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# Assessing Risk and Cost in India: Solar's Trajectory Compared to Coal

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Only months after the world's largest electricity blackout, which left over 600 million people in the dark, the energy supply gap in India has reached a level that jeopardizes the country's economic growth prospects and national security. Last July, average peak demand exceeded supply by 10.5 gigawatts (GW), or roughly 8.1 percent, according to the Central Electricity Authority (CEA). In January, demand exceeded supply by 8.4 GW, or roughly 9.9 percent. In 2006, India's Integrated Energy Policy developed by the country's central Planning Commission estimated that installed energy capacity in the country would need to reach 960 GW by 2031-32 in order to support 9 percent annual GDP growth. As of January 2013, India's installed capacity base stood at only 213 GW, implying that almost 37 GW of new generation capacity (the equivalent of 37 nuclear power plants) would need to be commissioned each year for the next two decades in order to meet this target.

With such ambitious requirements set against a lack of abundant domestic conventional energy resources, solar power must play a significant role in supporting the country's power sector growth plan. The country's landmark national solar policy, implemented through the Jawaharlal Nehru National Solar Mission (JNNSM), aims to build 20 GW of solar generation capacity by 2022, although the market opportunity is generally believed to be multiples of that target. But as India builds other types of power plants to electrify the 400 million people who were without power before the blackouts, some inevitable scenarios are becoming a reality. Coal-based power's cost and risk profile is steadily climbing, and solar energy is becoming increasingly attractive (i.e. more economically viable). Coal's predicament is based principally on domestic fuel scarcity and fuel price volatility driven by increasing reliance of importation of the resource, which affects both existing plants and those under construction.

**Coal**

India has made great strides in building new power generation capacity. In the past five years, the country has added 35 percent more generation, reaching over 213 GW—though a good portion of that capacity is not available during periods of peak demand due to fuel inventory shortages. Coal represents approximately 57.2 percent of India's total power capacity. This heavy reliance on coal power will exacerbate India's energy crisis and affect every sector of its economy.

According to Bloomberg New Energy Finance estimates, in July, the levelized cost of electricity (LCOE) for coal was estimated to be approximately Rs.1.9-4.8 per kilowatt-hour (kWh). However, it is well documented that coal supply shortages have crippled the nation's ability to meet electric demand, and the ability for new coal plants to secure supply contracts. Private coal plant developers have said that over 68 GW worth of new coal projects are at risk of default because they cannot secure supply.

The coal supply gap could be five times as big as it is today in 2017, according to Credit Suisse, and the cost of importing coal could equal 1 percent of GDP. The Economist reported last January that benchmark coal prices have risen at least 50 percent above its 2009 average. Others have pegged it as high as 180 percent. Meanwhile, solar module prices have fallen 70 percent since 2009.

Coal's risk profile should make anyone shudder. Reuters reported on 1 August that government data shows new thermal power projects face on average, a 15-month delay in construction. When you factor in the added costs of disruptions, defaults, imported fuel, national security, environmental damages from air pollution and climate change, and the Comptroller & Auditor General of India's report that the government lost Rs.10.7 lakh crore (~$196 billion) by giving away mining blocks rather than auctioning them, an LCOE of Rs. 4.8/kWh is probably significantly under-stating the true cost of generation to the country.

**Solar and the Supply Gap**

Solar power is produced during peak demand, when the power supply shortage in India is at a maximum level. Recent peak demand prices on the spot market have reached Rs.12/kWh. By comparison, the LCOE of most solar plants now under construction is in the Rs.8-9/kWh range and continuing to drop each year.

Solar has been price competitive with captive diesel power for over 24 months and is within striking distance of parity with coal. In addition, the Indian solar market has experienced an important level of maturation with the implementation of an initial 1,000 MW. With this, the perceived risk by developers and financiers of implementing new solar power assets has been dramatically reduced.

The sunlight in India is ample, reliable and, importantly, free of cost. When you factor in the speed with which solar plants are constructed (measured in months, not years), the case for solar in India becomes even more compelling. For example, Astonfield built its two megawatt solar plant in Uttar Pradesh in 67 days, compared to the 3-4 years it takes to build coal plants.

