INDIAN POWER SECTOR
AN OVERVIEW

P. ESTHER KAMALA
DIRECTOR(IRP)
CENTRAL ELECTRICITY AUTHORITY
# Structure of Indian Electricity Sector

<table>
<thead>
<tr>
<th>Category</th>
<th>Central Government</th>
<th>CEA</th>
<th>State Government</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy Making</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Regulators</strong></td>
<td>Central Electricity Regulatory Commission</td>
<td>State Electricity Regulatory Commission</td>
<td></td>
</tr>
<tr>
<td><strong>System Operators</strong></td>
<td>National Load Despatch Centre</td>
<td>Regional Load Despatch Centres</td>
<td>State Load Despatch Centres</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Central Generating Stations</td>
<td>State Generating Stations</td>
<td>Private Sector Players</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>Central Transmission Utility</td>
<td>State Transmission Utilities</td>
<td>Private Sector Players</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
<td>State Sector Distribution Licensee</td>
<td>Private Sector Distribution Licensee</td>
<td></td>
</tr>
<tr>
<td><strong>Markets</strong></td>
<td>Trading Licensee</td>
<td>Power Exchanges</td>
<td>Bilateral Markets</td>
</tr>
</tbody>
</table>
Peculiarities of Regional Grids in India

- **Southern Region**
  - High hydro potential
  - Low load
  - Monsoon dependent hydro

- **Western Region**
  - Industrial load and agricultural load
  - Low load
  - High coal reserves
  - Pit head base load plants

- **Eastern Region**
  - Very low load
  - High hydro potential
  - Evacuation problems

- **Northern Region**
  - Deficit Region
  - Snow fed - run-of-the-river hydro
  - Highly weather sensitive load
  - Adverse weather conditions: Fog & Dust
  - Storm

- **North-Eastern Region**
  - High load (40% agricultural load)

**Regional Grids**

**Deficit Region**

**Highly weather sensitive load**

**Adverse weather conditions:** Fog & Dust

**Very low load**

**High hydro potential**

**Evacuation problems**

**Low load**

**High coal reserves**

**Pit head base load plants**

**Industrial load and agricultural load**

**High load (40% agricultural load)**

**Monsoon dependent hydro**

**CHICKEN-NECK**
• Hydro potential in NER and upper part of NR
• Coal reserves mainly in ER
WIND AND SOLAR ENERGY RESOURCE MAP OF INDIA
Renewable Energy Potential in India (source: MNRE)
# Key Dimensions of Indian Grid

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Footprint</td>
<td>3.2 Million Km²</td>
</tr>
<tr>
<td>Population Served</td>
<td>&gt; 1.3 Billion</td>
</tr>
<tr>
<td>Peak Demand Met (2018-19)</td>
<td>175.5 GW</td>
</tr>
<tr>
<td>Annual Energy Met (2018-19)</td>
<td>1267.5 BU</td>
</tr>
<tr>
<td>Installed Capacity as on 31.07.2019</td>
<td>360 GW</td>
</tr>
<tr>
<td>Renewable Energy Capacity</td>
<td>79 GW</td>
</tr>
<tr>
<td>HVDC Transmission</td>
<td>15,556 CKm</td>
</tr>
<tr>
<td>Transmission Network (EHV &amp; HVDC) as on 31.03.2019</td>
<td>681,611 CKm</td>
</tr>
<tr>
<td>Inter-Regional Transmission Capacity</td>
<td>99 GW</td>
</tr>
<tr>
<td>International Exchange with Neighbouring Countries</td>
<td>~ 3 GW</td>
</tr>
<tr>
<td>PER CAPITA CONSUMPTION (2018-19)</td>
<td>1,181 KWH</td>
</tr>
<tr>
<td>T&amp;D LOSSES (2017-18)</td>
<td>21.04%</td>
</tr>
<tr>
<td>AT&amp;C LOSSES (2015-16)</td>
<td>23.98%</td>
</tr>
<tr>
<td>Annual Trading Volume</td>
<td>56 TWh</td>
</tr>
<tr>
<td>Power Exchanges</td>
<td>2</td>
</tr>
</tbody>
</table>
GROWTH OF INDIAN POWER SECTOR
TOTAL: 3,60,456 MW

**Sector-wise All India Installed Capacity (in MW) AS ON 30.07.2019**

- Private: 167461.8 MW (46%)
- Central: 90176.9 MW (25%)
- State: 102817.61 MW (29%)

