PRICES IN ELECTRICITY MARKETS

Power Markets and Trade in South Asia: Opportunities for Nepal

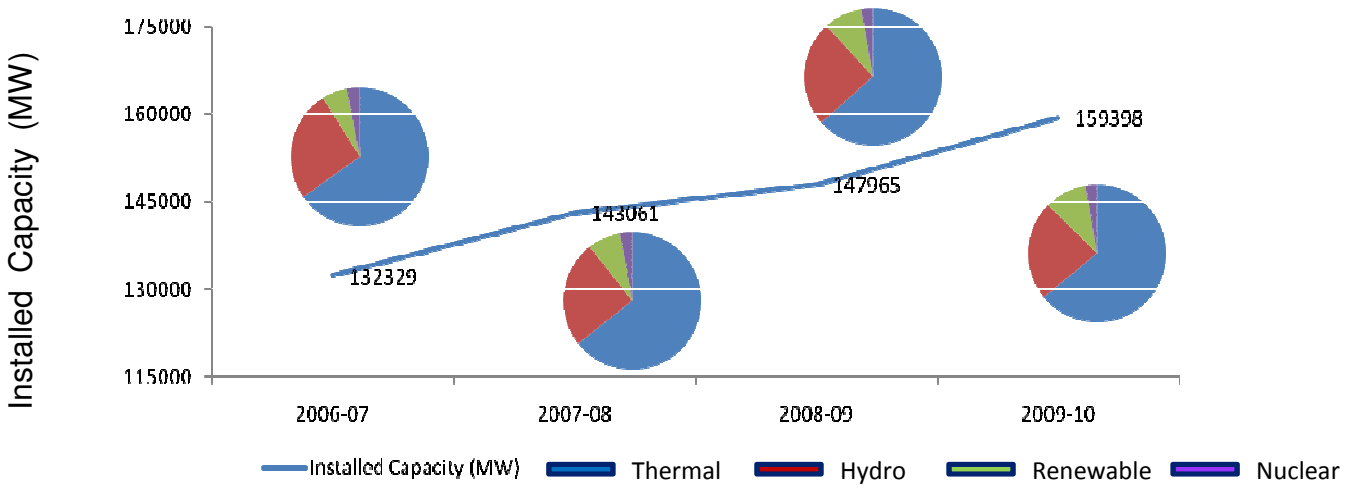
February 14-15, 2011

INDIA DEMAND/SUPPLY SCENARIO

Installed Capacity- Technology Break Up

Total Installed Capacity (MW) *As of December, 2010*

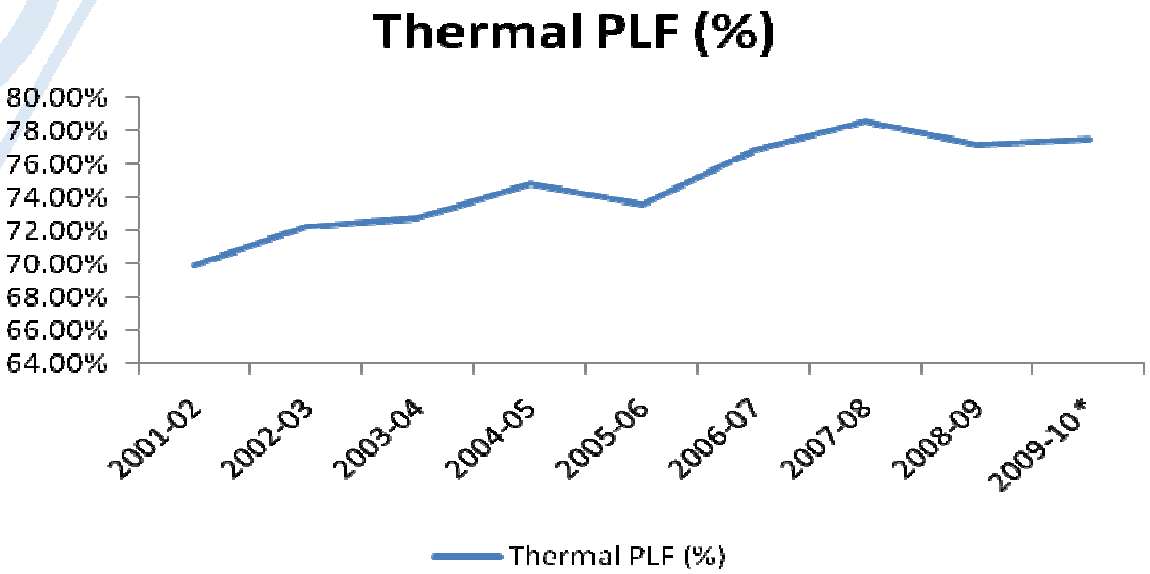
Region	Thermal (MW)				Nuclear (MW)	Hydro (MW)	Renewable (MW)	Total (MW)
	COAL	GAS	DSL	TOTAL				
Northern	23620	3885	13	27518	1620	13623	2777	45538
Western	31080	7904	17	39001	1840	7448	4918	53207
Southern	19383	4690	939	25012	1100	11299	8518	45929
Eastern	18235	190	17	18442	0	3882	345	22669
N. Eastern	60	787	143	990	0	1116	223	2329
Islands	0	0	70	70	0	0	6	76
All India	**92378**	**17456**	**1200**	**111034**	**4560**	**37368**	**16787**	**169748**



- The current capacity stands at around 170 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 53%,Hydro around 23%, and Gas around 11% of the total installed capacity

Source: CEA

Efficiency Trends



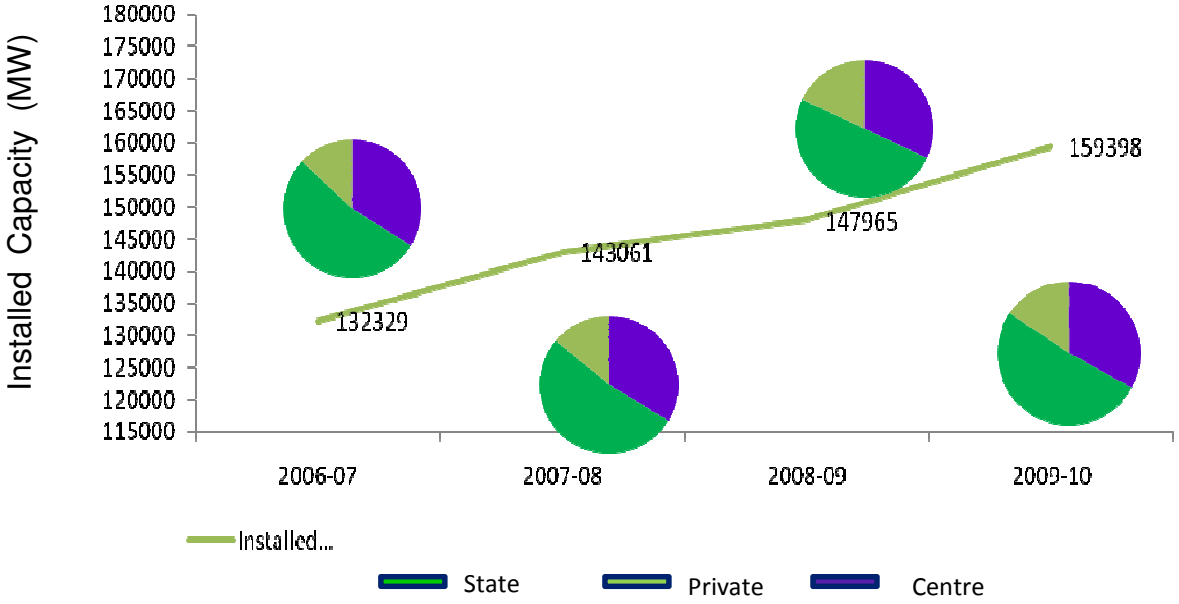
Source: CEA

• Capacity Mix is currently skewed in favour of relatively high PLF thermal projects. The thermal PLFs on an average are around 78%.
• Gas PLFs in the country are operating at a sub 60% PLF level currently. Shortage of gas supplies is primarily responsible for these plants to run at below their actual capability of 80% PLF level.
• Availability of domestic gas has increased with gas production in KGD6 basin. Nevertheless, given the Gas Utilization Policy, the domestic sources would need to be augmented by LNG to meet the requirements of the power sector.

