EARLY AGE-BASED RETIREMENT OF COAL POWER PLANTS: MISPLACED EMPHASIS?

Prayas (Energy Group)

Early Age-based Retirement of Coal Power Plants: *Misplaced emphasis?*

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Prayas (Energy Group)

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Early Age-based Retirement of Coal Power Plants: Misplaced emphasis?

Summary:

Some studies have suggested that early retirement of coal-based generation is a solution to address some concerns in the power sector. According to these studies, age-based retirement of power plants will result in cost and efficiency savings, which accrue from replacing older generation with newer options that are expected to be more efficient and due to circumvented expenses on pollution control equipment. This paper analyses the claimed benefits of such action and compares it against the attendant risks.

It concludes that the estimated savings from such early retirement are not very high. The argument of unviability of installation of pollution control equipment to meet environmental norms also does not apply uniformly to all old plants.

Along with this, these potential savings from early retirement must be weighed against the benefits of the older plants' capacity value and ability to provide ancillary services. The risks of retiring older capacity aggressively should also be considered, as it may give impetus to fresh coal-based capacity addition. Besides, given economic, operational, and environmental drivers, the older capacity is likely to fade away naturally over the next decade. The amount of coal-based capacity in the pipeline, predominantly from central and state generators is a bigger cause of concern. These possible excessive capacity additions, from pipeline capacity and aggressive early retirement, could result in surplus capacity, resource lock-ins, and stranded investments. Thus, the emphasis on early retirement appears misplaced.

Any decisions regarding capacity additions or retirement must be backed by rigorous modelling-based analysis and consideration of intersectional impacts. In particular, a simplistic age-based criterion for early retirement may prove counter-productive.

1. Introduction

Thermal generation has historically played a leading role in the Indian power sector. Recent developments, however, have cast a shadow over the role coal has hitherto played. Due to the confluence of several factors; such as the rapid growth of competitive renewable generation, surplus generation capacity with states, lower than anticipated demand, and the social and environmental externalities associated with coal-based generation, dependence on it is likely to reduce in the coming years.

In this context, a discourse in support of retiring coal-based thermal power plants (TPPs) that are 20-25 years old has been emerging, as a measure to accelerate the phase out of coal-based generation. Benefits such as significant cost savings and efficiency improvements, owing to the existence of newer, cheaper, and more efficient sources of generation, have been linked with this early retirement (Shrimali, 2020; Fernandes & Sharma, 2020).

The premise for such age-based retirement is that older TPPs are likely to be less efficient, and hence, more expensive. However, this may not always be the case. Take the example of TPPs such as Rihand, Singrauli, and Vidhyanchal. These plants are older than 30 years, but operated at load factors greater than 70% in FY20, and had an average variable cost of Rs. 1.7/kWh and a total cost of just Rs. 2/kWh on average, which is well-below Rs. 3.6/kWh, the national average power purchase cost of conventional power applicable during FY20 (Central Electricity Regulatory Commission, 2019). Additionally, existing older capacity can play an important role in providing ancillary support[1] in an energy system with growing renewable generation and in meeting peak demand due to their lower fixed costs, though they must, of course, meet prevalent environmental norms.

It is apparent that retirement of coal-based capacity is a complex issue, which encompasses multiple challenges and risks, and has far reaching economic, environmental, and operational implications on all power sector stakeholders. Given this, decisions regarding the retirement of capacity merit scrutiny, and this study is a first step towards this. Following this introduction, Section 2 of the paper outlines the context of the study, in light of existing discourse, and Section 3 details the methodology and data sources used in this study. Sections 4 and 5 discuss the potential benefits and neglected aspects of age-based early retirement. The final section of the paper brings out why the emphasis on early retirement of coal-based TPPs may be misplaced.

