



Solar Energy in India – Current Trends

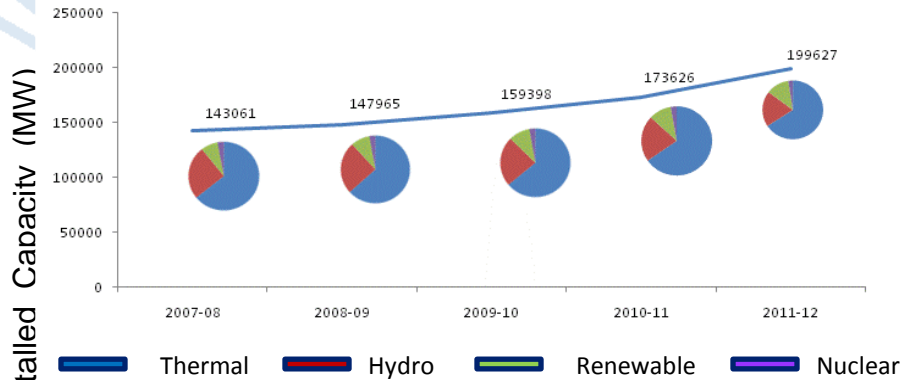
Anish De

September 20, 2012



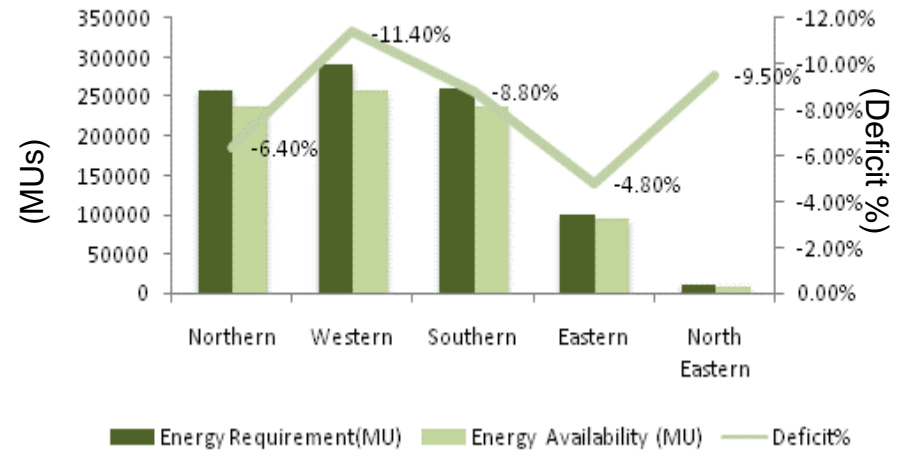
Current Installed Capacity and Power Supply Position

All India Installed Capacity (as of 31st March 2012): Technology Break Up

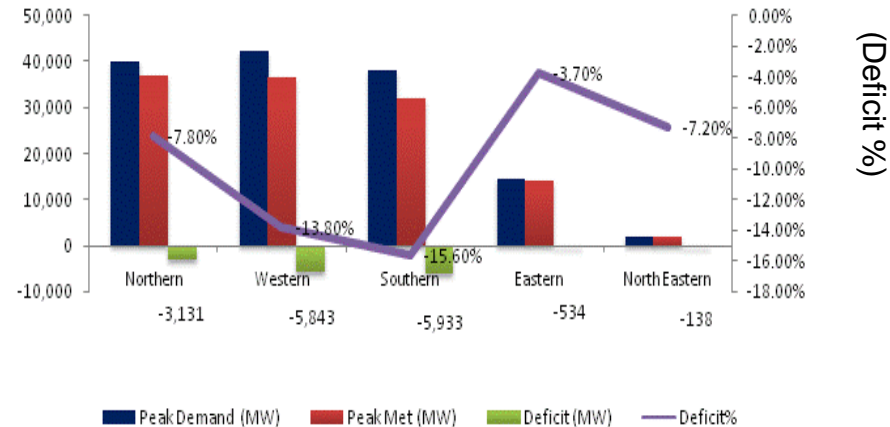


- The current capacity stands at around 200 GW
- Generation mix continues to be following a flat trend for the past four years with coal being the dominant source
- Coal accounts for about 56%, Hydro around 20%, and Gas around 9% of the total installed capacity
- Share of renewables have increased over the past, from 2% in 2003-04 to 6% in 2006-07 and now to 12% in 2011-12