Installed Capacity- Ownership

Installed Capacity as per Ownership (MW) — ***As of December, 2010***

Sector	Thermal (MW)				Nuclear (MW)	Hydro (MW)	Renewable (MW)	Total (MW)
	COAL	GAS	DSL	TOTAL				
State	47477	4077	603	52157	0	27257	2822	82236
Private	12481	6677	597	19755	0	1425	13964	35145
Central	32420	6702	0	39122	4560	8685	0	52376
All India	**92378**	**17456**	**1200**	**111034**	**4560**	**37367**	**16787**	**169748**



- Share of private sector has gone up from 13% in 2006-07 to around 18% indicating a shift towards private participation
- State sector continues to be dominant. Accounts for around 50% of the total installed capacity

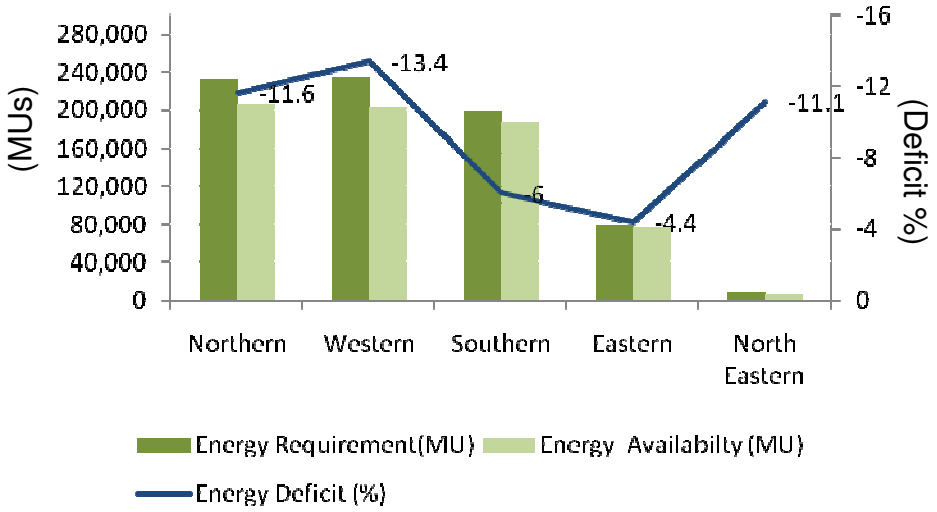
Source: CEA

Power Supply Position

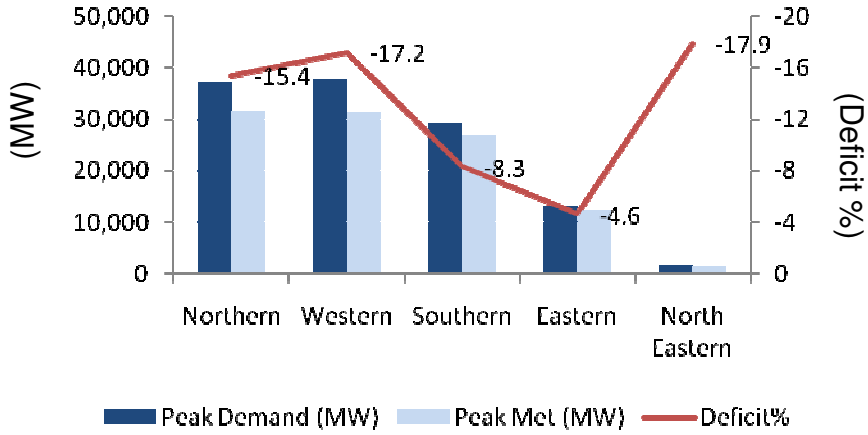
Demand/ Supply Gap — *2009-10*

Region	Energy Requirement (MU)	Energy Availability (MU)	Deficit%	Peak Demand (MW)	Peak Met (MW)	Deficit%
Northern	253,803	224,447	-11.6	37,159	31,439	-15.4
Western	258,551	223,153	-13.7	39,609	32,586	-17.7
Southern	220,557	206,525	-6.4	32,082	29,053	-9.4
Eastern	88,040	84,054	-4.5	13,963	12,885	-7.7
North Eastern	9,349	8,315	-11.1	1,760	1,445	-17.9
All India	**830,300**	**746,493**	**10.1**	**109,809**	**96,685**	**-12.0**

