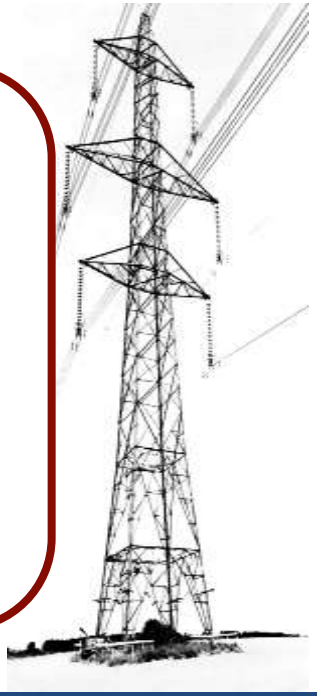
"Future Role of Thermal Generation"

~Flexible, Reliable, Sustainable, Efficient & Eco-friendly Power Generation providing Security & Stability to the Grid arising out of large scale Unreliable & Volatile RE integration~



Renewable Energy - Challenges in Grid Integration

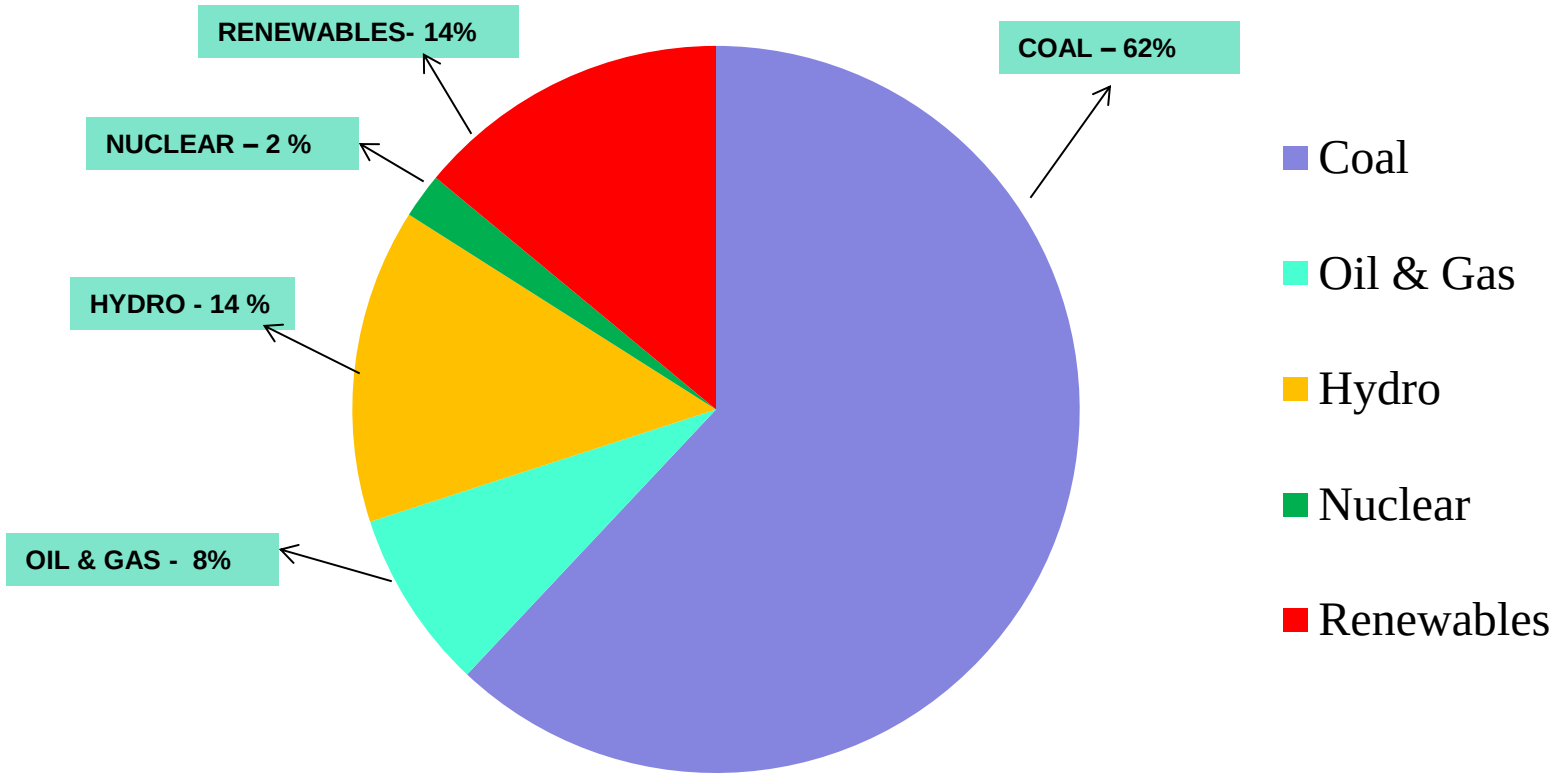
By

NTPC Limited





India : Installed capacity

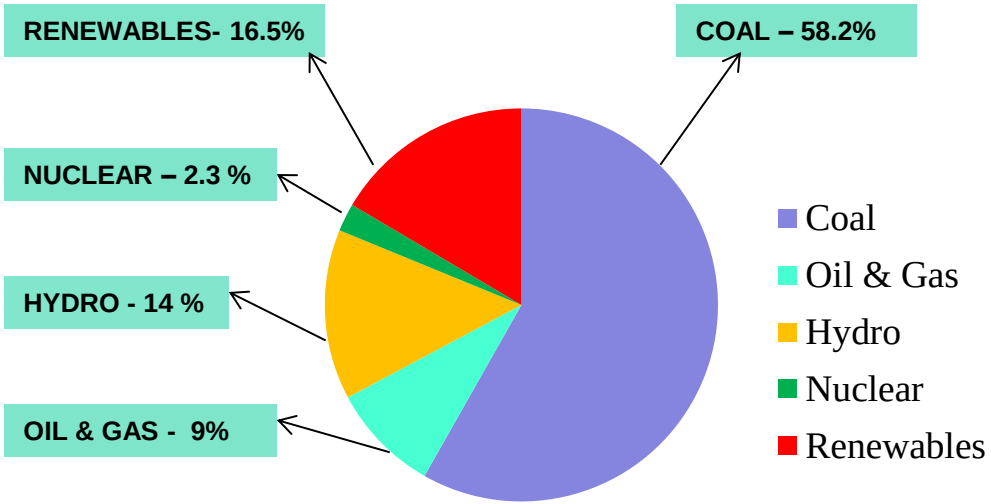


Total Installed Capacity as on 31.03.16 : 299 GW

Source: CEA

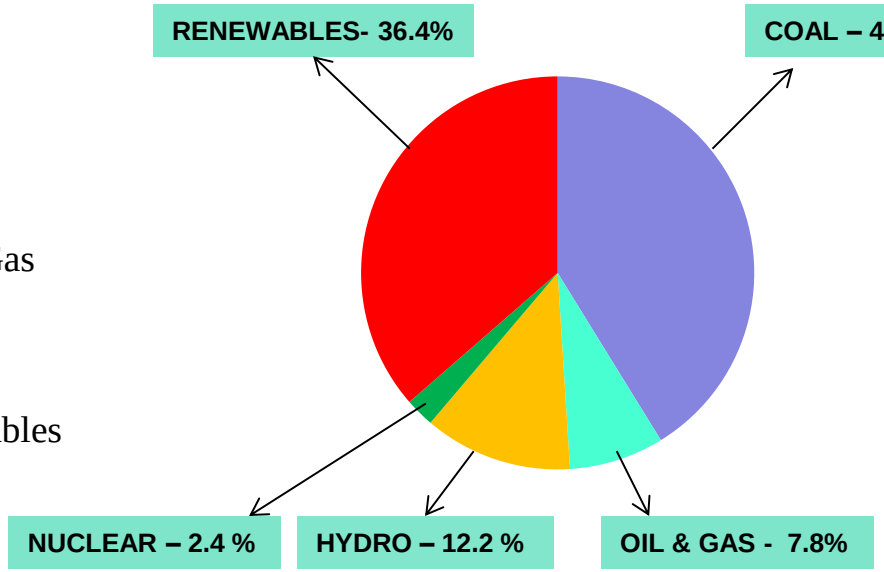
India : Installed capacity (Projected)

