POLICY BRIEF

USING THE National Clean Energy Fund to Clean Coal Power Plants

CENTRE FOR SCIENCE AND ENVIRONMENT

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Executive summary

A Ministry of Finance report on National Clean Energy Fund (NCEF) estimated that the clean environment cess will allow the government to cumulatively collect around Rs 55,000 crore by 2016–17. Of this, it estimated, less than half would be transferred to NCEF by 2016–17—actual funding so far has been likely even lower despite concerted efforts over the last two years. While increasing amounts are going to projects other than renewables to both increase and broad-base benefits, we believe that use of NCEF funds to clean the coal-based power sector has the potential to achieve several key goals: significant utilization of NCEF funds for pollution control technology; project costs vetted by independent regulator; clear emissions cut that will be enforced by online monitoring systems.

Centre for Science and Environment (CSE) estimates that the new environmental norms applicable to the coal-based power sector may require almost Rs 72,000 crore of investment by existing plants. While the estimated tariff increase is not material, raising this amount of funding from commercial banks would be challenging. Our model recommends that around Rs 47,000 crore, half of the anticipated coal cess over the next three years, be used to support the sector's investment needs. We believe the support should not be in the form of a subsidy but provided through 10–15-year-tenure loans at prime interest rates (currently around 9.5 per cent). Notably, the annual returns to NCEF from these loans would be around Rs 6,200 crore, which could be deployed to support renewable and clean environment projects.

INTRODUCTION

The NCEF was created in 2010 by introducing a 'clean energy cess' of Rs 50 per tonne on every tonne of lignite or coal sold. The overall objective of the NCEF is '*for funding research and innovative projects in clean energy technologies'.*

Since the NCEF's inception, the cess has been increased thrice—it was increased to Rs 200 per tonne from 1 March 2015 and Rs 400 per tonne from 1 March 2016. Given the recent increases, the fund has grown sharply over the last two years. A Ministry of Finance (MoF) brief on NCEF, dated 30 April 2015, states that cumulative coal cess, including a budgetary estimate of Rs 26,148 crore cess for 2016–17, would grow to Rs 54,336 crore. The report estimated cumulative project financing of Rs 9,021 crore by 31 March 2016. While more recent data on fund utilization is not available, it is likely that unused amounts are still substantial (see *Table 1: Coal cess accumulation*).

In the last few years, the government has made an effort to increase utilization. The Inter-Ministerial Group (IMG) has recommended funding from NCEF totalling Rs 34,811 crore

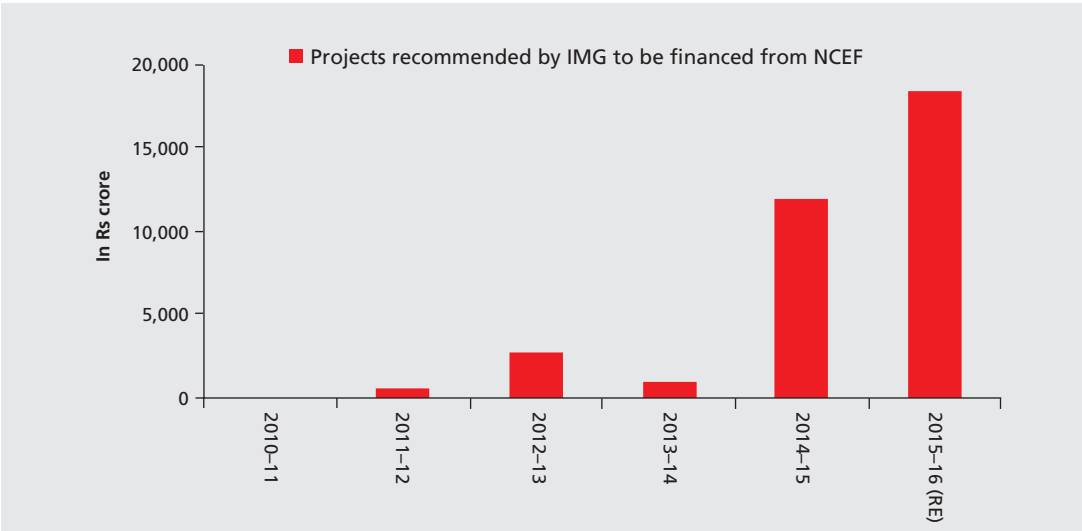
Table 1: COAL CESS ACCUMULATION (Rs crore)
Significant funds unutilized