Energy Deficit



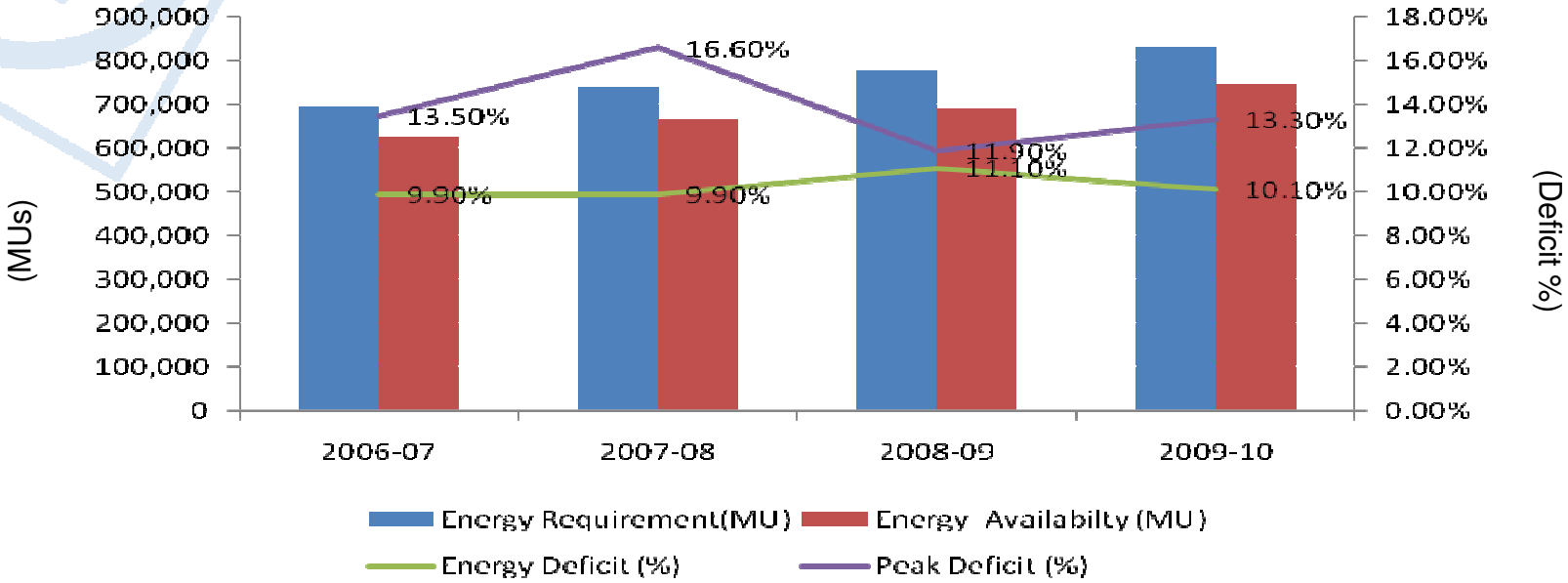
Peak Deficit



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

Source: CEA

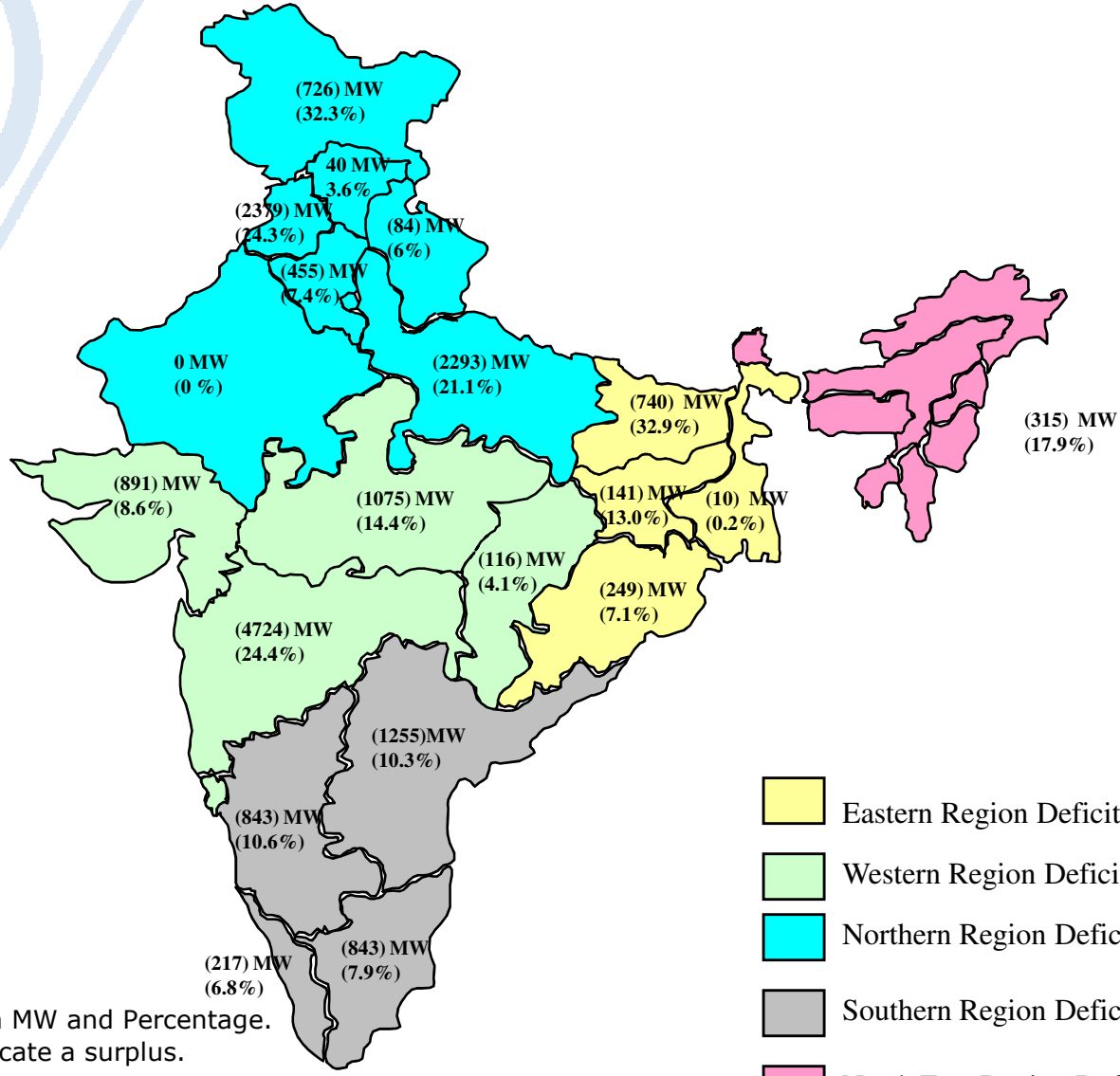
Comparative Energy Balance



Source: CEA

- **The country has been witnessing sustained energy and peak deficit**
- **An upward trend in the energy deficit till 2008-09 can be observed. In 2009-10 there is a slight dip on account of new capacity being added**
- **In 2007 -08, the peak deficit are high due to a surge in peak demand in that year.**

State Demand Supply Position

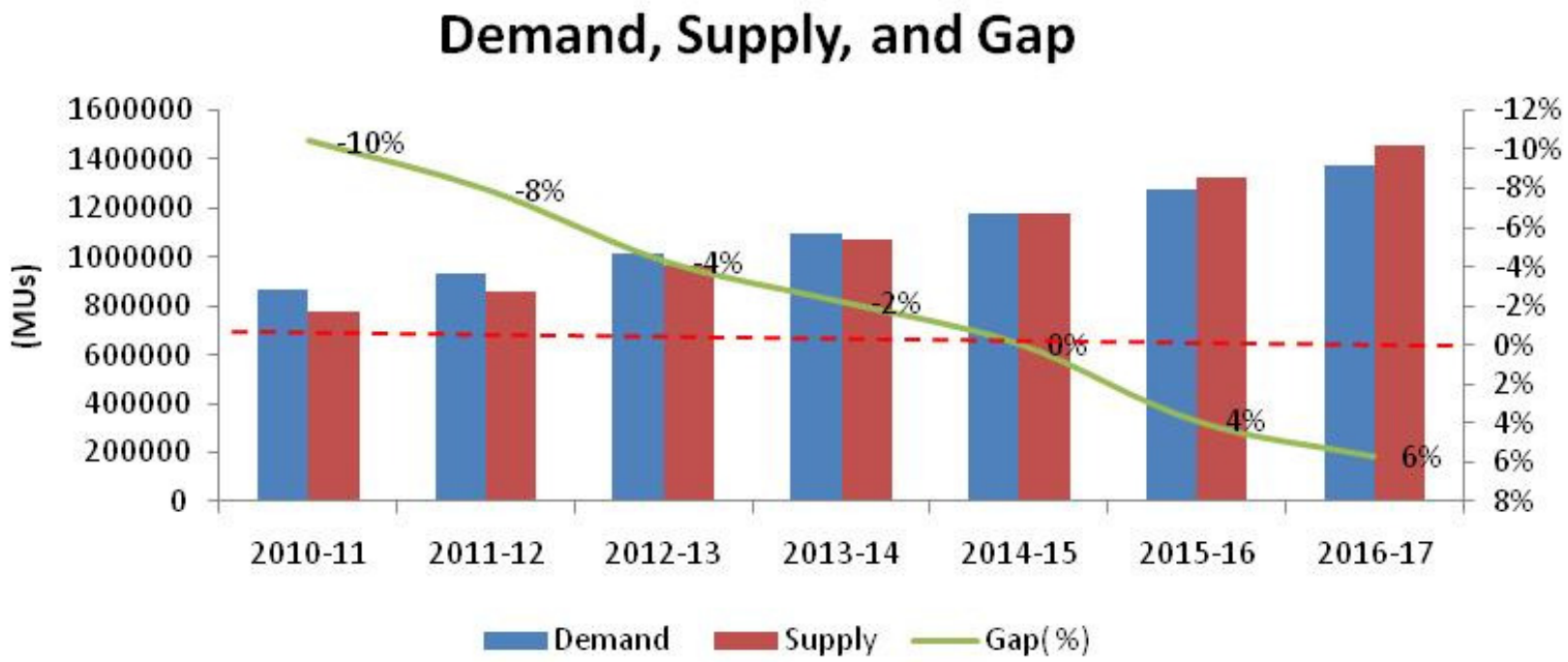


*Peak Deficit given in MW and Percentage.
Figures not in ( ) indicate a surplus.

