

# The Khurja Power Project

## A Recipe for an Indian Stranded Asset



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# Executive Summary

THDC India Limited's proposed 1,320 megawatt (MW) Khurja Supercritical Thermal Power Plant in the Bulandshahr district of Uttar Pradesh (UP) is a long delayed, out-dated business proposal that no longer meets the state's or the nation's rapidly changing energy market needs.

The Khurja project, valued at Rs12,676 crore (US\$1.8 billion), was first proposed in 2010; it was touted then as being essential to meeting the region's fast-growing electricity needs and alleviating local supply shortages. Today, the project remains mired in litigation with no indication of when construction might begin. Further, the rapid changes across the Indian electricity market in the past seven-plus years raises serious questions about the continuing need for the project's capacity and its very tenuous financial viability.

The deflationary momentum in the solar and wind generation sectors has enabled India's electricity sector to turn to deflationary, emissions-free, domestic alternatives in the past several years, particularly as renewable energy tariffs have fallen below Rs3.00/kWh with zero indexation for 25 years. In contrast, the Central Electricity Authority of India estimates the levelised tariff for an outdated-technology, super-critical mine-mouth coal-fired power plant operating at a realistic capacity factor of 60% would be Rs4.39/kWh.

The cost at the Khurja plant will almost certainly be higher. For starters, the plant is not a mine-mouth facility and will have to transport its coal more than 900 kilometres, incurring significant freight charges. In addition, the plant's initial cost estimates were prepared before the coal price increases of the past couple of years. Finally, the plant's environmental impact assessment (EIA) from November 2016 assumed the facility would post a capacity factor of 90%; the country's existing coal fleet has averaged below 60% for the past two years.

Even with optimistic assumptions, project developers estimate the Khurja plant's electricity cost at Rs4.88/kWh—far above current solar costs. IEEFA's estimate, accounting for coal freight costs, coal price inflation post the environmental impact assessment (EIA), and adjusting for the lower capacity factor, is that the plant's electricity would cost at least Rs5.67/kWh.

This raises serious questions about the plant's viability in a market rapidly moving to cheaper, cleaner alternatives. Compared to sub-Rs3/kWh renewables with zero indexation, the Khurja project, at realistic tariff of Rs5.67/kWh, is effectively reliant on a tax-payer sponsored subsidy of Rs6,946 crore (US\$10bn) over a period of 25 years.

Aside from cost issues, the Khurja project continues to be delayed by serious legal challenges on environmental issues. Its' coal, intended to be sourced from the proposed Amelia coal block in Madhya Pradesh, may not be mineable since it is in an area deemed "inviolable" by the Ministry of Environment, Forest and Climate Change (MoEFCC). In addition, farmers are challenging the land acquisition for the plant and the required compensation, with that dispute now before the Allahabad High Court.

More broadly, the Khurja project faces the same risks confronting India's entire coal plant pipeline today. For example NTPC Ltd, India's largest power generator, has shelved 13 GW of coal-fired power plants this year to-date, largely at the request of states seeking to cancel existing power purchase agreements (PPA) because of slower demand growth. Also, the ongoing price declines in renewable energy generation are prompting states to seek solar and wind resources to meet incremental demand.

Another complication for the Khurja plant is that 7.4 GW of coal-fired capacity is already under construction in Uttar Pradesh—far more than is needed according to IEEFA's estimates. Uttar Pradesh, as with the rest of India, has aggressive renewable energy goals over the next 10 years. Specifically, it plans to have 10.7 GW of solar installed by 2021/22, of which 4.3 GW will be rooftop solar. As per IEEFA's electricity sector model for UP by 2027/28, this will help boost renewables' share of the state's generation capacity to 49%, up from 11% currently. If the state meets these solar goals, demand for coal generation will fall significantly. The excessive new thermal capacity buildout will result in sub-optimal capacity factors of 63% for the state's coal-fired fleet, or even lower if the Khurja plant is built—seriously undercutting the plant's economic case.

Beyond Uttar Pradesh, the Khurja project does not fit with India's ambitious renewable energy goals and its desire to rationalise the finances of its many troubled coal-fired power plants, both operating and planned. The Khurja project will also undermine the turnaround of the Uttar Pradesh electricity distribution companies (Discoms) which are focussed on lowering their wholesale electricity costs via lower cost renewable energy projects at nearly half the price.

India's 275 GW renewable energy target is going to change how the country's electricity system operates, putting a premium on flexible peak-hour capacity to integrate the variable generation from wind and solar and maintain grid stability. More coal-fired power plants, with their inability to ramp quickly, are not what the country needs.

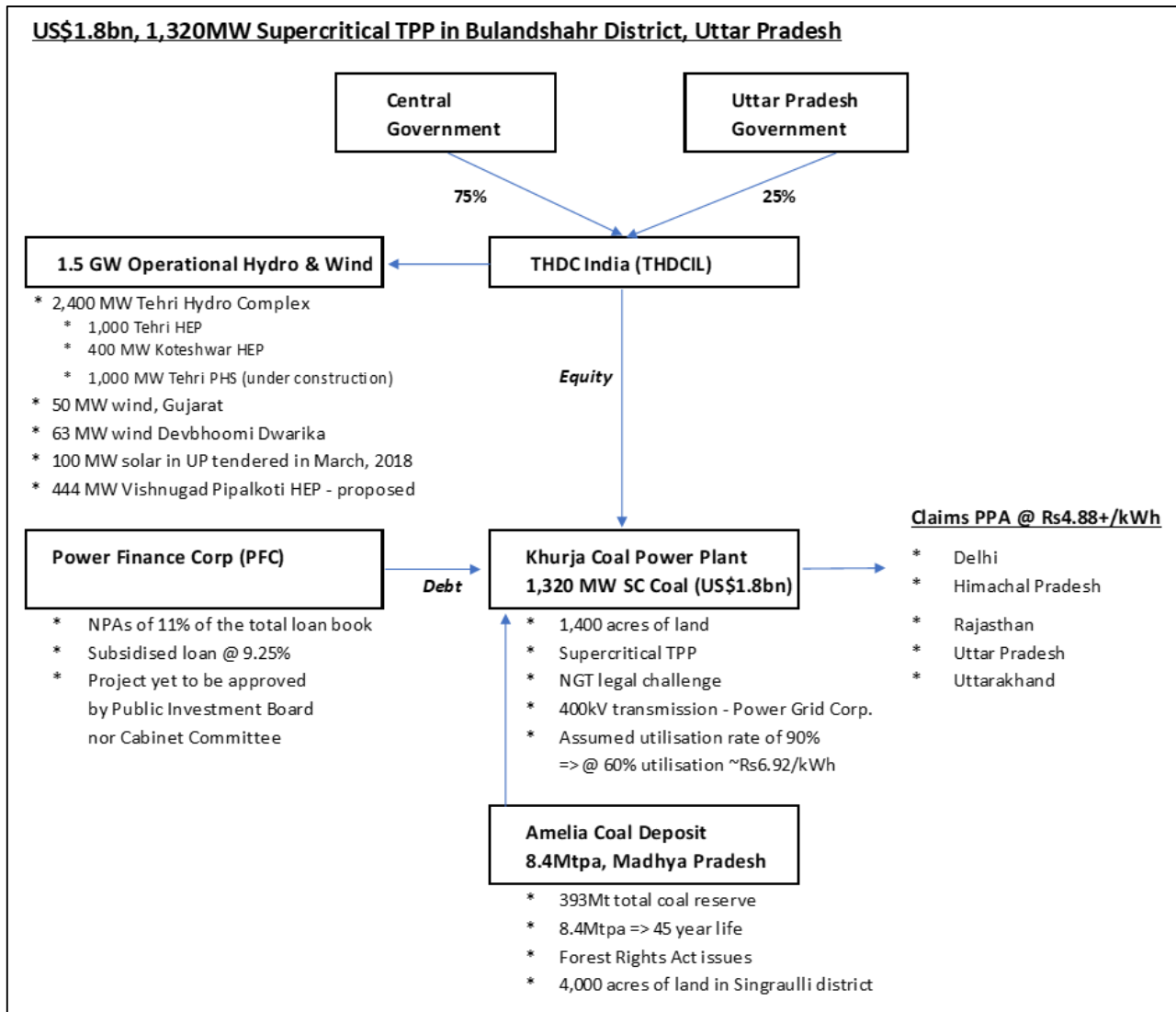
The Khurja project is entirely reliant on state-subsidised financing from India's Power Finance Corporation (PFC) which is already struggling with billions of dollars in stressed coal project loans. At end 2017/18 the lending agency estimated that assets totalling Rs31,000 crore (US\$4.5bn) were in jeopardy, amounting to 11% of its' total loan book. In IEEFA's view, lending another Rs9,000 crore (US\$1.26bn) to the Khurja project will make PFC's stranded asset problems worse.

Following the IL&FS (Infrastructure Leasing & Financial Services Limited) debacle of October 2018, IEEFA believes PFC and the Indian government would be better served if the lending entity continued recent efforts to boost its' involvement in the renewable energy sector. In the past year PFC's green lending jumped 260%, climbing from Rs2,500 crore (US\$370m) in 2016/17 to Rs9,000 crore (US\$1.3bn) in 2017/18. PFC's target of further increasing its exposure in the renewable energy sector to 20% of its total lending, up from 3% currently, is a move in the right direction.

The Khurja project sits increasingly outside the core competencies of hydroelectricity at THDC India which more recently is focusing on renewable energy and storage projects. THDC to-date has built 113 MW of wind power projects in Gujarat, bid on multiple solar power tenders, and is now building the 1 GW Tehri Pumped Hydro Storage in Uttarakhand. Given this more sustainable green focus, the Khurja project is little more than an expensive drag on the company's other expansion plans.

The Khurja facility, initially backed by the Uttar Pradesh government to meet existing shortages and expected demand growth, is no longer needed. Instead of improving access to energy and boosting energy security in northern India, the Khurja facility will add to the country's thermal and financial sector distress. In this report IEEFA presents a model of Uttar Pradesh's electricity system for the decade to 2028, and argues the long delayed, excessively expensive and redundant Khurja project should be cancelled.

**Figure 1: Khurja STPP Organisational Chart**



Source: IEEFA.

# 1. Introduction

## Background

The 1,320 MW Khurja project is a long-delayed, non-minemouth coal-fired power plant proposed to be built in the Bulandshahr district in the Indian state of Uttar Pradesh (UP).

Tehri Hydro Development Corporation (THDC) India Ltd, a 75:25 joint venture between the government of India (GoI) and the government of Uttar Pradesh (GoUP), continues to push this project. THDC signed a memorandum of understanding (MOU) with the UP government in December 2010 to build the power plant, but it remains unbuilt today.

Khurja was originally proposed as 3 units of 660 MW each but the 2016 EIA saw the project downsized to include just two units.