Energy Deficit 2011-12



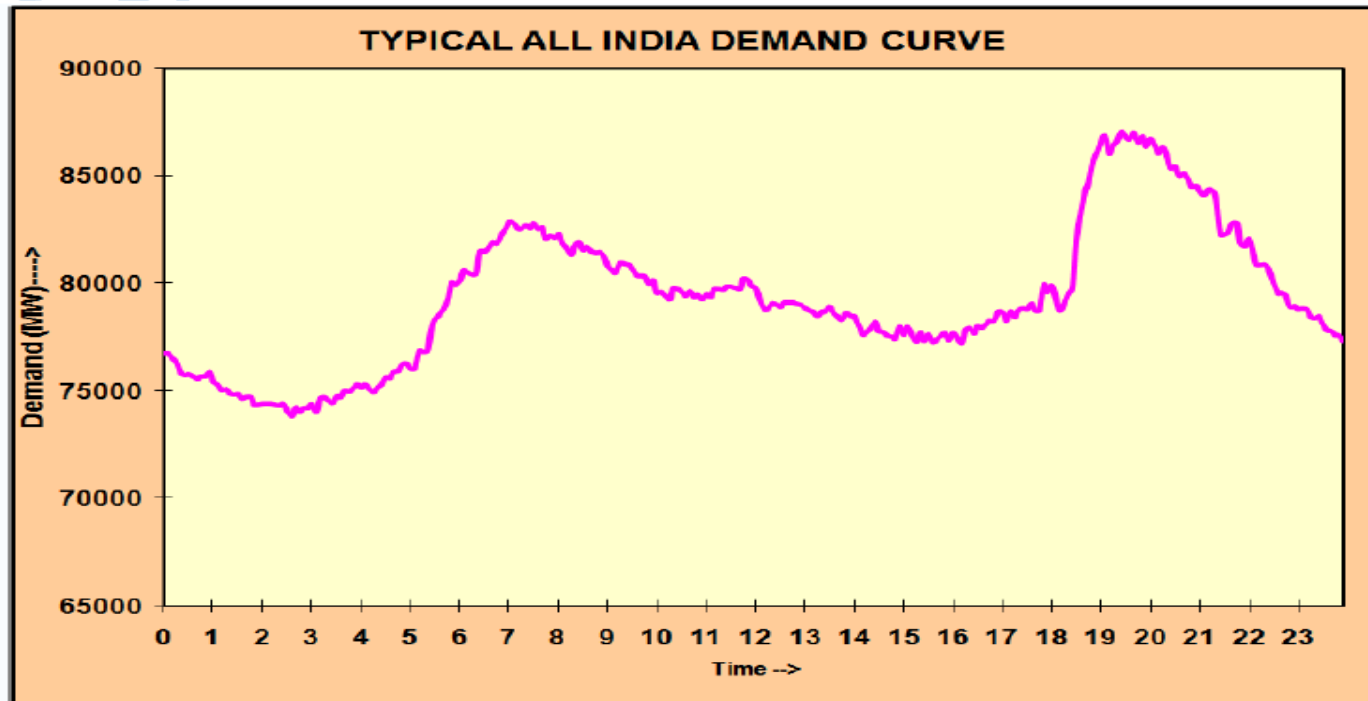
Peak Deficit 2011-12



- The country is in an overall deficit.
- North Eastern, Western, and Southern region experience larger regional imbalances.