Source: CEA – March 31, 2010

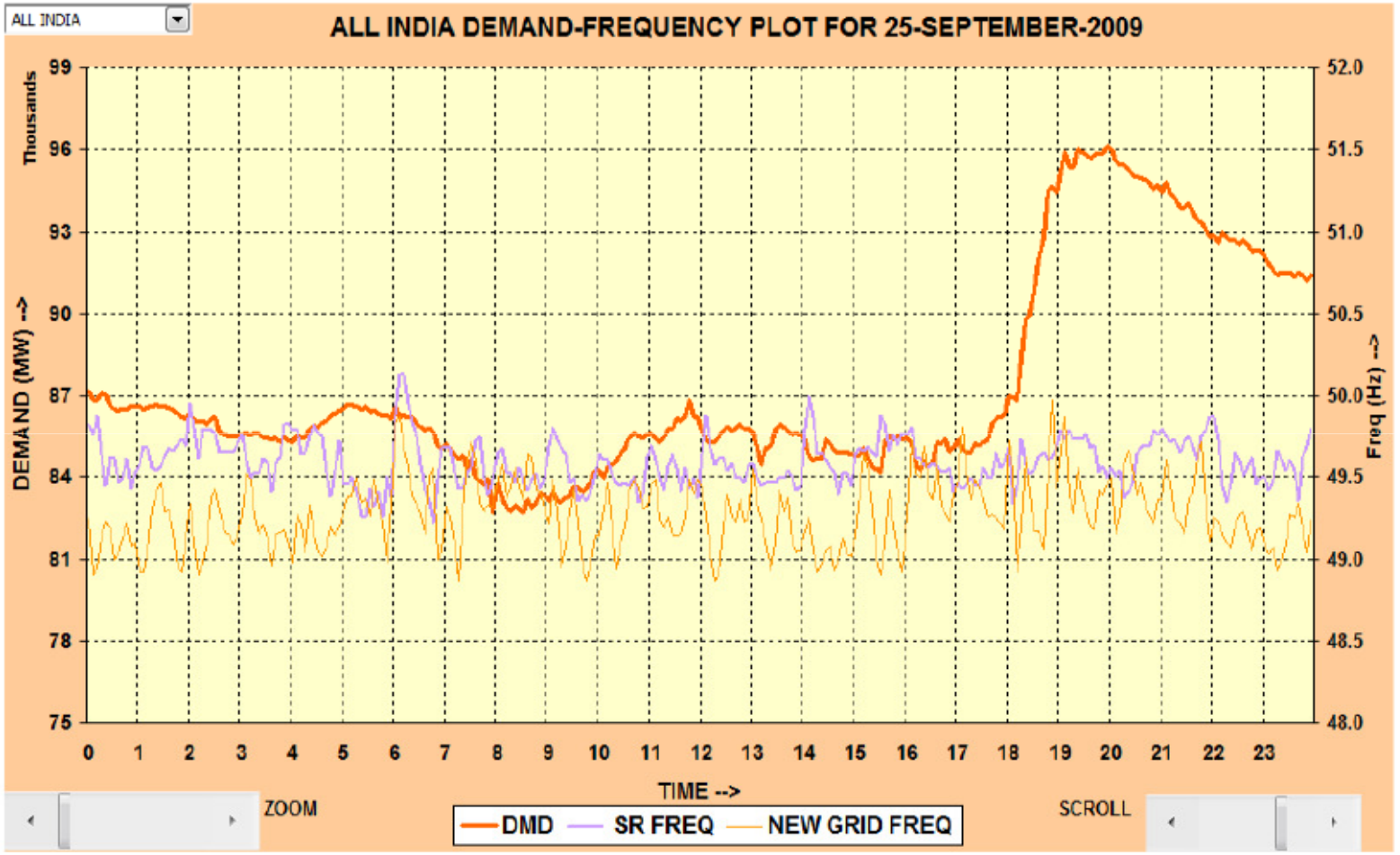
Clearly all the states in the country witnessed a peak deficit in FY 2009-10 barring Himachal Pradesh, which has a surplus

Future Energy Power Supply Position



All the regions & the country as a whole are in deficit till 2013-13 but turns into surplus from 2014-15. Though there is energy surplus, the peak deficit continues to exist.

Peaking Profile Observed in the Power System – September 2009



Source: NLDC

Peak Power Supply Position (MW)

ALL INDIA

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand (Mercados)	132,144	142,728	154,170	166,534	179,901	194,350
Peak Demand (EPS)	152,746	164,040	176,170	189,196	203,185	218,209
Peak Availability	118,488	128,614	141,580	153,322	172,323	185,083
Surplus/Deficit (Mercados)	-13,656	-14,114	-12,590	-13,212	- 7,577	-9,267
Surplus/Deficit (vis-à-vis EPS)	-33,072	-32,406	-28,312	-26,965	-21,639	-22,494
Surplus/Deficit (%) (Mercados)	-10%	-10%	-8%	-8%	-4%	-5%
Surplus/Deficit (%) (vis-à-vis EPS)	-22%	-20%	-16%	-14%	-11%	-10%

All India, Northern, Western and Southern region continues to remain in deficit with the tied up capacity till 2016-17, though on a y-o-y basis situation improves. Eastern and North-Eastern region turns into surplus from 2014 onwards.

Peak Power (MW) Supply Position

NORTHERN REGION

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand	39,461	43,071	47,012	51,316	56,015	61,147	66,751
Peak Availability from tied up capacity	32,304	38,011	37,827	44,828	49,441	54,915	56,699
Surplus/Deficit	-7,157	-5,060	-9,186	-6,488	-6,574	-6,232	-10,052
Surplus/Deficit (%)	-18%	-12%	-20%	-12.64%	-12%	-10%	-15%

WESTERN REGION

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand	39,326	43,001	47,020	51,414	56,220	61,474	67,220
Peak Availability from tied up capacity	35,968	38,600	45,965	51,260	56,523	62,698	68,638
Surplus/Deficit	-3,359	-4,401	-1,055	-154	303	1,224	1,418
Surplus/Deficit (%)	-9%	-10%	-2%	-0.3%	1%	2%	2%

SOUTHERN REGION

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand	31,582	34,425	37,522	40,903	44,586	48,607	52,994
Peak Availability from tied up capacity	28,922	31,831	32,382	33,438	34,568	39,888	42,670
Surplus/Deficit	-2,660	-2,594	-5,140	-7,465	-10,017	-8,720	-10,324
Surplus/Deficit (%)	-8%	-8%	-14%	-18%	-22%	-18%	-19%

Peak Power (MW) Supply Position

EASTERN REGION

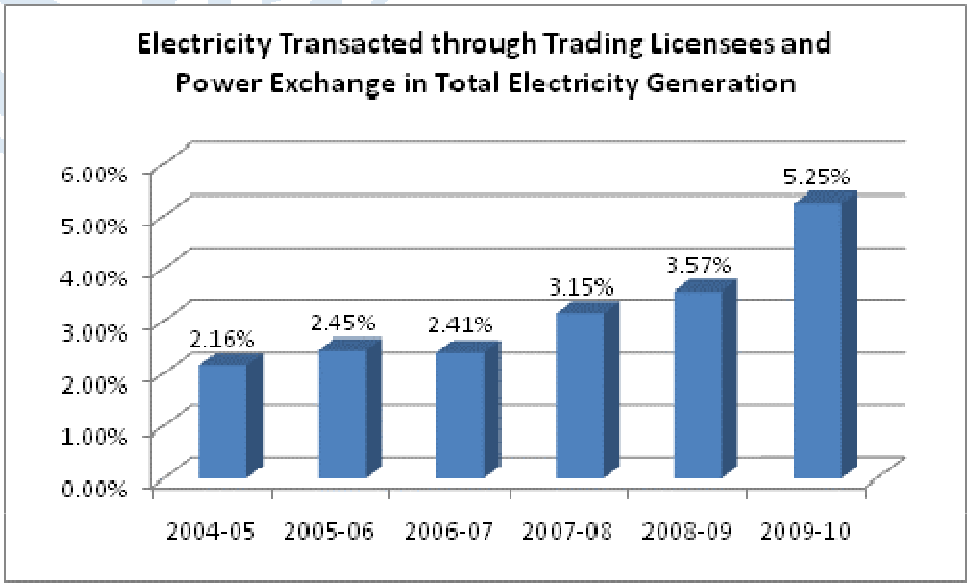
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand	11,926	12,835	13,816	14,870	16,008	17,230	18,547
Peak Availability from tied up capacity	11,948	13,439	13,273	15,036	17,651	19,650	22,902
Surplus/Deficit	21	604	-543	166	1,643	2,419	4,355
Surplus/Deficit (%)	0.2%	5%	-4%	1%	10%	14%	23%