Year	Coal cess collected	Transferred to NCEF	Financed from NCEF
2010–11	1,066	0	0
2011–12	2,579	1,066	220
2012–13	3,053	1,500	246
2013–14	3,471	1,650	1,218
2014–15	5,393	4,700	2,087
2015–16 (RE)	12,623	4,700	5,247
2016–17(BE)	26,148	8,447	NA
Total	**54,336**	**25,810**	**9,021**

Source: Ministry of Finance, 2016

Graph 1: IMG-RECOMMENDED PROJECTS

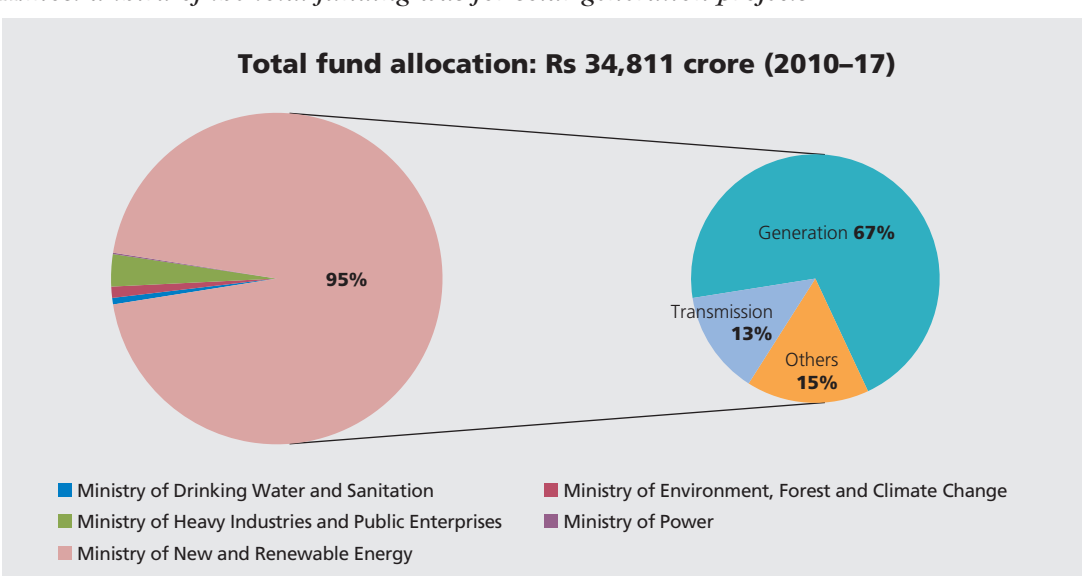
Sharp increase in funding recommendations



Source: Ministry of Finance, 2016

Graph 2: IMG-RECOMMENDED PROJECTS BY MINISTRY

Almost a third of the total funding was for solar generation projects



Source: Ministry of Finance, 2016

as of 30 April 2015 (see *Graph 1: IMG-recommended projects*). However, utilization has lagged. More than 95 per cent of the recommended projects in the last two years comprised projects to generate renewable energy or evacuate renewable power (see *Graph 2: IMG-recommended projects by ministry*). While a commendable goal, perhaps a wider use of funds is desirable for several reasons: to accelerate utilization; provide broader range for benefits to society; and to spread the risks across a range of sectors.

