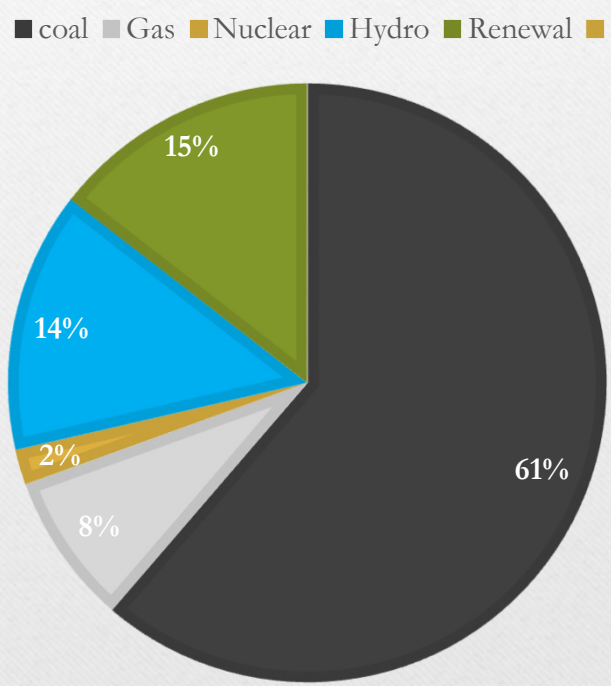
Updates and Future Directions of Indian Power Sector

Rajeev Kumar
Director, TPRM Division
Central Electricity Authority

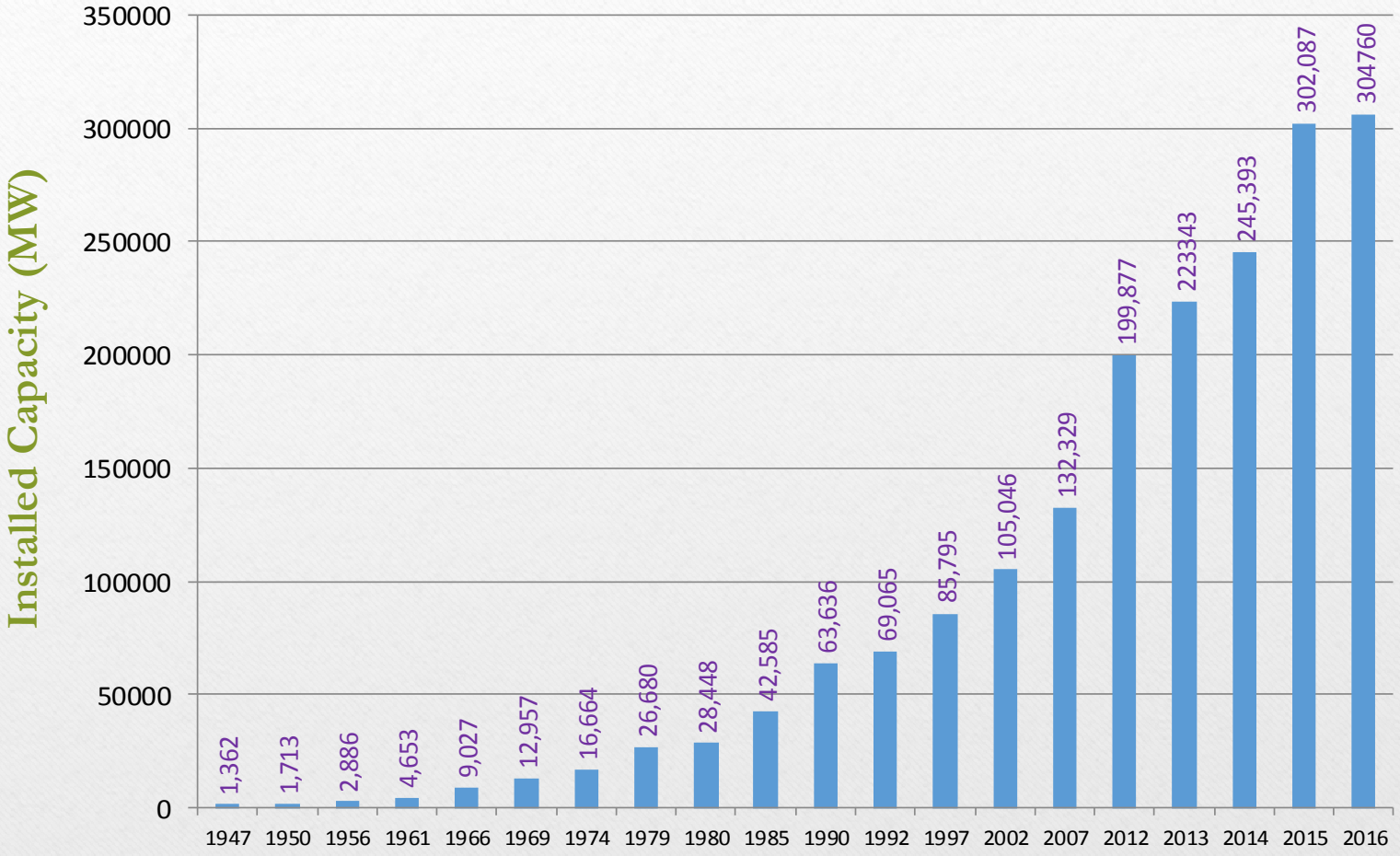
Installed Capacity (in MW) as on 30.09.2016