One could argue that, when completed, the size of a coal plant allows for significantly more power to be distributed to homes and industry than even the largest solar plants. However, the scalability of solar power can quickly add up significant capacity. For example, Germany with half the solar irradiance of India and less than 7 percent of the population, has installed over 32.7 GW of solar capacity since 2005. Small solar projects are ideally suited to be built quickly and in close proximity to demand centers across the country while larger utility solar projects can be located in the areas best suited to achieve the highest yield, such as in the deserts of states of Rajasthan and Gujarat.

Ultimately, solar power is not competing with any other power source for a seat at the table in India's energy mix. New power capacity from solar, coal, nuclear and gas (as well as other energy sources such as wind and hydro) will all be necessary for India to achieve its power capacity targets. For India to achieve 700-800 GW of power capacity in the next two decades, solar power will have to consist of at least 100 GW of that overall pie.

**Ramifications of Reliability and Supply Gaps**

India's ability to satisfy current power demand while implementing the country's strategic plan to increase power supply in order to support economic growth is critical to the nation's welfare. The stability of the Indian economy depends on the reliable supply of electricity, and the country's credit rating is also directly impacted by the country's infrastructure challenges, especially in the power sector. The rating agencies Fitch and Standard & Poor's (S&P) have already lowered India's credit rating to negative, and while Moody's has kept it stable they did note that the blackouts would result in a credit-negative effect. According to India Ratings & Research, which is part of the Fitch Group, for every 1 percent of GDP growth, power generation will have to increase 1 percent, and fuel supply unreliability would impact economic growth.

Now that solar power's costs are becoming increasingly affordable, its other benefits are empowering Indians in many ways— through improved national security due to reduced dependence on fuel imports, job creation in cities and rural areas, and lateral growth in other sectors of the economy due to electrification— and empowered Indians can achieve great things. However, one critical issue (and a rate limiting factor for the industry) is that Indian banks and financing institutions have yet to scale up their lending practices for the solar sector to support the pace of implementation necessary to achieve India's 10-year, 20 GW solar target.

**The Financing Challenge**

Investment banks have to make tough choices on energy projects, and the effects of those choices ripple through the economy with good and bad outcomes. Investments in power infrastructure and renewable energy projects have outstanding lateral benefits across India's economy, but the justification of putting rupees into coal plants comes with increasing levels of unacceptable risk, as detailed above. However, significant hurdles to securing financing for solar projects persist, even as prices have dropped precipitously. A combination of lingering misconceptions of solar as too expensive, coupled with the relative newness of India's operating solar plants, have produced onerous lending policies that make it challenging to get decent loan terms.

There are three major hurdles to securing financing for solar power projects. First, Indian banks continue to insist on developers providing 2-3 years of data for operating plants. They're still struggling to understand how generation levels are based on real data, and prefer to be in a wait-and-see mode for a period of three years after the first plants generate an adequate quantum of data to measure solar irradiance accurately. It's just a matter of time before operating solar plants have enough real-time generation data available to assuage concerns of Indian lenders on this aspect.

The second hurdle is debt service coverage, or DSC. Indian banks are being very conservative, insisting on 1.2-1.3 DSC ratio. For project economics to look more attractive to developers, DSC ratios should be at a minimum of 1.1-1.15. At this rate, the attractiveness of several projects begins to change substantially.

Third, Indian banks are insisting on debt service reserve allowances that are funded up front with equity rather than project cash flows which is unorthodox compared to other power project funding. It places a big burden on equity returns by having to invest about 36 percent instead of 30 percent for every project. The additional 6 percent weighs down returns. Will the coverage ratio decline over time based on the experience the operator shows irrespective of the project he's showing you? It would typically rise over time if you have more cash to cover your debt as you show you're paying down your debt. As a broad concept, these debt service reserve ratios should come down, moving closer to 85/15 or 90/10 as they're doing in Europe.

Despite these challenges, many solar plants have been built and more are coming, especially from the states within India that are taking a more proactive approach to launching their respective programs, typically in sizes of 500 MW-1,000 MW. In addition to this, there is a deeper level of seriousness to comply with the solar power Renewables Purchase Obligations as the regulators begin to take a tougher stand on compliance.