Khurja's cost is estimated at Rs12,676 crore (US\$1.8bn).<sup>1</sup> THDC said in June 2018 that it hoped to award a construction contract totalling Rs8,000 crore (US\$1.2bn) by the end of the year.

The power plant will be built with out-dated supercritical combustion technology; but it does assume the incorporation of a flue gas desulphurisation (FGD) system for pollution control.

When it was proposed, the plant was considered vital to guaranteeing the energy security of northern India which was then facing regular power outages. During the initial project development work, THDC was able to secure PPAs with the electricity distribution companies in Rajasthan, Uttarakhand, Uttar Pradesh, Himachal Pradesh and Delhi.

## Does India Need Yet Another Expensive Coal Plant?

According to the proponents, the Khurja plant was considered crucial for the energy security of Northern India which regularly faced power outages back in 2010. THDC had signed Power Purchase Agreements (PPA) with several state electricity distribution companies (Discoms) of Rajasthan, Uttarakhand, Uttar Pradesh, Himachal Pradesh and Delhi. However, the power supply situation in India has improved dramatically in recent years. As such, IEEFA would strongly advocate a re-evaluation over the need and viability of an expensive non-minemouth coal-fired power project in one of the poorest states of India.

Since the beginning of 2018, India's thermal power behemoth NTPC Ltd has confirmed the shelving of six projects at various stages of pre-construction development and worth 13 GW of capacity.<sup>2 3</sup> One of the core reasons for walking away from these long delayed coal-fired power proposals, as stated by NTPC, was the states' request to cancel the PPAs linked to the power projects. The states have acquired surplus generation capacity and electricity demand growth has been significantly slower than estimated at the time these plants were originally planned. At the same time, the states are now correctly preferring cheaper, more sustainable renewable energy to meet new incremental electricity demand. In the face of Prime Minister Narendra Modi's National Solar Mission, the rising structural headwinds against the non-minemouth coal-fired generation sector is one of the most important aspects that must be evaluated before going ahead with the construction of the Khurja plant.

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<sup>1</sup> ET EnergyWorld. [THDC to float Rs 8,000 crore tender for Khurja thermal power plant](#). June 03, 2018

<sup>2</sup> The Hindu. [Four mega projects shelved in the State](#). June 19, 2018.

<sup>3</sup> Financial Express. [NTPC may abandon two units if states renege on PPAs](#). July 31, 2018.

## Khurja's Coal Linkage is Under Challenge

Coal supply for the Khurja project is scheduled to come from the Amelia coal block in Madhya Pradesh (MP).<sup>4</sup> The rated coal capacity of this mine proposal is 8.4 million tonnes per annum (Mtpa). The coal block has total reserves of about 393 million tonnes (Mt). The cost of developing the coal block is estimated at Rs1,587 crore (US\$235m). Additionally, the distance between the mine and the power plant is some 900 km, which will add coal transportation costs of some Rs1,597/t or US\$22/t to the plant's fuel costs.

Under current Indian regulations, the coal mine linkage is an inseparable part of the combined project proposal and hence it is important to evaluate the risks associated with development of the power plant in conjunction with the coal mine.

IEEFA notes the coal mine (4,000 acres) and power project (1,400 acres) involves a combined 5,400 acres. An equivalent area of far less productive land could cater for over 1,000 MW of solar power, but does not displace irreplaceable farm and forest lands and their associated inhabitants, nor generate air/water pollution, carbon emissions or rehabilitation liabilities.

There are significant uncertainties about Khurja's coal supply and its real cost. We examine these issues in detail in section 4.

## Khurja's Tariff is No Longer Competitive

The cost of Khurja's electricity has been the source of much debate.

The project's EIA states that the cost of energy for the first full year of operation will be Rs4.88/kWh and the levelised cost of electricity (LCOE) for the lifetime of the project will be Rs4.63/kWh. The estimated LCOE assumes an optimistic plant load factor (PLF) of 90%; the average PLF for India's coal generators has been below 60% since 2016.

An even more optimistic assessment was given by director of THDC Vijay Goel earlier this year, when he said (without offering any specifics) the plant's tariff would be Rs3.61/kWh.<sup>5</sup> Given that construction has not started, Goel's assertions should be taken more as public relations than a contract quote.

We believe the Khurja plant's tariff will be much higher than all estimates and present our findings from section 4 onwards.

## Financing from Power Finance Corporation (PFC)

THDC India is looking to get state-subsidised financing from PFC at an annual interest rate of 9.25%. Given the troubled coal sector loans already overloading PFC's books, amounting to around 11% of its overall book or some Rs31,000 crore (US\$4.5bn)<sup>6</sup>, state financing for the Khurja project looks like a bad investment.

In keeping with the Indian government's ambitious green energy investment plans, PFC has been boosting its lending to the renewable energy sector, growing 260% since 2016, climbing from

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<sup>4</sup> The Tribune. [THDCIL gets Amelia coal mine in Madhya Pradesh](#). September 8, 2016.

<sup>5</sup> ET EnergyWorld. [THDC to float Rs 8,000 crore tender for Khurja thermal power plant](#). June 03, 2018.

<sup>6</sup> Power Finance Corporation – Investor Interaction Meet. May 15, 2018.

Rs2,500 crore (US\$370m) to Rs9,000 crore (US\$1.3bn) today. Further, PFC Chairman Rajeev Sharma expressed the corporation's desire to boost renewable lending to 20% of its loan book in a few years from 3% today,<sup>7</sup> as they consider these assets to be far less risky than thermal power assets.

IEEFA questions how financing a new non-minemouth coal fired power plant requiring an uncompetitive starting tariff of Rs4.88/kWh or more makes any sense when renewable energy projects require sub-Rs3/kWh (with zero indexation locked in for 25 years).

While PFC suggests it is open to responding to the structural changes in the power sector by increasing its exposure to renewable energy, the proposed new commitment to fund the Khurja project strongly suggests otherwise.

## Legal Issues Will Continue to Dog This Proposal

Currently, the Khurja power plant and the coal block are facing multiple legal challenges.

1. The allotted Amelia coal block coincides with a dense forest. Coal mining in the region has been challenged by villagers from Mahan village in Singrauli under the Forest Rights Act, 2006. Under the Act, consent from the local communities is required to use the forest land for mining or non-forest use under the Forest Rights of Local Communities. The locals have appealed for their community rights over the forest to be recognised. Moreover, the Ministry of Environment, Forest and Climate Change (MoEFCC) had classified the neighbouring Mahan block as inviolate and off-limits for mining.<sup>8</sup> The MoEFCC has recognised the forest of the coal-rich region to be of high quality, and Amelia has also been classified as an inviolate coal block by the ministry.

In the situation where the coal block does not get a mining permit, the Khurja project will face the same issue that many stranded coal-fired projects face today in India.

2. The Environmental Clearance (EC) given to the power project is been challenged before the National Green Tribunal (NGT).<sup>9</sup> The case is looking at unsatisfactory conduct in the mandatory public hearing under the EIA Notification 2006, possible falsification of data in the EIA of the project, and "non-application of mind" on the part of members of the Expert Appraisal Committee.
3. There is ongoing litigation over farmer's compensation in the Allahabad High Court.

This report will discuss in detail the potential stranded asset risk in the proposed Khurja project and its impact on THDC, potential lenders to the project, and the economic growth and livelihoods of people and businesses in the Northern Indian region who heavily rely on an affordable electricity supply.

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<sup>7</sup> Live Mint. [Power Finance CMD sees turnaround in stressed power assets in 2-3 years](#). June 4, 2018.

<sup>8</sup> First Post. [Mahan coal block not to be auctioned: Coal Ministry](#). March 20, 2015.

<sup>9</sup> DownToEarth. [NGT sends notices to THDC, pollution control board on coal-fired power plant in Uttar Pradesh](#). July 14, 2017.



## 2. Indian Electricity Sector Overview

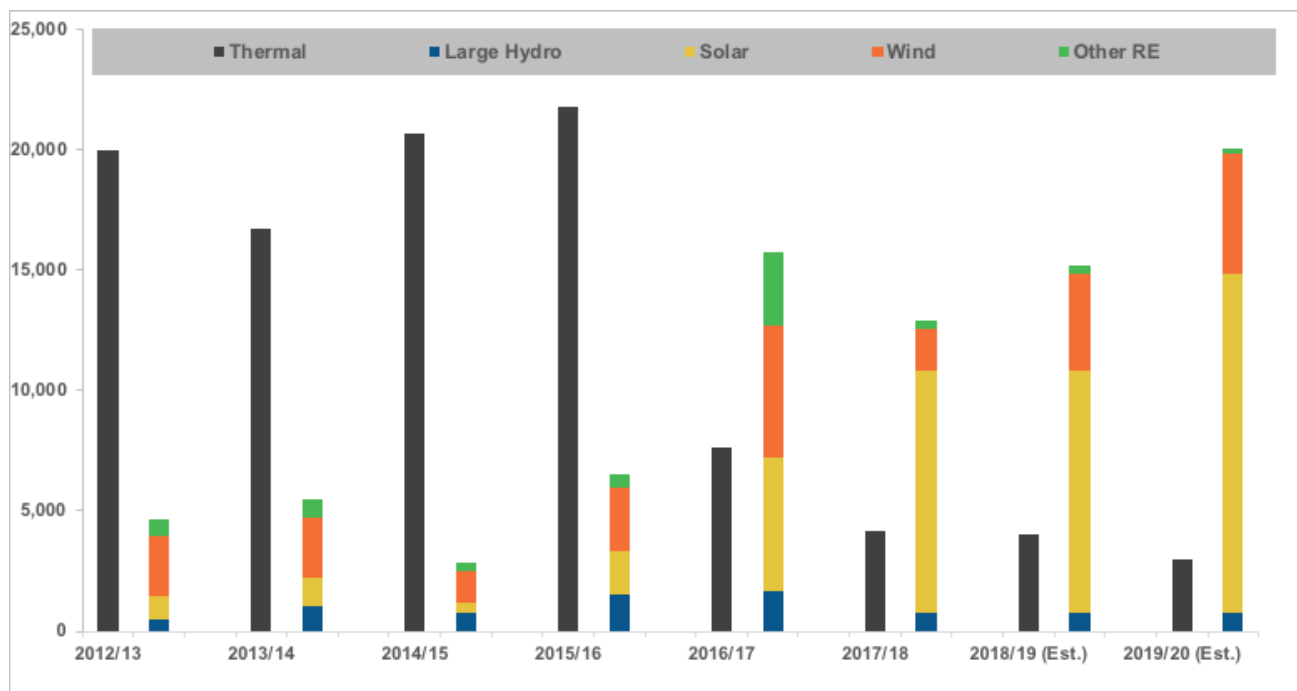
Prime Minister Narendra Modi's election in 2014 ushered in an era of transformation in India's electricity market, pushed largely by his ambitious plan to drive energy efficiency, improve India's grid system, and build 275 GW of renewable energy capacity by the end of 2026/27.