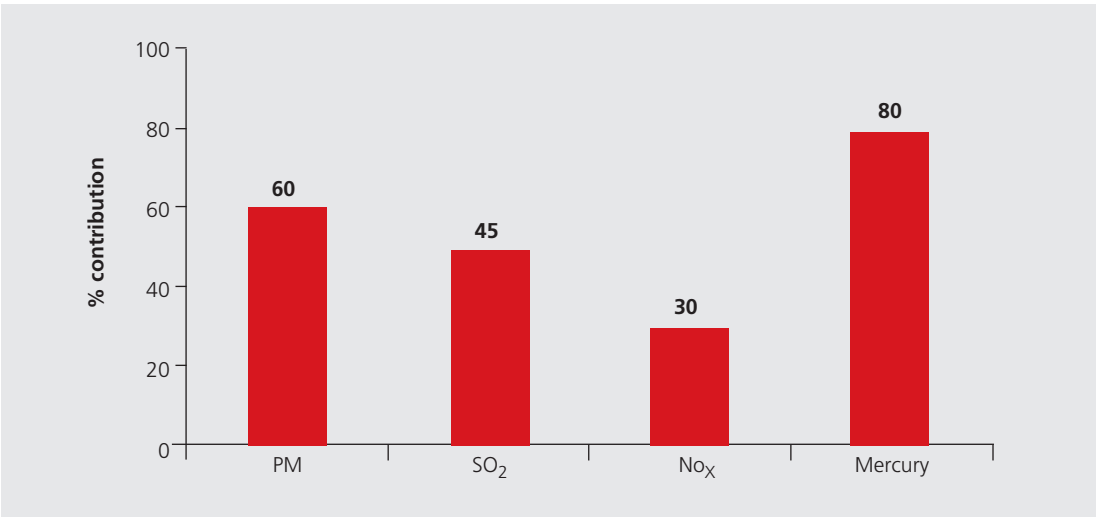
To address low utilization and consider a wider range of projects the cess was renamed clean environment cess in 2016. A steadily increasing share was expected to be transferred to ministries other than MNRE: '2015-16 Revised Estimates' forecasted that a quarter of fund allocation would be to non-energy projects; '2016-17 Budget Estimates' projected that over 40 per cent of the allocation would be for non-energy projects.

CLEANING EXISTING COAL PLANTS: SOLID BENEFIT

Coal-based thermal power plants are responsible for a disproportionate share of emissions from the industrial sector—60 per cent of particulate matter, 45 per cent of sulphur dioxide,

Graph 3: CONTRIBUTION OF COAL-BASED POWER SECTOR IN INDUSTRIAL EMISSIONS

Disproportionate share of industrial emission from coal-based power plants



Source: Centre for Science and Environment, 2014–15

30 per cent of oxides of nitrogen and 80 per cent of mercury emissions are from the coal-based power sector (see *Graph 3: Contribution of coal-based power sector in industrial emissions*). They also withdraw huge amounts of water—nearly half the domestic water needs of the country—and generate the second-largest amount of solid waste (fly ash).

Recognizing the serious pollution load imposed by the thermal power plants, MoEF&CC notified new environmental standards for the sector in December 2015 (see *Table 2: New standards*). Implementation of new standards will cut the PM, NOx and SOx emissions by 65 per cent, 70 per cent and 85 per cent respectively by 2026–27 compared to the business-as-usual scenario (based on CEA Draft National Electricity Plan, 2016 projections of 248-GW capacity and 1,246 billion units generation in 2026–27). Water withdrawal is expected to reduce by 85 per cent largely due to conversion of once-through cooling systems to cooling-tower systems (see *Graph 4: Benefits of the new emissions norms*).

NCEF support to clean power plants

A particularly beneficial use of NCEF could be to clean the coal-based power sector. Many coal-based power plants are located in densely populated areas where they are responsible for a significant share of the pollution load. The NCEF guidelines dated 18 April 2011 published by the Ministry of Finance contains an indicative list of projects which includes '*projects related to environment management particularly in the geographical areas surrounding the energy sector projects*'. Therefore, investments in pollution control equipments by power plants fall squarely within the goals of the fund.

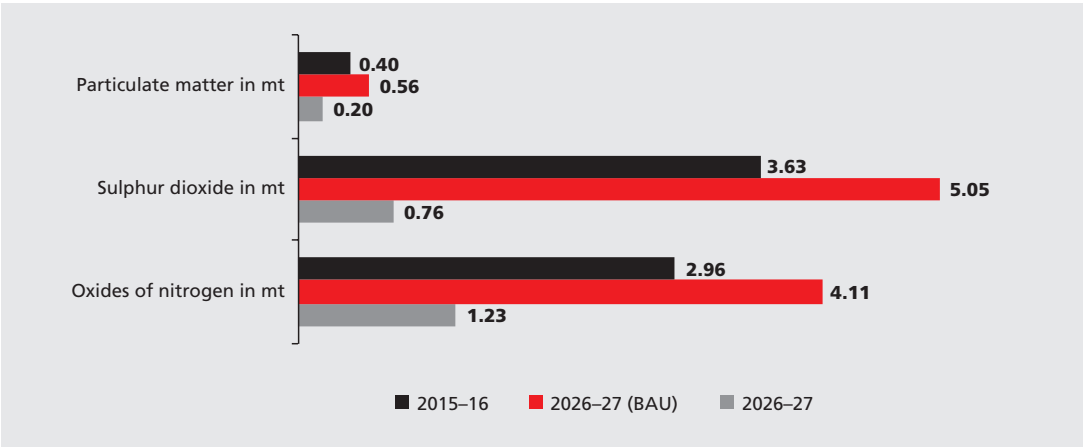
Given that coal-based power will remain central to India's electricity supply, it is important that the country makes investments to reduce thermal power sector's environmental

