Decommissioning of Coal-based Thermal Power Plants

A Baseline Study Report

Citizen consumer and civic Action Group (CAG)

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Significance of the study

Decommissioning refers to the technical actions taken for putting an end to the administrative controls from an authorized facility and reuse of the site. Decommissioning process generally includes planning, physical characterization, site decontamination, dismantling, and waste management.

The decommissioning process is used for dismantling thermal power plants that are operating beyond their useful life or have become inefficient for electricity generation and to prevent any further human-made disasters and public health issues. Decommissioning also helps in reducing habitat destruction, biodiversity loss and depletion of natural resources. It partially mitigates the climate crisis by preventing emissions from old power plants and facilitates power production in the country within the boundary of the global CO_2 budget.[1] This study is an overview of benefits and shortcomings associated with the decommissioning process of thermal power plants. The primary aim of this study is to turn the attention of local communities, policymakers and decision-makers towards the procedure, advantages and challenges associated with retiring old thermal power plants. The dissemination of the details for decommissioning of old thermal power plants, and replacing them with carbon-neutral modes of power generation among the stakeholders and communities is the secondary aim of this study.

Methodology

The study comprises a multilevel review of policies and programmes on decommissioning. The qualitative and quantitative data was consolidated and analysed thematically through peer-reviewed research articles and reports downloaded from websites like CEA (Central Electricity Authority), World Bank, DowntoEarth and Carbonbrief, as well as some online blogs/news articles.

[1] Have we already blown our carbon budget?

Introduction to a global scenario of decommissioning

Germany is the first country that has set an ambitious target to become carbon neutral by 2038, by shutting down 84 of its existing thermal power plants in the next 18 years, along with greater utilization of renewable sources like wind, solar, etc for energy production.[2,3 & 4]

Also, U.S. has brought about a 40% decline[5] in coal-fired generation over the last decade and is further planning to bring down the capacity of coal power generation from 12.7 Gigawatts (GW) in 2018 to 2 GW in the next six years.

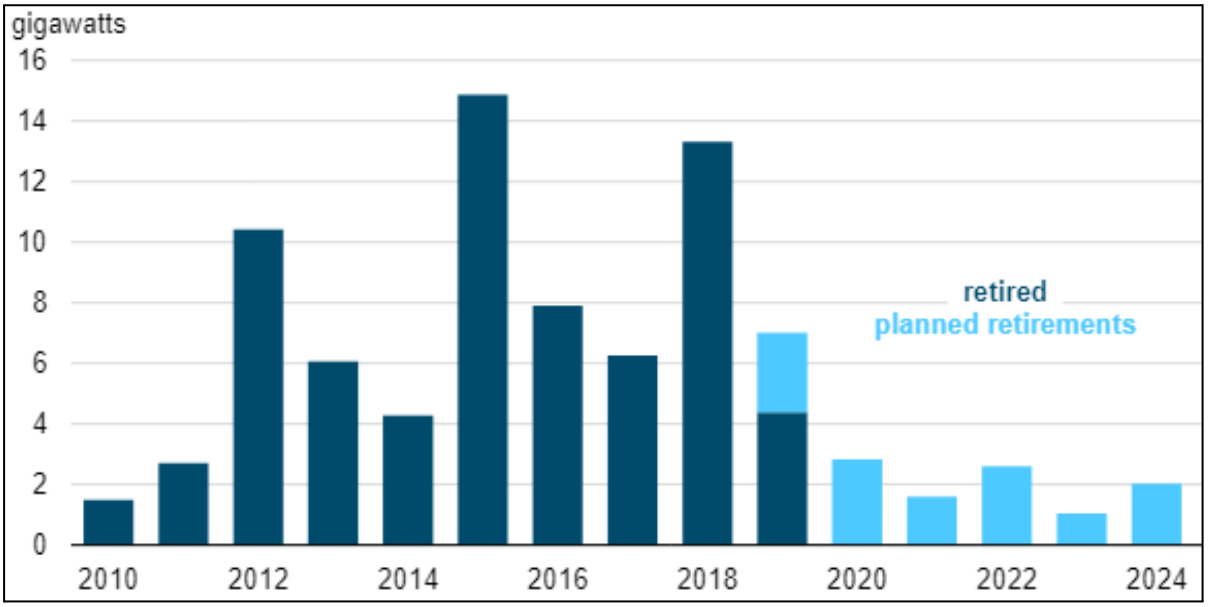

Figure 1: Total net summer capacity of retired and retiring coal units in the U.S between 2010 and 2025 (Source: EIA).