Since his election, India's renewable sector has grown significantly, doubling in the last three years overall, with a near doubling of its solar portfolio with a record 10 GW of solar capacity installed in 2017/18 alone. At the same time, there has been a drastic slowdown in new capacity construction in the country's troubled thermal power generation sector, particularly where the sector is reliant on expensive imported coal and gas.

India's long-term strategy to diversify and decarbonise its' electricity supply has been aided by technological improvements, massive, ongoing cost deflation, the availability of cheaper financing, and a growing interest from global renewable energy developers, utilities and investors.

In IEEFA's view this ongoing transformation offers a sustainable solution to the country's dire energy poverty and air pollution problems, whilst also reducing its currently crippling reliance on imported fossil fuels (oil, diesel, thermal coal, coking coal and liquid natural gas (LNG)). It also provides an opportunity to create jobs while boosting the government's "Make in India" program with manufacturing potential in solar, wind, batteries, electric vehicles and the entire energy efficiency value chain (e.g. solar irrigation pumps, solar hot water, heat pumps, air conditioners, LEDs).

**Figure 2.1: India Renewable and Thermal Power Capacity Additions (MW)**



Source: Central Electricity Authority of India (CEA), MNRE India, IEEFA estimates.

IEEFA expects more momentum in India's renewable energy transformation. This will see sustained renewable generation capacity additions of 15 GW in 2018/19 and 20 GW in 2019/20 (including

large hydro). In the year to date (August 2018), thermal power plants saw a net contraction of 1.1GW with 10 coal and gas units closed, none opened.

**Figure 2.2: India Electricity Sector Composition 2017/18**

	---- Capacity ----		-- Generation --		Capacity	Increase
	GW	%	TWh	%	Utilisation	GW yoy
Coal-fired	197.2	57.3%	979.4	75.1%	57.4%	5.0
Gas-fired	24.9	7.2%	53.6	4.1%	25.0%	-0.4
Diesel-fired	0.8	0.2%	2.0	0.2%	25.0%	0.0
Large Hydro	45.3	13.2%	126.1	9.7%	32.1%	0.8
Nuclear	6.8	2.0%	38.2	2.9%	64.3%	0.0
Renewables	69.4	20.1%	100.5	7.7%	19.7%	12.1
Bhutan	n.a.	n.a.	4.9	0.4%	n.a.	
<b>Total</b>	<b>344.3</b>	<b>100%</b>	<b>1,304.7</b>	<b>100%</b>		<b>17.5</b>
Capitve power	51.4					
<b>Total</b>	<b>395.7</b>	<b>114.9%</b>				

Source: Central Electricity Authority of India (CEA), IEEFA estimates.

## The 2018 National Electricity Plan

India's electricity sector blueprint, the 2018 National Electricity Plan (NEP), retains the ambitious core target of 275 GW renewables by 2027 from the plan's 2016 draft. It also includes a timeline for beginning to tackle the country's most-polluting coal-fired power plants, which should ease concerns about the lack of visible progress to date by the Ministry of Power in terms of the deferral of tighter air pollution regulations.

The NEP includes a new target for closing 48 GW of end-of-life coal plants. Specifically, the plan forecasts 22.7 GW of coal power plant closures by 2021/22, which includes 6 GW of normal end-of-life retirements and 17 GW of closures due to inadequate space for FGD equipment. The Plan notes these retirements "would not likely pose any problem in meeting the demand (for electricity) during 2021/22." An additional 26 GW of coal capacity is slated for retirement in the following five years to 2026/27.<sup>10</sup>

Accounting for these planned retirements and expected new construction totalling 94 GW, the NEP sees India's coal power capacity hitting 238 GW in 2027, 11 GW less than the 2016 draft.

**Figure 2.3: India's Declining Thermal Capacity Share- NEP 2018 Additions & Retirements**

GW	Mar-17	Share	2016/17-2021/22				2021/22-2026/27				National Electricity Plan	
			Adds	Closures	Mar-22	Share	Adds	Closures	Mar-27	Share	Draft	Change
<b>Coal + Lignite</b>	192		48	-23	217		46	-26	238		249	-11
<b>Gas</b>	26		0	-1	26		0	0	26		29	-3
<b>Total Thermal</b>	218	<b>67%</b>			243	<b>51%</b>			264	<b>43%</b>		
<b>Total Capacity</b>	327				479				619		650	-31

Source: National Electricity Plan India 2018.

<sup>10</sup> India's National Electricity Plan Annexure 5.4, 5.5, 5.6. Jan 2018.

### 3. THDC India Ltd

THDC India Ltd was formed in 1988 with a mandate to develop, operate and maintain the Tehri Dam and a 2.4 GW of hydropower complex on Bhagirathi river. This complex incorporates two power projects - the Tehri Hydro Power Plant (1,000 MW) and Koteshwar Hydro Energy Plant (400 MW), and the proposed 1,000 MW Tehri pumped hydro storage facility. In addition to the Tehri Hydro Power Complex, the company is building a 444 MW hydropower project in Vishnugad Pipalkoti on the Alaknanda River in Uttarakhand and a small hydro project of 24 MW on Betwa River in Uttar Pradesh (UP).

Recently, the developer has diversified into the renewable energy sector. THDC commissioned two wind power projects of 50 MW and 63 MW in Patan and Devbhoomi Dwarka, Gujarat respectively. Beyond that, THDC has signed an MoU with Solar Energy Corporation of India (SECI) to develop 250 MW of solar power capacity. It also entered an agreement with SECI and the Kerala State Electricity Board to develop a 50 MW of solar power plant in the Kasaragod district of Kerala.

In total, THDC has 5.7 GW of capacity in operation or under development, including the Khurja project.

While we acknowledge the associated dislocation of residents and loss of arable land, THDC's hydro projects have been crucial in building power security in the northern region of India, delivering irrigation benefits for UP's agriculture sector and providing drinking water for the National Capital Territory of Delhi and UP.

The Tehri pumped hydro storage project, currently under development, will be of immense value in providing dispatchable peak-hour power supply as UP integrates more variable solar power into its energy mix. For all the recent discussion on the role of batteries in electricity grid balancing, pumped hydro is currently the cheapest available option globally for electricity storage, and represents over 95% of all electricity storage capacity globally.

The company has seen robust growth with an average 14% return on capital between 2012/13 and 2016/17.<sup>11</sup>

In IEEFA's view, diversifying into the non-minemouth coal-fired power sector is both outside the corporation's core expertise and a highly risky proposition that is no longer aligned with the Government of India's energy sector plan.

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<sup>11</sup> THDC India Limited Annual Report 2016/17, Page 5.

## 4. Khurja's Questionable Viability

Indian thermal power sector remains in a state of financial disarray. The distress stems from several challenges including operational issues, the financial health of India's distribution companies, very poor promoter decisions on site location (giving rise to unjustifiably high coal rail transport costs), excessive reliance on increasingly expensive import thermal coal, lower than expected electricity demand growth and rising competition from increasingly inexpensive renewables. Before any final decision to proceed with Khurja is made, the parties must carefully evaluate the project's long-term financial viability.

We discuss key issues facing THDC's \$1.8bn stranded asset investment proposition in the sections below.

### A Tariff Hidden by Obscurity

Discussion of Khurja's proposed tariff is pivotal in appraising its financial viability. The quoted tariffs differ markedly in various documents and press reports related to the power project, injecting significant uncertainty into the evaluation process.

The project's 2016 EIA states the LCOE at Khurja will be Rs4.63/kWh LCOE, while first year costs are pegged at Rs4.88/kWh (even these two figures from the same document are entirely inconsistent).<sup>12</sup> The LCOE is the required tariff at which the net present value of the investment is zero. In other words, it is the minimum required average tariff for the power asset to reach a breakeven return at the end of its life. Anything less than that suggests the asset is unviable.

It is unclear why the levelised tariff for the first year is lower than the overall LCOE. This would only be possible if the tariff's indexation is much lower than the anticipated inflation rate. In the absence of any subsidy the first year's tariff is highly unrealistic and unviable.

An earlier estimate included in the 2015 report to Public Investment Board (PIB) cites Rs4.31/kWh for the plant's LCOE and Rs4.58/kWh for year-one operations. Another report from June 2018 quoted THDC's Goel saying the LCOE would be Rs3.61/kWh—22% less than the company's own EIA.<sup>13</sup> These fluctuating numbers against one of the project's most important metrics reflects uncertainty regarding the financial viability of the project from the proponents themselves.

The EIA assumes an unrealistic capacity factor of 90%. India's coal-fired fleet has been operating at a PLF of below 60% for the past two years, a key contributing factor to the coal sector's financial distress. The current situation in India's thermal power assets shows it has been extremely difficult for power plants to service their debt when plant utilisation rates fall below 60%.

As shown in Figure 4.1, the required minimum average tariff at Khurja will rise progressively as the operating rate falls below the unjustifiably high capacity factor assumption of 90%.

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<sup>12</sup> Environmental Impact Assessment Report for Khurja Super Thermal Power Project November, 2016, Page 52.

<sup>13</sup> ET EnergyWorld. THDC to float Rs 8,000 crore tender for Khurja thermal power plant. June 03.

**Figure 4.1: Khurja's Levelised Cost of Electricity at Different Capacity Factors**

Assumed Capacity Factors	LCOE at Given Capacity Factors					
	90%	80%	70%	60%	50%	40%
Generation Over Lifetime (TWh)	416.3	370.0	323.8	277.5	231.3	185.0
Total Cost Over Lifetime of the Plant (Rs m)	1,927,354	1,925,194	1,923,250	1,921,501	1,919,926	1,918,509
<b>LCOE Rs/kWh</b>	<b>4.63</b>	<b>5.20</b>	<b>5.94</b>	<b>6.92</b>	<b>8.30</b>	<b>10.37</b>

Source: EIA report November 2016, IEEFA estimates.

Note: The total cost over the lifetime of the power plant is adjusted for reduced operational expenditures/fuel costs with respective capacity factors.

## Rising Input Costs a Growing Threat

According to recent estimates from the Central Electricity Authority (CEA) of India, the average tariff for a new supercritical minemouth thermal power station at a 60% PLF should be Rs4.39/kWh.<sup>14</sup> Given that, it is irrational to assume that a power plant sourcing coal from a mine 900 km away will be able make money with a tariff of Rs4.88/kWh.