Type	Installed Capacity(MW)
Coal	187252.88
Gas	25057.13
Diesel	918.89
Nuclear	5780.00
Hydro	43112.43
Renewable	44236.92
Total	**306358.25**



Total Installed Capacity 306358.25 MW

Growth of Installed Capacity



Power Supply Position in India September 2016

Energy(MU)

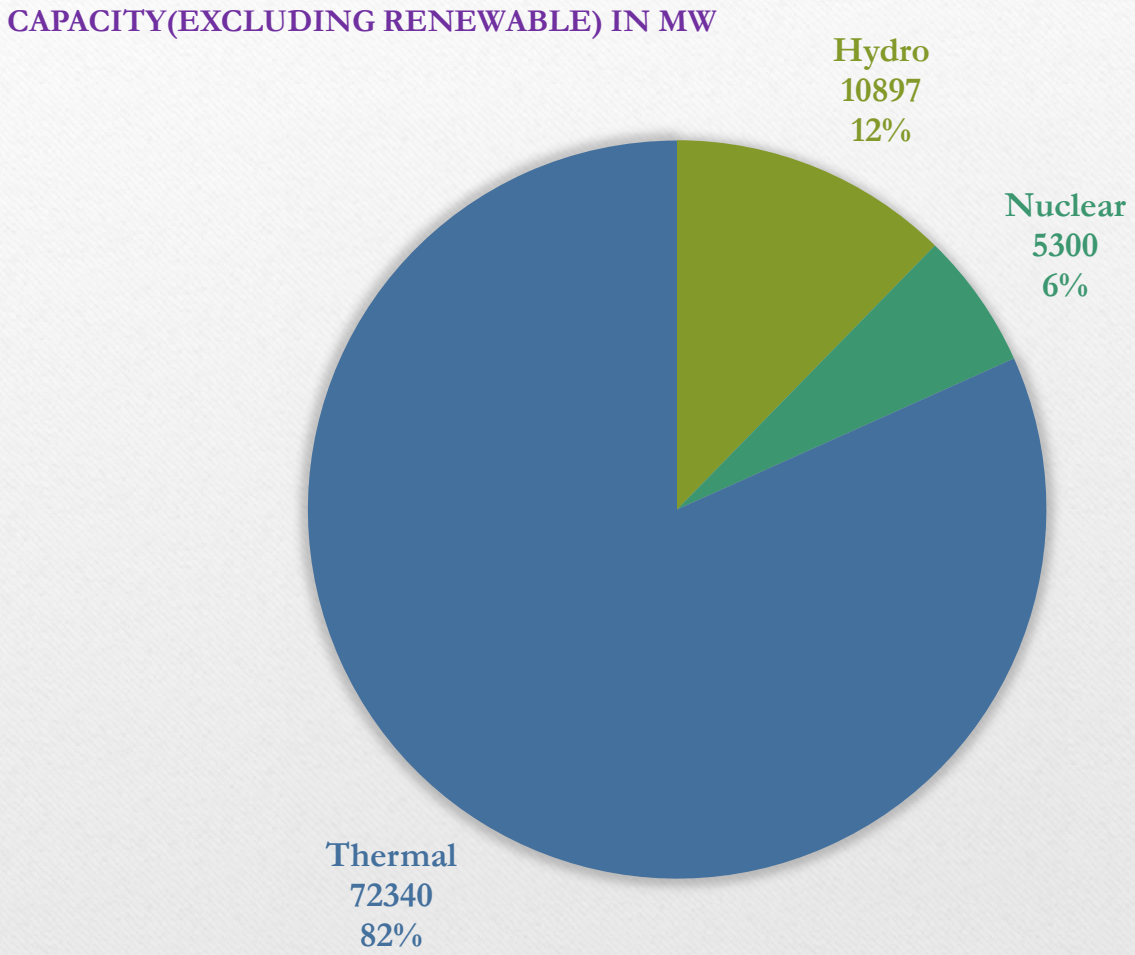
	Requirement	Availability	Deficit(MU)	Deficit (%)
Northern Region	33300	32646	-654	-2
Western Region	28683	28679	-4	0.0
Southern Region	24689	24686	-3	0.0
Eastern Region	10976	10964	-12	-0.1
North-Eastern Region	1373	1336	-37	-2.7
All India	99021	98310	-711	-0.7