Fuel Mix at the end of XIIth Plan



Projected Capacity on 31.03.17 :
333 GW

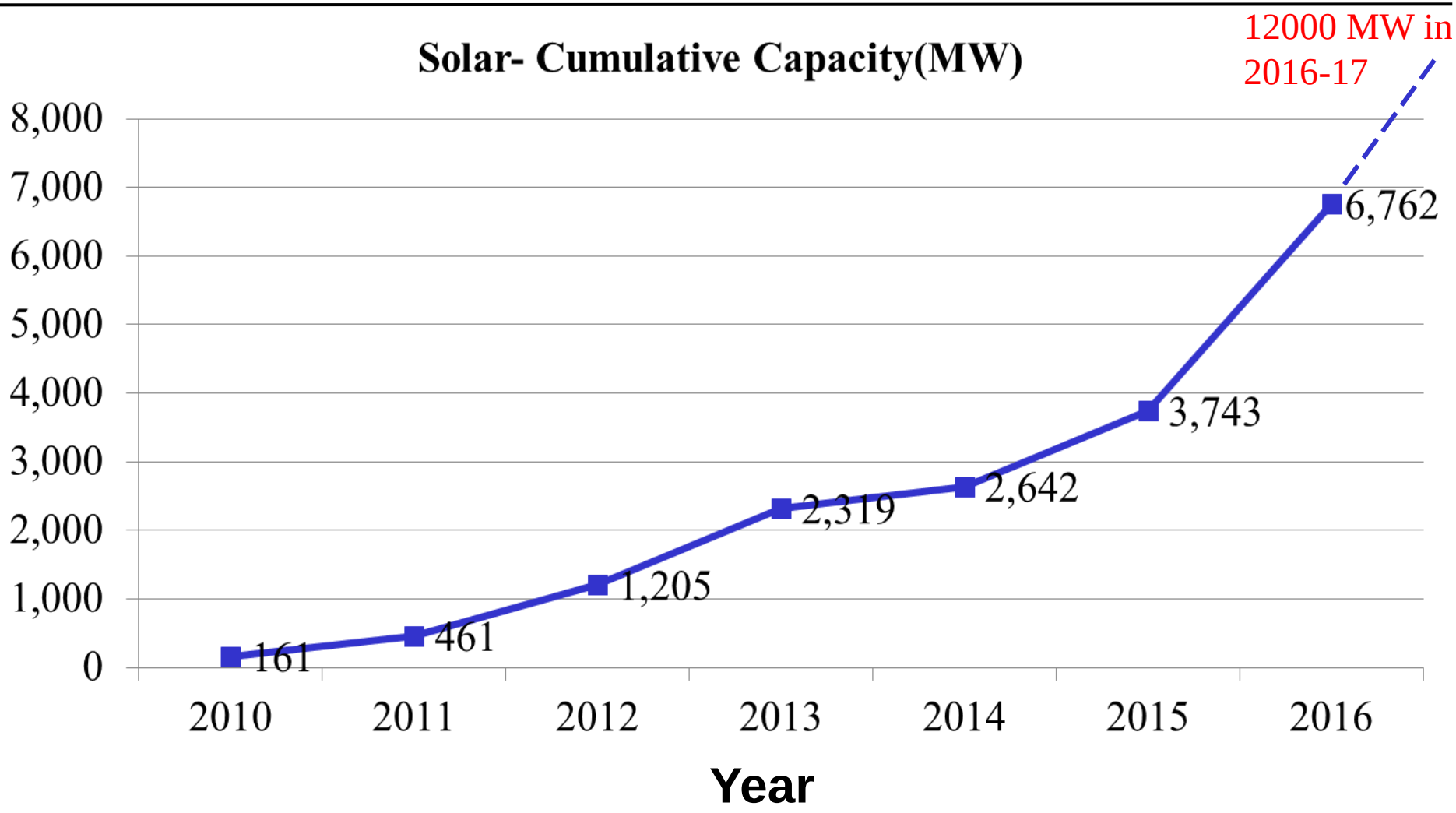
Fuel Mix at the end of XIIIth Plan



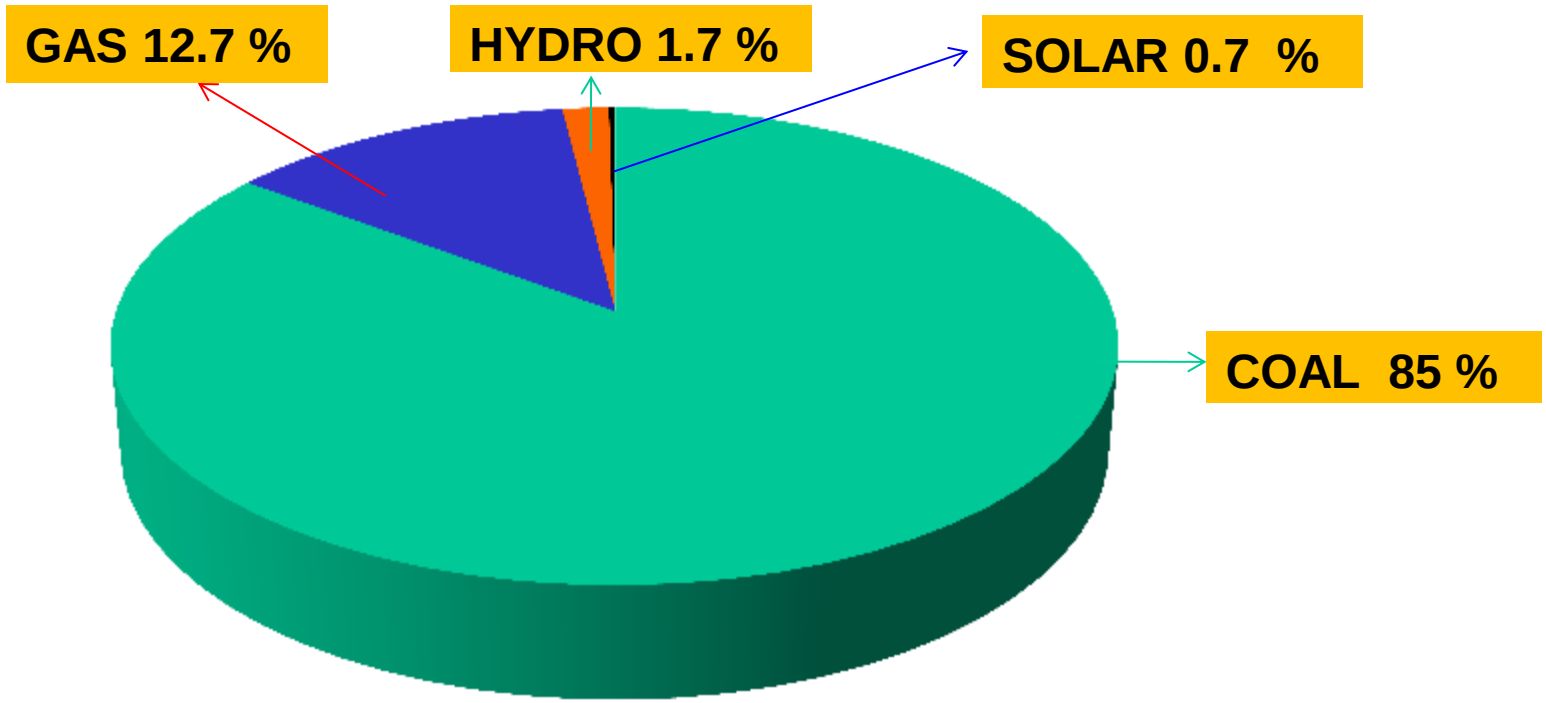
Projected Capacity on 31.03.22 :
498 GW

Source: CEA & Ministry of Power

India : Solar capacity addition in recent years



NTPC : Current capacity under operation



NTPC Group Capacity : 47.178 GW

Data as on 20.05.2016

NTPC : Solar Power Plan -2022

NTPC SOLAR POWER PLAN

10,000 MW OWN CAPACITY ADDITION(EPC)