Brookings India's research suggests that Indian Railways' coal freight charges have grown more than four times the wholesale inflation rate between 2011/12 to 2016/17.<sup>15</sup> Coal freight charges were further revised upward in the beginning of 2018, with a busy season surcharge levy of 15% for nine months of the year and a 5% development charge levied on standard rates.<sup>16</sup>

All told, coal transportation would add an estimated Rs1.28/kWh to the plant's generation costs. Adding this to CEA's base tariff estimate for a mine-mouth plant, a more realistic tariff for Khurja would be Rs5.67/kWh. This figure is however understated, as domestic coal prices have risen significantly in the two years since Khurja submitted its EIA. Average thermal coal prices in India rose 9% in January 2018 on the back of an increase in worker compensation by Coal India Ltd (CIL).<sup>17</sup> Additionally, levies and taxes on domestic coal have grown by about 32% since 2014/15, reflecting positive steps by the Government of India to price in some of coal power's many external costs.

**Figure 4.2: Fuel Cost for Generation for Khurja STPP**

Distance (km)	900
Freight Rate (Rs/t)	1,597
Freight Rate (Rs/kg)	1.60
Coal Requirement (Kg/kWh)	0.80
<b>Cost of Coal Transportation (Rs/kWh)</b>	<b>1.28</b>
Coal Price (Rs/kg)	1.41
Coal Taxes - Levies, Excise & Corporate (Rs/kg)	0.85
<b>Total Per Unit Fuel Cost Including Transportation (Rs/kWh)</b>	<b>3.08</b>

Source: CIL Annual report, India Railways Freight Information System, IEEFA estimates.

<sup>14</sup> CEA draft report on New Environmental Norms on Thermal Power Plant, Page 9.

<sup>15</sup> Brookings India. [Indian Railways and Coal: An Unsustainable Interdependency](#). July, 2018

<sup>16</sup> Indian Express. [Railways tweaks coal freight rates](#). January 11, 2018.

<sup>17</sup> Economic Times. [Coal India raises thermal coal prices by 9%](#). Jan 09, 2018.

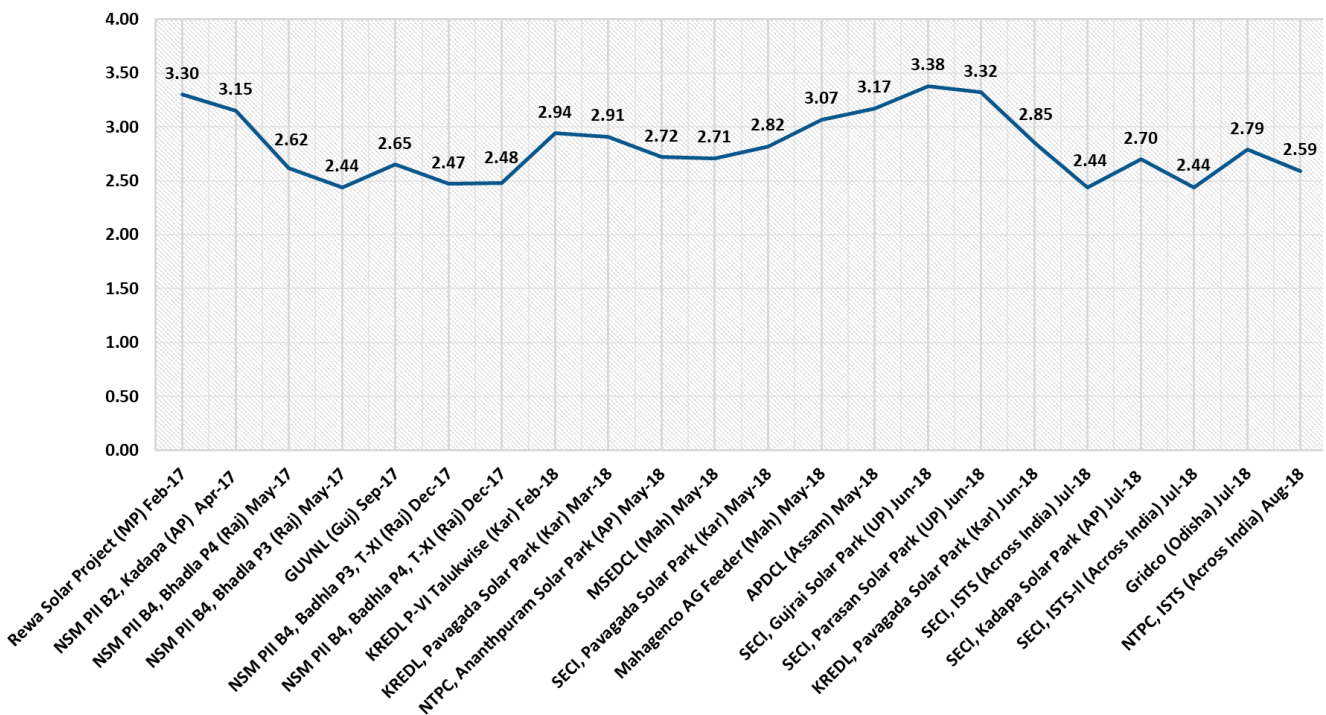
# Renewables are Winning Market Share

Competition from cheaper renewable energy sources is a big reason for the financial distress threatening upward of \$60bn in existing thermal power assets in India and must be included in any evaluation of the Khurja plant.

India's solar power tariffs have been on a downward trajectory following Prime Minister Narendra Modi's strategic endorsement of accelerated renewable energy deployments across India from 2014. Reverse bidding auctions in India since 2017 have resulted in solar tariffs below Rs3.00/kWh, with the lowest tariffs awarded at Rs2.44/kWh on multiple occasions with zero tariff indexation.

Wind's potential, unlike solar, varies geographically across India and does suffer considerable seasonal variation. States with strong wind energy potential such as Gujarat, Tamil Nadu and Karnataka, have slowly moved toward reverse bidding auctions for sourcing of wind power. However, even the wind tariffs have landed between Rs2.43-3.00/kWh due to deflationary cost gains driven by technological improvements and financial innovations, common across both the solar and wind power sectors.

**Figure 4.3: Lowest Bids in Solar Reverse Auctions in India (Rs/kWh) Since 2017**



Source: Mercom India.

Power Minister R.K. Singh said in August 2018 that India currently has 23 GW of solar capacity installed, 10 GW under construction and 24 GW tendered.<sup>18</sup> India's accelerating pace of renewable energy capacity additions is putting serious pressure on the thermal power sector.

Recently, NTPC reportedly shelved two thermal power projects --1,980 MW Nabinagar-2 and

<sup>18</sup> ET EnergyWorld. [India to comfortably achieve 100 GW solar energy target by 2022: Government](#). August 07, 2018.



1,600 MW Katwa in Bihar and West Bengal, respectively -- until it receives "re-confirmation" from the beneficiary states that they still require power from the projects. West Bengal, Bihar, Odisha, Sikkim and Jharkhand signed PPA to buy power from the projects in 2010; however Sushant Singh, the Power Minister in Odisha, recently requested his state's PPAs for the projects be cancelled due to surplus generation capacity.

In general, long-term PPAs for thermal power are now a thing of the past, with states preferring to meet their incremental power demand through far cheaper, more sustainable renewable energy purchases.

The UP, for example, has plans to install 10.7 GW of solar by 2021/22, of which 4.3 GW is planned as rooftop PV.<sup>19</sup> As part of this policy, UP has had solar power capacity tendered at various scales. In June 2018, Solar Energy Corporation of India (SECI) auctioned 50 MW of solar capacity for the grid-connected Gujrai solar park located in the UP's Kanpur Dehat district. ACME Solar Holdings won the auction by quoting a tariff of Rs3.38/kWh (US\$48.40/MWh) for Gujrai Solar Park.<sup>20</sup> ACME won another solar auction of 75 MW capacity at Rs3.32/kWh (US\$47.54/kWh) by SECI during the same month.

In July 2018, UP's largest solar reverse auction worth capacity of 1 GW discovered solar tariffs between Rs3.48-3.55/kWh. The winners included ACME Solar, Azure Power, Ray Power Infra, Hero Solar Energy and Canadian Solar. The auction was later annulled by the Uttar Pradesh non-conventional energy development agency (UPNEDA) without any official disclosure of the reasons why. However IEEFA suggests the winning tariffs were too high: more than a rupee per unit compared to the lowest solar tariffs in the country.<sup>21</sup>

As much as tender cancelations are an unwanted outcome, it reflects the desire of Indian states to progress with an energy system with a more substantial percentage of cheaper renewable energy sources. This also builds on concern for the financial viability of an expensive coal-fired facility that could be stranded even before it is commissioned.

Taking all of this into consideration, IEEFA believes a more realistic tariff for Khurja is near Rs5.67/kWh. When this is compared to the tariffs for clean renewable energy, now commonly available at less than Rs3.00/kWh, the economics for the Khurja project look dim. Any plan to go forward with this coal project, in IEEFA's view, would amount to little more than a massive ratepayer-sponsored subsidy in the order of Rs6,950 crore (US\$10bn) over 25 years. Such a commitment looks decidedly misplaced in light of coal's many externalities and the need for funds.

## The Real Need is Firming Capacity

India currently has surplus thermal capacity and does not need additional baseload thermal power. However, as the share of renewable energy in its energy mix rises, the country will need additional firming capacity and wider national grid inter-connectivity to integrate increasing amounts of variable solar and wind generation and prevent frequency and voltage fluctuations that adversely affect grid stability.

As part of this effort, India's Ministry of New & Renewable Energy (MNRE) is pushing to get additional storage and wind-solar hybrid facilities added to the grid. MNRE recently amended the

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<sup>19</sup> Mercom India. [Uttar Pradesh State Cabinet Approves Solar Policy 2017](#). December 08, 2017.

<sup>20</sup> Mercom India. [ACME Solar Wins 50 MW SECI Solar Auction With a ₹3.38/kWh Bid](#). June 08, 2018.

<sup>21</sup> The Economic Times. [Uttar Pradesh annuls 1000 MW solar auction without citing any reasons](#). Jul 29, 2018.

hybrid wind-solar policy to clarify that any form of storage – not just batteries – could be used in hybrid projects,<sup>22</sup> including pumped hydro, compressed air and flywheels.

There have been an increasing number of hybrid wind-solar projects coupled with small scale battery storage units tendered in India.<sup>23</sup> However the cost for battery storage remains high and absent time-of-use pricing incentives, these projects will largely be priced out of the market until battery costs come down.

In the interim, pumped hydro storage (PHS), if progressively implemented in the right manner, is a clean energy option offering firming capacity. India currently has 2.6 GW of pumped hydro storage capacity installed and operating. An additional 2.18 GW is under construction.

**Figure 4.4: Commissioned Pumped Hydro Storage Projects in India**

Project Name	State	Installed Capacity (MW)	Pumping Mode Operation
Kadamparai	Tamil Nadu	400	Working
Bhira	Maharashtra	150	Working
Srisaillam	Andhra Pradesh	900	Working
Ghatgar	Maharashtra	250	Working
Purlia	West Bengal	900	Working
Panchet Hill-DVC	Jharkhand	40	Not working
Sardar Sarovar	Gujarat	1,200	Not working
Kadana St.I & II	Gujarat	240	Not working
Nagarjuna Sagar	Andhra Pradesh	705	Not working
<b>Total Commissioned</b>		<b>2,600</b>	
<b>Total, Including Under Construction</b>		<b>4,785</b>	

Source: CEA, Bharat Heavy Electricals Ltd (BHEL), information as of July 2017.

