligation**	▪ Policy formulated in 2000 ▪ 15.4% RPO till 2015-16 ▪ 20% renewable RPO till 2020
	Solar targets	▪ No solar specific targets in RPO enforcements ▪ 22GW of solar power by 2020
	Compliance	▪ Implementing body: OFGEMS ▪ Yearly penalties exist but are redistributed to compliant utilities in the proportion of their share of total ROCs bought in the country
REC trading	**Price**	▪ Two ROCs for 1MWh solar produced ▪ Buyout price INR3,200/ROC (£36.99/MWh) ▪ (2010-11).
	Validity	▪ 2 years
	Volumes	▪ Data specific to solar ROCs is unavailable ▪ Overall 24,884,608 ROCs issued in 2010-11

Japan has defined penalties for non-compliance, quarterly accounting for compliance and a carry over of obligations

RPO implementation	**RPO obligation**	▪ Policy formulated in 2003 ▪ Target to install 16TWh of renewable energy by 2016
	Solar targets	▪ No solar specific targets in RPO enforcements
	Compliance	▪ Penalty of up to JPY1m (INR 0.7m) on interim and annual basis ▪ There is also a quarterly compliance mechanism ▪ 20% carry over of obligation is permissible
REC trading	**Price**	▪ Tradable New Energy Certificates (NEC) with a forbearance price of JPY11 (INR7.59)
	Validity	▪ 2 years
	Volumes	▪ NA

Australia has a differentiated non-compliance penalty enforcement and allows re-cycling of penalties

RPO implementation	**RPO obligation**	▪ Policy formulated in 2000 ▪ 45,000GWh (or 20%) RPO till 2020
	Solar targets	▪ No solar specific targets in RPO enforcements
	Compliance	▪ Monetary as well as civil penalties for severe non-compliance ▪ Severity based on reasons for non-compliance ▪ Re-cycling of penalties over three years ▪ Carrying forward a part of penalty to the next year
REC trading	**Price**	▪ Solar Credits REC multiplier of around 1.5 for small solar installations ▪ INR1,378/STC[1] and INR1,952/LGC[2]
	Validity	▪ 1 Year
	Volumes	▪ NA

Thank You

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Presentation to

Forum of Regulators

On

Standardisation of Regulatory Accounts

July 27, 2012

ABPS Infrastructure Advisory

Contents of this presentation…

1. **Background and Approach**
2. **Benefits of Regulatory Accounts**
3. **Reporting System on Power Regulatory Accounting - 2012**
4. **Allocation Factors for apportionment of Common Items**
5. **Segregation of Distribution ARR into Wires Business ARR and Supply Business ARR**

Background

- FOR functions includes harmonization, co-ordination and ensuring uniformity of approach amongst the Electricity Regulatory Commissions across the country.
- Recognising the need for Regulatory Accounts to be prepared by Utilities as distinct from Statutory Accounts, FOR had constituted a Working Group on "Standardization of Regulatory Accounts".
- FOR engaged the consortium of Sanjay Gupta & Associates and ABPS Infrastructure Advisory Pvt. Ltd. for providing assistance to the aforesaid Working Group.

Approach...1/3

- To analyse the gap between Accounting Principles followed by Utilities for preparation of their Annual Accounts and the principles required for development of Regulatory Accounts, ten (10) Utilities representing a mix of public sector Utilities, privately owned Utilities, Local Authority and Government Departments, were selected during the kick-off presentation on July 27, 2010.

Name of Utility	Type of Utility	Ownership
Gujarat State Electricity Company Limited	Generation	Public
Gujarat Energy Transmission Company Limited	Transmission	Public
Madhya Pradesh Generation Company Ltd.	Generation	Public
Orissa Power Transmission Corporation Ltd.	Transmission	Public
Eastern Power Distribution Company of Andhra Pradesh Limited	Distribution	Public
Dakshin Haryana Bijli Vitran Nigam Ltd	Distribution	Public
BSES Rajdhani Power Ltd	Distribution	Private
Brihan-Mumbai Electricity Supply and Transport Undertaking	Deemed Distribution Licensee	Municipal undertaking
The Tata Power Company Ltd.	Regulated as well as unregulated business	Private
Government of Goa Electricity Department	Transmission & Distribution	Public

Approach...2/3

Presentation on Gap Analysis before the FOR Secretariat on 22.09.2010

Presented difference between existing Accounting Policies followed for Audited Accounts and Principles required to be followed for Regulatory Accounts based on analysis of five selected Utilities.

Submission of Report on Gap Analysis

Final Report on Gap Analysis incorporating the observations during presentation

Presentation on the Draft Reporting System before the FOR Secretariat on 31.01.2011

After visits to rest of the Utilities, made the presentation which covered, inter alia, the Reporting System, Regulations for Regulatory Accounts for TRAI & IRDA, International Experience, etc.

Approach...3/3

Draft Report on Regulatory Accounts along with Formats submitted on 11.03.2011

Presentation on the Draft Reporting System before the FOR Secretariat on 14.02.2012

Submission of Revised Draft Report on 14.04.2012

Presentation on the Report on Regulatory Accounts and Mock Run of TPC and NTPC before the FOR Secretariat and representatives of GERC and MPERC on 04.07.2012

Submission of Revised Report on Regulatory Accounts along with Formats on 16.07.2012

- It was decided to do away with another set of Account Codes for Regulatory Accounts, as it will significantly add to the Utilities' burden.
- FOR Secretariat asked ABPS Infra/SGA to undertake a mock run of Regulatory Accounts for an Integrated entity like TPC and NTPC at the Central level using the suggested apportionment principles.

Report on Regulatory Accounts and the formats were revised as per the observations of FOR and representatives of GERC and MPERC and were submitted to FOR Secretariat.

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Benefits of Regulatory Accounts ...1/3

Two Fold Objective

Capture Information on the Regulated Business of the Utility (Entity having Integrated Operations or having only Regulated Business)

To reconcile the difference between Expenses allowed/allowable to the Utility as per Tariff Regulations/Orders and the Expenses incurred as per Audited Accounts

The Regulatory Accounts Formats will have to be filled up by the Utility and submitted to the Regulatory Commission after the finalisation of Audited Annual Accounts, subject to the time limit specified in the Reporting System, to be notified by the Commission.

Benefits of Regulatory Accounts ...2/3

- **Regulatory Accounts will not replace the ARR and Tariff formats**

- **Regulatory Accounts will supplement the Tariff Determination process, by providing the Regulatory Commissions information about the Regulated Business of the Utility and the reconciliation of figures in the Truing up Petition with the figures in the Statutory Accounts.**

- **Utilities, post finalization of their Statutory Accounts, will be required to prepare the Regulatory Accounts first, which will facilitate the filling up of formats for Truing up in accordance with the Tariff Regulations notified by Regulatory Commissions.**

- **Regulatory Commissions typically ask for reconciliation between figures of the Audited Accounts and figures claimed in Truing up Petition as part of data gaps. Submission of Regulatory Accounts with ARR/APR Petition will formalize the reconciliation.**

Benefits of Regulatory Accounts ...3/3

- **Regulatory Accounts will also show the proportion of common assets and common expenses allocated to the Regulated Business in case**
  - **common assets are used**
  - **common expenses are incurred for both Regulated Business in the State and Unregulated Business/Regulated Business in other State(s).**
- **The basis of allocation will also be shown in Regulatory Accounts.**
- **Regulatory Accounts are required to capture the assets, liabilities, expenses and revenue of the Regulated Business of the Licensee or the Generation Company as per the Regulatory Principles as distinct from the Accounting Principles followed for preparation of Audited Accounts.**
- **Also the Regulatory Accounts are required to be audited and certified by an Auditor, which will improve the authenticity of expenses and revenues in the Regulatory Accounts.**

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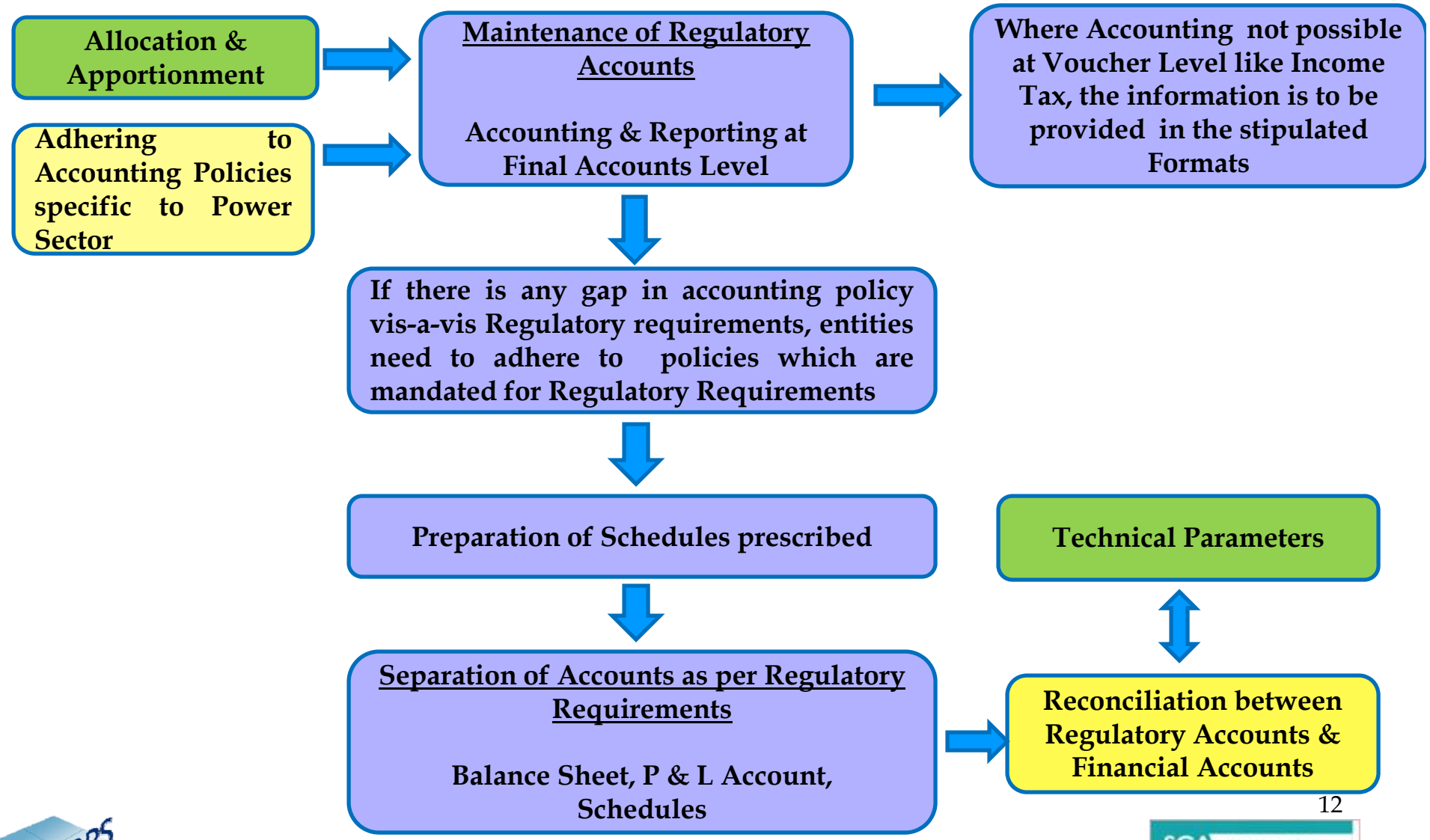
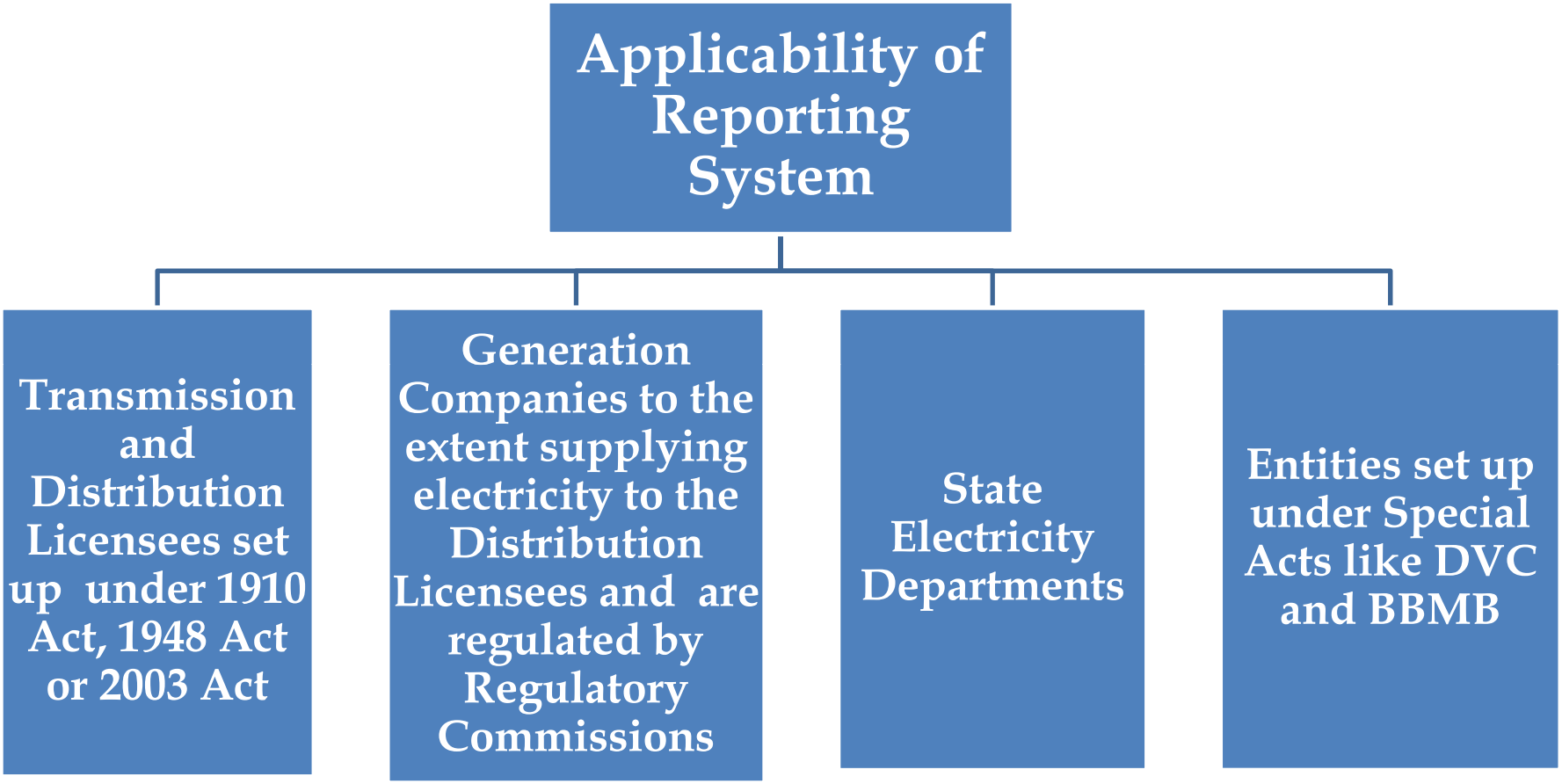
Reporting System on Power Regulatory Accounting – 2012 ...1/2