2. Context of the study

The discourse justifies the early retirement of TPPs on the following grounds[2]:

- Older plants are less efficient and more expensive to operate, and using newer generation capacity instead could result in:
    - Variable Cost (VC) savings
    - better Plant Load Factor (PLF) for newer plants, reducing their generation cost and mitigating the challenge of stressed assets
    - coal savings due to better operating efficiency of newer plants
- Older plants are nearing end of life and it may be prohibitively expensive for them to recover the cost of Pollution Control Equipment (PCE) investments required to meet the environmental norms in their balance life

These conclusions and recommendations for early retirement are mostly drawn based on broad analyses conducted on average values at the national/state level. However, given the nature of the power sector and the non-uniform nature of demand and supply, such decisions require careful analysis, ideally based on detailed power sector modelling. Comprehensive modelling of possible load curves and supply curves, and tools such as dispatch and capacity expansion models should be used to identify the best capacity mix to meet possible load scenarios at optimal cost[3]. Such modelling should become the norm to inform capacity addition or retirement decisions, given the scale of the investments and the potential risk of lock-ins.

However, in the absence of such analysis, in this study, we critically evaluate the claimed benefits of early retirement using a similar approach based on national-level, average numbers. We also consider possible risks of aggressive, early age-based retirement of old capacity.

3. Methodology

For the purpose of this study, all coal-based generating units that have a date of commercial operation on or before 31st December 2000 have been considered, as they would have completed an operational life of 25 years by 2025. This includes lignite-based generating units. A minimum lifetime of 25 years has been considered since typical power purchase agreements with thermal power plants are signed for this duration. Thermal power plants are likely to be operational at least for this period, though the operational

[1] Ancillary support includes services that enhance grid stability through means such as balancing capacity to address supply and demand variations, and services to maintain grid frequency

[2] Several studies have discussed the potential benefits from early retirement of coal-based TPPs (Dang, Nuwal, & Acharya, 2020; Shrimali, 2020; Fernandes & Sharma, 2020)

[3] Due to significant variation in demand during the day and across seasons, time value of generation, i.e. when the plant generates must also be accounted for, in addition to units of energy generation.

life of a well maintained plant can be as high as 40 years. The upper limit of 2025 pools together all capacity that could be potential candidates for early retirement even by 2025, and thus expands the set of plants for potential retirement and the potential benefits from their retirement.

The total coal-based capacity in the country satisfying these conditions (Central Electricty Authority, 2019) amounts to 55.7 GW. As per data compiled from CEA documents, 9.1 GW of this capacity has already been retired[4]. This leaves 46.6 GW of operational coal-based capacity that was commissioned before 2000 (pre-2000 capacity). The potential benefits of retirement of this capacity has been analysed based on the following parameters:

- Variable cost (VC): The VC is the cost incurred on a per unit basis for generation by a fuel-based power generation unit. Given that it will only be incurred when the plant operates, it is the predominant component of savings claimed from early retirement.
- Fixed cost (FC): The FC is the annual lumpsum payment related to capital investment and maintenance of the generation asset, and most of it has to be incurred independent of any generation. It includes components such as interest on loans, return on equity, depreciation, and operation and maintenance charges.
- Plant Load Factor (PLF): The PLF is calculated as a ratio of the actual energy generated by the plant to the energy it would have generated if it were operating for the entire period at its rated capacity, calculated on an annual basis. This percentage value is a measure of productivity and efficiency of the generation unit.
- Specific Coal Consumption (SCC): The SCC is a measure of efficiency and is calculated as the coal consumed by a generating station per unit of output, and measured as kg/kWh.
- Capital expenditure related to Pollution Control Equipment (PCE): The revised environmental norms were notified by the Ministry of Environment, Forest and Climate Change (MoEFCC) in December 2015 (Ministry of Environment, Forest and Climate Change, 2015). This has been amended a few times since, the latest amendment being in April 2021 (Ministry of Environment, Forest and Climate Change, 2021). In order to adhere to these norms, most generating units would require installation or retrofitting of PCE, which would result in additional capital expenditure, that would have to be recovered through tariffs.