Over the years, hydro power projects in India have underperformed in terms of generation. The implementation of many hydro projects has also been poor and controversial, particularly as the projects usually eventuate in the displacement of native population groups while threatening social and food security, and local environments. The projects have also been expensive.

## Pumped Hydro Storage (PHS)

The Tehri Dam proposal has been the subject of active protests since it was proposed. In addition to human rights concerns, environmentalists worry about the consequences of locating a large dam in the fragile ecosystem of the Himalayan foothills.<sup>24</sup>

The Tehri PHS project (part of the larger 2,400 MW Tehri Hydro Power Complex) was approved in July 2006 at an estimated cost of Rs1,657 crore (US\$235m). After significant delays, the project

<sup>22</sup> Ministry of New & Renewable Energy, India. [Amendment in National Wind-Solar Hybrid Policy](#). August 13, 2018.

<sup>23</sup> Mercom India. [SECI Issues 160 MW Solar-Wind Hybrid Tender with Battery Energy Storage System](#). August 16, 2018.

<sup>24</sup> Global Nonviolent Action Database. [Indian Villagers Protest Tehri Dam Construction](#).



was re-approved in 2011 at a revised cost of Rs2,978 crore (US\$426m).<sup>25</sup> Initially set for commissioning in 2016, the latest project update anticipates the facility as operational in May 2021.<sup>26</sup>

Odisha Hydro Power Corp (OHPC) has also proposed a PHS unit totalling 600 MW, at its existing 600 MW hydropower plant at the Indravati multi-purpose reservoir.<sup>27</sup> The project will use available surplus solar power during off-peak hours to raise the water to the upper reservoir and run the hydropower plant during the overnight period. The International Finance Corporation (IFC) is planning a US\$210m tender for construction of the project where total investment is estimated to be Rs3,000 crore (US\$440m). The project is considered to be crucial to bring peak electricity prices down and to improve the socio-economic conditions of villages in Odisha by supplying electricity at affordable prices. As advantageous as pumped hydro storage could be, responsible implementation is necessary to reap the equitable social and economic benefits it offers. Development projects in a country such as India come with plenty of negative externalities, of which some will adversely affect lower socioeconomic groups of the population. IEEFA recommends the Indian government proactively and responsibly address these externalities as a legally enforceable commitment as part of the approval, while continuing to enable promising developmental resources necessary for India's more sustainable long-term growth.

At the moment, India does not have time differentiated tariffs for peak power supply. This pricing mechanism will make storage and firming capacity projects viable and allow uninterrupted power supply, which is an extremely important facet for India's economic growth.

## Gas Peaker Plants

Like pumped hydro storage, gas-fired plants can be quickly switched on to respond to high demands on the grid.

NTPC Ltd. recently announced a pilot project to use 2.3 GW of its existing but stranded gas-fired capacity during the evening hours for peak-hour supply. This is part of NTPC's long-term plan to maximise the value of its underutilised gas-fired capacity to meet peak power needs while providing grid stabilisation and balancing services.

IEEFA also endorses CEA's plans to re-orient 20 GW of gas-fired capacity to better address fluctuations from large amounts of renewable energy that will be built by 2022.

It is a sound strategy to optimise India's stranded gas capacity which is not viable for baseload usage due to lack of sufficient domestic gas supply.

IEEFA endorses Central Electricity Authority's (CEA) plans to re-orient 20 GW of gas-fired capacity to better address fluctuations from large amounts of renewable energy scheduled to be built by 2022.

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<sup>25</sup> THDC India Ltd. [Tehri Pumped Storage Plant](#).

<sup>26</sup> THDC India Ltd. [Tehri Pumped Storage Plant](#).

<sup>27</sup> Live Mint. [Odisha plans ₹3,000 crore energy storage project](#). September 04, 2018.

## 5. Project Risks Are Mounting

### Power from Non-Minemouth Coal: An Unviable, Expensive Option for Uttar Pradesh

Uttar Pradesh (UP) has a total coal-based power capacity of 22 GW,<sup>28</sup> the majority of which is privately owned. There also are a large number of central sector plants (central government-owned and supply power to multiple states) located in the state, from which UP receives 40% of the output from these plants<sup>29</sup>. UP does not have in-state coal resources and must buy from neighbouring states including Jharkhand, Bihar, Madhya Pradesh and Odisha. The state also has several PPAs for small amounts of capacity with Bajaj Energy Private Ltd. at very high rates (Rs6.50 – 7.70/kWh).

The average cost of power from UP's coal plants (Rs4.40/kWh)<sup>30</sup> is much higher than the lowest renewable energy tariff in the latest auctions (Rs2.44/kWh).

The state is under lot of pressure from the Indian government to rationalise its power purchase costs under India's distribution company reform effort known as UDAY (Ujwal Discom Assurance Yojana). Given this, it would be difficult for UP's Discoms to sign PPAs with the Khurja project at its uncompetitive tariff.

**Figure 5.1: Rate of Sale of Coal-fired Power in 2015-16**

Plant	Capacity (MW)	Tariff (Rs/kWh)
Anpara Power Station	1,630	2.50
Barkhera Ipp Power Station	90	6.80
Harduaganj Power Station	610	4.90
Khamberkhera Ipp Power Station	90	6.80
Kundarki Ipp Power Station	90	6.60
National Capital Thermal Power Plant (Dadri)	980	5.00
Obra Thermal Power Station	1,094	3.30
Parichha Power Station	1,140	4.50
Rihand Power Station	3,000	2.80
Singrauli Super Thermal Power Station	2,000	1.90
Tanda Power Station	440	3.90
Utraula Power Station	90	7.70

Source: CEA.

<sup>28</sup> Central Electricity Authority of India. *ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS*. March, 2018.

<sup>29</sup> Central Electricity Authority of India. *Monthly Generation Reports*. March, 2018.

<sup>30</sup> Central Electricity Authority of India. *Executive Summary Report*. March, 2018.

## Uttar Pradesh's Demand: Supply Gap is Shrinking, Additional Demand to be Met Through Renewable Energy

The state's power supply situation has improved significantly in the past several years with the energy deficit declining from 12.5% in 2015/16 to 1.5% in 2017/18. Peak demand shortages have also fallen from 14.6% to 10.9% in the same period.<sup>31</sup> While around-the-clock demand is met with existing coal-based capacity, the state continues to face peak energy shortages. In order to meet that demand, Uttar Pradesh (UP) needs flexible generation, and not more baseload capacity.

IEEFA estimates that UP demand growth will be 5.9-6.0% pa, after considering 1% energy efficiency gains and a 1% reduction in technical and commercial losses. Currently, 7 GW of coal-based capacity is under construction and scheduled to be operational by 2027/28. During this same period, 6.7 GW of capacity will reach an end-of-effective-life of 35 years. We estimate half of this capacity will be retired, with the remainder continuing to operate beyond the effective life, unless the plants are forced to shut down for non-compliance with environmental regulations. Consequently, UP does not need any more coal-based capacity to meet its long term electricity demand needs.

Figure 5.2: Net Electricity Capacity Addition to 2027/28

Capacity Addition	GW	TWh
Coal (Addition - Closures)	4.1	20.9
Solar	18.3	39.3
On-shore Wind	0.0	0.0
Biomass	4.3	5.6
Small Hydro	0.0	0.0
<b>Total</b>	<b>26.7</b>	<b>65.8</b>

Source: IEEFA estimates.

## Off-taker Risk: Unresolved Discom Financial Issues

Distribution companies across India are facing financial difficulties due to the persistent gap between costs and revenue. This gap has narrowed in recent years, in part due to the country's ongoing reform efforts, but problems remain and Uttar Pradesh (UP) is under intense pressure to continue efforts to reduce costs for the state's distribution companies.

Power purchase costs are the single largest contributor to the cost of supply, meaning the state and its' distribution companies cannot afford any additional high-cost power supplies, such as the planned Khurja plant.

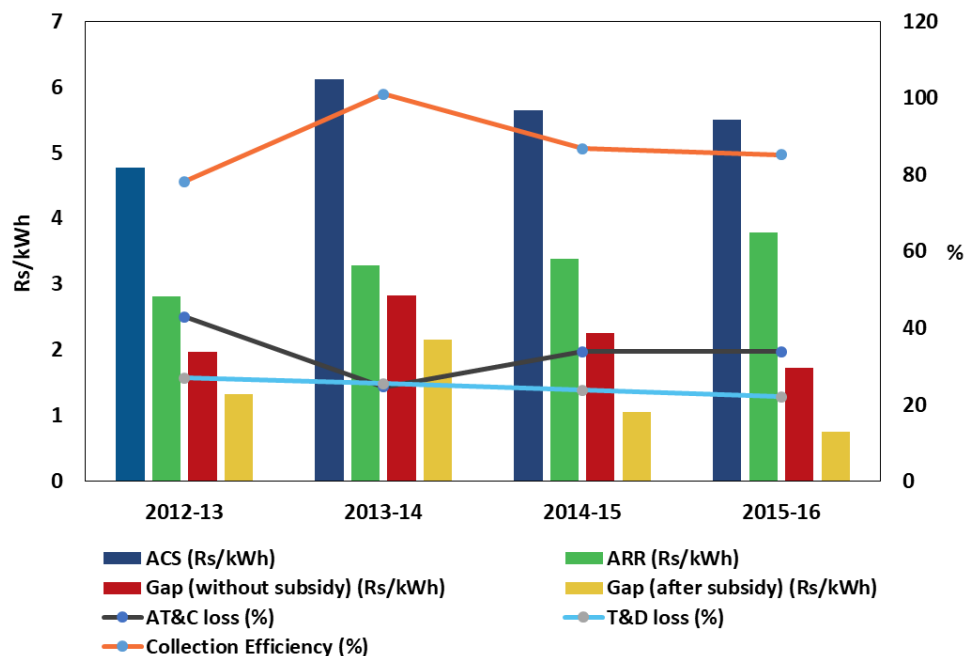
UP already has a basket of PPAs with high tariffs and in order to rationalise its costs, the state's principal distribution company, Uttar Pradesh Power Corporation Limited (UPPCL), already terminated a contract signed in 2010 with Bajaj Energy for electricity from a 450 MW coal plant.<sup>32</sup>

<sup>31</sup> Central Electricity Authority of India. [Power Supply Position Report](#). March, 2018.

<sup>32</sup> Financial Express. [UP power regulator disallows interim relief to Bajaj Energy after PPA termination](#). November 24, 2017.