China is the world's highest coal consuming country. It has constructed a tremendously higher number of coal-fired thermal power plants in 2018 to replace the few it had retired already.[6] This has made China surpass its

[2] Bye bye lignite: Understanding Germany's coal phaseout
[3] Germany to close all 84 of its coal-fired power plants, will rely primarily on renewable energy
[4] Mapped: How Germany generates its electricity
[5] Why there's no bringing coal back
[6] China bucking global shift from coal-fired power: environmental study

coal-fired capacity to feed its rocketing electricity demand.[7] The United States Energy Information Administration (USEIA) ranked India in third position in the list for coal usage from 1980-2013.[8] The CEIC data on Indian coal consumption between 1965-2018 showed a 61% rise during the period 2009-2018.[9] Simultaneously, the plant load factor (PLF) of coal and lignite based thermal power plants in India was reported to be reduced by 16.83% in the same period.[10]

Stepwise pre- and post-decommissioning procedures

According to the report of the Environmental Protection Agency (EPA) which is an independent agency of the United States, there are four crucial steps in the decommissioning process for coal-fired thermal power plants.[11] They are as follows:

Step 1

Shut-down: After investigating and evaluating the techno-economic and commercial situation of a power utility, it is stopped with the decision to retire them. During this phase, the actions taken by public or private power companies for phasing out a coal thermal power plant are as follows:

- Respective board for coal plant accords for approval of roadmap for decommissioning, remediation and redevelopment of the site.
- Deployment of dismantling personnel through the tendering process.
- Announcement for stopping the power production in a particular unit(s) in the thermal power plant.

[7] China is building coal power again
[8] Coal Consumption by Country
[9] India Coal Consumption
[10] Power Sector at a Glance ALL INDIA
[11] COAL PLANT DECOMMISSIONING

Step 2

Decommissioning: Once the thermal power plants reach the end of their lifespan or are found without any plan to comply with the emission control norms of Central Pollution Control Board (CPCB), they are decommissioned to replace with a newer unit with upgraded technology.[12] The major actions taken during this phase are as follows:

- Termination of permits like air pollution control, water withdrawn for cooling and water discharge for operation of the unit.
- Removal of hazardous materials and reusable equipment.
- Pull-down structure and close the ash pond.

Step 3

Remediation: The clean-up of contaminated areas such as water bodies and agricultural land adjacent to the retired thermal power plant and all the environmentally hazardous material that is stored/disposed of after decommissioning is essential for effective reuse of the site. This step aids in reducing the environmental burden caused by old and inefficient thermal power plants. The remediation step is performed as detailed below:

- The soil and water samples near the retired thermal power plant are collected, tested and documented for any contamination.
- A plan is developed for the cost and extent of clean-up in line with reuse of sites like residential or industrial.
- Stakeholders, environmental consultants and state pollution control boards are involved in the approval of the plan.
- The land-use restrictions are informed before redevelopment on that site to manage the leftover contamination on the site.

[12] 5.1 GW of Coal-Based Capacity to be Shut Down as Part of India's Phase-Out Plan

Step 4

Redevelopment: After getting rid of the retired thermal power plant, the site can be reused after clean-up as per the community needs to recover the cost of decommissioning, remediation and redevelopment. However, to avoid any new contamination, the re-use of the site should be based on a shared vision of the stakeholders. The redevelopment step is performed as detailed below:

- Secure Environmental Clearance (EC) after a well-conducted public hearing process for the upcoming projects like new thermal power plant or solar plant.
- Develop a plan against the challenges in redevelopment on the site that includes appointing a controlling agency, resource utilisation, economic development opportunities, zoning issues, restriction in land-use, vehicular traffic, site access, socio-economic and health impact on local communities.