Reporting System on Power Regulatory Accounting – 2012 ...2/2



All Licensees (including the Licensees undertaking the business of generation of electricity) and Generation Companies, who submit an application to the Regulatory Commission for determination of tariff under Section 64 of the Electricity Act, 2003/ Tariff Regulations notified by the Commission.

Appointment of Auditor and Audit of Regulatory Accounts

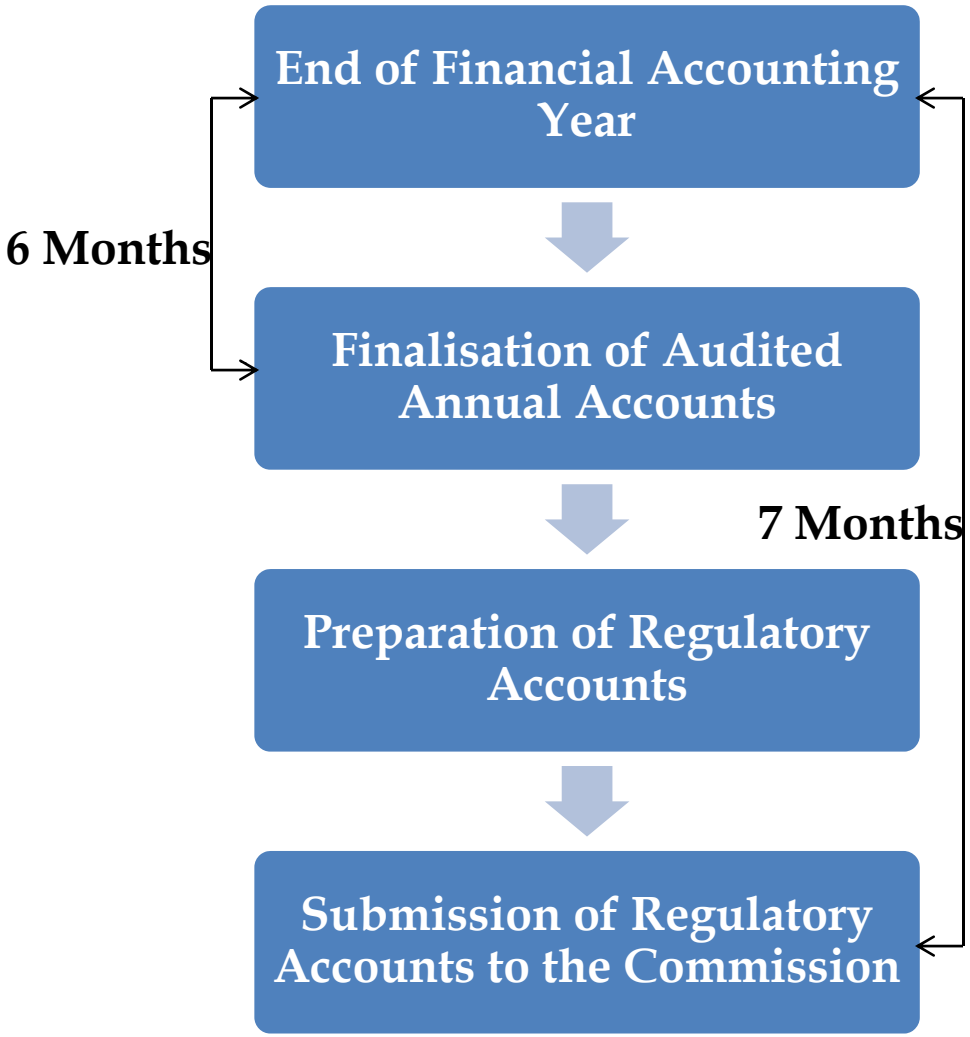
The Licensee or the Generation Companies to which this Reporting System will apply will appoint an Auditor.

Auditor will audit the Regulatory Accounts prepared by the Licensee or the Generation Company

Auditor will express the opinion – whether the Regulatory Accounts have been prepared in accordance with the Reporting System and applicable Tariff Regulations

The Auditor should be qualified for appointment as an auditor under section 224 or 233-B of The Companies Act, 1956.

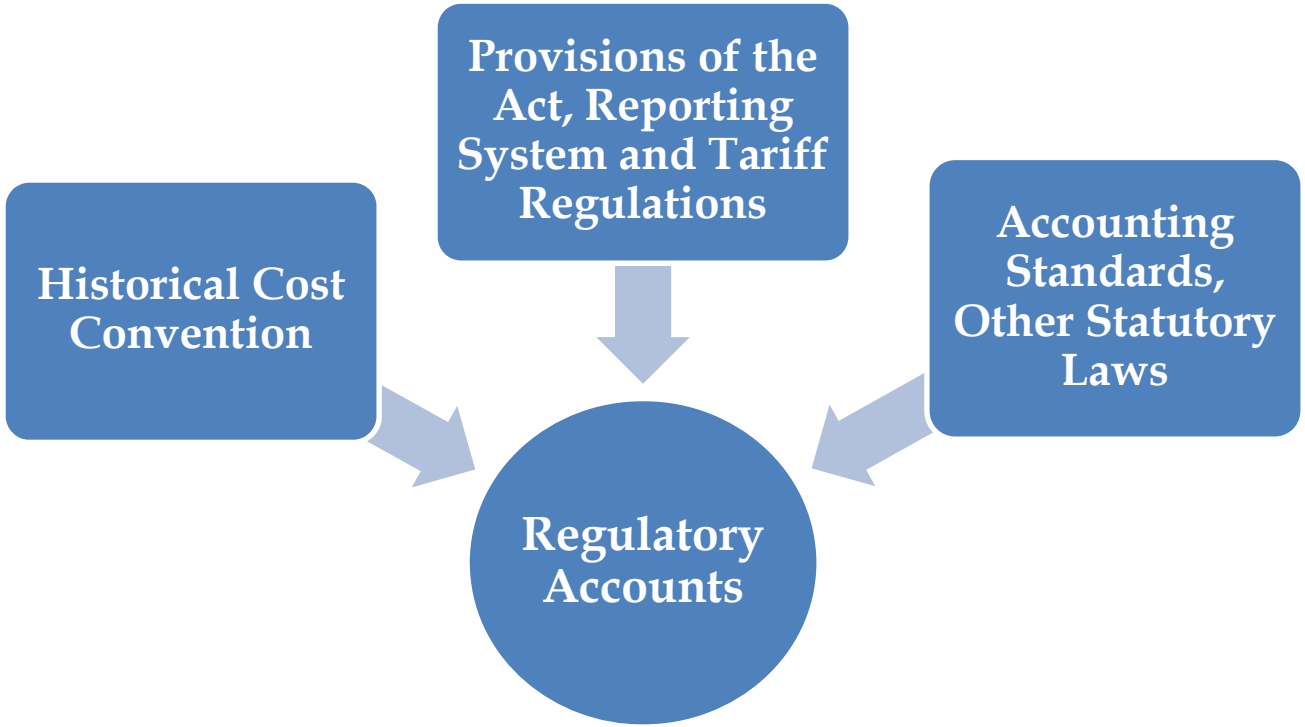
Periodicity of Submission of Regulatory Accounts and Maintenance of Information



Utilities will have to submit Regulatory Accounts as per the formats appended to the Reporting System once in a Financial Accounting Year, within seven months from the end of Financial Accounting Year.

Information for the purpose of Regulatory Accounts shall be maintained in such a way that it can be verified at the final accounts level.

Basis of Preparation of Regulatory Accounts



Where there is inconsistency between provisions of Accounting Standards/ other statutory laws and the provisions of the Act/ Reporting System/ Tariff Regulations, the Licensees or the Generation Company will follow the provisions of the Act/ Reporting System/ Tariff Regulations, for the purpose of Regulatory Accounts.

Regulatory Accounting Manual ...1/2

Every Licensee or Generation Company shall make a manual containing the following-

1. **Definition of terms used in the manual;**
2. **Introduction of the Utility**
3. **An overview of the Utility's organizational structure;**
4. **A clear categorisation of the regulated and unregulated activities of the Utility with further segregation of regulated activities covered under more than one Regulatory Commission;**
5. **A list of the entities within the Group, relationship of the Utility with other Group Companies or Subsidiaries or related parties in terms of common resources, etc.;**
6. **An overview of the financial accounting system, which may include policies with respect to the Regulatory Accounts;**
7. **Description of the treatment of related party transactions, allocation of common expenses and allocation of jointly used assets;**
8. **Products, Services or geographical areas, which shall be treated as separate segments while preparing Regulatory Accounts;**

Continued...