The Khurja project, with a levelised tariff of Rs4.88/kWh (or higher in our estimate) will face similar risks of having its PPAs dishonoured or terminated in the future.

**Figure 5.3: Financial Indicators of UP Electricity Discoms**



Source: PFC. Note: ACS (Average Cost of Supply) & ARR (Average Revenue Realised).

## Long Drawn Legal Disputes

The Khurja project remains subject to several court fights, affecting both its coal supply and the power plant.

Of contention is that fact that 97% of the land selected for the power plant is agricultural. Local farmers are contesting the amount of compensation they received. This dispute is currently before the Allahabad High Court.

There are legal questions on the coal block allocated for the plant.

There are disputes revolving around the forest rights of local communities, which have not yet been settled in accordance with Forest Right Act of 2006.

In addition, the environmental clearance awarded to the project is being challenged before the National Green Tribunal (a special court in India for environmental cases) under the grounds that data in the EIA may have been falsified.

Finally, MoEFCC has classified the Amelia block where the mine will be built as “inviolable,” meaning the mine is unlikely to get the forest removal clearances needed to proceed, throwing the whole project into jeopardy.

## Risk of Asset Stranding: A Waste of Public and Financial Resources

India's power sector is responsible for \$40-60bn of the country's 'bad debt' burden. The Reserve Bank of India hence issued a February 2018 circular on new lending rules classifying delayed debt servicing of just one-day as default.<sup>33</sup>

While coal sector lenders are trying to restructure and resolve some US\$40-60bn in stranded assets, an accelerating number of developers are walking away from their planned but now long stranded coal power plans. As a result, lot of planned coal based capacity has already been shelved.

**Figure 5.4: List of Stressed Coal Based Thermal Power Plant in Uttar Pradesh**

S. No.	Developer	Project	Unit	Funds (in Rs Crore)		Total Investment/Expenditure (in Rs Crore)
				Debt (Outstanding)	Equity	
1	Jaypee Power Ventures Pvt. Ltd.	Bara	1 to 3	11,494	4,044	15,537
2	Lanco	Anpara C	1&2	3,071	969	4,845

Source: 37 Standing Committee on Energy.

A lot of measures were proposed to revive NPAs in the power sector, including a consortium of banks led by the State Bank of India forming a stranded asset management company to take over 14 'stressed' coal power plants.

A deadline of 27 August 2018 was enacted, and then it passed with no further extension provided. The Ministry of Power recommended RBI extend the deadline by six months for the concerned parties to find a resolution. That did not happen. As per Reserve Bank of India's (RBI) resolution the non-performing assets now face the threat of being referred to NCLT for insolvency proceedings.

The problems in thermal power sector of India are deep and there is no quick fix. Whilst the Power Ministry as well as the industry have resoundingly opined there is no one single solution for more than 40 GW of stressed capacity, merely switching promoters for these assets is unlikely to change anything.

In IEEFA's opinion, the RBI is bringing much needed regulatory discipline in adhering to their resolution. We believe that RBI will move cautiously in its next steps, it being important to avoid taking these assets out of service as much as possible. Implementation in a phased case-by-case manner is required to avoid cancellations of coal supply contracts and PPAs, near term a far more disruptive outcome than what the power sector is facing right now.

## Financing Risk: Banks Understandably Wary of Yet More Lending to Coal Based Generation

Major Indian public sector banks that have historically lent to the thermal power sector are shying away from lending even more, as most of their recent investments have turned into bad debts.

<sup>33</sup> Reserve Bank of India. [Resolution of Stressed Assets – Revised Framework](#). February 12, 2018.

The stressed assets of the power sector's key financier, Power Finance Corporation (PFC) amounted to a crippling gross Rs31,000 crore (US\$4.5bn) in 2017/18. Due to RBI's stricter norms on NPAs from the February 2018 circular, the percentage of net NPAs to total loan assets increased from 3.5% to 7.4% by the end of 2017/18.<sup>34</sup> PFC has provisioning of Rs9,524 crore (US\$1.4bn) on its total NPAs of Rs31,000 crore. Further, some of the projects financed by PFC along with other consortium lenders have already been taken to the National Company Law Tribunal (NCLT) where the banks could wear a loss of 40-50%.

In January 2018, PFC (Consulting) agreed with PTC India (formerly Power Trading Corporation of India Limited) to assist 12 GW of commissioned thermal power plants to agree to PPAs.<sup>35</sup> However in a later interview, the Chairman of PFC clarified that the firm has no plans to acquire equity in stressed assets, and would look at only converting part of the unsustainable debt into equity and equity-like instruments.<sup>36</sup> As bad loans rise, the financial sector will be increasingly wary of lending to thermal power assets.

The Khurja proposal with a project cost of Rs12,676 crore (US\$1.8bn) also faces the risk of becoming a stranded asset due to high costs, the increasing availability of lower cost renewables, the cost of air pollution, and so forth, suggesting that securing financing will be an issue.

## Environmental Risk: Rising Pollution Pressures

Coal power is a major contributor of particulate matter (PM) 2.5 while also releasing sulphur dioxide, nitrogen oxide, mercury, soot and fly ash into the atmosphere.<sup>37</sup>

Air pollution is amongst the largest contributors to premature deaths in India, with PM 2.5 alone responsible for 1.3 million premature deaths a year.<sup>38</sup>

Much of the opposition to the Khurja project has been on environmental and public health grounds. The project would be built adjacent to the National Capital Territory of Delhi, which confronts severe air pollution problems; this has prompted the project's referral to the Environment Pollution Prevention and Control Authority (EPCA).<sup>39</sup>

As proposed, the Khurja project complies with existing environment regulations. However, with the nation's continuing air pollution problems, these rules are likely to be made stricter. This would involve additional expenditure on top of the Khurja's facility's already-high tariff, further endangering the plant's long-term economics.

While India currently has almost no regulatory limits to coal power plant pollution, IEEFA anticipates that India will move toward emissions-control laws more in line with the world's best practice. As power producing utilities see the inevitability of expensive upgrades, more will take the plant closure route.

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<sup>34</sup> Power Finance Corporation – Investor Interaction Meet. May 15, 2018.

<sup>35</sup> New India Express. PFC ties up PTC India to buy power from stranded power plants. January 05, 2018.

<sup>36</sup> Economic Times. There is no one-solution-fits-all approach to power sector stress: Rajeev Sharma, CMD, PFC. July 18, 2018.

<sup>37</sup> The Lancet. Hidden costs of energy: unpriced consequences of energy production.

<sup>38</sup> Health Effects. Burden of Disease Attributable to Major Air Pollution Sources in India. January 21, 2018.

<sup>39</sup> Catch News. Concern over green nod to UP power plant. August 27, 2018.

## Water Scarcity: Forced Shut Down of Thermal Plants

Water supply issues are a big problem for India's coal generators.

Between 2012 and 2017, water scarcity was suggested to be responsible for coal power generation losses of 5bn kWh each year.<sup>40</sup> In 2016 for example, Adani Power was forced to temporarily shut down its 2.6 GW Tiroda plant in Maharashtra due to water shortages.

The Khurja project with water requirements of 3,265 cubic metre per hour will face the same high risk of shut down due to water shortages.

Water supply issues are likely to become ever more frequent in the context of climate change, posing a continuing problem to coal plant economics by constraining generation.

Current regulations from the Ministry of Environment, Forest and Climate Change limit water usage to 3 cubic meters per MWh for coal plants.<sup>41</sup> Whilst India's coal power plants use average 3.8 cubic metres of water per MWh, solar uses 0.1 cubic meters and wind close to zero,<sup>42</sup> demonstrating another clear advantage for green generation.

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<sup>40</sup> Vasudha Energy Mapping Initiative. [Power Plant Data](#).

<sup>41</sup> Scroll. [Government dilutes norms to allow thermal power plants to use more water](#). October 30, 2017.

<sup>42</sup> IEEFA. [India's Electricity Sector Transformation](#). November 21, 2017.



## 6. Interstate Renewables Trade

The financial viability of the Khurja project also relies on the continued offtake from four additional states that entered the PPA back in 2011. Since then, India's electricity price dynamics have dramatically changed.

The states have continued to build renewable capacity to meet incremental electricity demand. On top of being a cheaper source of electricity, the states' drive to build renewable energy capacity comes from Renewable Purchase Obligations (RPO) enforced by the central government, as well as the assigned share of renewable capacity to reach the ambitious national target of 175 GW by 2021/22 and 275 GW by 2022.

**Figure 6.1: State-wise Breakup of Renewable Energy Capacity (MW) Targets by 2022**

State	Solar	Wind	Small Hydro	Biomass	Total
Delhi	2,762	0	0	0	<b>2,762</b>
Himachal Pradesh	776	0	1,500	0	<b>2,276</b>
Rajasthan	5,762	8,600	0	0	<b>14,362</b>
Uttar Pradesh	10,697	0	0	3,499	<b>14,196</b>
Uttarakhand	900	0	700	197	<b>1,797</b>

Source: MNRE.<sup>43</sup>

### Delhi

The Delhi Metro Rail Corporation (DMRC) in the country's first interstate open access agreement has signed up to buy power from 1 GW Rewa Solar Park situated in Madhya Pradesh. The Rewa Solar Park will supply a quarter of its electricity generated to DMRC, providing 90% of its electricity requirement.<sup>44</sup> While currently paying Rs7/kWh, DMRC will in future get electricity at Rs3.67/kWh including transmission charges from the Rewa Solar Park, an estimated saving of Rs1,400 crore (US\$205m) over a 25 year period.

The Delhi government has an ambition to build 2 GW of solar rooftop capacity by 2025. Recently, Delhi's power department proposed to launch a solar rooftop demand aggregation program for 40 MW of solar capacity on various buildings through the formation of a Renewable Energy Service Company. The government has identified residential rooftop solar as playing a key role in providing clean energy amidst the rising air pollution problem in the urban setting of Delhi.<sup>45</sup>

### Rajasthan

India's National Electricity Plan (NEP) (Jan 2018) identifies the state of Rajasthan as having maximum renewable energy potential.

Some 4.3 GW of solar capacity has already been approved under the National Solar Park Scheme in Rajasthan.

<sup>43</sup> Ministry of New & Renewable Energy, India. [Tentative State-wise break-up of Renewable Power target to be achieved by the year 2022.](#)

<sup>44</sup> India TV News. [Delhi Metro to get green power from MP-based Rewa solar plant in two months.](#) July 15, 2018.

<sup>45</sup> ET Energy World. [Delhi government to launch solar rooftop demand aggregation program.](#) July 23, 2018.