Power Supply Position in India September 2016

Peak(MW)

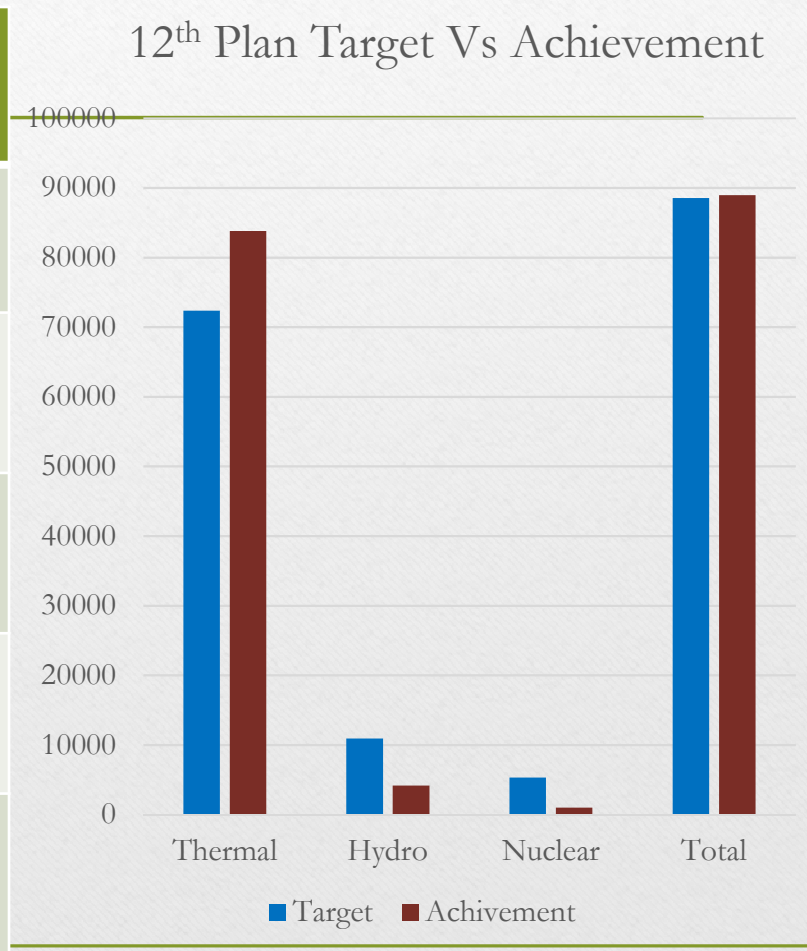
	Requirement	Availability	Deficit(MW)	Deficit (%)
Northern Region	52772	51816	-956	-1.8
Western Region	46100	46000	-100	-0.2
Southern Region	40654	40592	-61	-0.2
Eastern Region	18227	18210	-17	-0.1
North-Eastern Region	2430	2373	-57	-2.3
All India	159243	158059	-1185	-0.7