Opportunities and challenges in decommissioning

When a coal-fired thermal power plant is no longer efficient enough to be operational or has been commissioned more than twenty-five years ago, it is considered for decommissioning by the Central Electricity Authority (CEA). The planned shut-down or removal of old and inefficient units of thermal power plants leads to its decommissioning. This term was initially popular in the nuclear industry, and from the end of the 90s, decommissioning has become more and more of common interest among other industries as well. Decommissioning can reduce the acute and chronic effects of air, water and land pollution on nearby residents, fishermen and farmers.

In India, about 47% of the 396 thermal power plants are older than 25 years and their reducing efficiency sets a huge opportunity for the dismantling and recycling business.

However, it is anticipated that deconstruction of more than 40 year old units can be labour intensive projects and can adversely affect the environment at the end-point of the decommissioning process. There are other challenges in the decommissioning process such as hazardous waste generation, high cost of deconstruction, risks related to health and safety of labourers. However, it can be resolved through decommissioning in a systematic way, as follows:[13]

1. All potential sources of environmental contamination should be removed for restoration of land in the post-decommissioning phase.
2. Re-conditioning or reuse of equipment or their parts after dismantling the thermal power plant unit.
3. Reduce all the possible impacts on health and safety of labourers involved in dismantling through proper training and using safety equipment.
4. Deconstruction of the facility should be done under the safety guidelines.
5. The recyclable scrap material after deconstruction should be sold out to scrap dealers to minimise waste.
6. Planning for safe disposal of hazardous materials in line with hazardous and other wastes (Management and Transboundary Movement) rules, 2016.[14]
7. All socio-ecological risks and impacts should be identified early in the planning phase.
8. Rehabilitation of existing plants to improve their efficiency, instead of adding super-critical capacity.

[13] 4 key steps to decommissioning coal-fired power plants
[14] Hazardous and other waste (Management and Transboundary Movement) Rule, 2016

Decommissioning of coal thermal power plants in India

The Ministry of Power in India had ordered the decommissioning of coal-based power plants that were installed before 31 December, 2003. The CEA has suggested the retirement or renovation of more than 20 years old and inefficient coal or lignite based thermal power units by installing new supercritical units.[15] The efficiency of a coal thermal power plant depends on the performance of its boiler and the type of coal utilized.[16] Twenty-five years after commissioning, the power generation capacity of thermal power plants declines with successive years. Despite these well-known facts, decommissioning seems to be a difficult decision to be made in India due to its steady energy demand and declining economy. However, it is crucial to do away with the old thermal power plants as they keep on increasing the pollution load on the environment as well as fuel the industrial disasters.

India has recently retired some of its old coal/lignite based thermal power plants-particularly those constructed in the 1970's and 1980's - to replace them with new plants with some of them being supercritical plants.[17] A total capacity of 16,789 MW plants are to be retired as listed in the National Electricity Plan (NEP) report, 2018 out of which a total capacity of 8470.38 MW has been dismantled during the period 2016-2019.[18] Upcoming units that will replace decommissioned ones in India will contain the supercritical technology with a Thermal Efficiency Ratio (TER) of 42%.[19] Upcoming coal-fired thermal power plants will run on both imported coal and Indian coal, thus, will be more efficient[20] than conventional subcritical boilers with a TER of 32%.[21]

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[15] GUIDELINES FOR RENOVATION & MODERNISATION/LIFE EXTENSION WORKS OF COAL/LIGNITE BASED THERMAL POWER

[16] Boiler Efficiency

[17] 8,000 MW of old thermal power generation capacity phased out, says official

[18] CEA, National Electricity Plan, 2018

[19] Policy induce stepped-up thermal efficiency in power plants

[20] Difference Between Subcritical and Supercritical Boiler

[21] Super Critical Thermal Power Plant Boiler Efficiency Calculation Using Imported Coal

Retirement of coal/lignite thermal power plants in Tamil Nadu

According to a report by Climate Risk Horizon (CRH), the decommissioning of less efficient thermal power plants in Tamil Nadu will save a lot of money that is otherwise being spent on the renovation of these plants.