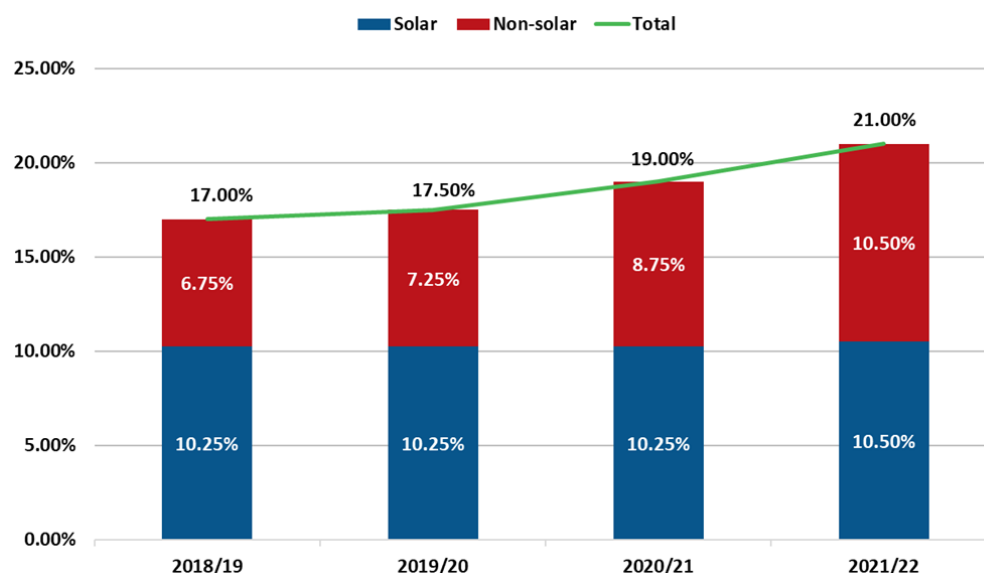
The state is also building the world's largest solar park of 2.2 GW in Badhla, Jodhpur district. The mammoth solar park has been auctioned in phases over a period of 15 months between 2016 and 2017. The third phase of the auction resulted in the record-breaking low tariff of Rs2.44/kWh (US\$34/MWh), which still remains the lowest solar tariff achieved through reverse auction in India's energy sector. The Badhla Solar Park is hoped to be fully operational by December 2018. Most interestingly, the Badhla Solar Park's 750 MW capacity was established by the Uttar Pradesh (UP) government with the help of SECI, with the aim of importing power from the solar park. The reverse auctions discovered the tariff between Rs2.62-2.63/kWh.<sup>46</sup>

Under the open access model, it is a lot cheaper for states to import solar power on wire instead of setting up polluting coal-fired facilities that rely on imported coal. SECI has been actively tendering interstate transmission system (ISTS) connected solar and wind capacity to create a 'Green Corridor' that can leverage the interstate renewable energy potential. To further support this interstate energy security paradigm, the Ministry of Power has waived off transmission charges for ISTS connected wind and solar projects till 2022.<sup>47</sup> This makes interstate renewable energy trade even cheaper.

The MNRE has revised the RPO targets upwards and created an RPO compliance cell to enforce stricter compliance.<sup>48</sup> The cell will monitor the progress on RPOs by coordinating with states and state electricity regulatory commissions and will take non-compliance related issues to the authorities.

While states turn up the heat on renewables, the viability of Khurja's PPA is thrown into doubt. It doesn't add up that Rajasthan, a renewable energy rich state, wants to import expensive coal-fired power when they are already exporting more than double the amount of cheaper electricity to UP. Once again, the sustainability of the Khurja project is questionable.

**Figure 6.2: RPO Trajectory for Indian States/UTs as Percentage of the Total Generation**



Source: Indian Ministry of Power.<sup>49</sup>

<sup>46</sup> The Economic Times. UP government setting up 750 megawatt solar plant at Badhla. May 21, 2017.

<sup>47</sup> Mercom India. Ministry of Power Waives ISTS Charges for Wind and Solar Projects Commissioned up to 2022. February 16, 2018.

<sup>48</sup> Mercom India. Will States Comply with the New Solar RPO Target? June 26, 2018.

<sup>49</sup> Ministry of Power, India. Long Term Growth Trajectory of Renewable Purchase Obligations. June 14, 2018.

## 7. UP Electricity Sector Outlook

Uttar Pradesh's energy mix is heavily dominated by thermal capacity, with coal accounting for about 72% of the installed capacity and about 86% of total generation.<sup>50</sup> In the last three years, the state added some 6 GW of coal capacity, providing an annual growth rate of 11%.<sup>51</sup>

**Figure 7.1: Uttar Pradesh Electricity Sector Composition 2017/18**

Source	Electricity Market Composition 2017/18					
	Capacity		Generation		Capacity	YoY Change
	GW	% of Total	TWh	% of Total	Utilisation	GW
Coal	18.1	72%	100.5	86%	65%	1.0
Gas	0.5	2%	0.7	1%	15%	0.0
Diesel	0.0	0%	0.0	0%	0%	0.0
Hydro	3.4	14%	7.8	7%	27%	0.2
Nuclear	0.4	2%	3.6	3%	94%	0.2
Renewable	2.7	11%	4.6	4%	20%	0.4
<b>Total</b>	<b>25.2</b>	<b>100%</b>	<b>117.3</b>	<b>100%</b>		<b>1.7</b>

Source: Central Electricity Authority, IEEFA estimates.

Hydropower accounts for 14% of the total installed capacity, followed by renewables (11%). While hydro capacity has remained stagnant, the state recently signed PPAs for 1 GW of new hydro power in 2016/17 as part of its clean energy initiative. UP also has 2.2 GW of biomass and 472 MW of solar capacity as of 2017/18.

Looking forward 10 years, IEEFA expects growth to continue in Uttar Pradesh's coal sector but at a much slower pace. Most of the state's incremental electricity demand will be met by cheaper, cleaner renewable energy capacity. The transition is evident in Figure 7.2 below.

**Figure 7.2: Uttar Pradesh Electricity Sector Composition 2027/28**

Source	Electricity Market Composition 2027/28					
	Capacity		Generation & Share			Capacity
	GW	% of Total	TWh	% of Total	FY18 Vs FY28	Utilisation
Coal	22.2	43%	121.4	64%	-22%	63%
Gas	0.5	1%	1.3	1%	0%	26%
Diesel	0.0	0%	0.0	0%	0%	0%
Hydro	3.5	7%	8.1	4%	-2%	27%
Nuclear	0.4	1%	3.6	2%	-1%	94%
Renewable	25.3	49%	55.4	29%	25%	25%
<b>Total</b>	<b>51.9</b>	<b>100%</b>	<b>189.8</b>	<b>100%</b>		

Source: IEEFA estimates.

<sup>50</sup> Central Electricity Authority of India. [Monthly Generation Reports](#). March, 2018.

<sup>51</sup> Central Electricity Authority of India. [Monthly Report on Broad Status of Thermal Power Projects in the Country](#). April, 2018.

Currently, there is 7.4 GW of coal capacity under construction in the state with an additional 5.3 GW in the permit and pre-permit stages. IEEFA does not believe any of the plants in the permitting stage will be built by 2027/28. In addition, there are 10 plants with a total capacity of 6.5 GW that were commissioned pre-992 and will be due for retirement by 2027. IEEFA estimates half of these plants will be closed down, while the remainder continue to operate taking the net growth in Uttar Pradesh's coal capacity to about 4 GW. In contrast, IEEFA expects installed renewable capacity to jump from the current rate of less than 3 GW to more than 25 GW in the coming 10 years.

**Figure 7.3: Uttar Pradesh's Coal-fired Project Status as on June 2018**

Status	Capacity (MW)
Operating	22,645
Under Construction	7,380
Permitted	1,980
Pre-permit	3,300
<b>Grand Total</b>	<b>35,305</b>

Source: Global Coal Plant Tracker June 2018.

Note: The 22.6 GW includes captive power plants above 30 MW and the capacity that is installed in UP but sells part of its generated power to other states as well.

In December 2017 the Uttar Pradesh government finalised the state's solar policy to include an installation target of 10.7 GW of new solar, including 4.3 GW of rooftop PV by the end of 2021/22. Their aim was to drive lower cost, more sustainable solar capacity.

To enact this policy, the state's New and Renewable Energy Development Agency has drafted guidelines giving state support to private solar parks. That support includes providing grid connectivity and ensuring state distribution companies purchase the plants' output.

Uttar Pradesh (UP) also aims to expand its biomass generation from 2.2 GW to 3.5 GW by 2021/22. Biomass is a dispatchable source of renewable generation, and expansion provides a great value-add in UP's effort to balance its' energy mix while maintaining system stability.

Co-firing crop stubble with coal in power plants is another potential avenue for increasing biomass generation. In November 2017, the power ministry directed NTPC to buy crop stubble from peripheral farmlands in New Delhi.<sup>52</sup> It is a productive solution that addresses air pollution issues in New Delhi with the added bonus of more sustainable fuel sourcing for NTPC and extra income for farmers. IEEFA recommends this solution be progressively adopted across India.

UP does not have any material in-state wind power potential. However, it was recently reported that UP is going to import wind power at Rs3.46/kWh from India's first ISTS-connected 1 GW wind farm commissioned in Kutch, Gujarat.<sup>53</sup> In addition to the PPA with Badhla solar park, this is a prime example of UP's increasing preference for cheaper interstate renewable energy. In IEEFA's view, this is the way forward which allows both RPO compliance while providing a cost-effective source for UP's incremental electricity demand.

<sup>52</sup> Business Standard. [Delhi smog: NTPC to buy crop stubble to help North India out of air crisis](#). November 17, 2017.

<sup>53</sup> ET Energy World. [India commissions first wind project connected to inter-state transmission system](#). August 24, 2018.

India's electricity demand has grown at 0.9 times GDP growth for last five years. In Uttar Pradesh electricity demand has grown materially faster, at 1.1 times GDP growth during the same period. The agriculture sector is the state's largest economic sector contributing ~22% of the state's GDP.<sup>54</sup> This is followed by manufacturing, construction and tourism.

In November 2017, the U.S. Energy Information Administration (EIA) published an analysis showing growing evidence of a decoupling between economic activity and electricity demand, and suggesting that improving energy productivity is keeping growth in electricity demand growth below that of GDP. This transition has been under way in many of the member countries involved in the Organization for Economic Cooperation and Development (OECD), as a result of ongoing energy efficiency improvements and with the ongoing economic shift from low-skilled manufacturing to services and more energy efficient manufacturing.<sup>55</sup>

Given the Indian government's emphasis on energy efficiency, IEEFA expects a similar decoupling of economic growth and electricity demand to unfold in UP. Consequently, IEEFA forecasts that the gross electricity to GDP growth ratio will fall to 0.95 times in the UP by 2027, as per Figure 7.4.

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<sup>54</sup> Government of Uttar Pradesh. [Uttar Pradesh Annual Plan 2016-17](#).

<sup>55</sup> US Energy Information Administration. [Link between growth in economic activity and electricity use is changing around the world](#). November 20, 2017.