**Fuel-wise Total All India Installed Capacity (MW) As on 30.07.2019**

- Coal: 202069 MW (56%)
- Gas: 24937.22 MW (7%)
- Hydro: 45399.22 MW (13%)
- Nuclear: 6780 MW (2%)
- Diesel: 637.63 MW (0%)
- RES: 80632.8 MW (22%)
INSTALL CAPACITY - RES

Development of RE in India

RES Installed capacity in MW as on 30.07.2019

- Solar Power: 30070.38 MW (37%)
- Small Hydro Power: 4604.8 MW (6%)
- Wind Power: 36686.82 MW (46%)
- Bio-Power: 9269.8 MW (11%)

Total: 80,632.8 MW

FIG IN MW
Planwise Growth of Installed Capacity in the Country (Utilities)

Plan/Year

End of Ist Plan (31.03.56) 31.12.47
End of the IInd Plan (31.03.61) 1362
End of the Annual Plan (31.03.69) 31.12.50
End of the IIIrd Plan (31.03.66) 2886
End of the Annual Plan (31.03.79) 148
End of the IVth Plan (31.03.74) 68
End of the Vth Plan (31.03.79) 32
End of the Annual Plan (31.03.80) 57
End of the VIth Plan (31.03.86) 58
End of the Annual Plan (31.03.85) 92
End of the VIIth Plan (31.03.91) 74
End of the Annual Plan (31.03.97) 30
End of the VIIIth Plan (31.03.92) 10
End of the Annual Plan (31.03.99) 3
End of the IXth Plan (31.03.02) 1
End of the Annual Plan (31.03.95) 1
End of the Xth Plan (31.03.07) 1
End of XIth Plan (31.03.12) 1
End of XIIth Plan (31.03.17) 1
End of XIIth Plan (31.03.17) 1

As on 31.03.2018 63721
As on 31.03.2019 65512

Sector wise Growth of Installed Capacity (MW) 2000-01 to 2018-19

Private
Central
State
Gross Electricity Generation in India Mode wise - (Utilities) (31.03.2019)

- Coal: 1022665.33 GWh, 74%
- Hydro: 134893.61 GWh, 10%
- Diesel: 124.8 GWh, 0%
- Nuclear: 37812.59 GWh, 3%
- Gas: 49833.75 GWh, 4%
- RES: 126759.09 GWh, 9%

TOTAL: 1371689 GWh

Sector wise Growth of Energy Generation (GWh) 2002-03 to 2018-19

- State
- Central
- Private

ALL FIGURES IN GWh
Installed Generating Capacity and Generation of Captive Power Plants in Industries having Demand of 1MW & Above - Mode wise (31.03.2019)

**Installed Generating Capacity**

- **Steam**: 34833.08 MW (60.06%)
- **Diesel**: 13484.90 MW (23.25%)
- **Gas**: 7752.96 MW (13.37%)
- **Hydro**: 48.26 MW (0.08%)
- **RES**: 1880.80 MW (3.24%)

**TOTAL** = 58000 MW

**Estimated Generation**

- **Steam**: 141137.00 GWh (80.65%)
- **Diesel**: 7723.00 GWh (4.41%)
- **Gas**: 23785.00 GWh (13.59%)
- **RES**: 2258.00 GWh (1.29%)
- **Hydro**: 97.00 GWh (0.09%)

**TOTAL** = 175000

@Estimated
Electricity(Supply) Act, 1948
State sector Dominant.
Private Sector Participation-
licensed
Constant Peak and energy deficit.
Low growth for Central sector

Major Challenges:
Lack of Inter-Regional Transmission Network.
Default in Payments by SEBs and lack of liquidity-Single point tariff.

1950
All India IC 1713 MW

End of IV Plan (1973-74)
Central Sector IC 2507.5 MW

Inadequate Resources led
Constitution of Central companies:
NTPC, NHPC, NEEPCO, NPCIL.
Large Capacities (200/210 MW)
Regional Projects-Regional grid.
Rate of growth of Central sector outpaced State Sector.