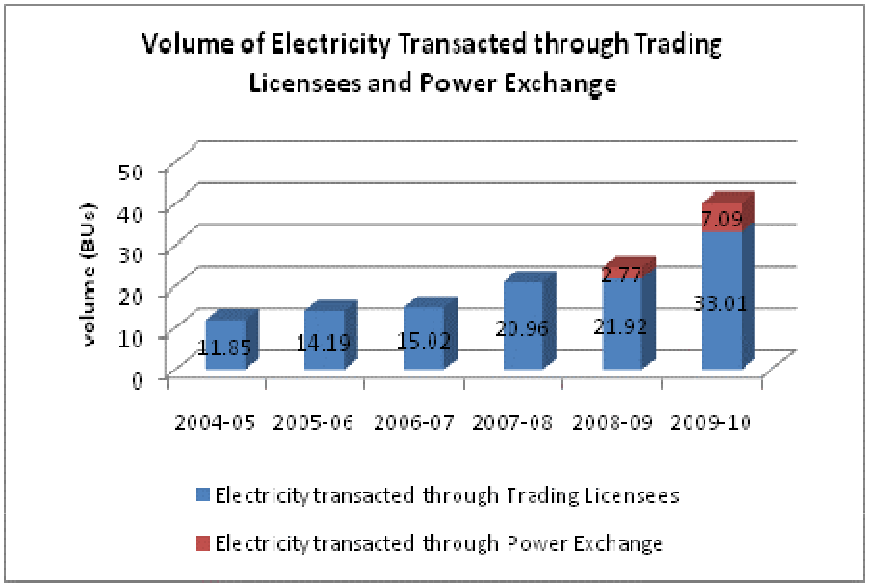
NORTH EASTERN REGION

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Peak Demand	1,734	1,867	2,011	2,166	2,332	2,512	2,706
Peak Availability from tied up capacity	1,414	1,708	2,188	3,296	4,049	4,396	4,806
Surplus/Deficit	-319	-159	178	1,130	1,716	1,883	2,100
Surplus/Deficit (%)	-18%	-9%	9%	52%	74%	75%	78%

SHORT-TERM TRANSACTIONS OF ELECTRICITY – VOLUME AND PRICES

Trends in Volume of Short-term Transactions of Electricity - Annual (2004-05 to 2009-10)

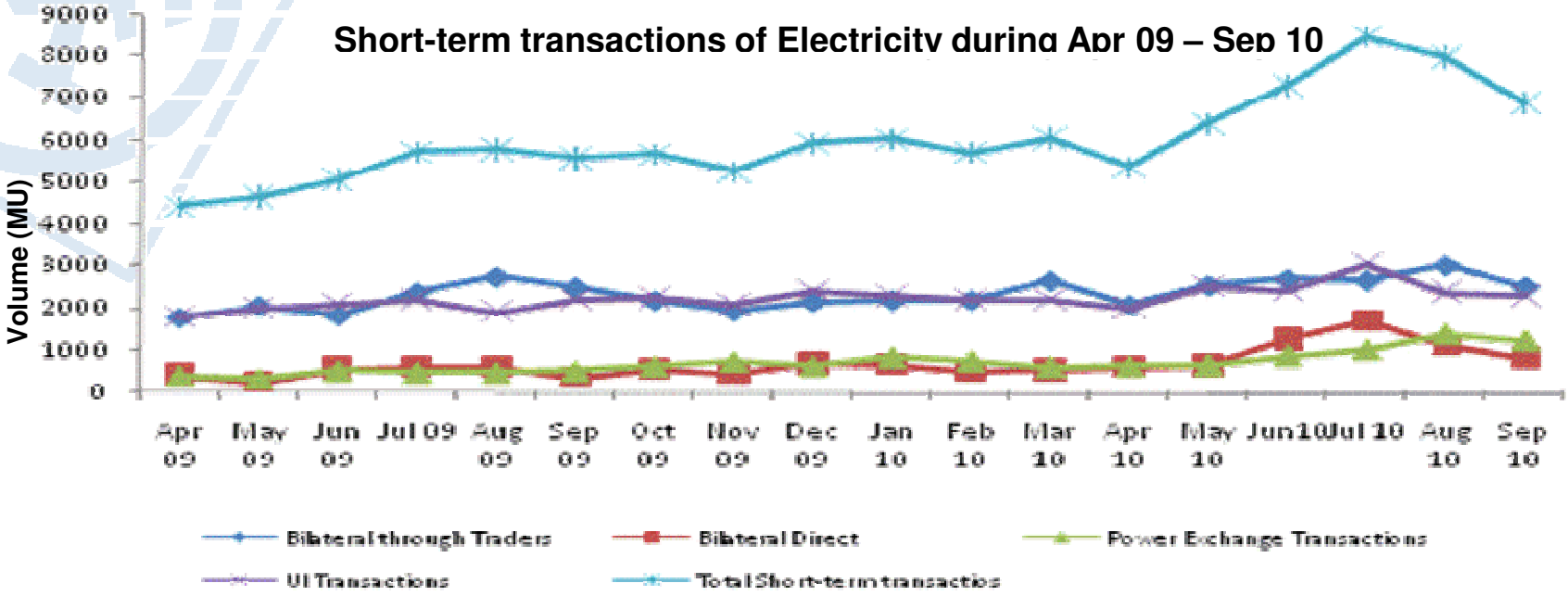




Source: CERC Monthly Market Monitoring Reports

- Volume of electricity transacted through inter-state trading licensees has more than doubled during the period i.e. from 12 BUs in 2004-05 to 26 BUs in 2009-10
- Volume of electricity transacted through power exchanges was 7 BUs during 2009-10.
- Total volume of both trading licensees and power exchanges during 2009-10 was 40.09 BUs. However, volume of electricity transacted through trading licensees and power exchanges in total electricity generation to approximately doubled i.e. from 2.16% to 5.35% during the period.

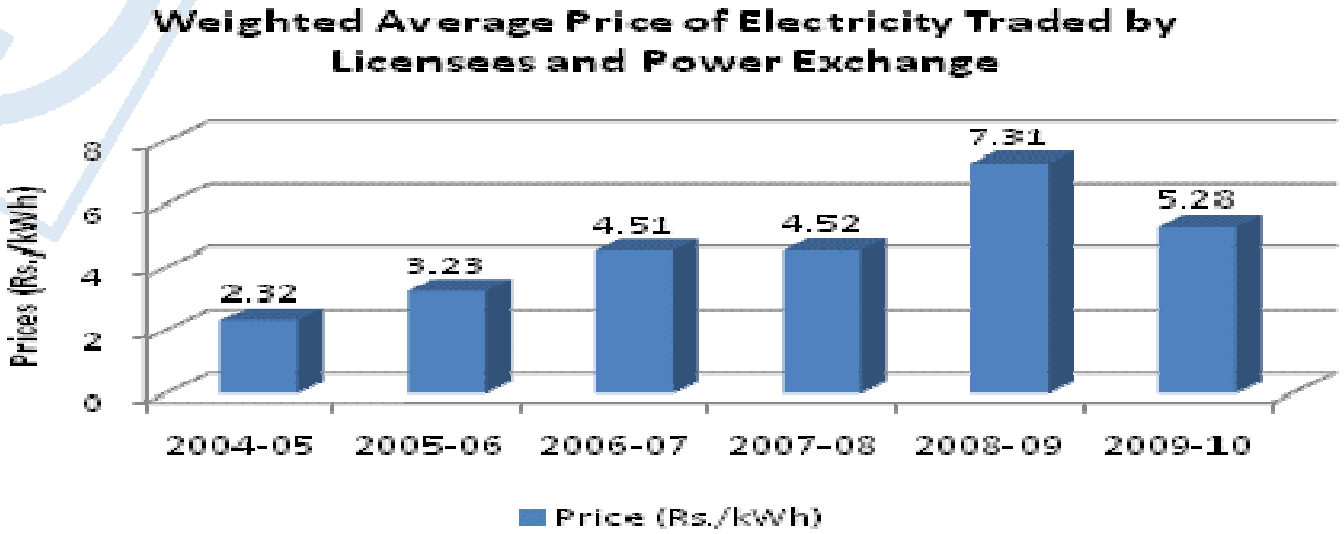
Trends in Volume of Short-term Transactions of Electricity - Monthly (April 2009 to September 2010)



Source: CERC Monthly Market Monitoring Reports

- There is a cyclical trend in the total volume of short-term transactions. This trend may have emerged due to demand and supply which vary from season to season
- The volume of short-term transactions of electricity in total electricity generation varied from 6.55% to 9.36% during the period
- With the amendment in UI Regulations in May 2010, volumes have increased on power exchange and direct bilateral sales because of heavy penalties imposed on large drawals from UI market. However, the volume of transactions in UI market have not changed much indicating there are still few states who rely on UI market to meet their demand.