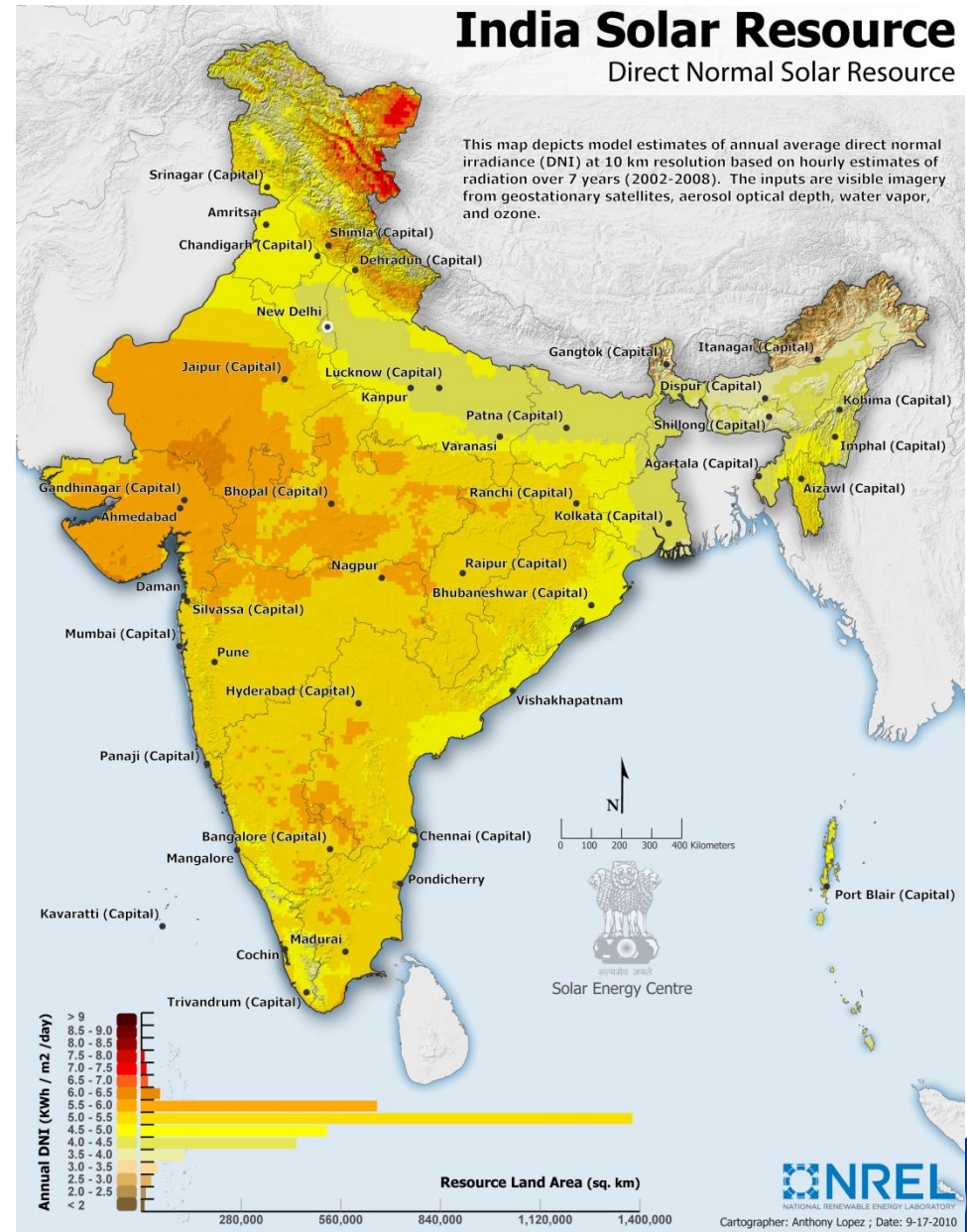
Peaking Profile Observed in the Power System, FY 2010



- The average peak load in the country is derived from aggregation of the daily load profiles. As the above chart indicates the profile is relatively flat with a sharp evening peak and a lower but extended morning peak
- There are significant seasonal variations between profiles
- As supply situation eases there is a possibility of more “peaky” demand profiles. However the utility response to high prices tends to reduce the peak demand served by the utilities. Load shaving between 10000 – 16000 MW is observed in the system, as per NLDC data