The requisite data for these parameters has been compiled from CEA documents, regulatory orders, and the Ministry of Power's Merit Order Despatch of Electricity for Rejuvenation of Income and Transparency (MERIT) database, which are publicly accessible. Data from financial year 2019-20 – the latest year for which it is available – has been used in the analysis. However, the data considered and the analysis conducted in this study are subject to a few caveats, which are elaborated below:

1. <u>Data:</u> The data for the parameters listed above has been collated at the unit level from CEA documents, regulatory orders, and the MERIT database. Due to constraints and shortcomings in collection and reporting, data is not available consistently across all the units for the capacity considered. However, the available data does account for VC, FC, and PLF for 81% of the capacity in question. Owing to this, the findings of this study are likely to be representative.
2. <u>Parameters:</u> The station heat rate (SHR) is the kilocalories of heat required to generate one unit of electricity. It is a preferred measure of efficiency that takes into account features such as the grade or quality of coal, along with the quantity. However, this data is not easily available at the unit level. Hence, SCC has instead been considered as a proxy for SHR.

[4] https://cea.nic.in/wp-content/uploads/2020/04/repl_thermal_units.pdf, and data compiled from CEA documents

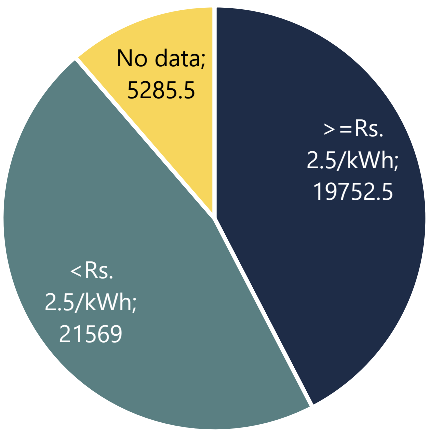
Using the data available, and in light of the caveats stated, a best-effort analysis has been carried out, wherein the aforementioned parameters are used to approximately assess the potential benefits claimed from early retirement of TPPs for the 46.6 GW of pre-2000 capacity.

4. Assessment of potential benefits from early retirement

4.1. Potential benefits from replacing older generation with newer generation

Significant cost savings are touted as a benefit of early retirement. These savings are predominantly from VC, as FC are mostly sunk costs and have components that will have to be paid regardless of early retirement. Therefore, for the early retirement to be economically viable and result in savings, the VC of the replacement generation must be lesser than that of the retiring capacity. The most likely candidates to replace generation from the retiring capacity are new coal-based capacity and renewable energy (RE) generation. The average VC of coal-based power plants that have been commissioned after 2015 (post-2015 capacity) is Rs. 2.5/kWh. The approximate cost of new renewable generation also amounts to the same. Given this, Rs. 2.5/kWh has been considered as the benchmark VC in this analysis. Retiring older plants with VC lesser than this benchmark will be uneconomical. Figure 1 shows the capacity-wise split of the 46.6 GW commissioned before 2000, based on the Rs. 2.5/kWh VC benchmark.

Figure 1. Split of capacity commissioned before 2000 based on the benchmark VC

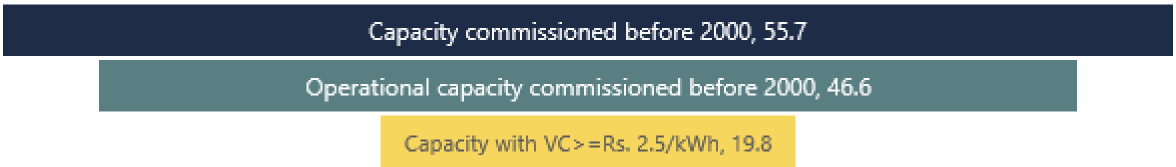


Source: Prayas (Energy Group) compilation based on CEA reports, regulatory documents, and MERIT database
Note: All values are in MW

As per figure 1, data is unavailable for 5.3 GW of the total considered capacity. Of the capacity with data available, retiring the 21.6 GW with VC below the considered benchmark will not be economical. This capacity is competitive with the capacity which would most likely replace it, as the replacement capacity will tend to have higher VC. The competitive nature of this 21.6 GW is illustrated by the fact that it operated at an average PLF of 59% in FY20, which is comparable to the PLF of the country's total coal generation fleet (56%), in the same year (Central Electricity Authority, 2020).