Table 1: Cost benefits of decommissioning thermal power plants in Tamil Nadu (source: TANGEDCO's recipe for recovery).[22]

Discom dues		15,885 crores INR
Potential savings	Avoided retrofits	1,854 crores INR
	Renewable energy replacement (only>20 years)	1,724 crores INR
	Rationalisation of under-construction projects	26,647 crores INR
	Fixed cost rationalisation	1,139 crores INR
	Renewable energy replacement (all>4/kwh)	6,097 crores INR

It is observed that at present in Tamil Nadu power plants that are more than 30 years old and inefficient occupy an installed capacity of 4,290 MW and these need to be decommissioned. In 2017, 1st, 2nd, 3rd, 4th and 5th units of Ennore Thermal Power Station (ETPS) of total installed capacity of 450 MW were decommissioned.[23] The Tamil Nadu Generation and Distribution Company (TANGEDCO) has proposed a 660 MW replacement project for ETPS that will be commissioned after 2022. In 2019, 7th unit (100 MW) and in 2020, 2nd, 4th, 6th and 8th units (3X50 MW+100 MW) of Neyveli Thermal Power Station-I were retired. These are

[22] TANGECO's recipe for recovery
[23] GoI, Decommissioning of ETPS

planned to be replaced by a new 600 MW installed capacity project proposed by Neyveli Lignite Corporation (NLC).[24, 25,26,27&28]

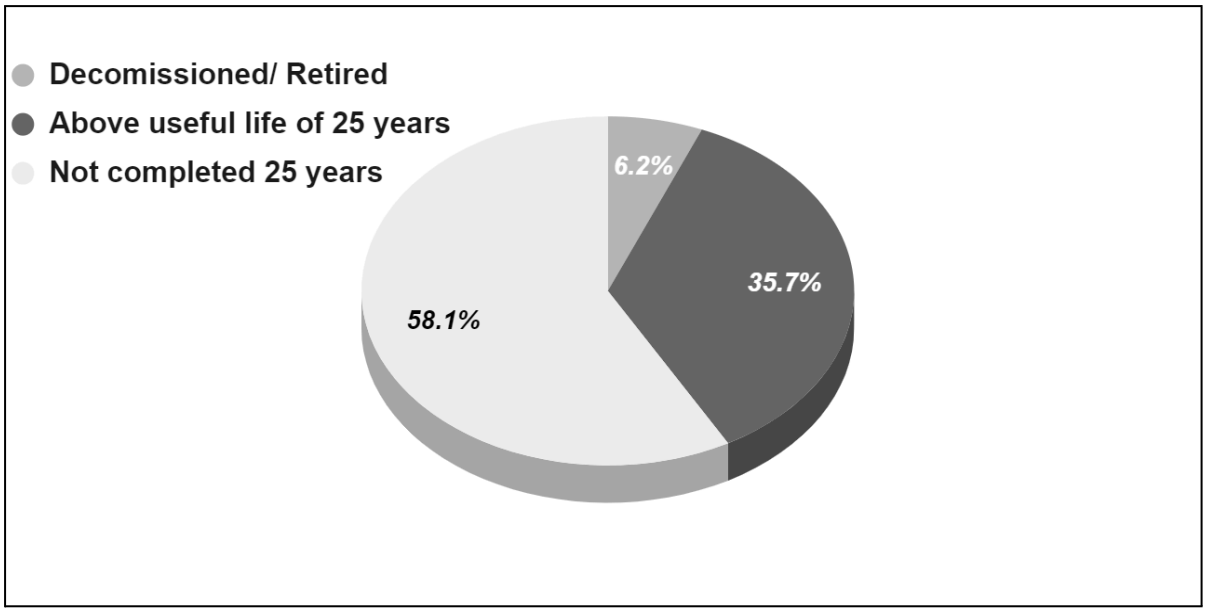

Figure 2: The status of coal-fired plants in Tamil Nadu as of August, 2020 (Source: CEA).