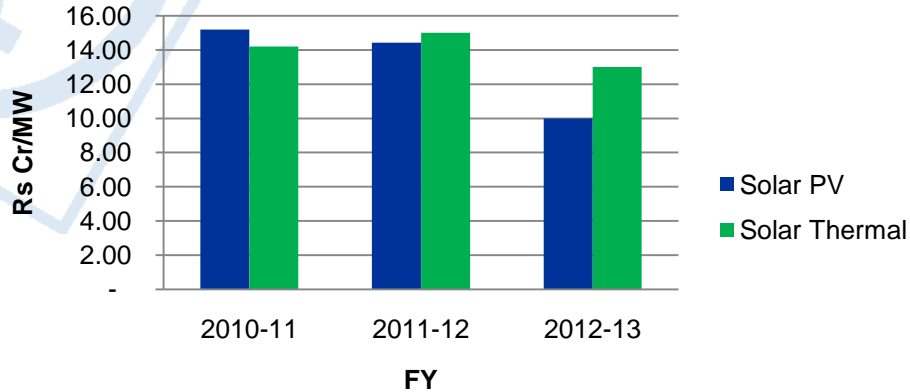
Harnessing India's vast Solar Potential

- Among the various renewable energy resources, **solar energy potential is the highest in the country.**
- The **equivalent energy potential is about 6,000 million GWh of energy per year.** As compared to this, the present level of generation of electricity in 2008-09 from all resources was 0.7 million GWh.
- The states that have **the maximum insolation are Rajasthan and Gujarat.** In addition, the states of Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Maharashtra and Chattisgarh also enjoy good insolation levels.
- Most of these states are in regions where the unmet electricity demand as well as the growth in demand for electricity is high**



Solar PV & Solar Thermal Cost & Tariff - Benchmark

Cost of solar PV & Solar Thermal

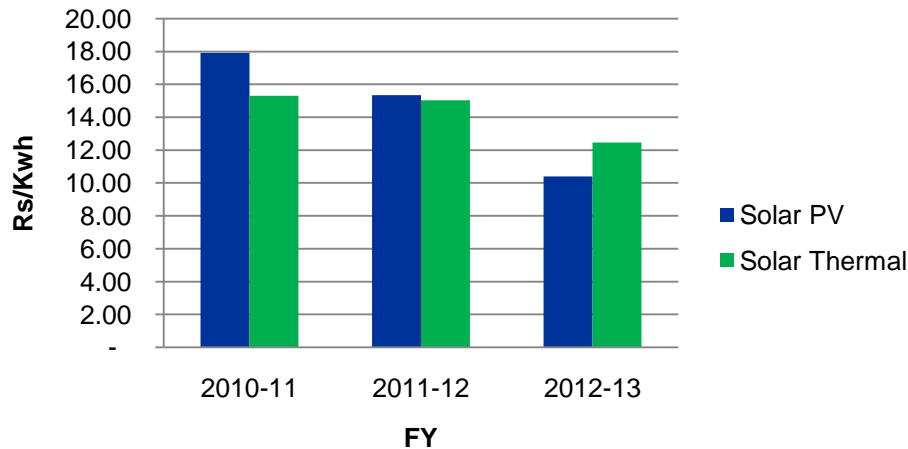


Rs Cr/MW	2010-11	2011-12	2012-13
Solar PV	15.20	14.42	10.00
Solar Thermal	14.20	15.00	13.00

Benchmark Cost & Tariffs

This has resulted in reduction in benchmark tariffs as shown below:

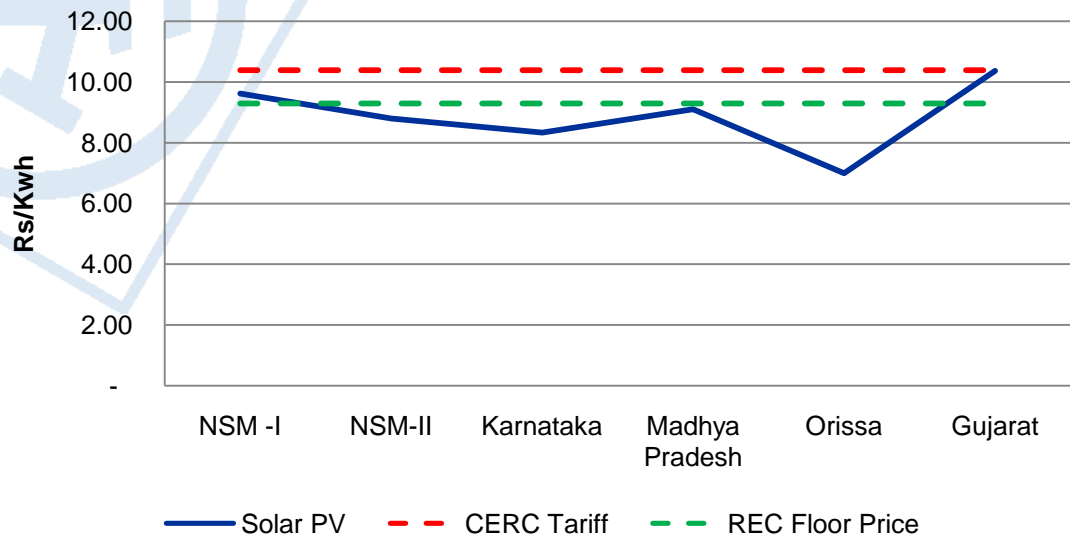
Solar Tariff



Rs/Kwh	2010-11	2011-12	2012-13
Solar PV	17.91	15.34	10.39
Solar Thermal	15.31	15.04	12.46



Solar PV & Solar Thermal Tariff - Bidding



Introduction of competitive bidding has brought down tariffs significantly, much below CERC benchmark tariffs and also lesser than Solar REC Floor price

	NSM –I Part 1	NSM-I Part 2	Karnataka	Madhya Pradesh	Orissa	Gujarat
Solar Thermal	11.27	-	11.13	-	-	12.91
Solar PV	9.62	8.80	8.34	9.10	7.00	10.37
CERC Tariff	10.39	10.39	10.39	10.39	10.39	10.39
REC Floor Price	9.30	9.30	9.30	9.30	9.30	9.30

State FIT

Av. Bid Tariff



Key Aspects for Discussion in the Workshop

- Solar power business models. What is the right policy framework for business model innovation?
- Solar power prices - Can we anticipate further price reductions? What are the appropriate price discovery mechanisms?
- Regulatory issues in solar RPO implementation – how can the market creation mechanism be provided with more certainty
- State policies – how have they performed? What is the future direction?
- REC Trading – does the mechanism need significant changes?
- Financing of Solar Projects - How to reduce the costs of finance?
- Solar technology Trends – What are the potential breakthroughs? How should they be encouraged?





The aim of the sessions to follow is to have
a structured dialogue on the issues





Solar Business Models



Current solar power business models

Solar Radiation



Solar Power Plant

Electricity Generation



Sale to Utility



NVVN

Bundled Power



Utility/Consumer

Sale through state policy or REC route



(I) FIT + GBI (PPA) (II) APPC+ REC (non-PPA)
(iii) Bid (iv) Captive

Merchant Sale



Px/Traders

Market Price + REC



Solar Resource Assessment

Solar Power Generation

Price Forecasting

Market Price

REC Price

Average Pooled Power Cost

Business Portfolio Optimization



National Solar Mission: Objectives and Targets

■ Mission Targets

- To create enabling policy framework for deployment of **20,000 MW of solar power by 2022.**
- To ramp up capacity of grid connected solar power to **1,000 MW by 2013** and additional capacity of **3,000 MW by 2017.**
- To create favourable conditions for developing **Solar manufacturing capability** in the country.
- To promote deployment of **20 Million solar lights by 2022.**