End of IX Plan (2001-02)
Central Sector IC 31605.5 MW (30%)

Few Regulations:
Two-part tariff introduced in 1992
CERC was established
ABT introduced in 2000

Huge Demand for CGS Power

- **X plan** Begin (2002-03)
  - Relevant Regulations:
    - National Tariff Policy 2006-Competitive Bidding
    - Multi Year Tariff regulations 2004-09

- **XI plan** Begin (2007-08)
  - Regulations:
    - Tariff Regulation 2009-14 (ROE=15.5%). Surrender of firm allocation by a beneficiary as per tariff regulations 2009.
  - Huge investment planning: 61000 MW PPAs signed by states with NTPC. High Participation by Private sector - Attractive ROE. Better performance by Central sector plants. Regulations insulated Cent. Generating Comp. from Losses

- **XII plan** Begin (2012-13)
Current scenario

Surrendering of firm power by states to the tune of 3890 MW.

- Highest ever capacity addition - private sector.
- Power Exchanges flourished.
- Power tariffs have reduced in open market.
- High Tariffs for non-pit head CGSs.
- Surplus power for many states.

Demand of Power from CGSs
## Major Unit Sizes and Steam parameters

<table>
<thead>
<tr>
<th>Size</th>
<th>Efficiency (%)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-50</td>
<td>~31</td>
<td>1950</td>
</tr>
<tr>
<td>60-100</td>
<td>32-33</td>
<td>1960</td>
</tr>
<tr>
<td>110 to 150</td>
<td>35-36</td>
<td>1970</td>
</tr>
<tr>
<td>200/210</td>
<td>36.3 - 37.8</td>
<td>1977</td>
</tr>
<tr>
<td>250</td>
<td>38.3</td>
<td>1995</td>
</tr>
<tr>
<td>500</td>
<td>38.5</td>
<td>1984</td>
</tr>
<tr>
<td>500</td>
<td>38.7</td>
<td>2010</td>
</tr>
<tr>
<td>660</td>
<td>39.5</td>
<td>2010</td>
</tr>
<tr>
<td>660/800</td>
<td>40.5</td>
<td>2012</td>
</tr>
</tbody>
</table>
CAPACITY MIX (SINCE MARCH, 1981)
Planwise Growth of All India Total Electricity Consumption (Utilities & Non-Utilities)

All India Electricity Consumption Sector Wise (Utilities & Non-Utilities) 2018-19@

TOTAL = 1196309 GWh

@ Estimated
1. At present, demand supply gap at an all time low of less than 1%. This gap is on account of factors other than non-availability of power.
2. Adequate power available in the country.
Transmission Technology

World’s longest multi-terminal HVDC to harness renewable Hydro Power from North-east

World’s Highest Voltage level

Voltage (kV)


220kV 400kV 500kV HVDC 765kV 800kV HVDC 1200kV
Evolution of the Grid

Pre 1991:
Five Regional Grids - Five Frequencies

October 1991:
East and Northeast synchronized

March 2003:
West synchronized with East & Northeast

August 2006:
North synchronized with Central Grid

Dec 2013:
All India Synchronized Grid

Merging of Markets, Power Exchanges
Electricity Act, 2003, Open Access
Merchant Power

Addition of large 500 MW & above gen. units and 765 kV trans. Lines, Ultra Mega Power Projects

Maps not to scale
As on March 2017, the inter-regional transfer capacity is as follows:

- **NORTHERN REGION:** 22,530 MW
- **WESTERN REGION:** 29,520 MW
- **SOUTHERN REGION:** 12,120 MW
- **EASTERN REGION:** 21,190 MW
- **NORTH-EASTERN REGION:** 2,860 MW

**Total:** 99,050 MW
Transmission links have been established between border states in Indian territory (Bihar, UP, Uttarakhand, Tripura, Manipur, West Bengal, and Assam) with neighbouring countries (synchronous/asynchronous/radial links).
Integrated Power Development Scheme (IPDS)

- Scheme approved on 20.11.2014 with a total outlay of Rs 32,612 crore which includes a budgetary support of Rs 25,354 crore from Govt. of India.

- The objectives of scheme are:
  - Strengthening of sub-transmission and distribution networks in the urban areas;
  - Metering of distribution transformers / feeders / consumers in the urban area.
  - IT enablement of distribution sector and strengthening of distribution network

- The component of IT enablement of distribution sector and strengthening of distribution network approved in June, 2013 in the form of RAPDRP for 12th and 13th Plans got subsumed in this scheme and approved scheme outlay of Rs 44,011 crore including a budgetary support of Rs 22,727 crore carried over to the new scheme of IPDS.
Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)

Scheme approved on 20.11.2014 with a total outlay of Rs 44,033 crore which includes a budgetary support of Rs 33,453 crore from Govt. of India.