This leaves 19.8 GW commissioned before 2000, with VC greater than the Rs. 2.5/kWh benchmark. The argument of cost savings from early retirement could potentially be applicable only to this capacity. Even with just these preliminary economic considerations, this pre 2000 capacity for which retirement may be an option economically is significantly lesser than the initial capacity of 55.7 GW, commissioned before 2000, as illustrated in figure 2. The 19.8 GW, pre-2000 capacity, is analysed further to estimate the extent of potential benefits in cost savings, PLF improvement, and coal savings if it was to be retired and the generation replaced with generation from newer coal-based capacity or RE.

Figure 2. Pre-2000 capacity which can potentially be considered for retirement based on economic reasoning



Source: Prayas (Energy Group) compilation based on CEA reports, regulatory documents, and MERIT database
Note: All values are in GW

4.1.1. Cost savings, PLF improvement, and coal savings

The 19.8 GW pre-2000 capacity generated 81 BU in FY20 (Central Electricity Authority, 2020). For comparison with this pre-2000 capacity, 64 GW of coal-based capacity commissioned after 2015 (post-2015) is considered. In FY20, this post-2015 capacity operated at an average PLF of 41%.

This analysis considers a scenario in which the 19.8 GW pre-2000 capacity is retired, and the corresponding generation is procured from the post-2015 capacity instead. In FY20, this would have required procuring an additional 81 BU from the post-2015 capacity. This would have improved the PLF of the post-2015 capacity from 41% to 56% on average, bringing it on par with the national fleet average PLF, thus potentially helping to alleviate some of its stress.

Given that the average VC of the 19.8 GW pre-2000 capacity under consideration for retirement is Rs. 3.1/kWh and the same for the post-2015 capacity is Rs. 2.5/kWh, such replacement of the 81 BU generated is likely to result in annual VC savings of Rs. 5,043 Crores, which is only ~2% of the annual VC of all coal-based electricity generation in FY20.

In reality, these savings are likely to be lower still. As seen in table 1, post-2015 capacity with VC lesser than the benchmark operated at a much higher PLF than the capacity with VC greater than the benchmark in FY20. Since the cheaper post-2015 capacity is already operating at a higher PLF, the distribution of generation reallocated from the pre-2000 capacity is likely to be skewed towards the more expensive post-2015 capacity, thus reducing the potential savings. Some of the reduction in savings may be offset by the improvement in VC of the post-2015 capacity due to better efficiency resulting from higher PLF. As can be seen, even the assessment of just VC savings from retiring old plants requires very careful analysis considering all such parameters.

Table 1. VC-wise split of post-2015 capacity

	VC< Rs. 2.5/kWh	VC>= Rs. 2.5/kWh
Capacity (MW)	21550	27760
Average PLF (%)	50%	28%
Average VC (Rs./kWh)	2.06	3.04

Source: Prayas (Energy Group) compilation based on CEA reports, regulatory documents, and MERIT database
Note: Only the post 2015 capacity for which VC data is available is presented

In addition to the PLF improvement and cost savings, reduction in coal consumption is also a benefit claimed from early retirement. This is assessed on the basis of SCC, instead of SHR, as elaborated in Section 3.

The 81 BU generated in FY20 by the pre-2000 capacity proposed for retirement, had an average SCC of 0.696 kg/kWh and consumed 57 MT. Under the scenario detailed above, replacing this generation from the pre-2000 capacity with post-2015 capacity is likely to result in improved SCC, and by extension, lower coal consumption.