Table 2: NEW STANDARDS (in mg/Nm^3)

	PM	SO_2	NO_x	Mercury
Current standards	150–350	none	none	none
New standards				
Units installed till 2003	100	<500 MW—600 >=500 MW—200	600	>=500 MW—0.03
Units installed between 2004 and 2016	50	<500 MW—600 >=500 MW—200	300	0.03
Units installed after Jan 2017	30	100	100	0.03

Graph 4: BENEFITS OF THE NEW EMISSIONS NORMS

Emissions will decline sharply despite increase in generation



Assumptions: a) Generation data from CEA report b) 34 GW installed prior to 1990 to be shuttered by 2026-27
Source: Centre for Science and Environment, 2016

footprint. The coal-based power sector needs sizable investment—Rs 72,000 crore over the next three years—to comply with the new norms. The sector can easily absorb a sizable portion of unused NCEF funds while providing vital, quantifiable benefits to the society.

Implementation status

CSE's preliminary survey of power companies and manufacturers over the last three months revealed that little progress has been made so far. Many plants have adopted a wait-and-watch approach in the expectation that the standards will be diluted or postponed. However, several leading companies have made noteworthy progress. NTPC executives have told CSE that its plants will meet or exceed PM and water use standards. Tata Power has done a need assessment for its plants and filed tariff applications for two of its plants. HPGCL, the Haryana state generator, has had discussions with the ERC about technology needs and costs. Several other companies such as JSW, UPRVUNL and PSPCL have done a need assessment.

Most plants have a good understanding about what needs to be done but commercial issues need to be resolved to ensure timely implementation. While broad agreement about technology costs is emerging, plants are unsure about financing availability and tariff increase to recover investment.

POLLUTION-CONTROL TECHNOLOGY

Major large manufacturers, including BHEL, Mitsubishi and GE-Alstom, have confirmed to CSE that pollution-control technologies options that are mature and suitable for Indian coal can meet the new standards. They are confident that global suppliers will be able to meet demand.

Current emission levels and new applicable norms are the two fundamental factors that will determine the technology most suitable for a specific plant. The emissions of most coal-fired power stations range are 50–350 mg/Nm^3 for particulate matter, 1,000–2,000 mg/Nm^3 for sulphur dioxide and 800–1,200 mg/Nm^3 for oxides of nitrogen.

Electrostatic precipitators (ESPs) that are currently operating in many countries are able to meet PM emission standards that are lower than the tightest Indian norms. Flue gas desulphurization (FGD) is a widely used technology to control SOx. Pollution-control experts assert that a significant share of newer capacity, especially larger than 500-MW, boilers are likely already meeting the NOX standards; older boilers can be retrofitted to meet the new norms.

Recommended technology

In addition to above parameters, existing pollution control measures, coal quality, boiler technology and age and size of the units would determine what new equipment and renovation is required. Since the new norms are based on the age and size of the units, we have detailed below the Indian fleet (see *Table 3: Unit size distribution*). Next, we have summarized the major pollution-control solutions based on above-mentioned parameters with a particular focus on the age and size of the units and the applicable standards (see *Table 4: Preferred solutions*).

Table 3: UNIT SIZE DISTRIBUTION

Almost half the capacity consists of large units installed after 2008

Unit size	Unit size distribution in GW				
	+25 years	1990–2003	2004–08	2009–16*	Total
up to 250 MW	28.6	16.3	2.1	5.8	52.8
> 250 and <500 MW	–	5.4	3.8	20.8	30
500 MW and above	5.5	9.5	6	82.8	103.8
Total	**34.1**	**31.1**	**11.9**	**109.4**	**186.6**