The objectives of scheme are:

- Separation of agriculture and non-agriculture feeders
- Strengthening of sub-transmission and distribution networks in the rural areas;
- Metering of distribution transformers / feeders / consumers in the rural area.
- Rural Electrification

The component of Rural Electrification approved in August, 2013 in the form of RGGVY for 12th and 13th Plans got subsumed in this scheme and approved scheme cost of Rs 39275 crore including a budgetary support of Rs 35447 crore carried over to the new scheme of DDUGJY.
Ujwal Discom Assurance Yojana (UDAY)

Launched by the Government of India on 20th November 2015 for operational and financial turnaround of state-owned Power Distribution Companies (DISCOMs).

Objectives

(i) Improving operational efficiency of DISCOMs;
(ii) Reduction in cost of power;
(iii) Financial Turnaround - Reduction in interest cost of DISCOMs;
(iv) Enforcing financial discipline on DISCOMs through alignment with State finances.
99.99% of our households are electrified

Objectives

(i) To provide electricity for every household
FUTURE SCENARIO
PROJECTIONS OF ELECTRICITY DEMAND-19TH ELECTRIC POWER SURVEY

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak Demand</th>
<th>Energy Requirement</th>
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<tbody>
<tr>
<td>2021-22</td>
<td>1,566</td>
<td>226</td>
</tr>
<tr>
<td>2026-27</td>
<td>2,047</td>
<td>299</td>
</tr>
<tr>
<td>2031-32</td>
<td>2,531</td>
<td>370</td>
</tr>
<tr>
<td>2036-37</td>
<td>3,049</td>
<td>448</td>
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Growth Rate (%)

<table>
<thead>
<tr>
<th></th>
<th>2016-17 to 2021-22</th>
<th>2021-22 to 2026-27</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAGR of Electrical Energy Requirement</td>
<td>6.18</td>
<td>5.51</td>
</tr>
<tr>
<td>CAGR of Peak Electricity Demand</td>
<td>6.88</td>
<td>5.77</td>
</tr>
</tbody>
</table>
Renewable Installed Capacity Target by 2022

- Solar: 57%
- Wind: 34%
- Biomass: 6%
- Small hydro: 3%

Projected Growth of RES Installed Generating Capacity (MW)

- **SOLAR**
  - 2016-17: 12,289
  - 2017-18: 25,475
  - 2018-19: 39,078
  - 2019-20: 45,305
  - 2020-21: 52,258
  - 2021-22: 60,000

- **WIND**
  - 2016-17: 32,280
  - 2017-18: 33,578
  - 2018-19: 43,035
  - 2019-20: 61,693
  - 2020-21: 80,899
  - 2021-22: 100,000

- **TOTAL**
  - 2016-17: 57,260
  - 2017-18: 71,768
  - 2018-19: 95,319
  - 2019-20: 120,772
  - 2020-21: 147,541
  - 2021-22: 174,998

YEAR
## Estimated Electricity Generation from RES in years 2021-22 and 2026-27

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed capacity of RES (GW)</th>
<th>Solar</th>
<th>Wind</th>
<th>Biomass</th>
<th>SHP</th>
<th>Total</th>
<th>Total Energy Requirement (BU)</th>
<th>Contribution of RES to Total Energy Demand(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021-22</td>
<td>175</td>
<td>162</td>
<td>112</td>
<td>37</td>
<td>15</td>
<td>326</td>
<td>1,566</td>
<td>20.8%</td>
</tr>
<tr>
<td>2026-27</td>
<td>275</td>
<td>243</td>
<td>188</td>
<td>63</td>
<td>24</td>
<td>518</td>
<td>2,047</td>
<td>25.3%</td>
</tr>
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</table>

**PROJECTED ELECTRICITY GENERATION FROM RES BY 2021-22**

- **Solar**: 50%
- **Wind**: 34%
- **Biomass**: 11%
- **SHP**: 5%
TYPICAL ALL INDIA DEMAND & NET LOAD CURVE (2021-22)