The average SCC of India's coal based generation in FY20 was 0.612 kg/kWh, representing a 12% improvement over the 0.696 kg/kWh of the pre-2000 capacity. Assuming that the 81 BU is generated from newer capacity with this national average SCC of 0.612 kg/kWh, it would have required 50 MT of coal, i.e. a saving of 7 MT. Even assuming a 20% improvement in SCC, i.e. just 0.557 kg/kWh – rarely seen in the Indian power sector – the coal savings for the 81 BU only amount to 12 MT. This translates to a saving of only about 1-2% of the total coal consumed by India's coal-based generation. The resultant savings in coal cost may be a little higher if such replacement results in reduced use of imported coal, however, it would still be in a comparative range[5].

Further, even if all the 5.3 GW of capacity for which data is not available is assumed to also have VC greater than the benchmark of Rs. 2.5/kWh, and similar operating characteristics as the other 19.8 GW, the conclusions broadly remain the same. The annual VC savings become about 2.5% of the total annual operational cost of coal-based generation, and the coal savings are in the region of 1.3-2.2% per year. Thus, it appears that while there would be some operational savings from retiring old plants, these are not likely to be significant, given the scale of the sector. These benefits will further vary, when weighed against the capacity and time value of the older capacity, as discussed in Section 4.

Cost savings aside, improvements in efficiency of the power generation mix is also a benefit claimed by the early retirement discourse. While this is desirable, the early retirement of TPPs appears to be a blunt instrument to achieve this objective. Introducing measures such as an inefficiency adder[6] and a National Merit Order Dispatch (MoD) stack[7] could aid in disincentivising inefficient generation.

4.1.2. Facilitating retirement through VC savings

The pre-2000 capacity is likely to have lower FC than its newer counterparts, given that most of their capital project costs have already been paid over the years of operation. This results in lower upfront payments and, by extension, lower cost of early retirement for the older TPPs. Even though the VC savings from retirement of pre-2000 capacity is only in the region of Rs. 5,000 Crores per year, it may still be beneficial if it can pay for the fixed cost of early retirement of old plants. To analyse the extent to which such facilitation is possible, figure 3 illustrates the FC-wise split of the pre-2000 19.8 GW under consideration.

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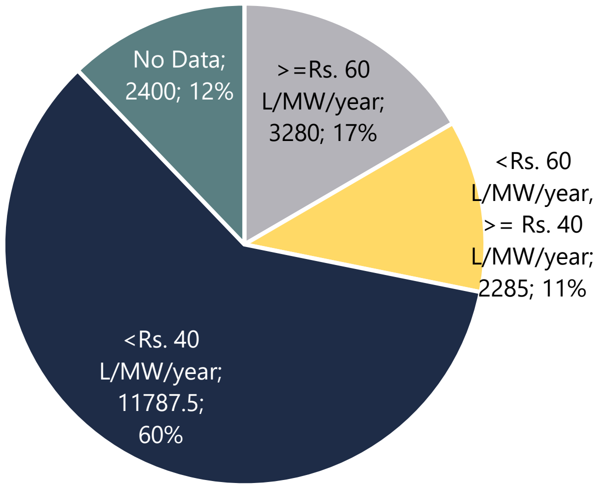
[5] Even if one assumes that all the 5.3 GW of capacity for which data is not available also has a VC >= Rs. 2.5/kWh (and similar operating characteristics as the other 19.8 GW), the conclusions broadly remain the same. The annual operational cost savings become about 2.5% of the total annual operational cost of coal-based generation, and the coal savings are in the region of 1.3% - 2.2% per year.

[6] An amount, charged based on upward deviation from the SHR norms, could be added to the VC of the generating station as a penalty. This would move inefficient plants (with higher SHR) down the Merit Order Dispatch stack, and reduce generation from such stations.

[7] A MoD stack for the whole country would take into account all the available generation units, and by default the plants with lower VC would be dispatched ahead of plants with higher VC. However, this would be subject to the demand for power and the availability of the plants with lower VC.