Capacity Addition Plan during 12th(2012-17) Plan



Capacity Addition Target Vs Achievements in the 12th Plan

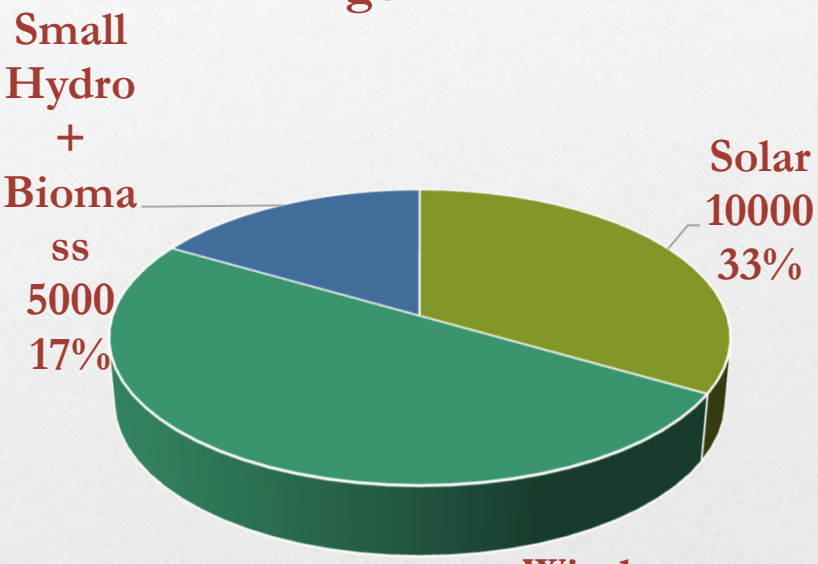
	Target	Achievement	
Type		Figure in MW	%
Thermal	72340	83788.20	115.5
Hydro	10897	4140.02	78
Nuclear	5300	1000	18.8
Total	88537	88928.22	100.44