Source: Centre for Science and Environment, 2016

Table 4: PREFERRED SOLUTIONS

Pollution-control technology is mature and widely available

	Pre-1990 *	1990–03	2004–08	2009–16
PM	• Basic ESP renovation	• Add fields in series or parallel to ESPs	• Newer capacity, especially post-08 ESPs designed to meet norms • Refurbish/renovate where ESP design appropriate but poor performance • Increase collection area (add fields)	
SOx	• None	• Coal washing for some using low sulphur coals; few could consider sorbent injection • Change norms for over 500MW units to 600 mg/Nm^3	• Smaller units—coal washing, sorbent injection; partial FGD • Units larger than 500 MW—dry or wet FGD	
NOx	• Basic boiler optimization	• Boiler R&M—burner modification;	• Some may already be meeting norms • Burner modification, OFA for others	

**Pre-1990 plants should be quickly retired; however, old plants that are allowed to operate for a limited period of time should undertake basic upgradation to cut PM and NOx emissions.*

Source: Centre for Science and Environment, 2016

TECHNOLOGY COSTS

The power generators have cited highly inflated cost estimates for pollution control equipment. CSE reached out to a range of industry players to arrive at the cost of various pollution control equipment and upgradation expenditures (see *Table 5: Benchmark cost estimates*). We got data from major domestic and international equipment suppliers,

Table 5: BENCHMARK COST ESTIMATES

SO_2 control is the most capital intensive

Technology required	Approximate cost in Rs (lakh/MW)
ESP upgradation	5–15
De-NO_X (retrofit)	10–15
Partial FGD	25–30
FGD	50–60
SNCR/SCR (only for new plants) *	20–25

**Units that are commissioned after 2017 may need to install Selective Catalyst Reduction (SCR) or Selective Non catalytic Reduction (SNCR) technology to meet NOx standards.*
Source: Centre for Science and Environment, 2016

independent industry experts and EPC contractors. We have also reviewed recent tariff filings by leading power companies, including NTPC, to cross-check the estimates. Finally, some State Electricity Regulatory Commissions (SERCs) have confirmed these cost estimates.

Industry-wide investment

We have calculated total investment expected to be made by the existing capacity based on pollution-control technologies required for broad categories of plants. Benchmark costs were used for the technologies (see *Table 6: Total cost of installing pollution-control equipment*) Strikingly, over 70 per cent of the total industry investment would need to be made by newer, larger units. This category comprises almost half of total capacity and is required to meet the tightest norms. However, these plants are also best equipped to recover higher costs—they are likely to be more efficient and have longer remaining lives.

1. ***34-GW capacity older than 25 years*** (considered to have exceeded the design life) should be expeditiously shut since a sizable majority is inefficient, highly polluting, with high cost of generation and low plant load factor (highlighted in the report '**Shutting old capacity—the 34-GW question'** by CSE). The approval to continue operating old units for a short time without meeting the new standards must be subject to a clear plan to decommission them and, in a few cases, replace them with new supercritical units. However, some units with good operating performance and low cost of generation and with significant remaining life (if they have undertaken life extension) may be allowed to invest in pollution-control technology—upgradation of ESP and boiler retrofittinmg—so they can meet the new standards.

2. ***43-GW capacity (installed during 1990–2008)*** will require moderate investment. A significant share may need to upgrade their ESPs to meet PM norms and retrofit boilers to comply with NOx norms. Units falling in this category should invest in basic control measures to reduce SOx (coal washing; sorbent injection, if feasible) to meet 600 mg/Nm^3 standards. It is possible that some 500-MW units constructed before 2003 may not have space for FGD; however units commissioned after 2003 can instal FGD.

3. ***27-GW capacity*** (***small units installed after 2008)***—Some of these might be already meeting the PM and NOx norms, fraction of this capacity may need to upgrade the ESPs or retrofit the boilers. They should not need to instal FGDs but may need to consider other alternatives to control SO_2.

4. ***83-GW capacity (large units installed after 2008)*** were typically designed to meet both the new NOx and PM standards. Most may at most need relatively minor renovations. However, these units will need to invest significant amounts to instal FGDs to meet the SOx standards.

Table 6: TOTAL COST OF INSTALLING POLLUTION-CONTROL EQUIPMENT

Over 70 per cent of investment would be borne by the new, large units

Commissioning year	Capacity (GW)	Cost range/MW	Approx. cost (in Rs crore)
Before 1990	34	None for half the capacity; Rs 10–20 lakh for the rest	1,700
1990–03	31	20–30 lakh for ESP and DeNOx;	7,750
2003–08	12	Rs 15–25 lakh for ESP and DeNOx; Rs 25–30 for SOx for large units	4,050
2008–16 (small units)	27	Rs 20–30 lakh	6,750
2008–16 (large units)	82	Rs 50–75 lakh	51,500

Source: Centre for Science and Environment, 2016

FINANCING CHALLENGE

While availability of pollution-control technology is not a bottle neck, raising financing will be a challenge for several reasons. Strong companies should be able to raise financing, however, the industry will have significant cumulative funding needs. Many power companies are financially weak partly on account of low plant utilization, which in turn is due to distressed discoms not purchasing enough power. As a result banks are reluctant to meaningfully increase their exposure to the sector.