- Commissioned so far : 310 MW
- Under Construction : 560 MW
- Under Tendering : 1750 MW
- NIT Planned -
  - 2016-17 : 2000 MW
  - 2017-18 : 2000 MW
  - 2018-19 : 2000 MW
  - 2019-20 : 1380 MW

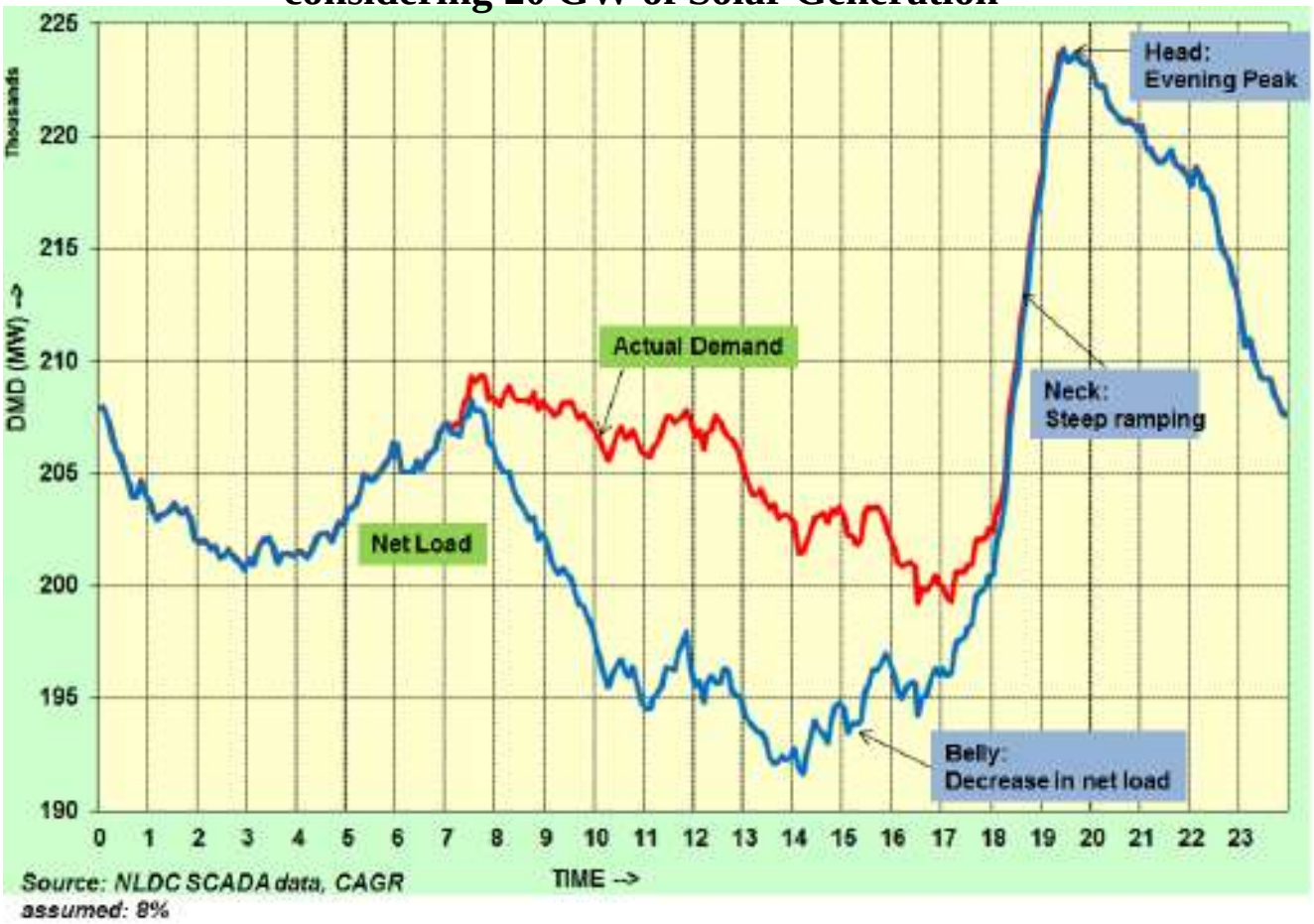
15,000 MW UNDER NSM (MNRE SCHEME)