Application	Phase I (2010-13)	Phase II (2013-17)	Phase III (2017-22)
Utility grid power, including roof top	1,100 MW	4,000-10,000 MW	20,000 MW
Off Grid Solar Applications	200MW	1000MW	2000MW
Solar Collectors	7 million sqm	15 million sqm	20 million sqm



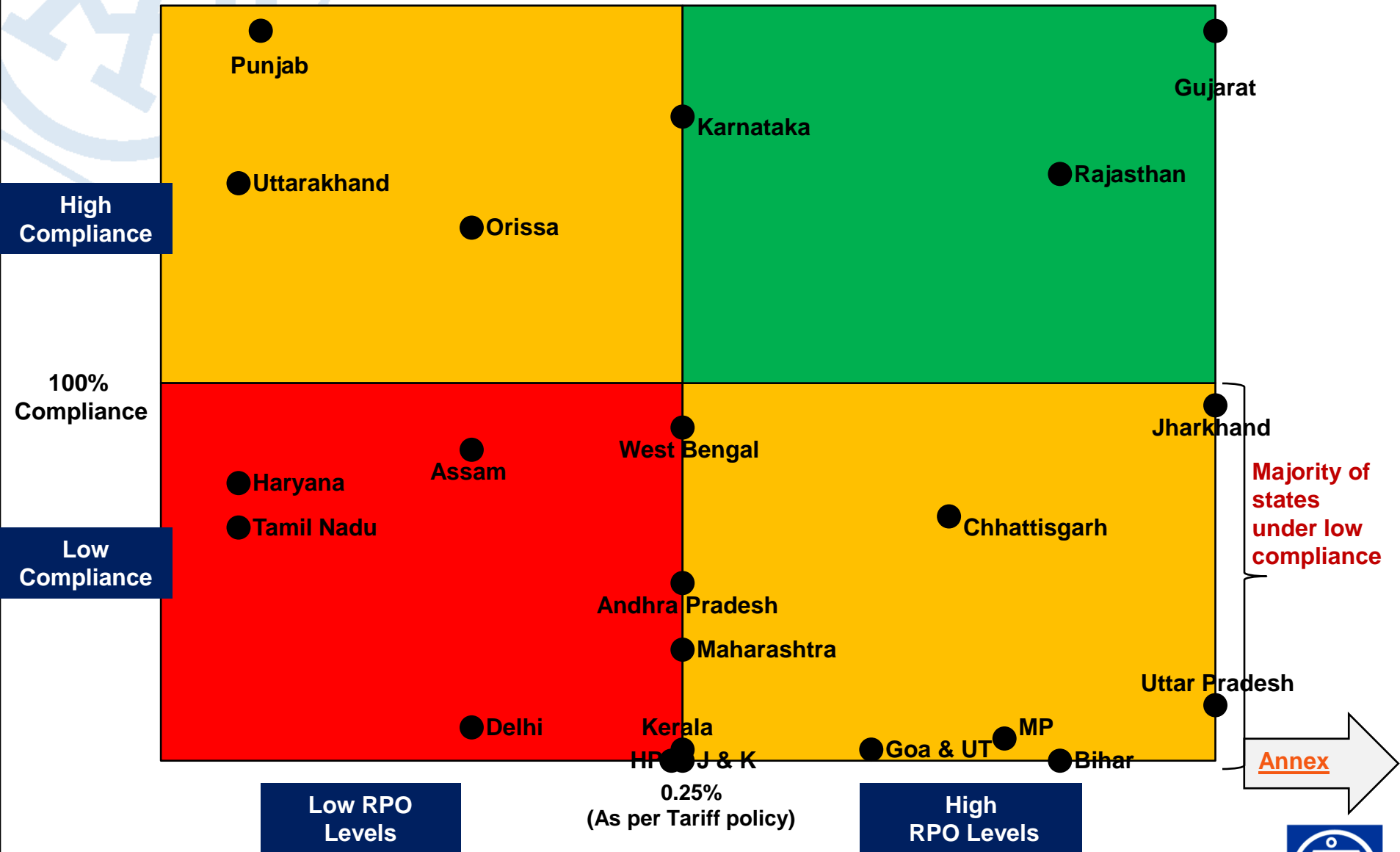
Current state-wise RPO targets

State	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
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%	0.50%	0.75%	1%	2%	3%
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%	0.25%	0.25%	0.25%	0.25%	0.25%
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