Figure 3. FC-wise split of pre-2000 capacity with VC>=Rs. 2.5/kWh



Source: Prayas (Energy Group) compilation based on CEA reports, regulatory documents, and MERIT database
Note: All values are in MW

As is seen, a majority (60%) of the total pre-2000 capacity considered has lower FC, amounting to lesser than Rs. 40 lakhs/MW/year. This 11.8 GW generated 44.6 BU in FY20. The total cost for this generation is, on average, Rs. 3.7/kWh, which includes a VC of Rs. 3.1/kWh and a FC of Rs. 0.6/kWh. This is comparable to the national average power purchase cost for conventional generation at Rs. 3.6/kWh.

If generation from this 11.8 GW is replaced with post-2015 generation having an average VC of Rs. 2.5/kWh, as described in the scenario considered, it will result in annual VC savings of Rs. 2,447 Crore. On the other hand, the annual FC paid for this capacity in FY20 was Rs. 3,083 Crores. Thus, it's unlikely that VC savings alone can compensate for the FC payments for early retirement. These observations remain consistent on extending the FC limit to include all capacity with FC lesser than Rs. 60 lakhs/MW/year. On replacing generation from this larger bucket of 14.1 GW with post-2015 generation, the resultant annual VC savings is Rs. 2,960 Crores, compared to the annual FC paid for this capacity, which was Rs. 4,208 Crore.

However, as with the VC savings, this comparison between the VC savings and FC payments, is not straight forward and requires deeper analysis. The actual FC to be paid for early retirement would depend on factors such as the share of the FC which would not have to be paid upon early retirement (such as some O&M expenses), the share of the FC that is due to recently undertaken repairs and maintenance or additional capitalisation, and how much of the embedded asset (e.g. land, dedicated transmission network etc.) can be monetized upon retirement[8].

Hence, a more detailed unit-wise analysis is required to understand if VC savings can pay for FC, post retirement.

4.1.3. Considering replacement with RE

The discussions hitherto have only considered one extreme scenario where all old coal-based generation is replaced by its more recent counterpart. However, in reality the displaced coal generation is likely to be replaced by a mix of coal and renewables, based on time of day, seasonality, and cost. Therefore, it would be interesting to understand the implications of replacing all the old coal-based generation with RE, using a similar broad-brush analysis, to examine the other extreme.

[8] The annual VC savings are compared against the current annual FC payment stream. Instead, an upfront one-time payment of the remaining FC of the plant could also be considered. The calculation of such residual payments would be dependent on many case-by-case parameters, though the conclusions drawn are likely to broadly remain the same.

It should be emphasised that RE generation is variable and intermittent. For example, solar is diurnal and wind is predominantly seasonal. Moreover, RE has a utilisation factor which is much lower than that of thermal generation. Hence, the RE source may not be able to supply power at the same time that the coal-based plant it potentially replaces did. Owing to this, a one-for-one comparison of coal-based generation with RE is not really appropriate. However, we do so in order to get a broad understanding of the implications of replacing all the old coal-based generation with RE.

In this scenario, the benefit of improving the low PLF's of new TPPs and addressing such stressed assets will not be realized if the replacement were RE generation. On the other hand, the realized coal savings could be significantly greater, as all the coal used to generate from the retiring units will be saved on replacement with RE. But, since the benchmark VC of Rs. 2.5/kWh is also roughly the cost of recent RE generation, the VC savings estimated are likely to remain in the same ballpark. Given that it may not be possible to replace old coal-based generation entirely with RE and the mixed benefits of doing so, the case for more detailed disaggregated analysis of early retirement of coal-based TPPs – even when potentially replaced by RE generation – remains.

4.2. Potential benefits from circumvented PCE installation

In order to be in compliance with the revised environmental norms, notified by the MoEFCC in December 2015, TPPs maybe required to undertake additional expenditure towards installing PCE or implementing other solutions. Adherence to the norms by all TPPs is crucial, given the impacts of pollution from thermal generation. But taking up the additional capital expenditure towards compliance is a cause of concern with regard to economic viability, especially for older TPPs. Given that these older TPPs are nearing end of life, they may find it difficult to recover such investments in their balance life. Hence, it is argued that it may be better for older coal capacity to retire rather than incur such PCE related additional capital expenditure.