Regulatory Accounting Manual ...2/2

9. **Segmentation of Regulated Business**
   a) **Generation – Hydro, Thermal, Renewable or any other,**
   b) **Transmission,**
   c) **SLDC,**
   d) **Distribution - Wheeling & Retail Supply business and**
   e) **Trading**

   (State Wise and/or Licence wise)
10. **Accounting System followed for each segment of the regulated business, report in Sl. No. 9 above.**
11. **Description of studies, surveys and model employed in cost apportionment and allocation process;**
12. **Procedure for maintenance and updating manual.**

A copy of such manual shall be filed before the Commission within a prescribed time frame from the date of notification of this Reporting System by the Commission.

Accounting Policies for Regulatory Accounts ... 1/6

Particulars	Policy for Regulatory Accounts
Value of Fixed Assets	Shall be stated at Historical Cost, as allowed by the Commission for determination of tariff.
Addition to the Fixed Assets	At cost of acquisition or construction including any cost attributable to bringing the assets to their working condition and actually put to use for the benefit of consumers.
Renovation & Modernisation	Generation Company or Transmission Licensee shall separately indicate the addition of fixed assets in respect of renovation and modernization.
Grants and Consumer Contribution received for creation of Fixed Asset	All Grants and Consumer Contribution received for capital expenditure shall be reduced from the value of fixed assets for the creation of which these funds have been used. In case the entire asset has been created out of Grants/Consumer Contribution, the asset shall not be shown in Regulatory Accounts.
Asset wise Cost Breakup and corresponding Liability (optional)	Generation Company or Transmission Licensee shall be required to provide the asset wise break up of cost, asset wise liability incurred, asset wise accumulated depreciation charged till date and depreciation charged in the financial Accounting Year.

Accounting Policies for Regulatory Accounts ...2/6

Particulars	Policy for Regulatory Accounts
Depreciation	• Depreciation shall be charged as per the rates, method and the extent specified in Tariff Regulations. • Depreciation shall continue only till writing off of 90% of the original cost of the fixed asset or till the asset permanently ceases to be in use, whichever is earlier. • Advance Against Depreciation, if allowable, shall be shown as per the provisions of Tariff Regulations.
Loans	• Actual Loans and Normative Loans shall be shown separately in Regulatory Accounts. • Total Loans for Regulatory Business shall be determined in accordance with the provisions of Tariff Regulations. • Repayment of loans (Actual or Normative) of Regulated Business shall be made as per the provisions of Tariff Regulations.
O&M Expenses	O&M Expenses (consisting of Employee Expenses, Repair & Maintenance Expenses and Admin. & General Expenses) shall be stated in Regulatory Accounts in accordance with the Tariff Regulations.

Accounting Policies for Regulatory Accounts ...3/6

Particulars	Policy for Regulatory Accounts
Equity	• Where the actual equity including the retained profit invested in the regulated business is more than normative equity as per Tariff Regulations, the difference between actual and normative equity shall be treated as normative loan and interest shall be allowed on the normative loan as per Tariff Regulations. • Otherwise, actual equity invested in capital assets for the regulated business shall be considered for tariff determination purpose.
Return on Equity/ Capital Employed	• Return on Equity / Capital Employed shall be shown in the Regulatory Accounts as per the provisions of Tariff Regulations. • Where Return on Capital Employed has been allowed, interest on loans shall not be shown in Regulatory Accounts.
Income Tax (if RoE/RoCE is allowed on Post-Tax basis)	• Income Tax paid or payable, at actuals, on the income stream from the Regulated Business shall be considered in Regulatory Accounts. • Income Tax on the amount of efficiency gains or incentives shall not be considered in Regulatory Accounts.
Income Tax (if RoE/RoCE is allowed on Pre-Tax basis)	Income Tax shall be shown as a part of RoE or RoCE in the Regulatory Accounts and shall not be shown separately.

Accounting Policies for Regulatory Accounts ...4/6

Particulars	Policy for Regulatory Accounts
Interest on Working Capital, Interest on Consumer Security Deposit, Contribution to Contingency Reserve	These shall be computed and shown in Regulatory Accounts as per the provisions of Tariff Regulations.
Incentive / (Disincentive) for Higher/(Lower) Availability	These shall be computed and shown in Regulatory Accounts as per the provisions of Tariff Regulations.
Sharing of gains/(losses) due to Efficiency Gains /(Losses)	These shall be computed and shown in Regulatory Accounts as per the provisions of Tariff Regulations.
Carrying Cost	Carrying Cost shall be computed and shown in Regulatory Accounts as per the provisions of Tariff Regulations or as allowed by the Commission in previous years.

Accounting Policies for Regulatory Accounts ...5/6

Particulars	Policy for Regulatory Accounts
Revenue	• Revenue from sale of power shall be accounted for on accrual basis in cases whether the determination of retail tariff is done on the basis of distribution loss approach. • In States where the AT&C Loss method is used for tariff determination, the revenue from sale of power shall be accounted for on cash basis. • Reconciliation of actual collection, sales, and debtors shall be provided in the notes to the accounts. • Where the sale of energy prior to the end of a Financial Accounting Year has not been billed, a provision for such unbilled revenue shall be made at the end of Financial Accounting Year so as to treat the amount as revenue in the Financial Accounting Year in which supply of power shall be made.
Non Tariff Income	Non-Tariff Income, attributable to the Regulated Business shall be shown in Regulatory Accounts, which will be used for reduction of ARR of the Licensee or the Generation Company.
Other Income	Other Income shall be considered for reduction in ARR of the Licensee in the Regulatory Accounts, as per the provisions of Tariff Regulations.

Accounting Policies for Regulatory Accounts ...6/6

Particulars	Policy for Regulatory Accounts
Regulatory Asset	• **Regulatory Asset shall be shown under Asset side of Regulatory Accounts, as approved by the Commission/as per provisions of Tariff Regulations.** • **In the absence of any provision in Tariff Regulations,** **1. The total amount of outstanding Regulatory Asset at the end of the year shall be shown, as a separate entry, under the Assets side of the Accounts.** **2. The period of amortisation of the Regulatory Asset and the carrying cost of the Regulatory Asset shall be explained under the Notes to the Regulatory Accounts.** **3. For every year of amortisation, the amount of Regulatory Asset amortised during the year as approved by the Commission and the carrying cost allowed by the Commission on the balance Regulatory Asset shall be shown under the Revenue side, once the Utility is allowed to bill the same to the consumers.**

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Recommended Allocation Factors for Apportionment of Common Items...1/5

- **Integrated Utilities carrying out:**
  1. **Regulated Business as well as Unregulated Business**
  2. **Regulated Business in one State and other Regulated Business in Other State(s)**
  3. **More than one Regulated Businesses within one State**

  may utilise some common assets/ incur common expenses meant for all the Businesses.
- **Common items needs to be apportioned to different businesses based on some Cost Driver, so that the share of cost allocated to the Regulated Business does not amount to subsidising the Un-regulated Business.**
- **Different Allocation Factors have been proposed and discussed in the Report with advantages and disadvantages.**
- **Recommended Apportionment Factors are summarised here.**

Recommended Allocation Factors for Apportionment of Common Items...2/5

Sr. No.	Particulars	Allocation Principle
A	**Fixed Assets**	
I	Plant & Machinery	Technical Parameters ▪ Contracted Capacity – Generating Stations and Transmission Networks ▪ Connected Load or Consumption – Distribution Networks
II	Land, Building & Civil Structures	No. of direct employees belonging to different businesses
III	Other Fixed Assets	Proportion of value of fixed assets directly attributable to different businesses
B	**Current Assets**	
I	Stores and Spares	Proportion in which the common asset has been apportioned (in case common stores and spares are identifiable with a particular common asset) Or Proportion in which the total common assets have been apportioned (in case common stores and spares are not identifiable with a particular common asset)

Recommended Allocation Factors for Apportionment of Common Items...3/5

Sr. No.	Particulars	Allocation Principle
B	**Current Assets**	
II	Receivables and Investments	On the basis of revenue accruing from different businesses
C	**Liabilities**	
I	Long Term Loans and Interest on Long Term Loans	Proportion in which the common asset has been apportioned (in case common long term loan is identifiable with a particular common asset) Or Proportion in which the total common assets have been apportioned (in case common long term loans are not identifiable with a particular common asset)
C	Current Liabilities and Provisions	On the basis of revenue accruing from different businesses
D	Revenue from Common Assets	Proportion of revenues directly identifiable with different businesses.

Recommended Allocation Factors for Apportionment of Common Items...4/5

Sr. No.	Particulars	Allocation Principle
E	**Expenses**	
I	Generation Expenses and Power Purchase Costs	▪ Capacity Charges – Contracted or Allocated Capacity ▪ Variable Charges – Power Procurement (MU)
II	Transmission, SLDC and Distribution Expenses	Allocated Capacity between various businesses
III	Employee Expenses	On the basis of measurable parameters, e.g., ▪ Operating Staff – Time devoted to different businesses ▪ Procurement Department – Value of procurement of materials for different departments ▪ IT Department – No. of computers used for different departments etc.

Recommended Allocation Factors for Apportionment of Common Items...5/5

Sr. No.	Particulars	Allocation Principle
E	**Expenses**	
IV	R&M Expenses	Proportion in which the total common assets have been apportioned
V	A&G Expenses	No. of direct employees belonging to different businesses
VI	Depreciation	Proportion in which the total common assets have been apportioned
VII	Interest and Finance Charges	Proportion in which the total common liabilities have been apportioned
VIII	Return on Equity Identifiable with Common Asset	Proportion in which the total common assets have been apportioned
IX	Income Tax	▪ RoE – If the different businesses are regulated ▪ PBT – If the other business is not regulated