Majority of states under low compliance



Captive Compliance Requirement

Company Name	Captive Power Capacity (MW)	Solar Capacity Required for solar RPO compliance (MW) in 2012-13
J.K. Lakshmi Cement Ltd.	93.00	3.00
Indian Petrochemical Company Ltd.	257.00	3.40
Bharat Petroleum Corporation Ltd.	189.00	4.00
Wardha Power Company Ltd.	405.00	4.20
Ultratech Cement Ltd.	129.00	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
Gujarat Alkalies and Chemicals Ltd.	247.00	8.70
Ambuja Cement Ltd.	290.00	10.00
Steel Authority of India(SAIL)	578.00	12.00
Bokaro Power Supply Company Pvt. Ltd.	302.00	12.50
Bajaj 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.	2089.00	81.00
	Total	379.06



Comparison of Regulations – Few select states

State	Regulations
Punjab	<p>Provided that on being so approached, the Commission may review the fulfillment of the renewable purchase obligation by the obligated entity, keeping in view its performance and allow the shortfall to be carried forward to the next year in addition to the renewable purchase obligation for that year. At the end of 3 years period, the Commission may, if deemed appropriate, review the fulfillment of renewable purchase obligation by the obligated entity and pass suitable order(s)</p> <p><i>(Source: PSERC, Notification No. PSERC/Secy./Reg/55, 3rd June 2011)</i></p>
Jharkhand	<p>From next year onwards the Commission will endeavor not to interchange the obligation of Solar vs. Non-solar RPO. This year the Commission has considered the interchange and allowed it because of non-availability of Solar Power.</p> <p><i>(Source: TSL Tariff Order for FY 2012-13, JERC, June 2012)</i></p>
West Bengal	<p>Energy from cogeneration and renewable sources generated within the State and used for captive purposes within the State shall be taken into account for computing the achievement of purchase target of a licensee in whose licensed area such captive use of energy from cogeneration or renewable sources is made provided the licensee submits the necessary details of such use to the Commission each year.</p> <p><i>(Source: WBERC, Notification No. 47/WBERC, 10th August 2010)</i></p>
Haryana	<p>Every obligated entity including distribution licensee, consumers owning captive power plant and long term open access consumers in Haryana shall purchase from renewable energy sources under the RPO not less than 2% for the FY 2012-13 and 3% for FY 2013-14.</p> <p>Solar RPO shall be 0.25% of the overall RPO (~0.05%) as specified under sub regulation (1) above with an annual of 0.25%</p> <p><i>(Source: HERC Regulation No. HERC/23/2010, Notification 3rd Feb 2011)</i></p>



Key Challenges Foreseen

- Adequacy of DNI for certain applications
- Inadequacy of data on insolation – current data is imperfect and inadequate to support project development (particularly for Solar Thermal)
- High equipment and development costs
- No strict enforcement of compliance
- Evolution of a more robust (including a voluntary) market for RECs
- High cost of finance
- Resource concentration in few states – market access
- Transmission access and costs
- Grid Integration





Thank You





Annexure



State solar Compliance FY 2012-13



State	Projected Demand (MU)	Solar RPO Target (2012-13)	Solar RPO Target (2012-13)	Capacity required for meeting Solar RPO	Total Capacity Tied Up as on 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	29.21
Gujarat	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	12.99
Jammu & Kashmir	14,573	0.25%	36.43	21.9	0	21.89
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
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%	²¹ 104.74	62.9	52.05	10.88
			Total	2,352.4	1,956.06	396.35



Thank You





Annexure

