Cleaner Power for India:

Assessing India's Coal Power Fleet

Can India's Existing Coal Power Fleet Provide Cleaner, More Affordable Power?

Coal-fired power plants are one of the most important components of the global energy mix, delivering almost 38 percent of the world's power generation. India, in particular, depends on its thermal power plants to ensure affordable access to electricity for its citizens on its march to provide 24x7 *Power for All* and fuel the world's fastest growing large economy. Currently over 70% of India's electricity generation is from coal, with estimates that more than 10 million Indian jobs directly and indirectly serve the industry.

Cleaner Power for India

A rapidly changing energy landscape has challenged the status quo, and coal-based power plants must transform to stay relevant:

1. Renewables are a major part of India's energy future via the Government of India's (GoI's) inspiring capacity addition target of 175GW by 2022. Conventional generation using coal is essential to address flexibility needs arising when the sun does not shine or wind does not blow. India's daily ramp-up requirement is likely to exceed 80 GW by 2022.

2. India was the third-largest CO_2 emitter and the second-largest SO_X emitter in the world in 2015; the power sector is one of the biggest contributors to these emissions. GoI has adopted new, stricter local pollutant norms, but we are still not addressing CO_2 emissions in coal stations by raising efficiency levels – which is readily achievable as demonstrated in Gujarat's Ukai and Wanakbori plants.

3. Making power more affordable eases the burden on the country's financials and accelerates access. By raising efficiency in existing plants, we burn less coal, which not only improves CO_2 emissions, it decreases the variable cost of power.

The Way Forward

Once achieving the 175 GWs renewable target, coal will still be the single largest source of power generation. Therefore, it is imperative to produce that power as responsibly as possible.

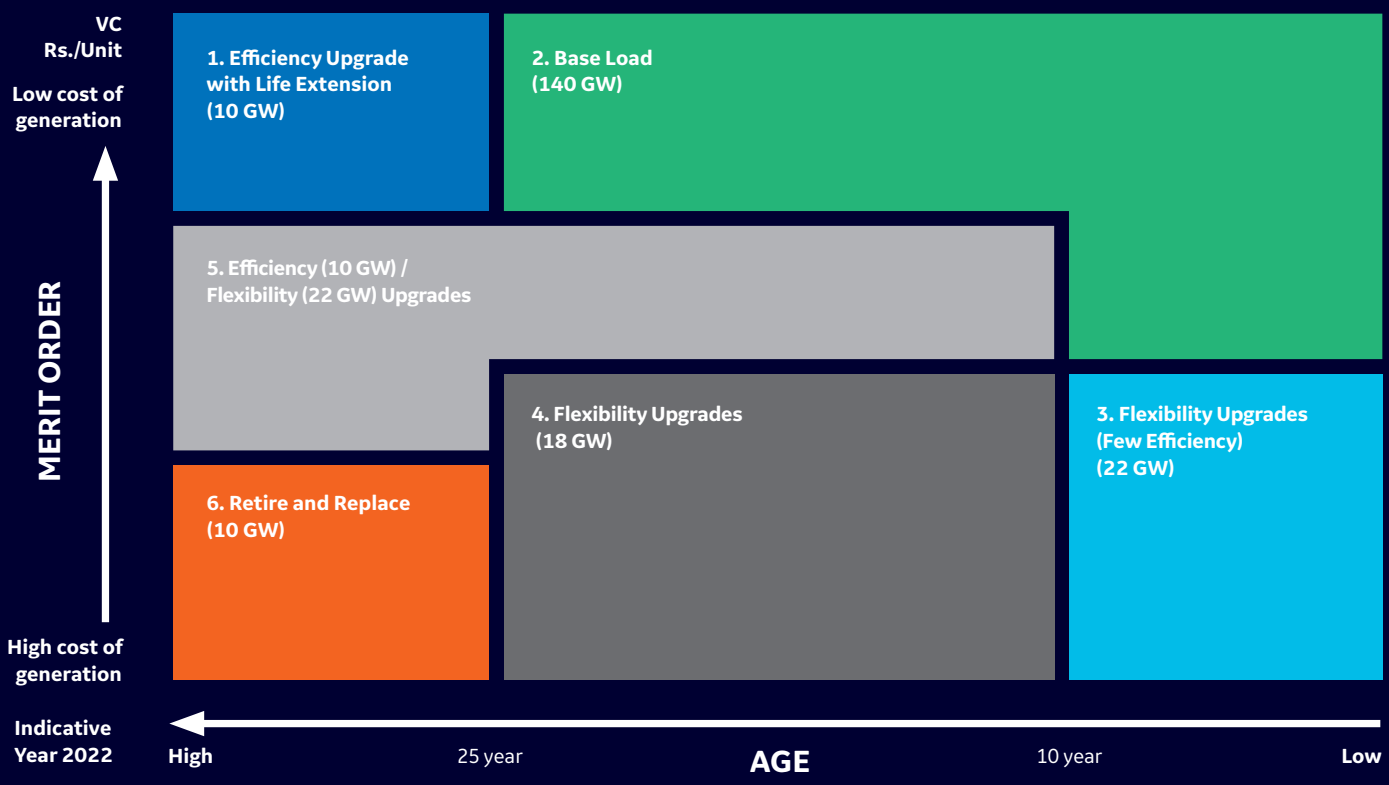
Currently, coal power plants in India are running at suboptimal levels. In 2014, the average efficiency of thermal power plants was 33.5%, which is more than 10% lower than the best operating coal plant in the world. There is huge potential in improving efficiencies of coal plants in India, and this could be the single most important factor in curbing CO_2/GHG emissions, reducing other air pollutants, and lowering the cost of power. There is 20GW of units that make excellent investment cases for efficiency upgrades, which primarily address the steam turbine.