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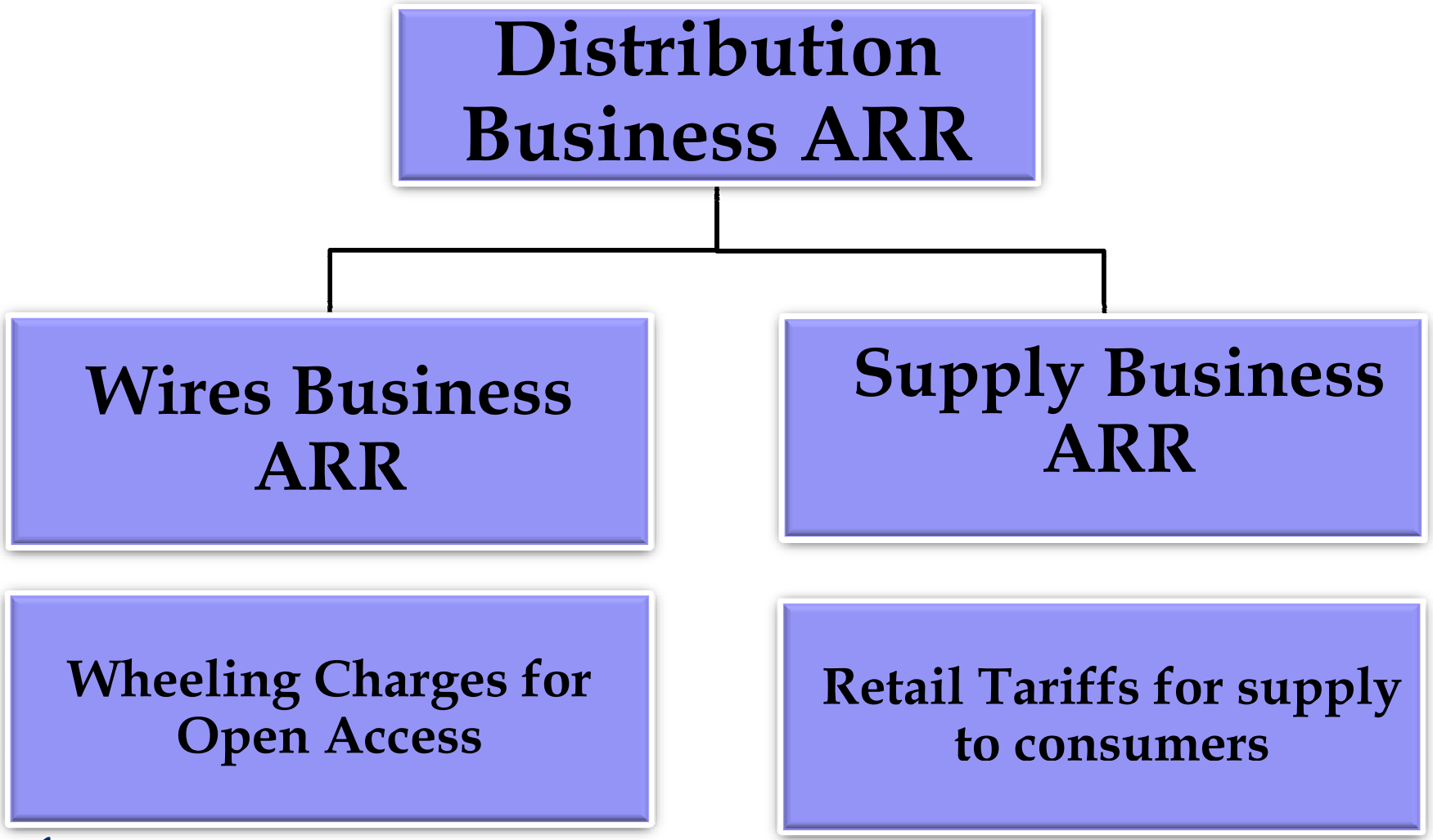
Segregation of Distribution Business ARR into Wires Business ARR and Supply Business ARR ...1/5



Segregation of Distribution Business ARR into Wires Business ARR and Supply Business ARR ...2/5

- **It is necessary to segregate the Distribution Business ARR between Wires Business and Supply Business. Ideally, this should be achieved by separately accounting for all the items of ARR between Wires business and Supply business.**
- **However, till the time complete accounting segregation is achieved by the Distribution Licensees, separation of Wires Business ARR and Supply Business ARR can be done by apportioning the components of ARR of Distribution Business between the Wire Business and the Supply Business, as per the Allocation Matrix shown below:**

Segregation of Distribution Business ARR into Wires Business ARR and Supply Business ARR ...3/5

Sr. No.	Particulars	Wires Business	Supply Business
1	Power Purchase Expenses including Transmission Charges	0%	100%
2	Employee Expenses	60% - 70%	30% - 40%
3	Administration & General Expenses	50%	50%
4	Repair & Maintenance Expenses	90%	10%
5	Interest on Working Capital	10%	90%
6	Interest on consumer security deposits	0%	100%
7	Provision for Bad Debts	5% - 10%	90% - 95%
8	Non Tariff Income	10%	90%

Segregation of Distribution Business ARR into Wires Business ARR and Supply Business ARR ...4/5

Sr. No.	Particulars	Wires Business	Supply Business
9	Depreciation		
(i)	If the detailed asset class-wise break-up of GFA between Wires Business and Supply Business is available	Same to be used for apportionment of depreciation	
(ii)	If only the overall asset break-up between Wires Business and Supply Business is available	Proportion of GFA between Wires Business and Supply Business to be used for apportionment	
(iii)	If asset breakup between Wires Business and Supply Business is not available	90%	10%
10	Interest on Long-term Loan Capital		
(i)	If asset breakup between Wires Business and Supply Business is available	Proportion of GFA between Wires Business and Supply Business has to be used for apportionment	
(ii)	If asset breakup between Wires Business and Supply Business is not available	90%	10%

Segregation of Distribution Business ARR into Wires Business ARR and Supply Business ARR ...5/5

Sr. No.	Particulars	Wires Business	Supply Business
11	Return on Appropriate Rate Base		
(i)	If asset breakup between Wires Business and Supply Business is available	proportion of GFA between Wires Business and Supply Business has to be used for apportionment	
(ii)	If asset breakup between Wires Business and Supply Business is not available	90%	10%
12	Income Tax	In the same ratio used for apportioning the Returns or 90:10	

Thank You

Power Quality - An Issue that needs address

July' 2012

31st Meeting of Forum of Regulators (FOR)

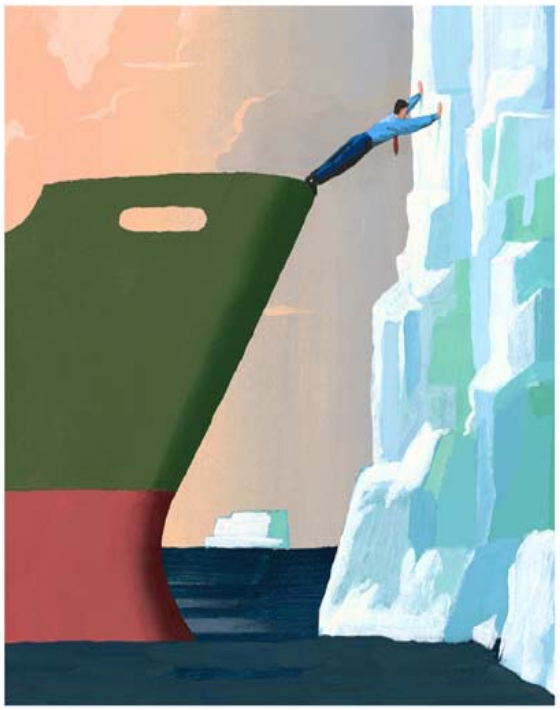
Vizag

Shri A Velayutham,
Shri Manas Kundu

Power Quality

- Power Quality is a measure of ideal power supply system.
- Quality of Supply (QoS)
  - Continuity or Reliability (24 X 7)
  - Supply Quality
- It looks into the
  - ✓ Voltage magnitude
  - ✓ Frequency
  - ✓ Wave shape
- QoS refers to maintaining a near sinusoidal voltage to a bus at rated magnitude and rated frequency.

Power Quality – Definition



- Mark McGranaghan:

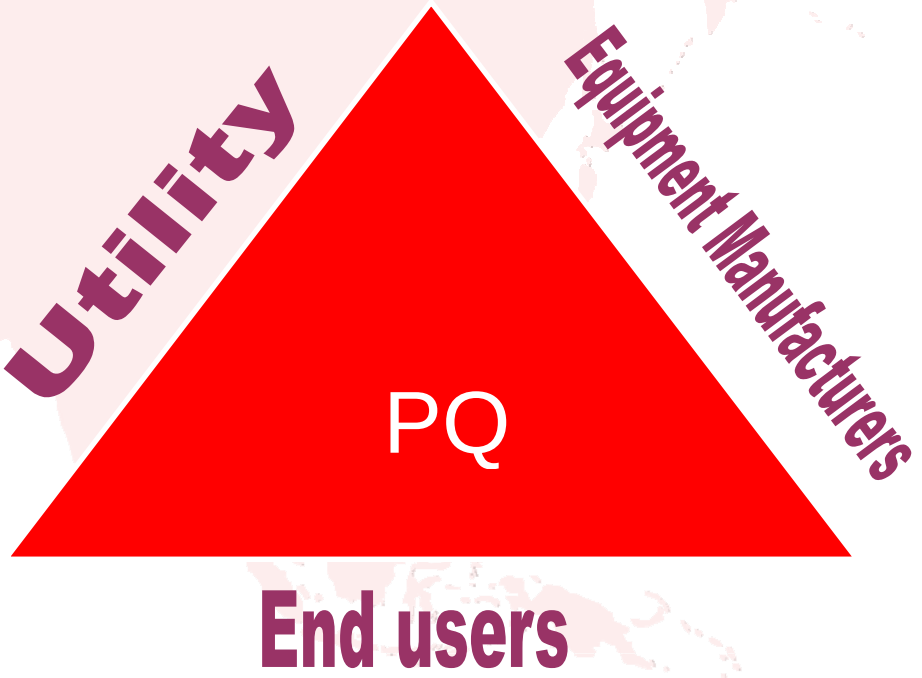
"Any power problem manifested in voltage, current, of frequency deviation that results in failure or mis-operation of customer equipment".

- M. Bollen:

"Various sources use the term power quality with different meanings. […] What all these terms have in common is that they treat the interaction between the utility and the customer, or in technical terms, between the power system and the load".

Power Quality – not always the same

- Different perspective
- … even among the same group of end users



Sources of Power Quality Problems

- Power electronic devices
- IT and office equipment
- Arcing devices
- Load switching
- Large motor starting
- Embedded generation
- Sensitive equipment
- Auto reclosing schemes
- Storm and environmental related damage

Effects of Poor Power Quality

Possible effects :

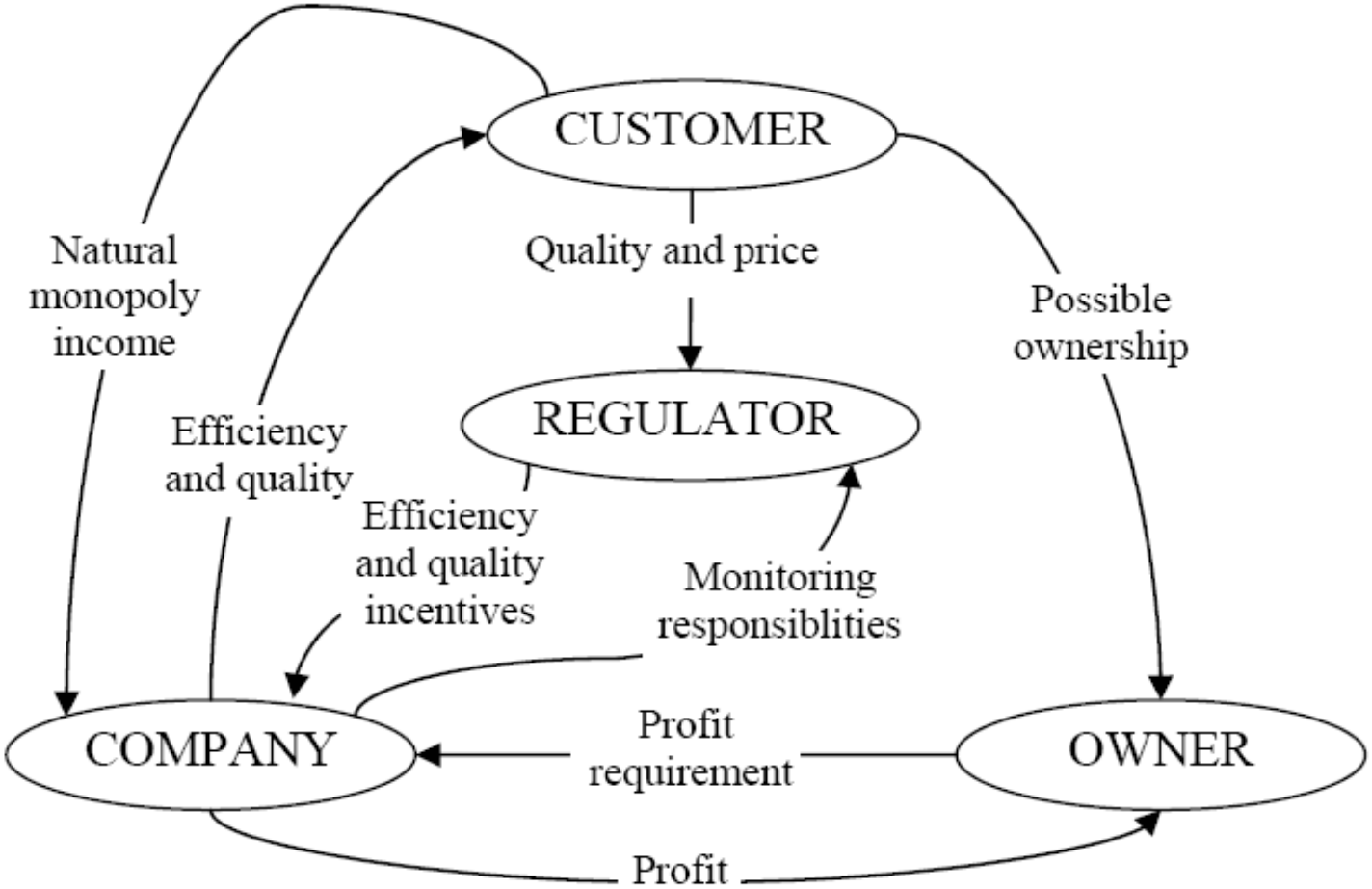
- Mal-operation (of control devices, mains signaling systems and protective relays)
- More loss (in electrical system including transformers)
- Fast ageing of equipment like Motors
- Failure of equipment like Capacitors, PCBs
- Loss of production and quality
- Radio, TV and Telephone interference

Why Power Quality has become important?