Renewable Capacity Addition During 12th Plan

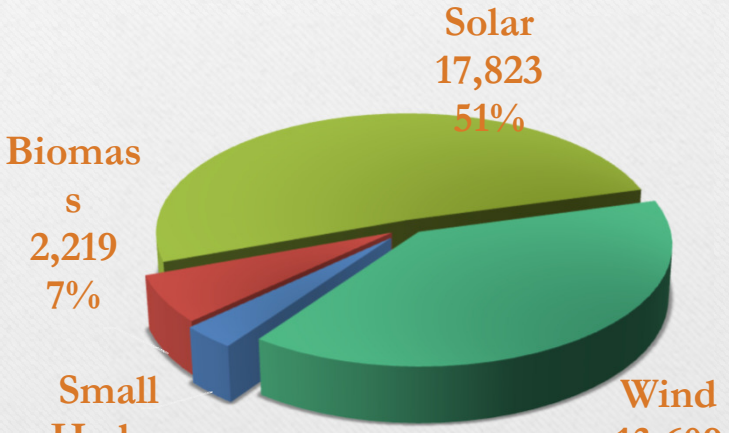
FIGURES in MW

Target



TOTAL : 30,000

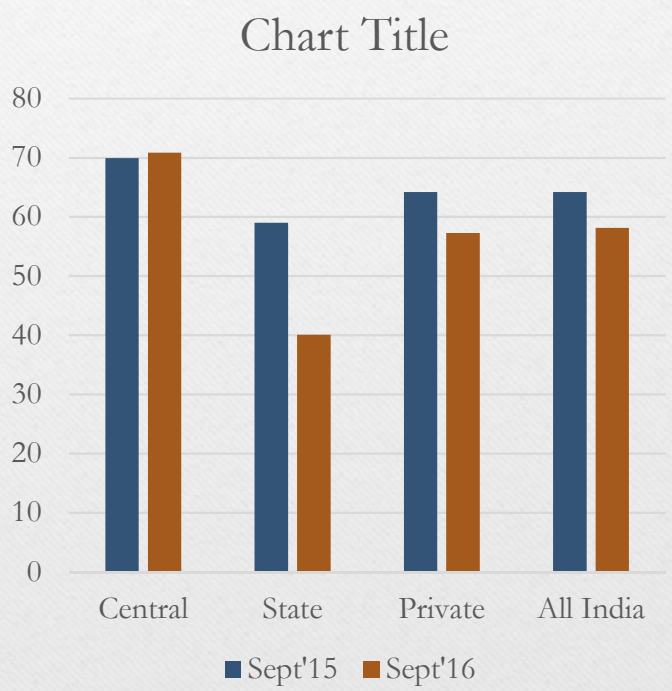
LIKELY CAPACITY ADDITION



TOTAL : 34,755

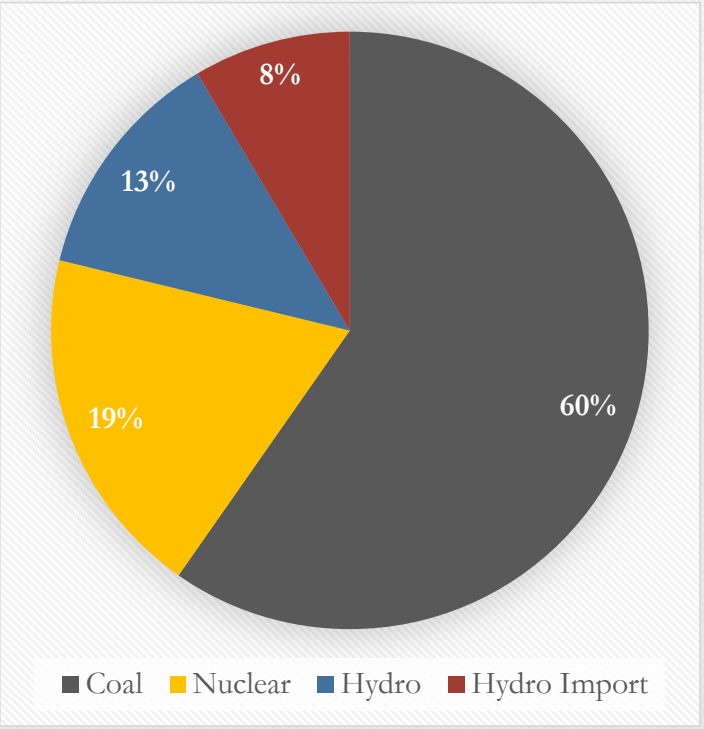
All India PLF Sector-wise for Sept., 2016

	% PLF	
Sector	Sept'2015	Sept'2016
Central	69.92	70.85
State	58.99	40.09
Private	64.21	57.29
All India	64.18	58.13



Capacity Addition(in MW) Plan during 13th Plan (2017-22) (tentative)

Type	Capacity in MW
Coal	56400
Nuclear	18000
Hydro	12000
Hydro Import	8040
Total	86400