Affordability of coal/lignite based power generation in Tamil Nadu

1. **An existing sub-critical thermal power plant:** Through the financial reports from March 2017 to March 2020 of Neyveli Lignite Corporation (NLC), which is a "navratna" company of the Indian government, it was found that the overall liabilities, debt and debt on equity of the company has increased by 55.15%, 137.19% and 122.11% respectively.[29] The increased debt and debt to equity ratio are an indicator of increased reliance on debt for the company's operations amid reduced investor confidence which is evident from stagnant equity as opposed to burgeoning debt over the last four years. The operational efficiency of NLC has decreased, since, the

[24] NTPS Unit 2, 4 & 8
[25] NTPS Unit 6
[26] NTPS Unit 5
[27] NTPS Unit 3
[28] NTPS Unit 7
[29] Financial analysis

asset turnover has reduced by 38.24% and the payback period has significantly increased by 94 days. The reduced profitability of NLC in terms of Return on Capital Employed (ROCE), Return on Equity (ROE) and Return on Assets (ROA) which are 3.26%, 8.42% and 4.69% respectively, clearly indicates that it can affect the market competitiveness of its thermal power plant in generating power at low cost in comparison with renewable energy in Tamil Nadu. The continued downward trend for the costs of renewable energy is already pushing the government and investors to invest in secure, affordable, and clean energy.

Out of the 3,690 MW installed capacity, NLC has already decommissioned Neyveli Thermal Power Station-I (600 MW).[30] Now, it should decommission the units that are more than 30 years old, which is Neyveli Thermal Power Station-II (1370 MW). To replace the decommissioned capacity NLC should replace them with renewable energy technologies like Concentrated Solar Power (CSP) plant, Floating Solar Photovoltaic (FSPV) and Rooftop Solar Photovoltaic (RSPV). It can operate as coal-solar hybrids with the existing new units of Neyveli Thermal Power Station-I Expansion (420 MW), Neyveli Thermal Power Station-II Expansion (400 MW) and New Neyveli (1,000 MW), respectively, till these thermal power units work efficiently. Further, the remaining units of thermal power plants should be completely phased out through proper decommissioning and replaced with clean energy sources.

2. **A proposed super-critical coal thermal power plant:** The upcoming super-ambitious projects of TANGEDCO, the Cheyyur thermal power plant of 4,000 MW installed capacity has been granted Environment Clearance (EC) for commissioning, however, it is scrapped now.[31] Since it will be running on imported coal, the

[30] S Asia's 1st thermal station at Neyveli decommissioned
[31] Cheyyur ultra mega power project to be scrapped soon

tariff rates will be less competitive than renewable energy in Tamil Nadu, thus, will add to the already debt-burdened Indian economy. In addition to this, it will also lead to a delay in retiring old/inefficient coal power plants in order to levelise the tariff and regulate the financial risks of additional fiscal costs to build and operate Ultra Mega Power Project (UMPP). Cheyyur plant will be 48% more expensive in terms of cost for electricity production by 2035 in comparison with solar commissioned in 2018 in the state.[32] Also, in the 1,255 acres of land area utilised for this project, a CSP project with a generation capacity of 210 MW (6 acres=1MW) and a Capacity Utilisation Factor(CUF) of 50% can be commissioned.[33]