- Tranche 1 : 3000 MW
  - NIT done : 3000 MW
  - Awarded : 1520 MW
  - RA done(yet to award) : 1000 MW
  - RA to be done : 480 MW
- Tranche 2 : 5000 MW
- Tranche 3 : 7000 MW
  (MNRE Guidelines to be issued)

Future Load Generation Scenario

Expected All India Duck Curve

considering 20 GW of Solar Generation



- **Wide gap w.r.t. the belly of the duck curve indicates commensurate reduction in other sources of generation..**
- **Steep rise in demand at the neck needs to be matched with corresponding generation..**

?

In the Indian context , what would be the complementing source?

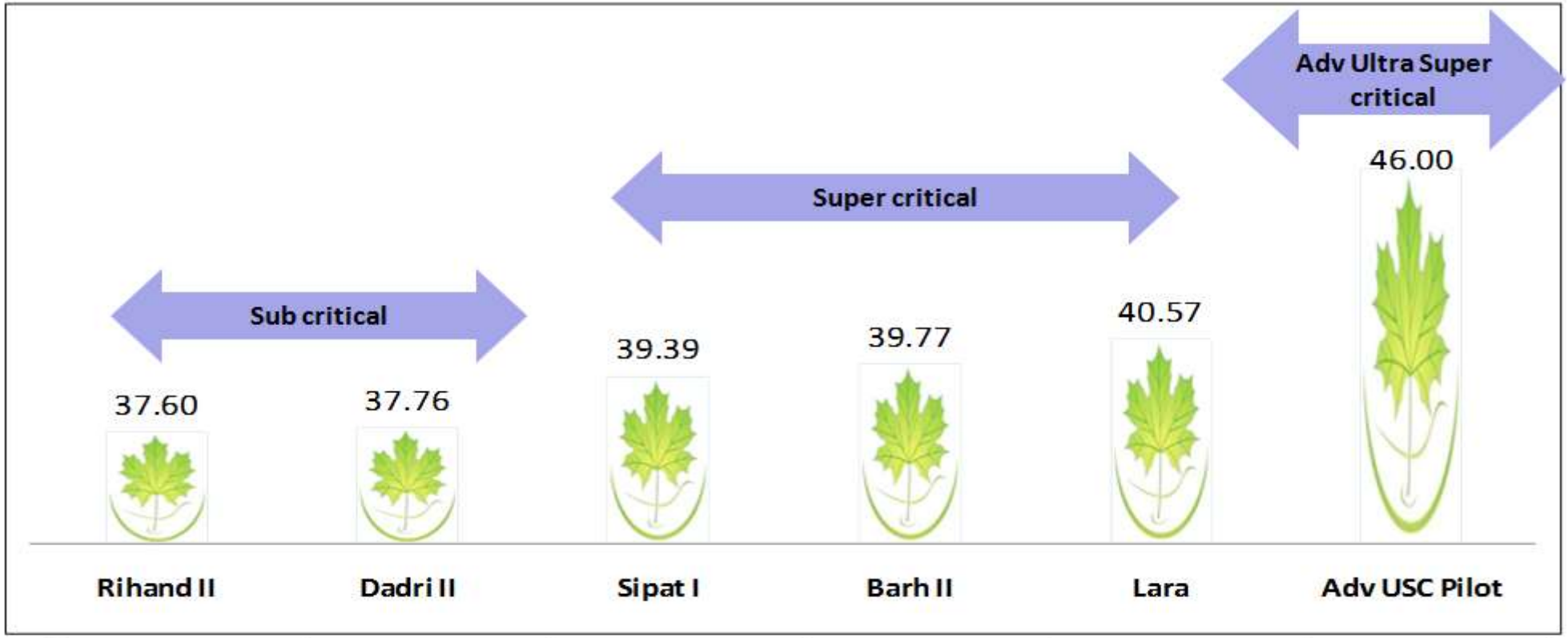
Complementing the gap

- Gas based capacity cannot effectively contribute towards balancing the grid, even though they have a high ramp rate.
- Insufficient capacity of Hydro and pumped storage power plants also poses limitation towards grid balancing.
- Considering the resource availability of Gas generation & Hydro potential, Grid balancing appears to be difficult without substantial coal based generation.
- Therefore, coal based generation shall complement the gap and continue to be the major source of reliable power for safe and stable operation of grid… till we have proper storage solution.

Complementing the gap (contd..)

- Effective operation of modern Coal plants can take care of Grid imbalance to a large extent which in turn gives Reliability, Sustainability & Affordability.
- Looking into this aspect, NTPC has already ventured into world class thermal generation technology by way of inducting Super Critical units.
- Planning for adoption of Advanced Ultra Super Critical technology is under way with a pilot project by 2020.
- All these efforts shall lead to cutting down of Carbon foot print to a great extent.

Reduction of carbon footprint by increasing cycle efficiency



Every 1 % increase in efficiency reduces CO_2 emissions by about 2.5%

Adverse effects due to Cycling

- Mechanical failure due to interaction of Creep and fatigue.
- Stress related failures in thick-walled components of boilers.
- Mechanical fatigue related failures in turbine rotors when it passes through a series of critical speed while starting.
- Thermal shocking of economizer headers /super heater headers.
- Carry over of oxide scales from boiler to turbine, causing erosion of turbine blades.
- Infiltration of dissolved gases leading to increased corrosion.