The impact of PCE costs on the economic viability of a thermal generation project is an important cause of concern. However, this is not an issue that is related to the age of the project alone. In fact, data indicates that of the 46.6 GW of operational capacity commissioned before 2000, 14.9 GW has total cost (i.e. FC+VC) below Rs. 3/kWh. The tariff impact of PCE is estimated to be around Rs. 0.25-0.75/kWh (Srinivasan, et al., 2018). Even if one assumes a higher tariff impact of Rs. 1/kWh because the older generation units will have to recover this investment in a shorter time period, the total tariff for generation from this 14.9 GW commissioned before 2000 with PCE installation will still remain below Rs. 4/kWh. This suggests that such capacity may well find it viable to install PCE, given that the national average power purchase cost for conventional generation is Rs. 3.6/kWh, even without considering the PCE related costs.

Further, 23.6 GW of the 46.6 GW of operational capacity commissioned before 2000 has already issued tenders for PCE installation (Central Electricty Authority, 2020), and hence, undertaken some operational and economic investments towards adherence to the revised norms. Of this, 14.2 GW have already awarded bids, and 840 MW, all of which was installed prior to 1995, have already commissioned PCE.

From the above, it is apparent that some older plants have already undertaken PCE related expenditure and others may still be viable despite such costs. It could also be argued that these costs are anyway justified if the health benefits of retrofitting PCE are considered.

Things are further complicated by a notification from the MoEFCC on Apr 1, 2021 according to which older plants close to retirement can continue to operate without installing PCE by paying a penalty, applicable on generation beyond their specified date of retirement (Ministry of Environment, Forest and Climate

Change, 2021)[9]. Thus, they are no longer legally required to install a PCE at all (problematic as that may be). In any case, generation costs from old plants will go up – either due to PCE installation or due to the penalty – as a result of which generation from older plants would reduce.

Hence, a purely age-based decision for retirement is not an effective measure even with regard to the financial feasibility of PCE installation. It would be more apt if decisions regarding retirement are taken on a unit-wise basis, taking into account varying crucial parameters like balance life, PLF, current cost of generation, cost of measures required to meet the norms, etc.

5. Neglected aspects of early retirement

The discourse around the benefits of early retirement of coal-based power plants often fail to take into account the benefits of operating older capacity and repercussions of retiring them.

For instance, it is important to note that the savings claimed from early retirement do not account for the capacity value of the extant, older capacity. In a power system with growing renewable generation, pre-2000 capacity, can effectively provide ancillary and balancing services and aid with meeting seasonal and peak demand at prudent costs, owing to lower FC (Singh & Tongia, 2021). The potential savings from their early retirement would diminish if such benefits are considered.

Additionally, unplanned, early retirement of coal based capacity may also have significant repercussions. Aggressive early retirement could trigger a shortage mentality with regard to generation capacity addition, especially at the state level. Since perceived shortages are anathema to state energy politics, they may inadvertently lead to calls for a fresh wave of investments in coal-based capacity – typically by state owned entities – given the prevailing political incentives. For example, excessive capacity additions driven by poor planning and a perception of shortage have been carried out in the states of Maharashtra and Telangana in the recent past (Prayas (Energy Group), 2017, pp. 29-31; Prayas (Energy Group), 2020). A more recent example was seen in Mumbai, when in response to the power outage in the city for one day, there were calls to add new capacity (Business Standard, 2020).

Hence, unplanned early retirements can potentially trigger unnecessary capacity additions that are likely to stay in the generation mix for longer, with the associated economic and environmental implications.

6. Misplaced emphasis on early retirement

On one hand, the early retirement of TPPs based on age is not likely to bring in significant savings. The estimated operational savings that can be realised from the early retirement of coal-based power plants appears to be limited. Replacing generation from pre-2000 capacity with recent post-2015 coal-based generation will likely result in annual VC savings of around 2% and annual coal savings of 1-2% at the national system level. Additionally, the claim of facilitating early retirement through VC savings paying for the FC of the retiring capacity does not seem to hold at the aggregate level and can only be corroborated with disaggregated, unit level analysis. The conclusion remains broadly the same even when RE generation is considered as the replacement for the retiring coal-based generation.