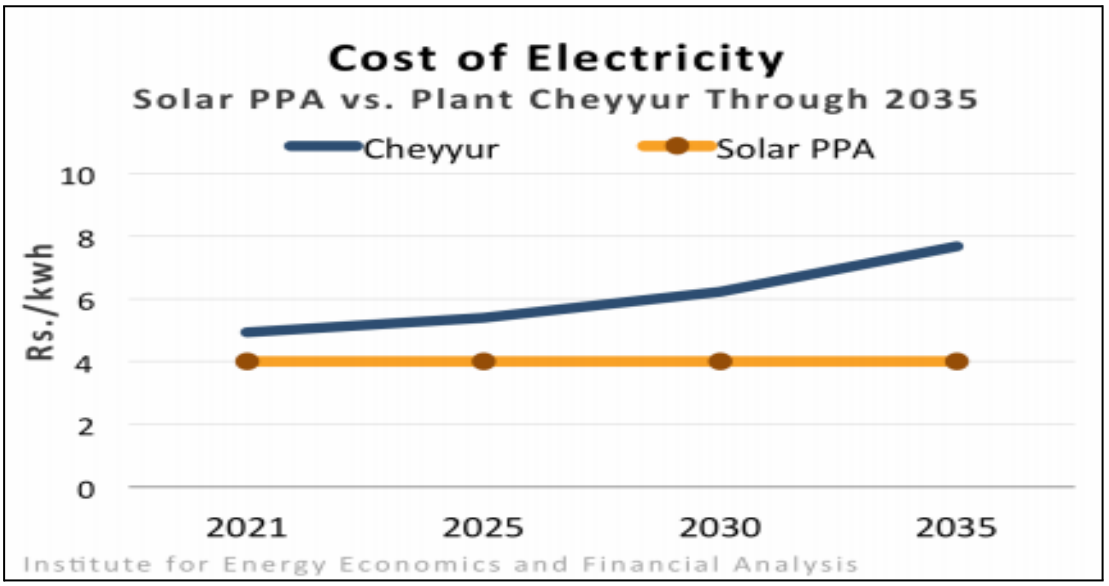

Figure 3: Graphical representation of electricity cost, coal Vs solar project.

A detailed post-decommissioning replacement plan

The Mettur Thermal Power Station I (MTPS I) (4X210 MW) is a more than 30 year old plant whose PLF has reduced from 81% in 2015-16 to 78.92% in 2018-19.[34] After decommissioning all the four units of MTPS I

[32] Cheyyur UMPP: Financial Plan Will Make Electricity Unaffordable
[33] THE STATE OF CONCENTRATED SOLAR POWER IN INDIA
[34] Declining Efficiency of Mettur Thermal Power Station: Reasons, Risks and Remedies?

the general performance of MTPS will be changed, however, it can be replaced with a 22 MW CSP project which operates with a CUF of 50% that supplies a hybrid power with MTPS II. Along with that, a proposed 100 MW FSPV with a CUF of 35% can be commissioned over the Stanley reservoir of Mettur Dam and RSPV of 242 MW with a CUF of 20% can operate in Salem district of Tamil Nadu.

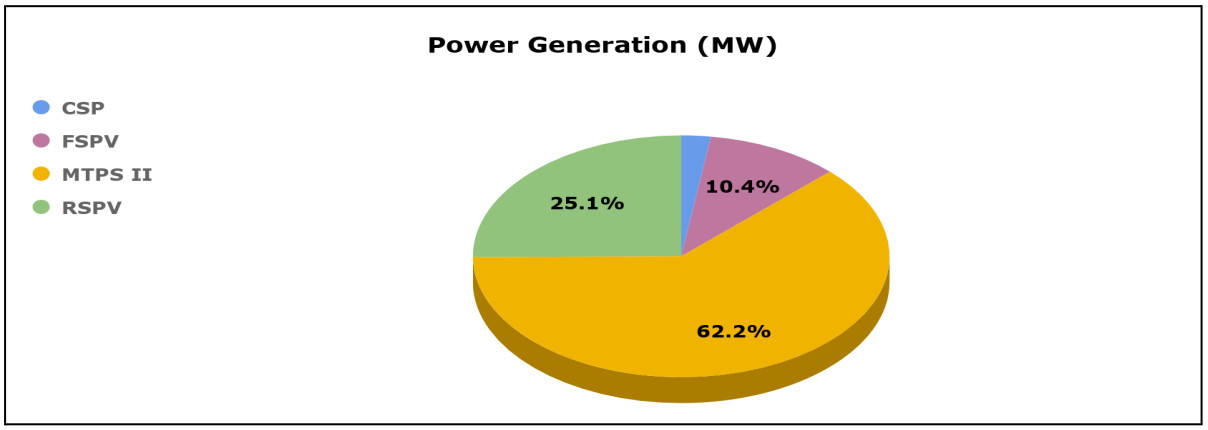

Figure 4: Projected contribution (%) in power generation by each of the sources (Source: ThermalWatch).

Conclusion

It is clear from the points discussed in this report that decommissioning is the best way to reduce environmental pollution and health hazards for residents in the surrounding areas from the short and long term impacts of running the old and inefficient power plants. Thus, a comprehensive decommissioning plan should be developed with a focus on minimising the potential negative impacts during the decommissioning work and maximising post-decommissioning opportunities.