ALL INDIA DEMAND VS. NET DEMAND OF PEAK DAY

DUCK CURVE

ALL INDIA DEMAND
NET DEMAND

MW

HOUR

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

111,000 131,000 151,000 171,000 191,000 211,000 231,000 251,000

203675 200324 196901 194771 195354 199412 204988 205598 205194 207161 209487 210331 208052 205204 204551 205389 205410 202824 202370 220798 225751 221086 221790 211214 207765 207085 215702 215326 210790 211214 207765 207085

196801 194356 191176 188876 188636 192483 198726 194079 172674 156613 147147 141050 136740 137938 145695 160706 179418 193163 210323 215326 220798 225751 221086 221790 211214 207765 207085 215702 215326 210790 211214 207765 207085
India’s Intended Nationally Determined Contribution (INDC) 40 % cumulative power installed capacity from non-fossil fuels by 2030.

<table>
<thead>
<tr>
<th>Year</th>
<th>Likely IC (GW)</th>
<th>Likely IC of Fossil Fuel (GW)</th>
<th>Likely IC of Non-Fossil Fuel (GW)</th>
<th>% of Non-Fossil Fuel in IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2022</td>
<td>479.4</td>
<td>243.0</td>
<td>236.4</td>
<td>49.3%</td>
</tr>
<tr>
<td>March 2027</td>
<td>619.0</td>
<td>263.9</td>
<td>355.1</td>
<td>57.4%</td>
</tr>
</tbody>
</table>
To find out the least cost optimum generation mix in the year 2029-30 considering possible/feasible technology options, fuel constraints if any, intermittency associated with Renewable energy sources etc.
Likely Installed Capacity (MW) in 2029-30

TOTAL IC : 8,31,502 MW

- Solar, 300,000, 36%
- Wind, 140,000, 17%
- Gas, 24,350, 3%
- Biomass, 10,000, 1%
- Hydro, 73,445, 9%
- Nuclear, 16,880, ...
- Battery : 34,000MW/136,000MWh

Likely Gross Generation (MU) in 2029-30

- Nuclear 4%
- Wind 12%
- Hydro 8%
- Biomass 1%
- Gas 2%
- Coal 50%
- Solar 23%
- TOTAL IC : 8,31,502 MW
- Battery : 34,000MW/136,000MWh

- Nuclear
- Coal
- Gas
- Biomass
- Hydro
- Wind
- Solar
Peak Demand/ Maximum Net Demand Day (7th Oct)

Peak Demand – 340 GW, Energy Req- 7.21 BU
MILE STONES OF INDIAN POWER SECTOR

THERMAL

- In 50s: Stoker fired thermal units were in use up to 30 MW
- In 60s: Pulverised Coal Technology introduced
- In 70s: First 60 MW indigenous Pulverised Coal boiler Commissioned
- In Late 70s: 200/210 MW units were synchronized
- In 80s: 500 MW units introduced
HYDRO

- In 1947 508 MW Hydro capacity
- In early 60s 1050 MW Bhakra Nangal Complex commissioned
- In 60s First Under Ground Hydro Station at Koyna commissioned
- In 70s Water from river Beas diverted to river Satluj through tunnels and Dehar Power Station (990MW) constructed
- In 80s First pump storage scheme at Kadamparai commissioned
NUCLEAR

• In 60s First Nuclear Power Station at Tarapur (2x160MW) using enriched Uranium commissioned
• In 70s RAPP using natural Uranium (2x220MW) commissioned
• In 90s RAPP-I refueled indigenously
## Plan wise Growth of Electricity Consumption in India

### Domestic Sector

<table>
<thead>
<tr>
<th>Plan/Year</th>
<th>Estimated GWh</th>
</tr>
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<tbody>
<tr>
<td>1947-50</td>
<td>423</td>
</tr>
<tr>
<td>1950-60</td>
<td>934</td>
</tr>
<tr>
<td>1955-61</td>
<td>1492</td>
</tr>
<tr>
<td>1963-66</td>
<td>2355</td>
</tr>
<tr>
<td>1966-69</td>
<td>3184</td>
</tr>
<tr>
<td>1973-74</td>
<td>4645</td>
</tr>
<tr>
<td>1978-79</td>
<td>7576</td>
</tr>
<tr>
<td>1979-80</td>
<td>8402</td>
</tr>
<tr>
<td>1984-85</td>
<td>15506</td>
</tr>
<tr>
<td>1989-90</td>
<td>29577</td>
</tr>
<tr>
<td>1991-92</td>
<td>35854</td>
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<tr>
<td>1996-97</td>
<td>55267</td>
</tr>
<tr>
<td>2001-02</td>
<td>79694</td>
</tr>
<tr>
<td>2006-07</td>
<td>111002</td>
</tr>
<tr>
<td>2011-12</td>
<td>171104</td>
</tr>
<tr>
<td>2012-13</td>
<td>183700</td>
</tr>
<tr>
<td>2013-14</td>
<td>199842</td>
</tr>
<tr>
<td>2014-15</td>
<td>217405</td>
</tr>
<tr>
<td>2015-16</td>
<td>238876</td>
</tr>
<tr>
<td>2016-17</td>
<td>259311</td>
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</table>