Although the industry expressed concern about the impact of investment on the cost of generation, we believe this would not be a hurdle. At a conference organized by CSE, the Central Electricity Regulatory Commission (CERC) representative said that investment for pollution-control equipment can be included in capex to calculate tariff increase. CSE researchers and independent analysts believe the cost increases would be 20 to 35 paisa per unit on average; a Central Electricity Authority (CEA) official has suggested a similar impact on tariff in discussions with CSE. We think this level of increase in tariff would be acceptable to consumers given tariff increases have averaged 8 per cent per annum over the last five years. Undoubtedly, ERCs need to expeditiously process tariff applications to enable companies to raise financing.

NCEF financing

One of the criticisms of the NCEF in a 2013 report by the National Institute of Public Finance and Policy is that the fund does not have appropriate monitoring mechanisms in place and is not able to track whether the financed projects are achieving the stated goals. This problem is exacerbated given most of the financing by NCEF is in the form of subsidy or viability-gap funding. These issues can be substantially addressed by financing pollution-control equipment in thermal power plants.

First, the technology installation itself is driven by MoEF regulations. Technology choices would be influenced by guidelines from CEA and costs and reimbursements approved by various ERCs resulting in additional control. Finally, state pollution control boards would monitor if the emission levels have reduced as mandated. With the recent policy to instal Continuous Emissions Monitoring Systems, the new norms can be effectively enforced.

However, outright subsidy to the thermal power sector would defeat one of the goals of the coal cess—the industry should pay at least a portion of the cost of the pollution from burning coal. Therefore, we suggest that NCEF addresses the problem of 'difficulty in obtaining funds' through subsidized loans. This mechanism would especially benefit financially weak state-owned companies which may face difficulty in accessing commercial financing. The power companies can recover the cost of financing through tariff increases.

FINANCING SUPPORT—RECOMMENDATIONS

Since the total investment will be vetted/approved by ERCs, the task of deciding funding support can be straightforward. However, certain parameters may be considered to decide the amount, tenure and interest rate for individual projects.

Amount of loan: NCEF should fund a maximum of 70 per cent of project cost, with the balance coming from the company or commercial banks, given the typical 70/30 debt to equity assumption for power projects. A sliding scale can be used such that larger post-2008 units can get the maximum loan with decreasing amounts for old units. The rationale is that newer units need to comply with tighter norms that require relatively larger investment. Units that are over 25 years old should not get any assistance (see *Table 7: Loan amount*).

Interest rate: The projects should enjoy interest rate equalling prime banks lending rate (currently around 9.5 per cent per annum).

Table 7: LOAN AMOUNT

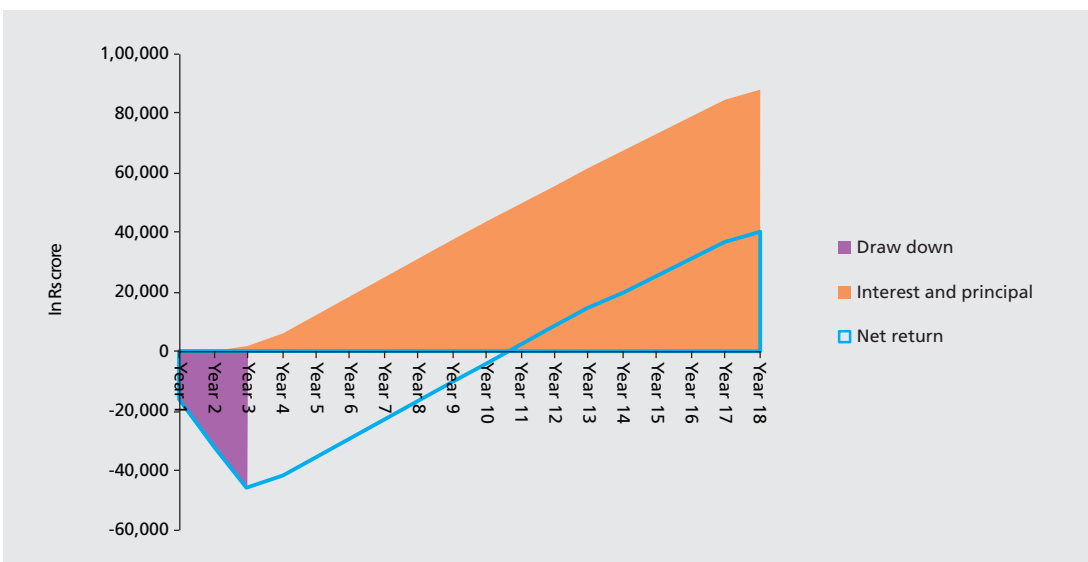
Larger loan amount for newer and larger units given their larger investment