To enable renewable integration in the most optimal way, the recommendation is to run new, higher-efficiency supercritical units on higher loads (>70%) as these units will see higher impact on O&M and heat rate degradation if used for flexing operations. Identify subcritical units 200-500MW with the mission to support grid flexibility by running at loads as low as 30%. The benefit of flexing identified coal units to a much lower load of 30% "focus flex" vs. flexing all coal units is more than Rs. 10,000 crores per year. We should avoid flexing all coal units and upgrade some of the identified units for flexible operation with reasonable investments.

How should we make these decisions?

A framework to assess and address needs of various coal-based power generating plants in India is required and should include the cost of generation and the unit's age to determine the course of action. A typical framework could look like the following chart. Every unit should have a defined operating profile and effort should be made to make the unit operate optimally to support that profile.

INDIA'S COAL POWER FLEET



Efficiency Upgrade with Life Extension -10 GW

Low cost of generation and required flexibility needs are bringing a second life to these units which have been outstanding performers. We should upgrade these units to extend life and improve efficiency.

2. Base Load -140 GW

The sector is on the right track with these high-quality units by driving air quality upgrades; the focus must now shift to implementation (which is widely delayed, even vs. GoI's extended schedule) and enforcement of the norms.

3. Flexibility Upgrades (Few Efficiency) -22 GW

High-cost newer units; upgrade to mostly flexible operation and in some cases implement efficiency upgrade solutions to reduce cost of generation to move them to base load.

4. Flexibility Upgrades - 18 GW

High cost of generation for 10-25 year old plants; upgrade for flexible operations to help renewable integration and meet peak demand.

5. Efficiency - 10 GW / Flexibility - 22 GW

Analyze cost benefits and merit order positioning to determine whether to drive efficiency or flexibility upgrade. Location will also play a major role – those close to load centers / far from mines will be candidates to flex. The impact of efficiency improvement can be huge: Gujarat State Electricity Corporation's Ukai plant demonstrated over 14% heat rate improvement post-upgrade, resulting in 50 crore of annual savings while drastically reducing CO_2.

6. Retire and Replace - 10 GW

Plants near the end of their useful life should be replaced with higher efficiency ultra-supercritical (USC) plants. In fact, retirement has already been planned for many of these units and orders for new USC units are in process across the country.

India's energy sector is faced with a critical choice: make existing thermal plants a relevant, leading part of the sector's cleaner future, or squander the potential for cost-effective assets. We believe in the people who work every day in India's thermal sector; let's challenge them to lead!

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