- Fatigue related failure of copper components of electrical equipments.

Environmental Impact due to Cycling

- Increase in CO2 emissions
- Increase in water treatment requirement
- Increase in chemical consumption
- Adverse effect on performance and reliability of Flue Gas Desulfurization (FGD) equipment and Selective Catalytic Reduction (SCR) systems

Impact of cycling on the cost and reliability

- Increased fuel consumption due to increased plant start-ups and part-load operation (and therefore, reduced efficiency)
- Loss of plant efficiency arising from increased wear to components
- Increased Operations and Maintenance(O&M) costs due to increased wear-and-tear to plant components & component failures
- Increased environmental costs resulting from increased specific emissions
- Loss of income due to longer and more frequent forced outages
- Increase in fuel oil consumption & APC percentage
- Increase in water consumption and water treatment costs

Preparedness for Flexible Operation

Practices already adopted in NTPC :

- Forecasting of Renewable Generation
- Ancillary Services Regulation
- Sliding Pressure operation for part load optimisation
- Primary Control (RGMO/FGMO)
- Maintenance Scheduling

Practices under way of implementation :

- AGC pilot Project
- Specification for future plants modified to suit two shift operation
- Study of engineering and economic impact of cycling through international consultant

Preparedness for Flexible Operation (contd.)

Issues need to be considered in future:

- **Technical**

❖ **Design changes in next generation thermal plant with new materials for greater operational flexibility :**
  - **Thinner components**
  - **Improvements in instrumentation**
  - **piping warm-up system**

❖ **Preparation for Flexible operation of existing base load stations :**
  - **Modification of components/retrofits**
  - **Modified chemical regime**
  - **Changes in operational practices**

Preparedness for Flexible Operation (contd.)

- **Market Options**
  - ❖ **Time of day Tariff/Demand side management in line with RE generation**
  - ❖ **Market based compensations for cycling cost**

- **Support required**
  - ❖ **Learning from experience of RE rich International power generators/ Grid managers.**

THANK YOU

NTPC Limited

(A Government of India Enterprise)

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