On the other hand, improvements in system efficiency is a desirable outcome, but options such as introducing an inefficiency adder and implementing a national MoD stack are likely more effective levers to achieve it, as opposed to the early retirement of TPPs.

[9] Several aspects of the 2021 revision of the environment norms are debateable and merit scrutiny (Sardana & Ramanathan, 2021). For instance, plants are no longer legally required to install a PCE, as long as a penalty is paid instead, which seems to tolerate a “pollute and pay” approach.

Additionally, the argument of retirement on the parameter of vintage alone does not apply to the unviability of PCE installations in older plants, as some older plants with shorter balance life may still be economically viable post PCE installation. The situation is further complicated by the notification from MoEFCC allowing plants closer to retirement to operate without installing PCE till the specified date of retirement, after which any generation from such unit is levied with a penalty (Ministry of Environment, Forest and Climate Change, 2021).

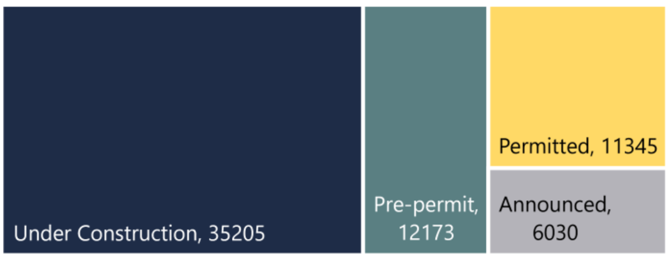
This is not to say that none of the old plants should be retired early. As demonstrated in this paper, a more detailed analysis considering the various technical, economic and operating characteristics of individual plants and units, could throw light on specific units or plants whose retirement provides benefits. However, a purely age-based criterion for retirement can be counter-productive.

As discussed in section 4, any of these potential benefits from early retirement must be weighed against the potential benefits of older plants –with perhaps limited operations– such as its capacity value and its role in effectively providing the critical ancillary services required to support the growing share of renewable energy in power generation. In addition to the limited benefits, aggressive early retirement of TPPs may also potentially set off calls for a fresh wave of capacity additions.

Given the opportunities and obstacles, any decision making associated with retirement of capacity merits deeper analysis, accounting for multiple parameters such as plant/unit level details, contractual commitments, load shapes, generation shapes, capacity value, etc. These decisions must also be reviewed on a regular basis, to reflect the changes in the power sector. However, despite the crucial role they will play in the interim, it is important to note that owing to their advanced age and increasing costs due to repair, maintenance and environmental norms related expenses, the older capacity is likely to fade away naturally over the next decade or so. The emergence of more competitive alternative sources of generation, the availability of cheaper power, and other economic, operational, and environmental drivers further strengthen this possibility.

The coal-based capacity in the pipeline, on the other hand, is a cause of concern. India has 64.8 GW of thermal capacity that has been proposed and may come up in the foreseeable future, as illustrated in figure 4. This pipeline capacity is most likely to be in excess of the modest net coal-based capacity addition required to meet future demand, as indicated by some modelling studies, such as (Central Electricity Authority, 2020; Sreenivas, et al., 2020; IEA, 2021).

Figure 4. Capacity in the pipeline



Source: Boom and Bust 2020, July 2020, (GEM, Sierra Club, Green Peace, CREA)
Note: All values are in MW

The two pronged potential for excessive capacity additions, both from pipeline capacity and perceived shortage on account of aggressive retirements, pose a more serious threat than the generation from older capacity. These capacity additions are likely to stay in the generation mix for longer and could result in surplus capacity, resource lock-ins, and stranded investments. In light of this, the focus on early retirement based only on age, without sufficient analysis, appears misplaced and it may be more pertinent to prevent excess coal-based capacity addition.

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