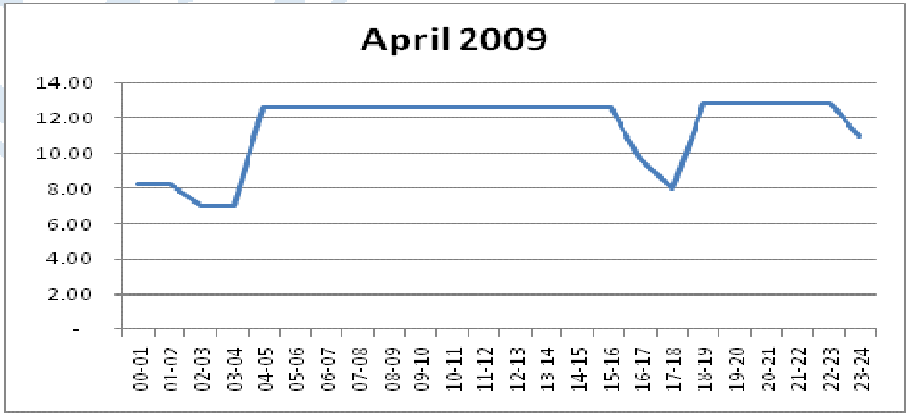
Trends in Prices of Short-term Transactions of Electricity – Annual (2004-05 to 2009-10)

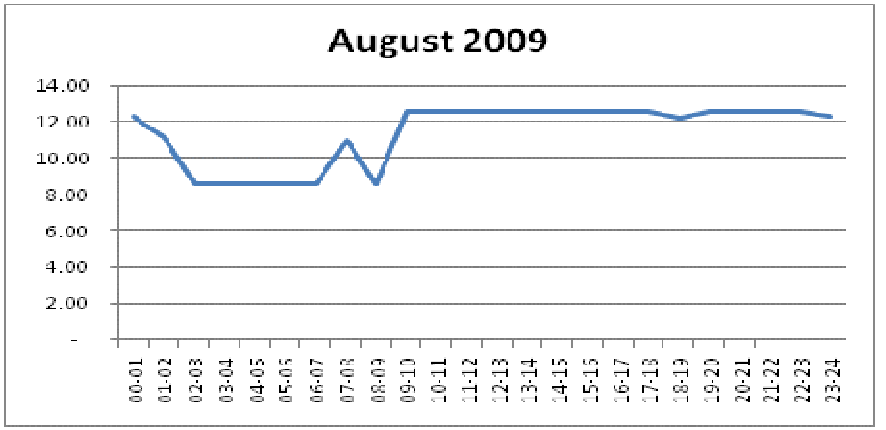


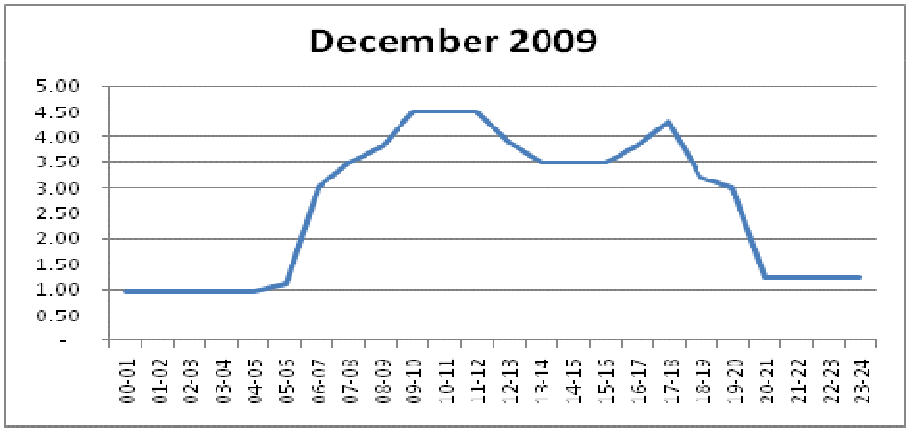
Source: CERC Monthly Market Monitoring Reports

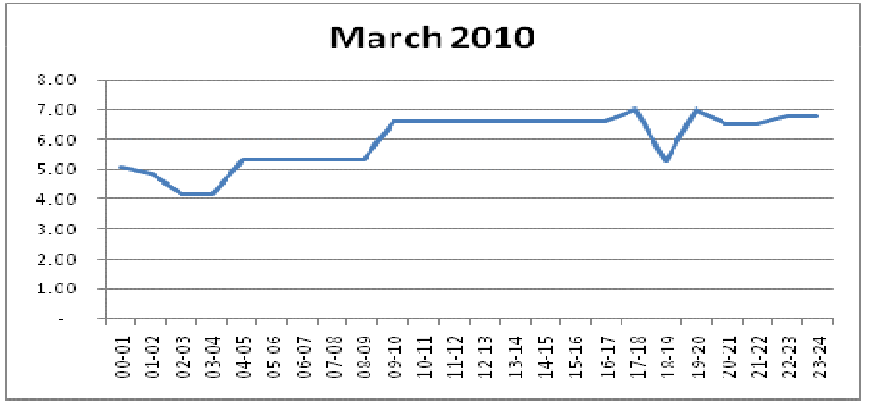
- The weighted average price of electricity transacted through trading licensees has increased three times during the period i.e. from Rs.2.32/kWh in 2004-05 to Rs.7.31/kWh in 2008-09 but dropped again in 2009-10 to Rs 5.28 per kWh .
- The price of electricity transacted through IEX and PXI was Rs.5.31/kWh and Rs.5.72/kWh respectively in 2009-10. The weighted average price of electricity transacted through licensees and PXs was Rs.5.28/kWh.