Coal Fired Units – Sizes, Efficiency & Share

Unit Size (MW)	Steam Parameters	Design Efficiency (%)	Share in capacity (%)
<100	60/ 482, 90/ 535	~31	5%
100 to150	130/ 535/535	35-36	9%
200/210	130,150/535/535	36.3,37.8	26%
250	150/535/535	38.3	9%
300-350	170/ 538/538	38.5	6%
500	170/ 538/538 (565)	38.5 (38.7)	27%
600	170/ 538/538	38.5	8%
660/700/800	247/565/593	40.5	10%
		Total	100%

Efficiency - Gross efficiency based on HHV

Age Profile of Potential Thermal Units for R&M/Retirement/Replacement (as on March-2016)

Capacity Range (in MW)	> 15 years but <20 years	>20 years but < 30 years	> 30 years	Total
200/210 LMZ	1	25	40	66
200/210 KWU	24	52	9	85
250	7	-	-	7
500	5	16	-	21
TOTAL	37	93	49	169

Supercritical Unit Sizes

Unit Size (MW)	Parameters	Design Efficiency * Gross on HHV
660	247kg/cm^2 538/565 ^{O}C	39.5 %
	247kg/cm^2 565/593 ^{O}C	40.5 %
700/ 800	247kg/cm^2 565/593 ^{O}C	40.5 %

Expected Efficiency Gain of ~ 5% over sub- critical 500 MW Units (170 kg/cm^2 535/535 ^{o}C)

Supercritical Units Commissioned as on September 2016

Unit Size (MW)	No. of units	Total Capacity (MW)
660	40	26400
685/700	2/3	3470
800	8	6400
Total:	53	36270

First Supercritical unit of 660 MW Commissioned in Dec-2010

Supercritical Units Under Construction as on Sep-2016

Unit Size (MW)	No. of Units	Total Capacity (MW)
660	51	33660
800	19	15200
Total:	70	48860

INDIA AIMING EMISSION REDUCTION IN POWER SECTOR

In continuing efforts to safeguard the environment and reduce emissions from power sector, India has made the following commitments in COP 21:

- India intends to reduce the emissions intensity of its GDP by 33 to 35 % by 2030 from 2005 level.
- To achieve about **40 percent cumulative electric power installed** capacity from **non-fossil fuel based energy resources** by **2030** with the help of transfer of technology and low cost international finance.
- Introducing new, more efficient and cleaner technologies in thermal power generation
- Further, to reduce emissions from Thermal Power Stations, Ministry of Environment, Forest and Climate Change has also issued new environmental norms in December 2015 regarding Suspended Particulate matter (SPM), SOx, NOx, Mercury. Norms for specific water consumption by Thermal Power Stations have also been notified to conserve water.
- The present installed capacity of coal based thermal power plants is 1,87,252 MW as on 30.09.2016 and around 70000 MW is under construction. The impact of the environmental norms on thermal power generation is under study

Govt's Thrust Areas

- Solar Mission
- Rural Electrification
- Distribution reform

Solar Mission

- Government of India revised target of Jawaharlal Nehru National Solar Mission (JNNSM) to generate 100,000 MW by 2022 — five times the previous target.

- The target will comprise 40 GW power generated through rooftop units and 60 GW through large and medium scale grid connected solar power projects.

- JNNSM was launched in 2009 with a target for grid connected solar projects of 20,000 Mw by 2022.

- The total investment in setting up projects with capacity of 100 GW will be around Rs 6 lakh crore

- The new Solar target of 100 GW is expected to abate over 170 million tonnes of co2 over its life cycle.

Road Ahead for Thermal Generation Planning

- With 50,025 MW of coal based capacity expected between 2017-22 along with the committed capacity of 22,470 MW from Hydro, Nuclear and Gas, there may not be any further requirement of additional capacity during 2017-22.Further,for 2022-27, capacity addition requirement will be assessed based on Mid term Review of Demand.

- The Plant load factor of the coal based power plants may vary between 50% to 60% depending upon variation in Electricity Demand and achievement in capacity addition from conventional and Renewable Energy Sources.