- Increased use of non linear loads and power electronic equipment with low immunity
- These create PQ problems; also affected by PQ problems
- Consumers are more aware
- Instruments available to measure PQ indices such as power factor, harmonics and displacement factor

Perspectives

Group Expectations



Source: Quality regulation in electricity distribution business, Lappeenranta University of Technology, Tampere University of Technology, Finland

QoS Perspectives

Consumers:

- Electricity is just another raw material QoS data relates to availability, but dips are equally or more important to consumers
- Consumers have different dependencies, cost bases and attitudes to investment
- Consumers' losses difficult to assess, even post event -published data tends to emphasise the extreme
- Published data is aggregated and distant. Customer effects are highly localised.

Suppliers:

- Ageing of infrastructure, cost of replacement
- Change in industrial demographics and geography of energy consumption
- Long feedback time to judge effectiveness of actions. Many desirable actions have long financial payback times
- Price regulation v. investment

Regulators:

- Interruption duration data is not accurate -especially start time
- Very short interruption and dip data is not generally available
- Relationship between cost/benefit of improvements is far from clear
- Long feedback time for improvement initiatives
- Price regulation v. investment

Main things that customers expect regarding electricity supply:

- Reliability (No interruptions or low frequency of interruptions)
- Quick restoration time
- Timely reliable information in case of a problem

CoS / VQ - Differences

Continuity of Supply

- Customer is affected by every interruption
- Lack of reliability means costs for all customers
- Power interruptions are mainly caused in the network

Voltage uality

- Customer is not affected until certain VQ level
- Different effects for different customers
- Voltage quality is largely influenced by (other) customers

QoS Components

CEER identifies three aspects of Quality of Supply:

- **Continuity of supply** (availability)engineering issue, a function of network design, state of maintenance and investment *artially regulated*

- **Voltage uality** engineering issue, function of network impedance, load distribution and planning *tandardised, not regulated*

- **Commercial uality** service response, customer relations, dispute resolution performance, price *Regulated*

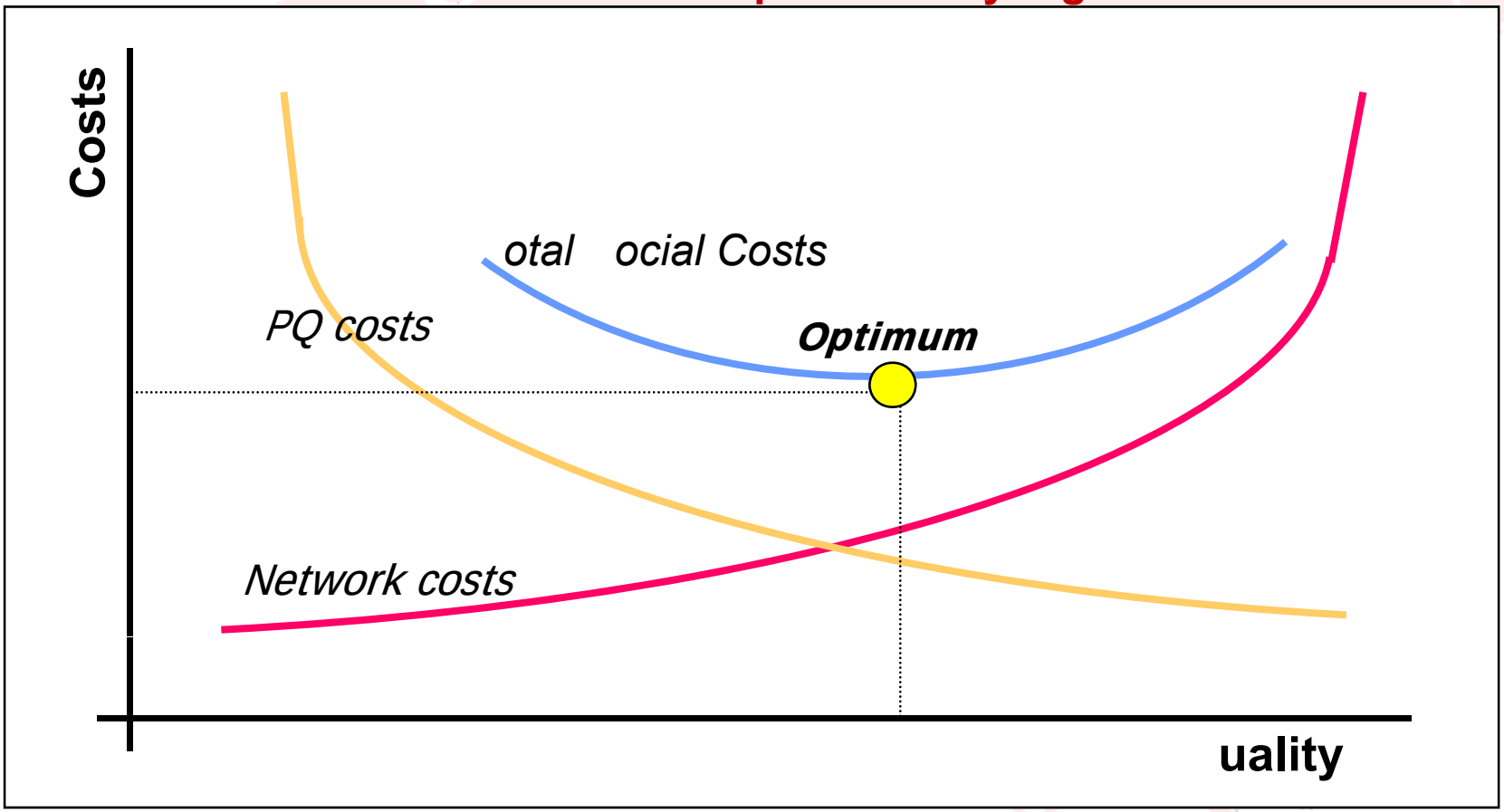
Regulation Conceptual

Capex / QoS conflict?

Providing higher quality will generally require higher costs – conflicting incentives

Regulatory system should provide guidance on what level of quality to choose

= establishment of explicit uality regulation



KEMA 2007

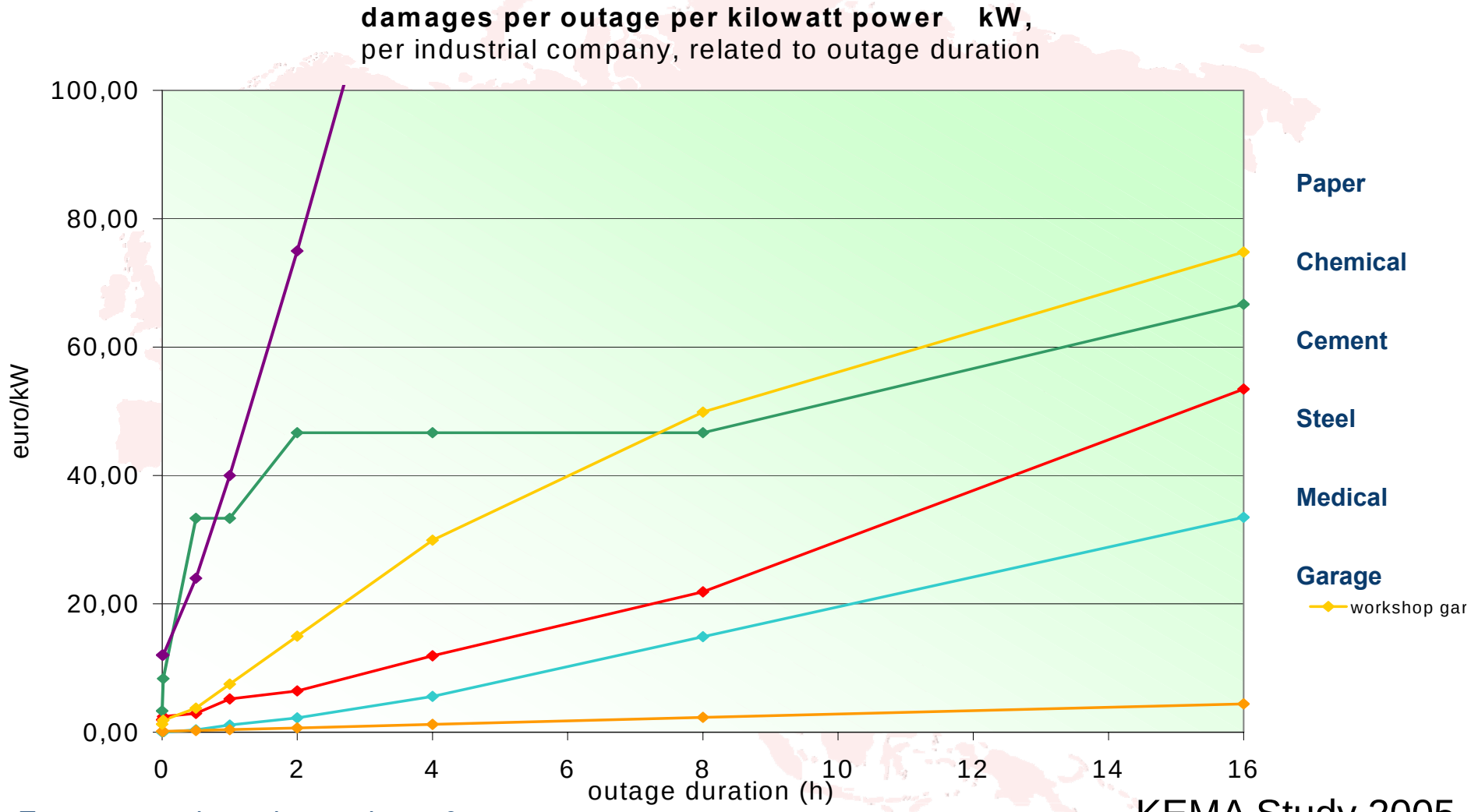
PQ Cost

Cost influence factors

- Duration of the interruption
- Perceived reliability level
- Timing
- Advance notice
- Consumer dependency