### Yearly Growth Rates

<table>
<thead>
<tr>
<th>Plan/Year</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947-50</td>
<td>11.87</td>
</tr>
<tr>
<td>1950-60</td>
<td>10.14</td>
</tr>
<tr>
<td>1955-61</td>
<td>9.73</td>
</tr>
<tr>
<td>1966-69</td>
<td>9.18</td>
</tr>
<tr>
<td>1970-75</td>
<td>13.41</td>
</tr>
<tr>
<td>1979-85</td>
<td>9.08</td>
</tr>
<tr>
<td>1985-90</td>
<td>7.21</td>
</tr>
<tr>
<td>1990-2000</td>
<td>9.57</td>
</tr>
<tr>
<td>2000-10</td>
<td>7.21</td>
</tr>
<tr>
<td>2010-17</td>
<td>9.57</td>
</tr>
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</table>
Plan wise Growth of Electricity Consumption in India
Commercial Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Plan/Year</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947-50</td>
<td>@ Estimated</td>
<td>3.18</td>
</tr>
<tr>
<td>1950-60</td>
<td>@ Estimated</td>
<td>9.50</td>
</tr>
<tr>
<td>1960-70</td>
<td>@ Estimated</td>
<td>11.78</td>
</tr>
<tr>
<td>1970-80</td>
<td>@ Estimated</td>
<td>7.15</td>
</tr>
<tr>
<td>1980-90</td>
<td>@ Estimated</td>
<td>7.45</td>
</tr>
<tr>
<td>1990-2000</td>
<td>@ Estimated</td>
<td>8.28</td>
</tr>
<tr>
<td>2000-10</td>
<td>@ Estimated</td>
<td>11.47</td>
</tr>
<tr>
<td>2010-17</td>
<td>@ Estimated</td>
<td>7.69</td>
</tr>
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</table>
Plan wise Growth of Electricity Consumption in India
Industrial Sector

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</thead>
<tbody>
<tr>
<td>% Growth</td>
<td>11.08</td>
<td>10.40</td>
<td>11.57</td>
<td>5.02</td>
<td>6.55</td>
<td>4.43</td>
<td>10.36</td>
<td>4.70</td>
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</tbody>
</table>
## Plan wise Growth of Electricity Consumption in India
### Traction Sector

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</tr>
</thead>
<tbody>
<tr>
<td>% Growth</td>
<td>3.60</td>
<td>12.71</td>
<td>48.63</td>
<td>4.74</td>
<td>5.87</td>
<td>7.10</td>
<td>4.33</td>
<td>4.17</td>
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</tbody>
</table>

**Diagram:**
- Plan wise Electricity Consumption Growth in GWh
- Year intervals indicate the end of respective plans.
- Growth percentages show the increase in electricity consumption over the years.
Plan wise Growth of Electricity Consumption in India Agriculture Sector

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</tr>
</thead>
<tbody>
<tr>
<td>% Growth</td>
<td>9.03</td>
<td>66.96</td>
<td>71.06</td>
<td>13.55</td>
<td>12.60</td>
<td>7.52</td>
<td>2.05</td>
<td>7.81</td>
</tr>
</tbody>
</table>

Chart : 23
Probable reasons for Change in scenario

- Huge Generation Capacity Addition
- Seller’s Market to Buyers Market
- Actual Demand Vs 18th EPS projections
- Open Market Platform
- 175 GW RES Capacity Achievement by 2022
- 8% of solar RPO by the year 2022 as per Tariff Policy 2016
- Low PLF of Coal based Capacity
Highlights of 12th Plan (2012-17)