Unit size	Commissioned	% of project cost	Max project cost/MW
All	*	70	Rs 1 crore
>500 MW	2008–16	70	Rs 75 lakh
<500MW	2008–16	65	Rs 40 lakh
>500MW	2004–08	65	Rs 60 lakh
<500MW	2004–08	60	Rs 40 lakh
All	1990–2003	60	Rs 30 lakh

**Those already under construction on the date of notification*
Source: Centre for Science and Environment, 2016

Graph 5: FUNDS DRAWDOWN AND REPAYMENT

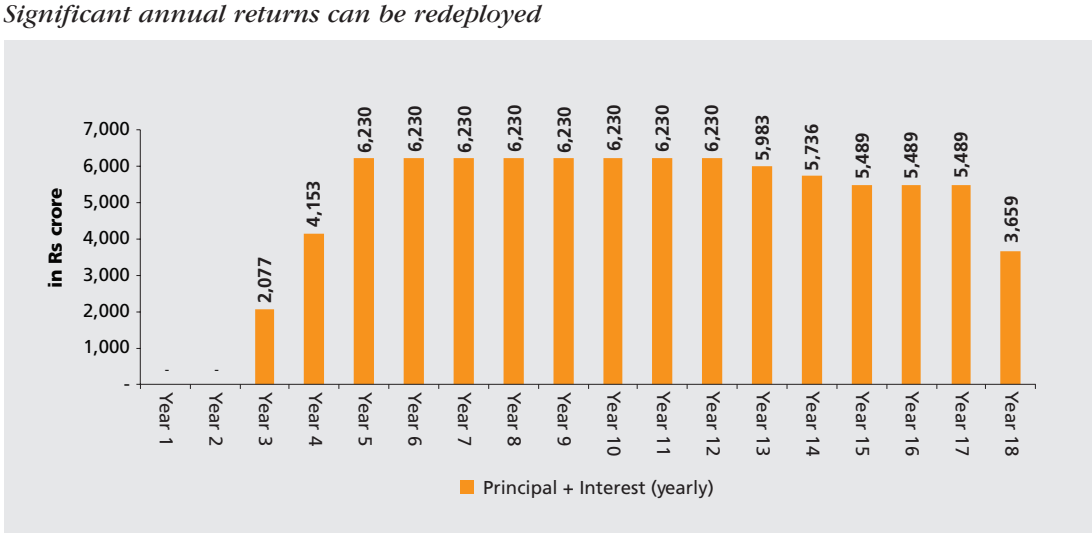
Net return of over Rs 42,000 crore



Source: Centre for Science and Environment, 2016

Graph 6: ANNUAL REPAYMENTS

Significant annual returns can be redeployed



Source: Centre for Science and Environment, 2016

Tenure: The loan amount may have a duration of 15 years for projects commissioned after 2004 and up to 10 years for projects commissioned before 2004.

Funding requirement: Our rough estimates suggest that existing thermal power plants would need to invest around Rs 72,000 crore over the next three years to comply with the new norms. Our model suggests NCEF could fund around Rs 47,000 crore over the next three years. Given an estimated coal cess of over Rs 26,000 core in 2016–17, around half of the coal cess collected in the next three years would be able to cover the sector's needs.

Repayments: Notably, the net return (in excess of loans extended) for the fund would be over Rs 42,000 crore (see *Graph 5: Funds drawdown and repayment*); the annual return of principal plus interest to the NCEF would be nearly Rs 6,200 crore, which can be redeployed for renewable or other clean environment projects (see *Graph 6: Annual repayments*).

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