Source: KEMA 2005

Consumer dependancy and duration characteristics

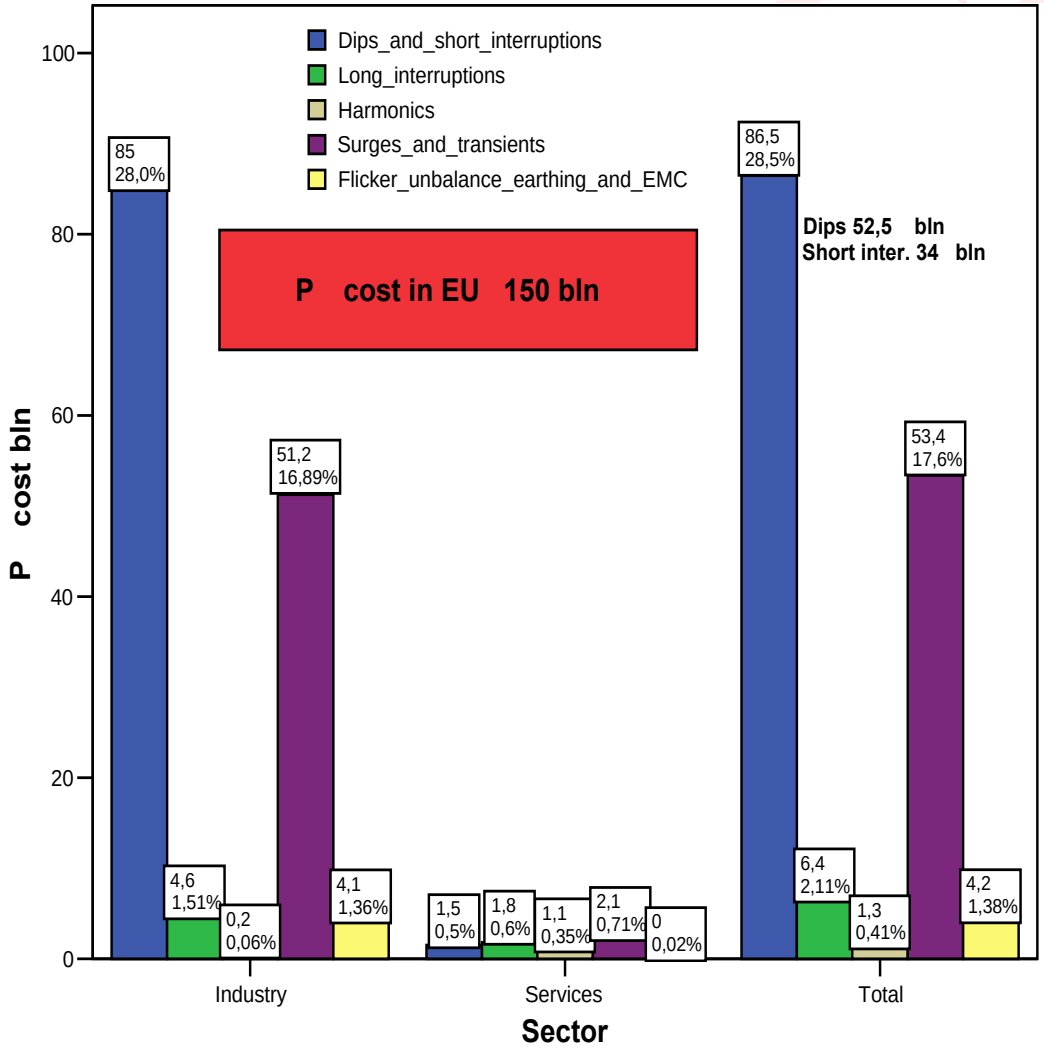


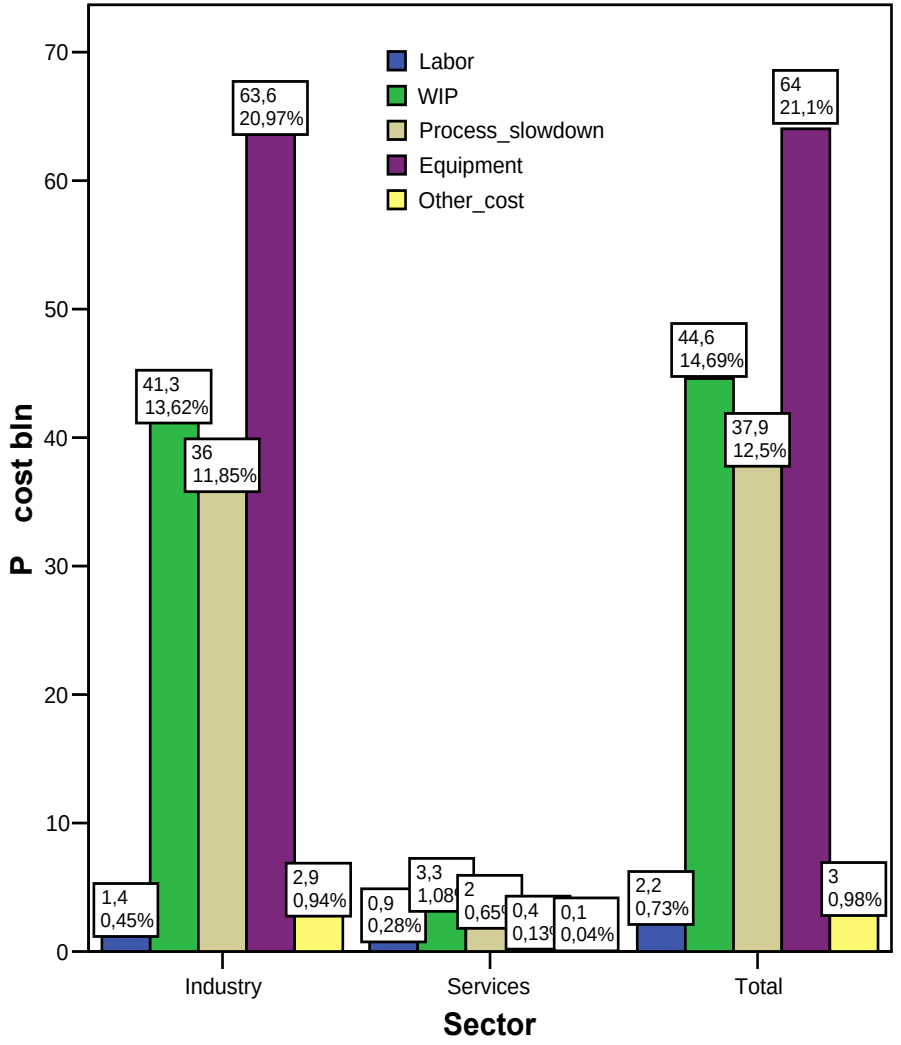
ource: E aga ine volu e issue 2

KEMA Study 2005

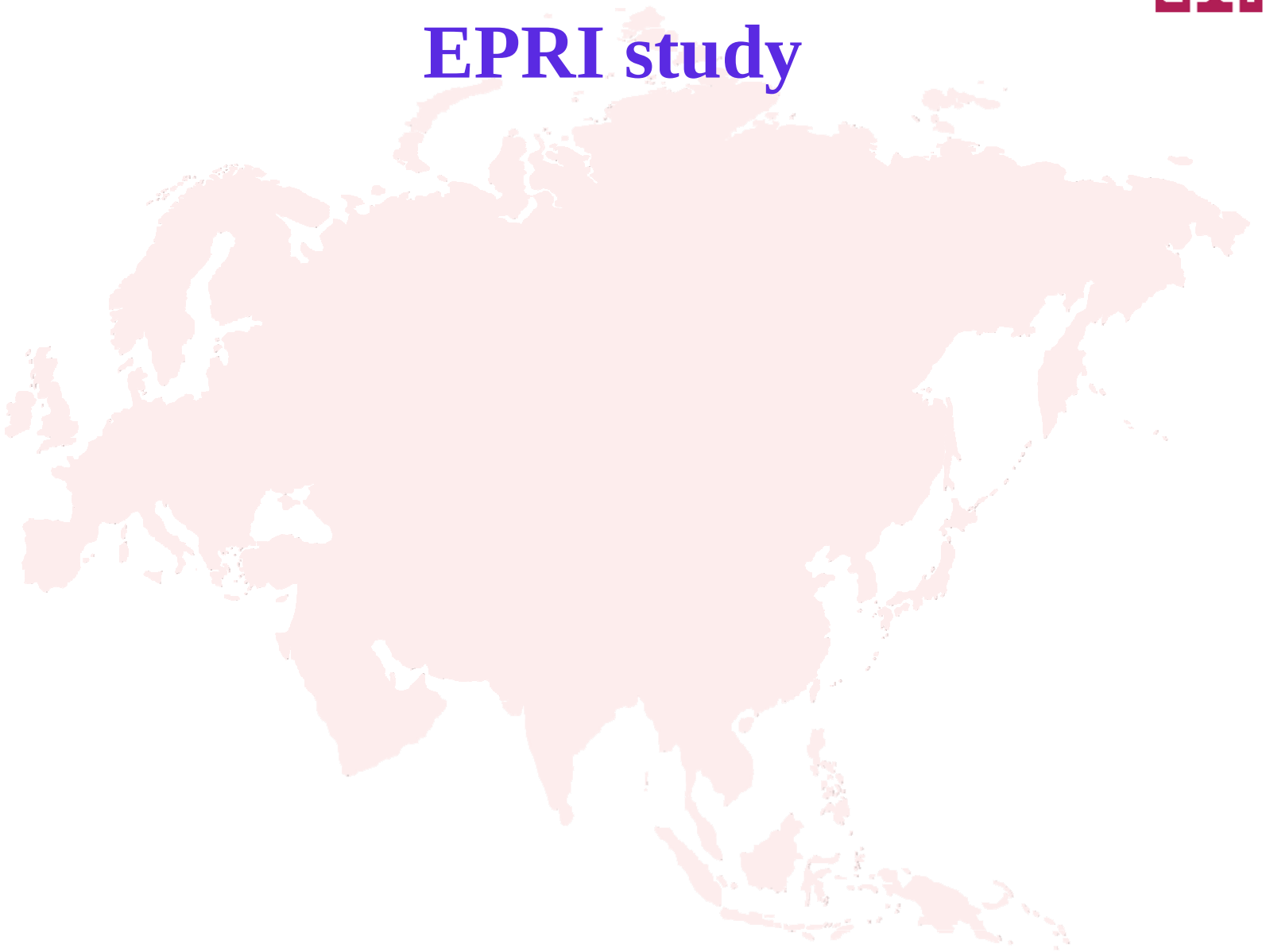
LPQI study

PQ Cost Summary



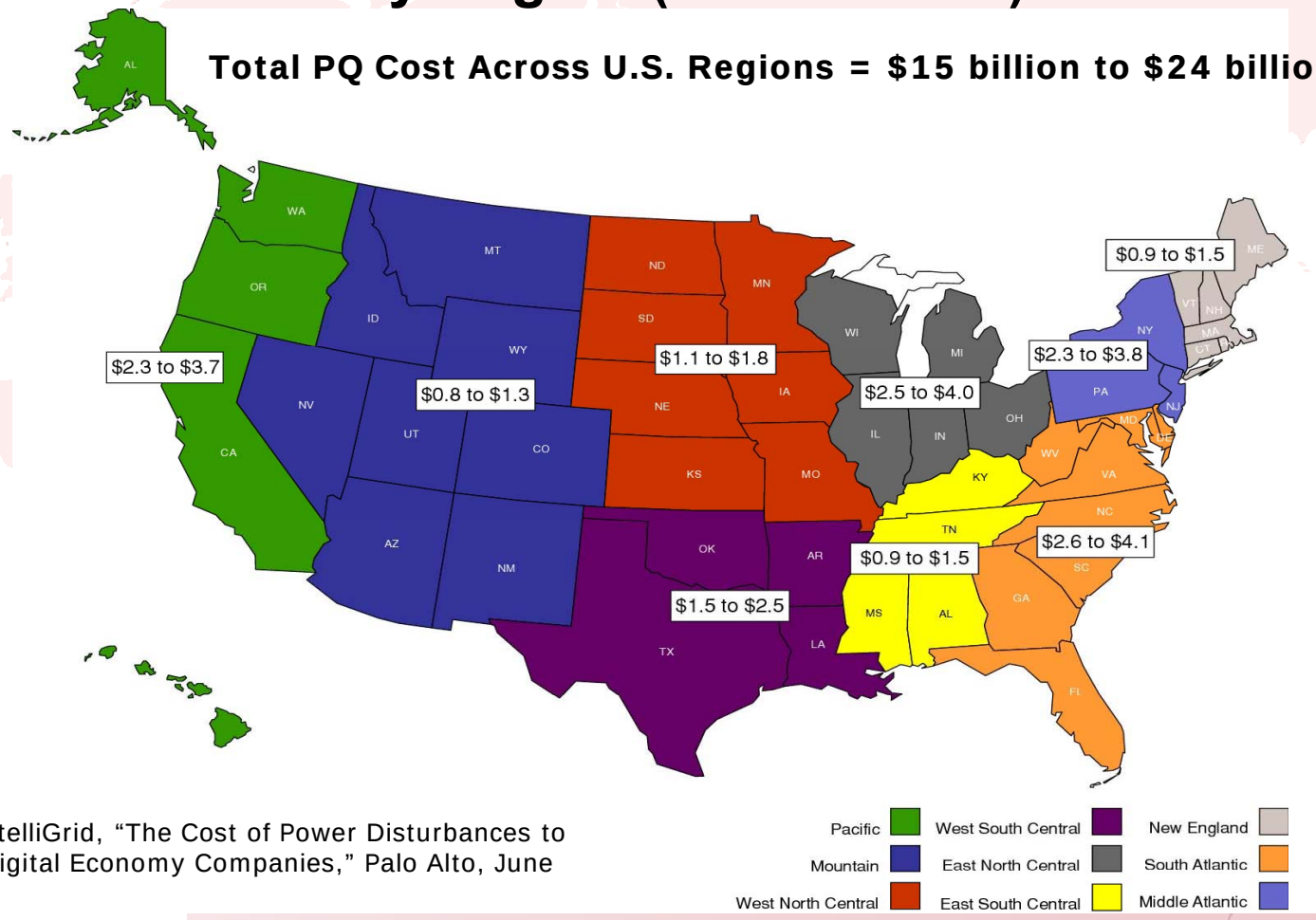


EPRI study



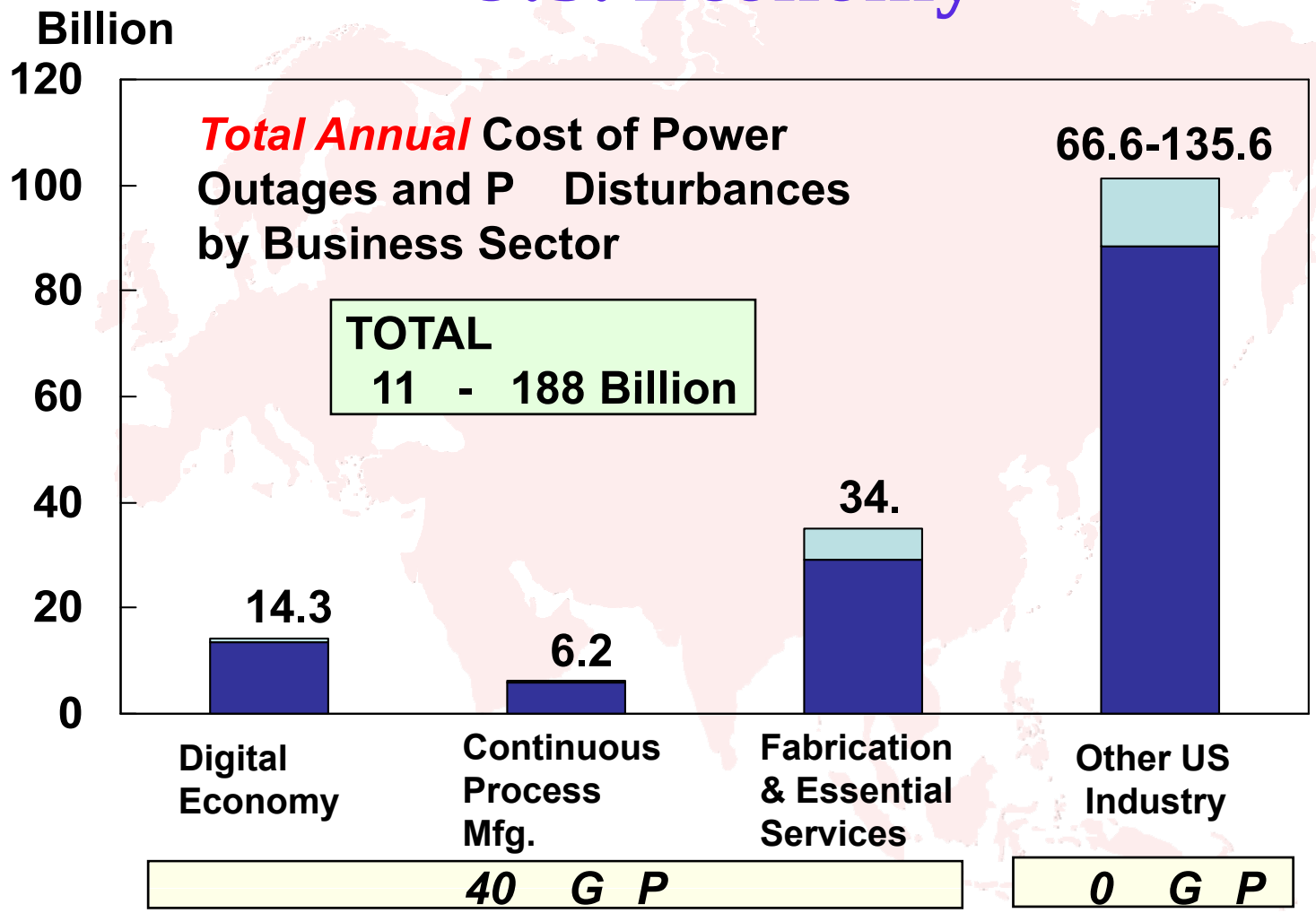