- Total coal requirement may be around 730-800 MT in 2021-22

Road Ahead for Thermal Generation Planning contd

- Renewable Energy Sources to contribute around 20% of the Total Energy Requirement by 2021-22.
- Share of Non-fossil fuel installed capacity to increase to 47% by March,2022.
- Coal power plants need to have enhanced ramping capability
- Minimum technical limit for Coal power plants may have to be revised downward.
- Gas and Hydro Power Plants need to play a major role in meeting the ramping & balancing requirement

CEA-JCOAL Co-Operation

MoU between CEA and JCOAL

1st MOU between CEA and JCOAL for Pre-Prinary Study for Efficiency and Environment Improvement of Coal Fired Power Plants was signed on 30.4.2010.

The 2nd MoU between CEA and JCOAL was signed on 11.06.2012 for carrying out detail diagnostic study for energy efficiency oriented R&M activities in thermal power units.

The 3rd MoU between CEA and JCOAL on Japan - India Cooperation for Project on Efficiency and Environmental Improvement for Sustainable, Stable and Low-carbon Supply of Electricity has been signed on 22.01.2016.

Highlights of the MoU Works

- Joint identification of relevant issues such as condition based monitoring (predictive/risk based maintenance) of USC/SC units.
- Study on adoption of available technologies to meet new environment standards and the economic viability of using such technologies in existing plants on Indian coal. The study in progress.
- Study to explore the feasibility of replacement of old inefficient small size units by new units based SC/USC technologies atleast at one site.
- Conductance of RLA and CA studies by JCOAL in One (1) 210 MW coal based unit of thermal power station and submission of report.
- Consideration of financial viability and provide advice and support for the concerned utility to utilize finance schemes for implementation
- Jointly organize and conduct CCT Transfer Program in Japan.
- Jointly organize and conduct an annual workshop in India.