Prices in Competitive Market in 2009-10 on Representative Days







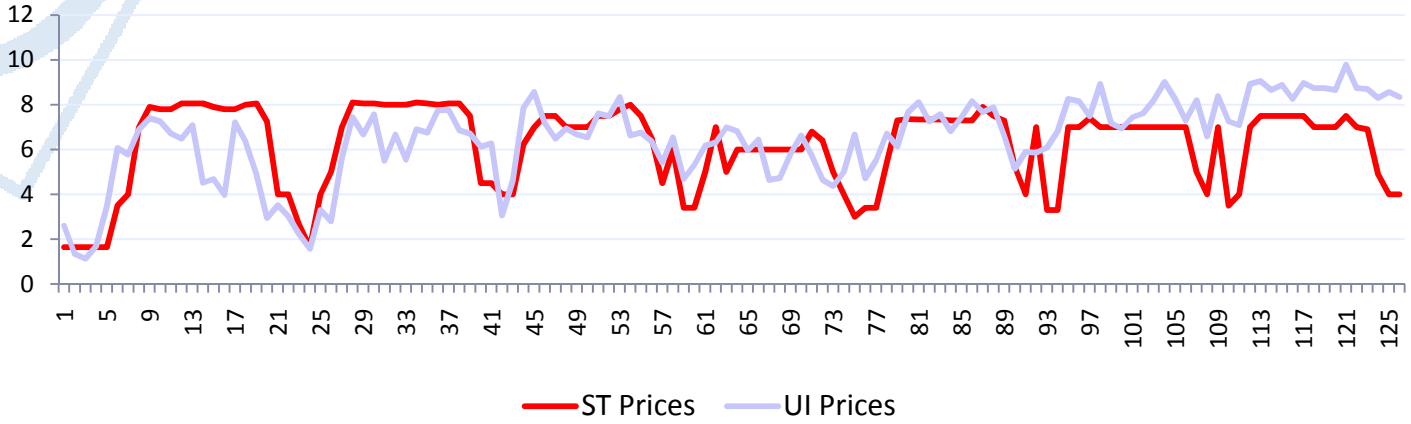


Source: IEX

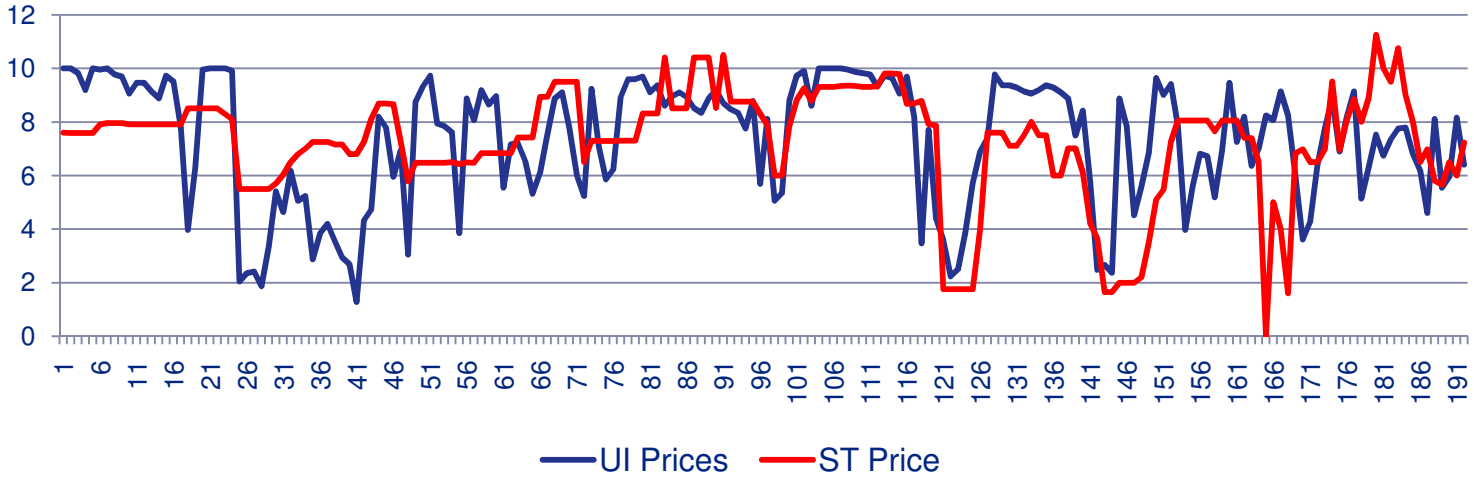
Average prices have been high in the short-term market on account of demand outstripping supply. At current levels of average prices in the market, it may be possible to set up peaking power stations on merchant basis. However, such high average prices will not (and should not) sustain.

ST Prices & UI Prices Movement a representative day in a month

Weekday



Holiday



ST Prices move in sync with UI prices. Movement in UI prices influence ST price formation.

MONTHLY PRICE FORMATION AT NATIONAL LEVEL_BASE CASE (TOTAL TARIFF IN RS/KWH)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Apr	5.81	4.76	4.32	6.15	4.34	3.74
May	5.63	4.60	4.78	5.93	4.79	4.38
June	5.05	4.20	5.08	5.27	3.51	2.98
July	4.50	3.95	5.28	4.22	3.29	2.89
August	4.56	5.03	5.40	4.71	4.04	3.61
September	4.65	5.16	5.48	5.82	4.04	3.62
October	4.55	4.28	5.52	5.73	4.59	4.29
November	4.01	4.75	5.55	5.51	4.06	4.03
December	4.17	4.04	5.92	5.55	4.60	4.58
January	4.08	4.59	5.93	5.63	5.18	5.32
February	4.20	4.09	5.80	5.62	5.20	5.26
March	4.29	5.88	5.94	5.70	5.35	5.39
Average	**4.62**	**4.61**	**5.42**	**5.49**	**4.42**	**4.17**

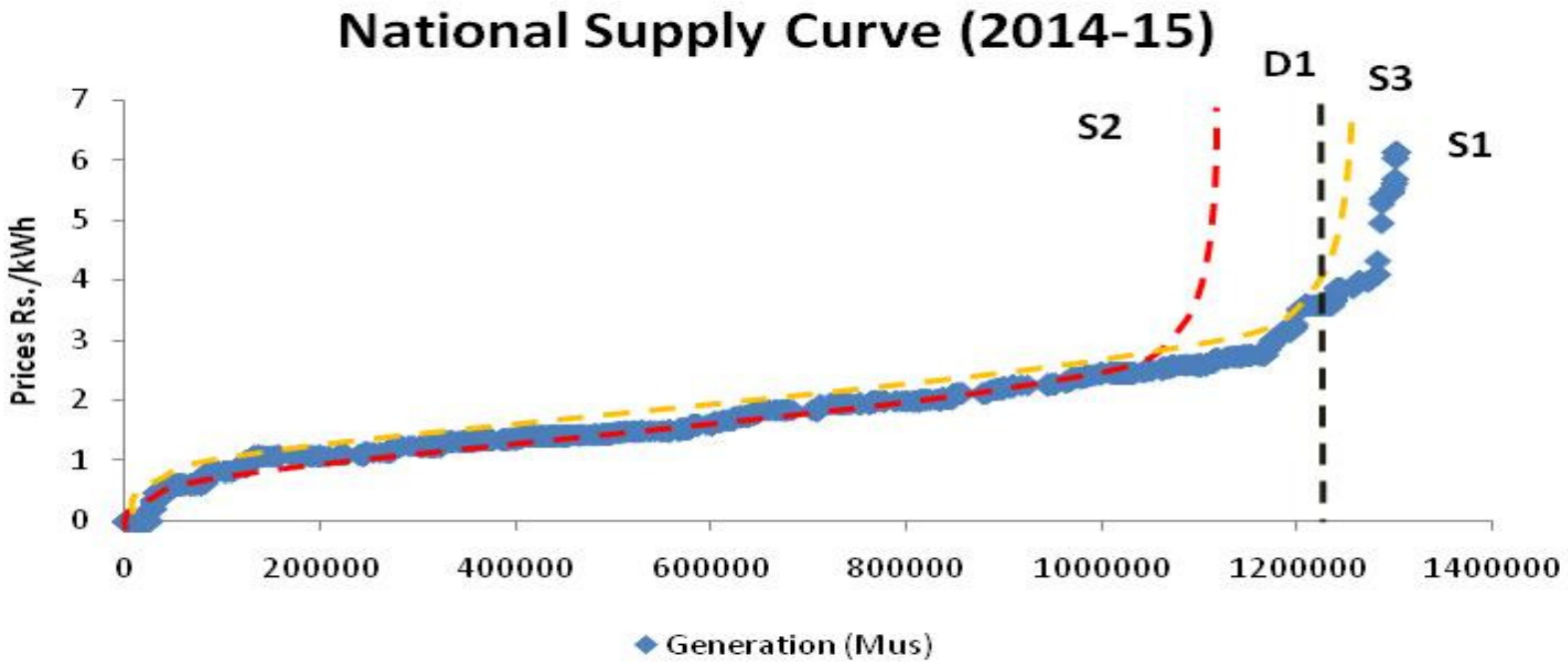
The Prices Anticipated in the Short Term Markets are expected to soften over a period with substantial capacity additions expected, but perk up thereafter