PQ Is Expensive To Industry

Estimated Annual Cost of P Problems to All Business Sectors by Region (US Billions)



Source: EPRI IntelliGrid, "The Cost of Power Disturbances to Industrial and Digital Economy Companies," Palo Alto, June 2001

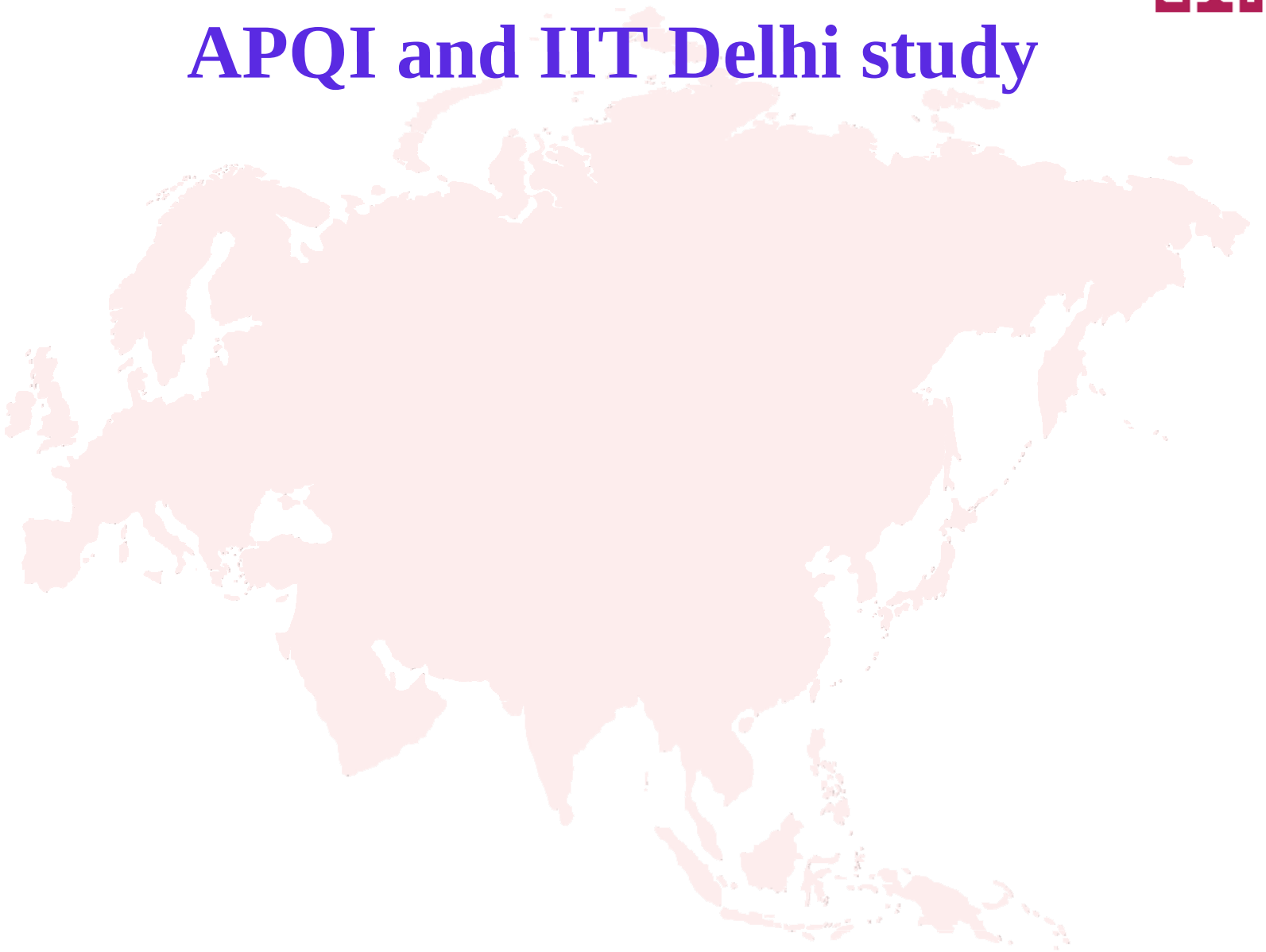
The Cost of PQ and Reliability to the U.S. Economy