- **Highest ever Conventional Capacity addition achieved in one year**: 23,976 MW in 2015-16.
- **Private sector to have 56% contribution in the Total capacity addition**.
- **Super-critical technology based coal power plants to contribute around 39% of the total capacity addition from coal based plants**.
- **Capacity Addition from Conventional sources of 99,209 MW against target of 88,537 MW. (112% of the Target)**.
- **Capacity Addition from RES of 32,757 MW against target of 30,000 MW. (109% of the Target)**.
- **Largest Wind & Solar capacity addition of 3,300 MW and 3,019 MW respectively achieved in 2015-16**.
Plan wise Growth of Installed Capacity in India
Coal/ Lignite based Plants

MW

End of 1st Plan (31.03.56)
End of 2nd Plan (31.03.61)
End of 3rd Plan (31.03.66)
End of 4th Plan (31.03.71)
End of 5th Plan (31.03.76)
End of Annual Plan (31.03.77)
End of 6th Plan (31.03.81)
End of 7th Plan (31.03.85)
End of 2 Annual Plans (31.03.88)
End of 8th Plan (31.03.90)
End of 9th Plan (31.03.92)
End of 10th Plan (31.03.95)
End of 11th Plan (31.03.97)
End of 12th Plan (31.03.00)

MW

31.12.47
31.12.50
31.12.53
31.12.56
31.12.59
31.12.62
31.12.65
31.12.68
31.12.71
31.12.74
31.12.77
31.12.80
31.12.83
31.12.86
31.12.89
31.12.92
31.12.95
31.12.98
31.12.01
31.12.04
31.12.07
31.12.10
31.12.13
31.12.16
31.12.19
31.12.22
31.12.25
31.12.28
31.12.31
31.12.34
31.12.37
31.12.40
31.12.43
Plan wise Growth of Installed Capacity in India
Gas/ Liquid based Plants

<table>
<thead>
<tr>
<th>Plan/Year</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.12.47 End of 1st Plan</td>
<td>31.12.50 End of 2nd Plan</td>
</tr>
</tbody>
</table>
Plan wise Growth of Installed Capacity in India
Diesel based Plants

Plan/Year

MW


98  149  228  300  352  276  241  164  165  177  165  168  294  1135  1202  1200  838  838

End of 1st Plan (31.03.56)
End of 2nd Plan (31.03.61)
End of 3rd Plan (31.03.66)
End of 4th Plan (31.03.71)
End of 5th Plan (31.03.76)
End of Annual Plan (31.03.81)
End of 6th Plan (31.03.86)
End of 7th Plan (31.03.91)
End of 8th Plan (31.03.96)
End of 9th Plan (31.03.01)
End of 10th Plan (31.03.06)
End of 11th Plan (31.03.11)
End of 12th Plan (31.03.16)
31.03.2018
### PER CAPITA ELECTRICITY CONSUMPTION IN VARIOUS COUNTRIES IN 2014 & 2015

**Source:** IEA publication 'Key World Energy Statistics 2014' website (other than India)

* Per capita consumption = (gross electrical energy availability / mid year population)
Salient Features of UDAY

- States shall take over 75% of DISCOM debt as on 30 September 2015 over two years - 50% in 2015-16 and 25% in 2016-17.

- Government of India will not include the debt taken over by the States as per the above scheme in the calculation of fiscal deficit (FRBM Limit) of respective States in the financial years 2015-16 and 2016-17.

- States will issue non-SLR including SDL bonds in the market or directly to the respective banks / Financial Institutions (FIs) holding the DISCOM debt to the appropriate extent.

- DISCOM debt not taken over by the State shall be converted by the Banks / FIs into loans or bonds with interest rate not more than the bank’s base rate plus 0.1%. Alternatively, this debt may be fully or partly issued by the DISCOM as state-guaranteed DISCOM bonds at the prevailing market rates which shall be equal to or less than bank base rate plus 0.1%.

- UDAY is optional for all States. However, States are encouraged to take the benefit at the earliest as benefits are dependent on the performance.

- Outcomes of operational improvements will be measured through following indicators:
  - Reduction of AT&C loss to 15% by 2018-19 as per the loss reduction trajectory to be finalized by Ministry of Power (MoP) and States; and
  - Reduction in gap between Average Cost of Supply (ACS) & Average Revenue Realized (ARR) to zero by 2018-19 as finalized by MoP and States.