Note: These prices have been estimated under certain set of assumptions and must be used only in conjunction with expert advice

Economic Rationale for Peaking Capacity Addition

- An optimal mix of Baseload and peaking capacity is important for reducing the overall economic cost of power in the power system
- Peaking capacity is also critical for maintaining system reliability. The cost of lack of reliability is very high for electricity users
- Peaking capacity helps enhance network security – avoiding the high economic cost associated with system failures
- The direct economic impact of shed load in terms of value of lost load is very high
- Utilities can contain spot market procurement costs and UI burden with availability of peaking capacity at their disposal

National Supply Curve in 2014-15



- **Majority of capacity is at a variable cost ranging from 0.60- 3.4 Rs/kWh. This is primarily the hydro and the coal based thermal generation. Generation from diesel, naphtha will fetch a higher price and this is the capacity that will be backed down when the aggregate demand will be met.**
- **If the aggregate demand and aggregate supply curve intersect at a point where cumulative generation exceeds 1100000 then the price formed will be higher and this costly generation will have to be dispatched**

Pricing Mechanisms for Peaking Power

Options for Peak Power Pricing

Option 1	**Regulated Energy Only Contract**
Option 2	**Regulated Energy Only Contract with minimum offtake requirements**
Option 3	**Separate Regulated Capacity and Energy Charges**
Option 4	**Separate Capacity Charge (regulated or bid based) with Energy Charge Linked to Day Ahead Market (DAM)**
Option 5	**Reliability service as part of Ancillary Services (AS) Market**

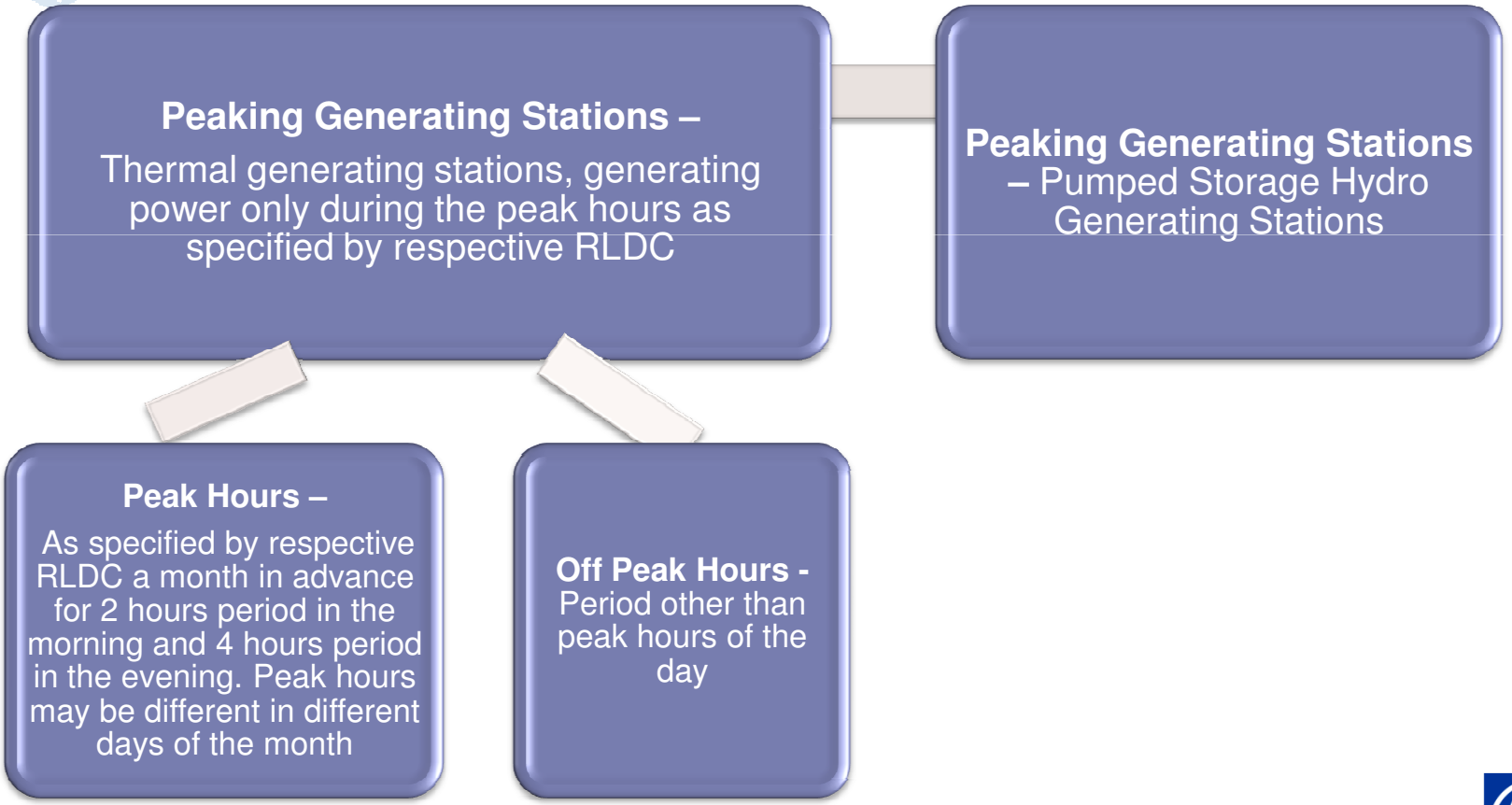
Application of Peak Load Charges at Retail Level

- Structure of peak load tariffs has been conceived as being in two parts at the wholesale level, the same structure must be implemented at the retail level.
- Fixed component of peak load charges can be applied as a lump sum charge on select consumer categories differentiated either by consumption or category.
- Variable charge can be implemented as a time of Day (TOD) charge for such consumers or alternatively can be recovered as monthly reliability charge

Consumer Category	TOD (kWh)	Reliability Charge (kW)
Domestic Urban	X	√
Domestic Rural	X	X
Commercial	√	√
Industry (Small)	X	√
Industry (Large/Medium)	√	√
Agriculture	X	X
Railways	√	√

CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2010

CERC in its Draft Amendments of Tariff Regulations realised the need to meet peak demand and suggested measures to incentivize generators as also mitigate the risks to the investors for setting up power stations for meeting peaking power requirements



CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2010

Computation and Payment of Capacity Charge and Energy Charge for Thermal Generating Stations

Alternative methodology for the Thermal Generating Station other than Peaking stations (AFC for peak hours and off peak hours in ratio of 1:2.4)

(a) For Coal/Lignite based thermal generating stations in commercial operation for less than ten (10) years on 1st April of FY
(b) For Coal/Lignite based thermal generating stations in commercial operation for ten (10) years or more on 1st April of FY
(c) For Gas/liquid fuel based combine cycle thermal generating stations in commercial operation for less than ten (10) years on 1st April of FY
(d) For Gas/liquid fuel based combine cycle thermal generating stations in commercial operation for ten (10) years or more on 1st April of FY
(e) For existing Gas/Liquid fuel based open cycle gas turbine stations

Computation and Payment of Capacity charge and Energy charge for the Peaking Stations

(a) For new Gas/Liquid fuel based open cycle gas turbine peaking stations and Gas based reciprocating Engine peaking stations

Computation and Payment of Capacity Charge and Energy Charge for Hydro Generating Stations

Hydro Generating stations other than Pumped Storage Hydro Generating Stations

Pumped Storage Hydro Generating Stations

Key Principles in Proposed Modification in Regulations for Peaking Power

- Peaking power stations recognised as a separate class of generating assets. Baseload stations can also avail peaking tariff structure during peaking hours (optional)
- Two part tariff arrangement extended to peaking power stations, including gas based peaking power and pumped storage plants
- Fixed costs of peaking power stations to be recovered over the peak hours
- Availability norms for peaking stations to be higher
- Normative operating and cost parameters (SHR, O&M, Auxiliary Consumption, etc.) provided for

Thank You