**Figure 7.4: Uttar Pradesh Electricity Supply & Demand 2027/28**

GDP Growth (%)	8.8%												
Electricity to GDP Multiplier Pre-EE	0.95												
Electricity Demand Growth	8.4%												
Energy Efficiency (%)	-1.0%												
Electricity to GDP Multiplier Inclusive	0.84												
Reduced Grid AT&C Losses	-1.0%												
<b>Year Ended March</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>	<b>2023/24</b>	<b>2024/25</b>	<b>2025/26</b>	<b>2026/27</b>	<b>2027/28</b>	
Gross Production (TWh)	105.7	118.3	125.3	132.8	140.7	149.1	158.0	167.5	177.6	188.4	199.8	211.9	
Gross Production Growth (%)		11.9%	5.9%	5.9%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.1%	6.1%	
AT&C Losses (TWh)	31.9	32.7	33.3	34.0	34.6	35.2	35.7	36.2	36.6	36.9	37.2	37.3	
AT&C Losses (%)	30.2%	27.6%	26.6%	25.6%	24.6%	23.6%	22.6%	21.6%	20.6%	19.6%	18.6%	17.6%	
Reduced Grid Losses		-2.6%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	
Real GDP Growth (%)	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	
Electricity Multiplier (x)	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Electricity Growth (%)	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	8.4%	
Energy Efficiency	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	-1.0%	
Net Demand Growth (TWh)	73.8	85.7	92.0	98.8	106.1	113.9	122.3	131.3	141.0	151.4	162.6	174.6	
Net Demand Growth (%)		16.1%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	

Source: IEEFA estimates.

Factoring in annual energy efficiency gains of about 1%, IEEFA estimates Uttar Pradesh's net electricity demand growth will be 0.84 times its' GDP growth in the coming decade. The introduction of LEDs, energy efficient air conditioners, solar irrigation pumps and better building construction standards will add to this reduction in cost while promoting a less polluting source of procurement.

Additionally, IEEFA's modelling assumes UP will be able to trim their increasingly high aggregate technical & commercial (AT&C) losses from the current 27.6% to 17.6% in 10 years, a 1% annual decline. Cutting these losses is an urgent priority, assisted by the federal government's UDAY reform program aiming to improve the financial condition of the country's distribution utilities. By definition, cutting losses from transmission and distribution reduces the requirement for new electricity production. Reducing commercial losses, which mostly occurs due to electricity theft, will require the roll-out of a smart metering system that should immediately reduce such losses.

In June 2018, Power Minister R.K. Singh announced a US\$21.5bn program—Kisan Urja Suraksha Evam Utthaan Mahaabhiyan (KUSUM)—to distribute 2.75m solar irrigation pumps with a million of these pumps to be connected to the grid. This plan has the potential to eventually eradicate heavily subsidised, imported diesel-based pumps, deliver energy savings and provide energy

security to India's struggling agriculture industry.<sup>56</sup>

Taking all of this into account, IEEFA projects a net 7.4% CAGR in electricity demand over the coming decade. This translates to a demand increase of 89 terawatt-hours (TWh) and production expansion of 94 TWh by 2027/28, including the generation required to offset 4.5 TWh net of imported electricity in 2017/18.

**Figure 7.5: Uttar Pradesh Electricity Sector Expansion by 2027/28**

<b>UP's Waterfall Chart</b>			
Net Electricity Consumed in UP in 2017/18 (TWh)			86
Real GDP Growth	8.8%	pa	
Electricity to GDP Multiplier	0.95	times	
Electricity Demand Growth	8.4%	pa	89
Energy Efficiency	-1.0%	pa	1
Growth: Gross Production Losses			26
Reduced Grid AT&C Losses	-1.00%	pa grid efficiency gain	-19
Net Electricity Consumed in UP in 2027/28 (TWh)			175
Net Expansion in Electricity Demand 2027/28 (TWh)			89
Net Expansion in Electricity Production Required (TWh)			94
<b>The Increase in Net Electricity Demand is Met by (TWh)</b>		<b>TWh</b>	<b>Uplift</b>
Solar Expansion		27	28%
Solar Rooftop Expansion		14	15%
Solar Thermal Expansion		0	0%
Interstate Wind Import (Non-solar RPO)		21	23%
Increase in Biomass Generation		10	11%
Increase in Hydro Electricity		0	0%
Increase in Gas-fired Electricity (Higher Utilisation)		1	1%
Increase in Nuclear Generation		0	0%
Change in Coal-fired Power Use		21	22%
<b>Net Expansion in Electricity Production by 2027/28 (TWh)</b>		<b>94</b>	<b>100%</b>

Source: IEEFA estimates.

<sup>56</sup> ET Energy World. Solar power scheme entailing Rs 1.4 lakh cr to be implemented from next month: RK Singh. June 05, 2018.

## 8. India's Coal-fired Project Pipeline

The Non-Performing Assets (NPAs) worth US\$40-60bn in India's thermal power sector have continued to clog the banking sector, inhibiting potential to continue to generate new financial credit in the economy. Out of the 40 GW of financially stressed capacity, 15 GW is not yet commissioned.

India's coal-fired power sector woes reflect the combination of excessive financial leverage, sector-specific operational inefficiencies, poor planning and poor due diligence. In addition, the growing competition arising from accelerated deflation in renewable energy tariffs add to the scepticism of would-be investors in the sector. The country's financial sector has been ill-equipped in forcing promoters to write-off their equity investment in stranded assets. This has resulted in delays and bigger losses to debt providers, particularly as interest expenses continue to accrue on long-stalled, increasingly unviable projects.

While coal sector lenders are trying to restructure and resolve US\$40-60bn in stranded assets, an accelerating number of developers are walking away from their planned but now long stranded coal power plants. NPTC Ltd have shelved 13 GW of its planned projects in the last eight months due to a number of reasons common across the stressed assets, including a lack of local coal supply linkages, PPA cancellations, legal disputes and the issue of generating capacity surplus to the lower than expected growth in electricity demand.<sup>57</sup>

**Figure 8.1: India's Coal-fired Power Project Pipeline as of June-2018**

Coal Plant Pipeline in India (GW)	
Current Status	GW
Announced	16
Pre-permit	24
Permitted	23
<b>Announced + Pre-permit + Permitted</b>	<b>63</b>
Construction	39
Operating	219
Shelved	97
Cancelled 2010-2018 (June)	476
<b>Cancelled or Shelved 2010-2018 (June)</b>	<b>573</b>
Closed 2010-2018 (June)	8

Source: Global Coal Plant Tracker (GCPT).

India's coal-fired projects are shrinking faster than expected. As shown in figure 7.1, GCPT data reports 573 GW of coal-fired power projects in India were cancelled or shelved between 2010 and June 2018.<sup>58</sup>

<sup>57</sup> IEEFA. [Coal Plant Cancellations Are Coming Faster Than Expected](#). August 23, 2018.

<sup>58</sup> GCPT deems a project as cancelled if there is no development progress on the project for four years and shelved after two years. Another sign of companies quietly walking away from their projects includes project

With 39 GW already under construction, much of the 63 GW in planned capacity in various stages of pre-construction development will simply add to existing surplus capacity, increasing the number of distressed assets. In such a situation, generation facilities will compete with the coal-fired sector, resulting in sustained sub-optimal capacity utilisation rates.

Two of the largest stranded imported coal assets in India are the ultra-mega power plants in Mundra, owned by Adani Power (4.6 GW) and Tata Power (4.0 GW). Both plants were listed for sale for a token Rs1 each in May 2017 but neither has found a buyer. The price was too high in light of the billions of dollars in debt attached to the two projects. Adani Power reported a net loss of Rs825 crore (US\$120m) in the first quarter of 2018/19, a near doubling relative to the previous period, highlighting the magnitude of the equity write-down required but yet to be enforced by compliant directors, auditors and the stock exchange. In the meantime, the unplanned idling of Adani Mundra has forced the state of Gujarat to buy more expensive power on the open market.

In such an environment of dramatic, permanent, technology-driven disruption and cost deflation, NTPC has been judicious in cancelling surplus expensive coal-fired project proposals that have been stalled for years.

As it stands, is highly questionable as to why the PFC should risk lending to the Khurja project when it looks very much like another unviable, stranded asset.

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names vanishing from company documents. In total, about 18 GW of projects were shelved in just the six months to June 2018.



# Conclusion

The proposed Khurja coal project is an uncompetitive, expensive option for Uttar Pradesh, India's most populous and poorest state, and the four other states that backed the development in 2010. Thanks to the rapid commercialisation of increasingly low cost renewable energy, the planned US\$1.8bn investment now looks out-dated and financially unviable. It has all the makings of yet-another Indian stranded asset.

While there has been little clarity offered by THDC, the levelised tariff is certain to be at least 20-25% higher than Rs4.88/kWh due to increases in coal prices and railway freight charges for coal transportation in the last two years. Furthermore, the states of Uttar Pradesh, Rajasthan and Delhi have recently signed up to ever-cheaper renewable energy PPAs.

In IEEFA's view, further sustained reductions in absolute renewable energy prices are inevitable – witness the 25-30% solar module price reduction in 2018 to-date.

The Khurja project is a 'lose-lose' deal for those states that decide to honour the PPA. If the project is built, the plant's electricity will cost almost twice that of new solar and wind power; and if not operating, purchasers will still pay more in the form of an extravagant capacity charge.

Among the key risks, the most pressing is the proposed Khurja plant's impact on local air pollution due to its proximity to Delhi. Khurja is 100-120 km from the national capital, which already faces alarming levels of air pollution not improved by the addition of 1.3 GW of new coal capacity. In winter 2017 the supreme court ordered the shutdown of the 705 MW Badarpur plant also located near the capital, due to air pollution concerns. As stricter emissions control regulations are introduced, the Khurja plant will be forced to install expensive retrofit equipment that will further diminish its already questionable long-term economic viability.

THDC's recent diversification into renewable energy and pumped hydro storage is increasingly aligned with the current and future needs of India's electricity sector. The company should expand on these efforts which promise positive returns on investment and cancel its' Khurja proposal.

India's ambitious renewable energy targets need to be backed by flexible capacity in the form of battery storage, pumped hydro storage, interstate grid connectivity and flexible gas generation for peaking supply.

The Khurja project will not meet any of the needs in India's developing, renewable-based energy system which aims to deliver affordable energy for all. In addition, India's ambition to achieve "double digit growth rate" hinges on its' energy security, thereby requiring cautious investment of tax-payer's money.

In IEEFA's opinion, the Khurja plant is not needed and should not be built.

# Institute for Energy Economics and Financial Analysis

The Institute for Energy Economics and Financial Analysis (IEEFA) conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy and to reduce dependence on coal and other non-renewable energy resources. More can be found at [www.ieefa.org](http://www.ieefa.org).

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