Achievement Under 3rd Phase MoU

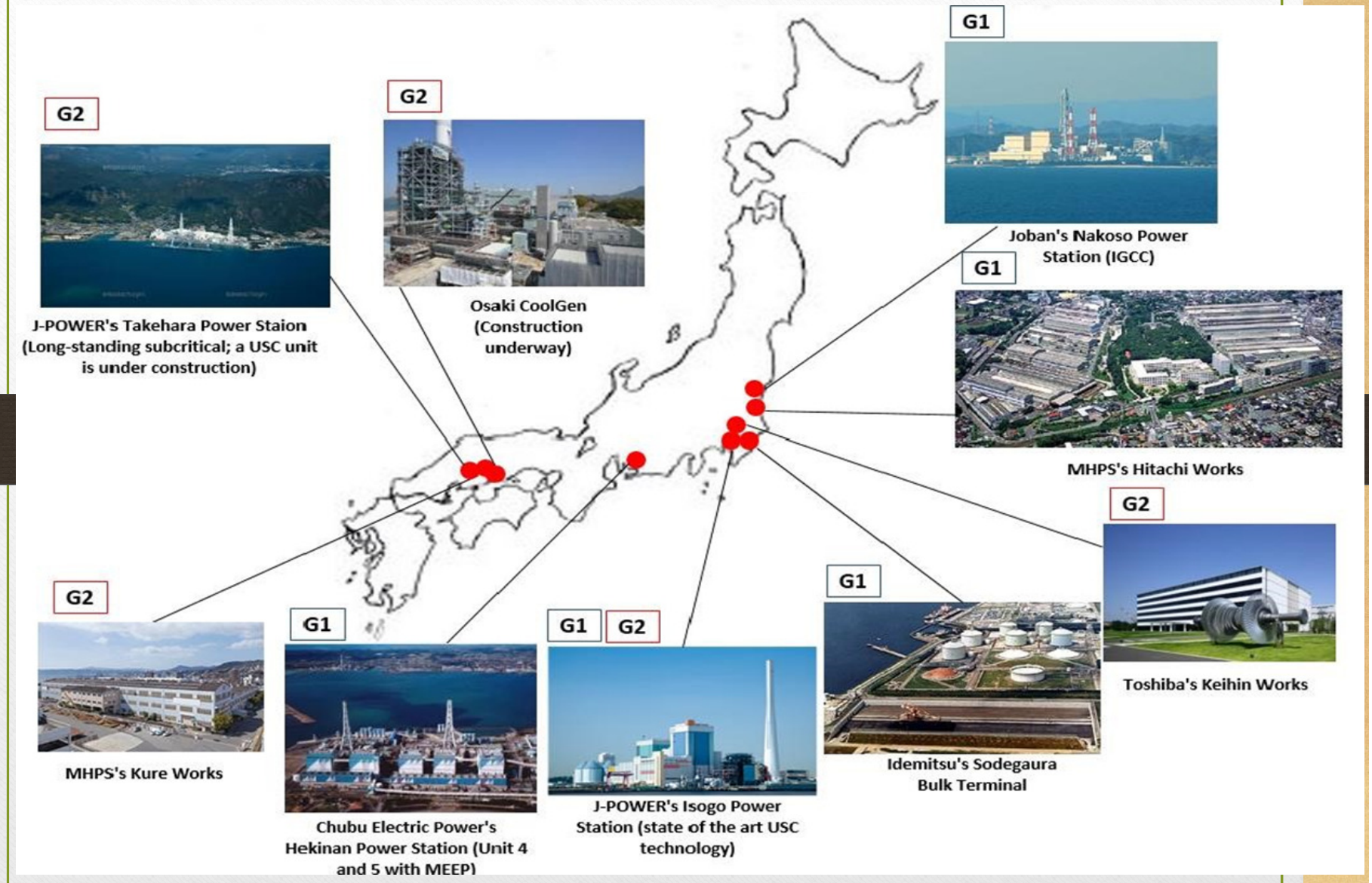
- Under CEA- JCOAL Co-operation a study on replacement of old units of Badarpur TPS by highly efficient super critical units of higher size has been carried out.
- JCOAL has carried out RLA/CA diagnostic study at Unit-3 of Dadri TPS of NTPC
- Under Clean Coal Technology (CCT) Programme three study tours to Japan have been organised in which participants from different power utilities participated in the study tour
- Under CEA- JCOAL Co-operation a study is being carried out by JCOAL on adoption of available technologies to meet new environment standards and the economic viability of using such technologies in existing power plants.

Major Benefits of CCT Program

- Exposure to the best practices in R&M of old Thermal Power Plants
- Exposure to the Ultra Supercritical Technology for Thermal Power Generating Units
- Exposure to Japanese experience in replacement old inefficient thermal generating units by SC/USC units
- Technology up gradation for Compliance of Environmental norms
- Experience sharing in O&M of Supercritical Units
- Visit to selected TPS in Japan viz. Isogo, Henikan
- Exposure to manufacturing facility for power plant equipments

Schedule of CCT Program

- Group 1: Course for Senior Engineers and Managers Entire period: From October 19 to 27, 2016 Period of stay in Japan: October 20 to 27 (morning), 2016
- Group 2: Course for Senior Engineers and Managers Entire period: From January 11 to 19, 2017 Period of stay in Japan: From January 12 to 19 (morning), 2016


G2
J-POWER's Takehara Power Staion (Long-standing subcritical; a USC unit is under construction)
G2
Osaki CoolGen (Construction underway)
G1
Joban's Nakoso Power Station (IGCC)
G1
MHPS's Hitachi Works
G2
Toshiba's Keihin Works
G1
Idemitsu's Sodegaura Bulk Terminal
G1 G2
J-POWER's Isogo Power Station (state of the art USC technology)
G1
Chubu Electric Power's Hekinan Power Station (Unit 4 and 5 with MEEP)
G2
MHPS's Kure Works

Thank you For the attention

नमस्कार