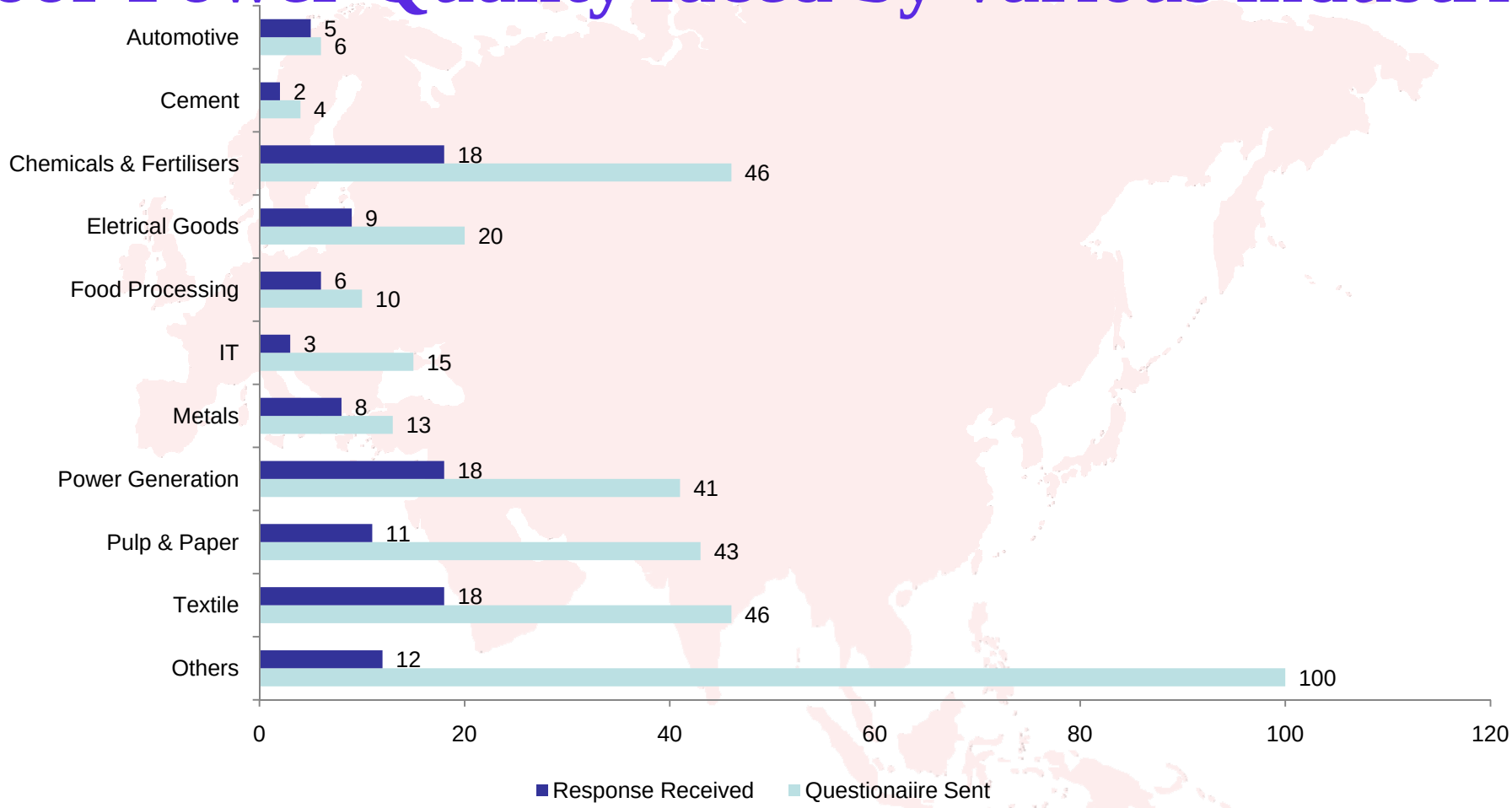
Source: Primen Study: The Cost of Power Disturbances to Industrial & Digital Economy Companies

EPRI IntelliGrid

APQI and IIT Delhi study



India Survey – To Assess Economic Impact of Poor Power Quality faced by various industries



India Survey - Problem Faced

- It is a big challenge to survey the various power quality problems that are existing in industries.
- The industries are not aware of the importance of power quality and standards, so they do not pay attention to respond to the PQ questionnaire.
- Many of the industries are not willing for PQ assessment to be done in their premises as they do not have necessary instrumentation and infrastructure
- Many of them are not interested to know about solutions to PQ problems.
- Large industry with CPP does not recognise impact of long/short interruptions

Main Power Quality Problem

	Capacitor Bank Failure	Computer Screen Free e	Loss of Data	Overheating of Motors	Flickering of Lights
Metals	✓	✓	✓	✓	
Paper & Pulp	✓	✓			✓
Electricals Goods	✓	✓		✓	✓
IT	✓	✓			
Plastic & Rubber	✓	✓			
Food processing	✓				
Power Generation	✓	✓	✓	✓	✓
Education	✓				✓
Pharma	✓	✓	✓		✓
Cement	✓	✓		✓	
Automobile	✓			✓	
Aviation	✓	✓	✓		
Services	✓	✓			
Telecom	✓			✓	
Textile		✓	✓		✓
Chemicals Fertilisers			✓		✓

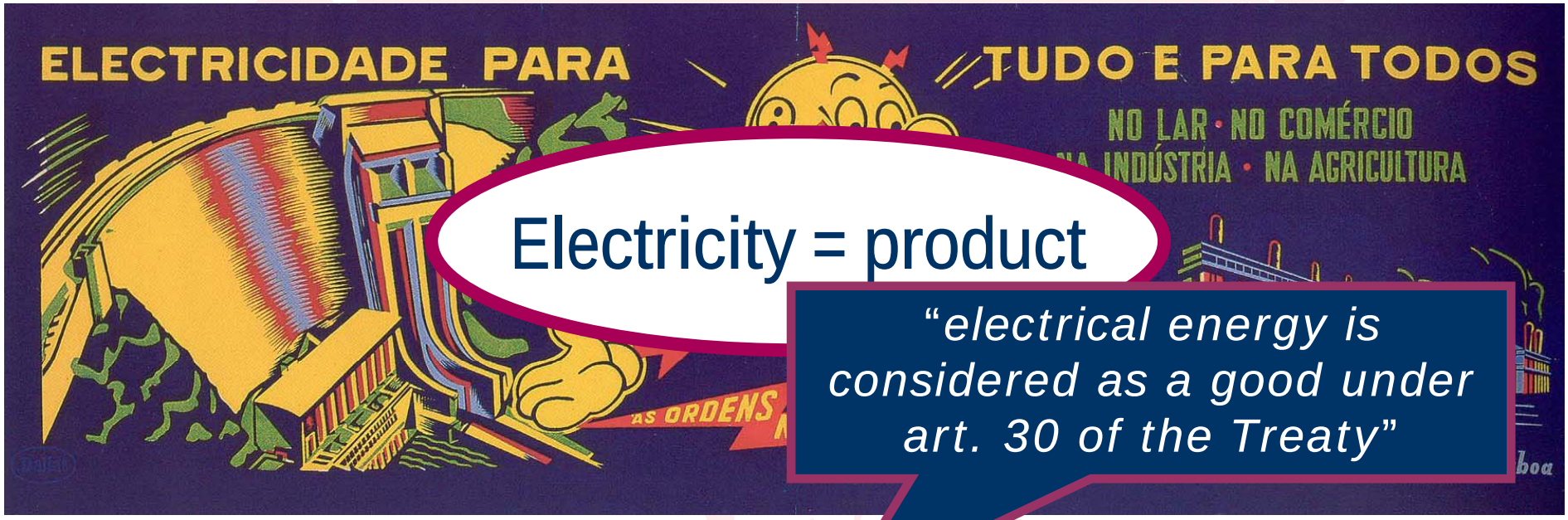
Conclusions of India Survey

- Almost all the industries suffer due to various power quality problems. Many industries are not even aware of various PQ problems like harmonics, flickers etc.
- It is a must to educate and create awareness among industries regarding power quality.
- Reliable power and Quality power shall help enhance productivity and GDP growth
- ERCs may deliberate on this issue for evolving policy decision
- National Standard body must initiate steps to introduce PQ standards for immunity of equipment /industrial products

Legal Framework in EU and India

Directive 85/374 CEE (25 July 1985)

Electrical energy – Product or essential public service



- European Court of Justice (27 april 1994)

Directive 2004/108/EC – EMC Directive

e uipment
and
fixed installations

fixed installations:

- must comply with the essential requirements
- require neither an EC Declaration of Conformity (DoC) nor CE marking

Directive 2004/108/EC – EMC Directive

e uipement
and
fixed installations

"Manufacturers of equipment intended to be connected to networks should construct such equipment in a way that prevents networks from suffering unacceptable degradation of service when used under normal operating conditions. Network operators should construct their networks in such a way that manufacturers of equipment liable to be connected to networks do not suffer a disproportionate burden in order to prevent networks from suffering an unacceptable degradation of service.

The European standardization organizations should take due account of that objective (including the cumulative effects of the relevant types of electromagnetic phenomena) when developing harmonized standards."

EA 2003 Provisions

- Suspension of Distribution License when failed to maintain quality of electricity [Section 24 (1)(a)]
- CERC to adjudicate dispute with reference to PQ in Regional Grid system between RLDC and Regional System users [Section 29(5)]
- SERCs to adjudicate dispute with reference to PQ in State Grid system between SLDC and State System users [Section 33(4)]
- District Co-ordination Committee to review the quality of power supply and consumer satisfaction [Section 166(5)(b)]

EA 2003 Provisions

- CERC to specify and enforce the standards with respect to quality, continuity and reliability of service by licensees. [Section 79(1)(i)]
- Central Advisory Committee to advise CERC on matters relating to PQ [Section 81(ii)]
- SERCs to specify and enforce the standards with respect to quality, continuity and reliability of service by licensees. [Section 86(1)(i)]
- State Advisory Committee to advise SERC on matters relating to PQ [Section 88(ii)]

EA 2003 – Electricity Act, ERC – Electricity Regulatory Commission, CEA –Central Electricity Authority, BIS – Bureau of Indian Standards

PQ Regulations

- CEA have notified PQ standards
- IEGC and State Grid Code by ERCs
- Supply Code, SOP, Distribution Code, PQ monitoring committee by ERCs
- PQ issues addressed in TO/ARR by ERCs
- Equipment standards by BIS
- Review of regulations in line with International practice

CEER

Council of European Energy Regulators

- Regulation Quality of supply:
  - Cost efficiency and quality
  - Renewables and distributed generation
- Benchmarking Reports (2001, 03, 05 and 08):
  1. commercial quality
  2. voltage quality
  3. continuity of supply

Arguments - text

The reasons for investigating the cost of poor PQ

- Building awareness of the potential magnitude of PQ costs which may largely affect the productivity of the company
- While statistics and indicative values are helpful, no two companies, even when operating in the same sector, will be equally vulnerable to PQ disturbances. Individual surveys are needed
- As PQ becomes more and more the subject of contract between a user and a supplier, the cost of PQ needs to be quantified to establish a measure of a value of improved PQ for which the user is going to pay a premium price or receive compensation if PQ is inadequate
- In case of failure caused by a PQ event for which the supplier is contractually liable, the amount of compensation will need to be determined. PQ survey will allow a prompt and accurate determination of the amount of PQ loss.
- Awareness of the cost of PQ will help to minimise it. Once the PQ cost is known many small and simple incremental improvements are easily justified and possible.
- Finally PQ cost knowledge is a tool for regulators to set incentives for suppliers. The benefit should retain for the whole society

Power Quality; reasons to address

- Energy sector undergoes market transformation. The liberalization of electricity market has brought a risk that quality of electricity supply may deteriorate. Electricity regulators have a role to guard this quality.
- People in private life but also economy rely on continuous supply of electricity. More renewables or severe weather increase a risk of power blackout. Once the continuous supply is in place there is a concern about quality of this supply. End user equipment has certain immunity to voltage disturbances. This immunity and the performance of supply should create an overlap referred to as compatibility.
- The immunity of equipment can be increased as well. The crucial role here would be to define precisely the level of quality which will separate the responsibility. This concept is known as responsibility sharing. The increase in level of detail in IEC 61000 series standard or EN 50160 standard helps.
- When the responsibility for end user power quality problems lays a charge on suppliers, the crucial thing will be to solve the equation of how much investment is needed to compensate PQ cost to society. Technical measures are available but the knowledge on level of PQ impact is not satisfatory to move to the optimum societal cost balance point.

P Issues need to figure in the Forum of Regulators platform for future deliberation

Some conclusions

- A lot of activities - Good way
- Lack of harmonisation
- Balance between costs and benefits
- Need of data
- Smart meters

Power Quality Parameters to be Monitored

- Voltage sags and swells
- Voltage unbalance
- Frequency deviations
- Voltage harmonics and sub-harmonics
- Current harmonics
- Flickers and fluctuations
- Power factor

Suggestions

- FOR may constitute a working group/task force on PQ to address related issues.
  - Cost of Poor PQ
  - Benchmarking of PQ regulations at various States
- DISCOMs may be insisted to display PQ performance data in public domain.
- Utility may have to identify polluting consumers by providing monitoring equipments and Harmonic mitigation effort by such consumers have to be monitored
- PQ issues may be specifically addressed in ARR of Licensees by SERCs

Thank You