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Indian Power Prices—How Renewable Energy is Cheaper than Coal

Consideration of the deflationary impacts of renewable energy, plus a greater focus on energy efficiency and reduced grid transmission losses, provide an increasingly economically rational alternative to India.

Privatisation of the Power Generation Sector

Faced with the prospect of a significant rise in electricity demand, from 2004 onwards the Government of India (GoI) renewed its focus on a partial power sector privatisation. This program involved putting out to private market tender a large number of electricity power purchase agreements (PPA), most priced in the range of Rs2-3/kWh. Many Indian firms diversified into the coal and gas-fired power generation sector on the back of US\$1-4bn commitments to build greenfield power plants. The GoI launched its Ultra Mega Power Projects (UMPP), that involved building massive 4.0 GW coal-fired power generators on a single site.

A key aspect of this large scale coal-fired power expansion was the contractual agreement to supply power at the tendered price for up to 25 years.

The PPA contracts were generally long term in nature (15-25 year terms) and included little scope for price indexation to cover for inflation. At the time, the associated fuel (coal and gas) was expected to be supplied predominantly from domestic Indian sources. However, even where there was an expectation that some imported coal would be required to balance supply sources, the presumption was that cheap coal supplies could be sourced from Indonesia, often via captive partly owned greenfield coal mine developments. With Indonesia implementing coal export taxes, Tata Power is looking to sell its Indonesian coal JV and Adani Enterprises' consistently

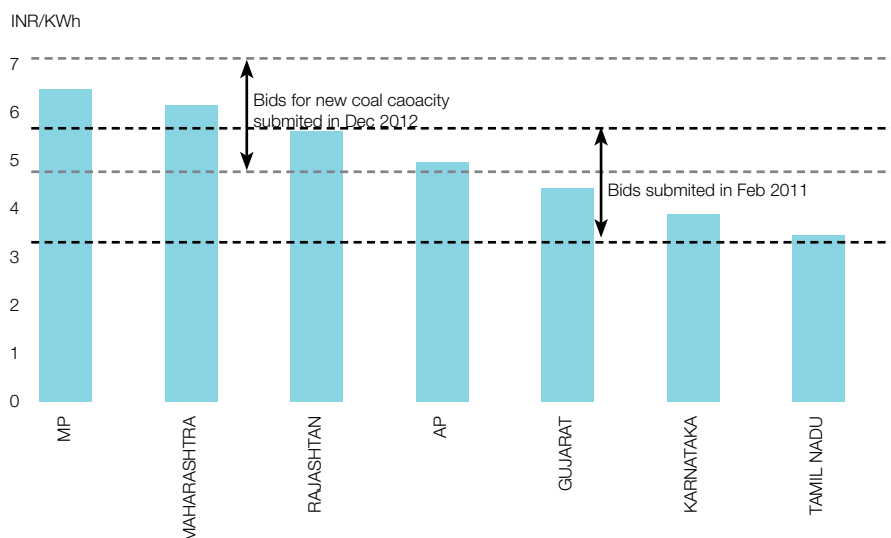


Figure 1: Wind Feed-in-Tariffs in India are below Coal Tariffs.

unable to deliver on its Indonesian production goals, this strategy is being reconsidered. Signatories to these contracts were not provided tied coal supply agreements nor protection from exchange rate volatility. This last issue was then compounded by UMPP financings often being denominated in US\$.

Loss-making Power Companies

Unable to source sufficient domestic thermal coal, these power companies have been faced with the dilemma of either running their coal-fired power plants at well below optimal utilisation rates, and / or sourcing expensive US\$ denominated imported thermal coal. Either choice has resulted in many of the private listed power companies reporting operating losses over

a sustained period of time. For example, Adani Power reported a loss of US\$87m in the Dec'2013 quarter. GVK Power & Infrastructure Ltd (GVK) reported a loss of US\$7m and Tata Power lost US\$12m in the Dec'2013 quarter.ix

Market Forces of Australia commissioned **Equitorials**, an Indian energy focused financial analysis firm in Mumbai to evaluate the question of what wholesale electricity price would be required to justify the construction of a Greenfield electricity plant on the coast in India that was to be fueled by thermal coal sourced from the Galilee Basin in Australia. The modeling assumes a UMPP, given this conservatively offers the lowest cost coal-fired power generation tariff. A smaller scale project would involve higher average costs.



Using the US\$77/t fully costed thermal coal price from Carmichael (FOB APCT, Queensland, 2014 terms) gives a landed price in India of US\$92/t, which equates to Rs6,929/t (based on a modelled Rs70/\$ by 2018). This requires a wholesale Indian electricity tariff of Rs5.73/kWh in its first full year post commissioning (2018) – refer Figure 5. Using the 5% higher energy and lower ash content GVK coal, a first full year wholesale tariff of Rs5.41/kWh would be required.

This puts the cost of imported coal-fired power generation 40-90% above the current Indian wholesale price of electricity of Rs3.00-4.00/kWh and two-to-three times the PPAs written over 2006-2009 on proposed coal-fired power plants.

There is scope for the blending of cheap domestic coal with this imported coal to lower the average fuel input cost. However, India is committed to expanding domestic coal production as fast as it can, and despite this, coal imports have risen from 10% to 20% of total usage over the last four years.

This in part reflects Coal India's inability to deliver on its stated production growth targets. As such, the calculations have priced the cost of that portion of coal-fired power generation that will be based on imported fuel, given this represents the marginal source of additional fossil fuel production, given it is this higher cost product that more domestic wind, solar, hydro or biomass capacity is well positioned to replace.

Across India, the wholesale cost of generating wind power in India is around Rs4.60/kWh – again materially below the cost of imported-coal fired power generation.

The Phase II Batch 1 solar auction of Feb'2014 was completed with a maximum feed-in-tariff on offer of Rs5.50/kWh, admittedly after a government investment subsidy of up to 30% of the initial installation cost. By 2020 at the latest this solar subsidy will have served its purpose and will no longer be needed. The cost of solar electricity generation in India has fallen 65% over the last three years alone. The latest auction alone should see 750MW of new utility scale solar installed by 2015.

With continued economies of scale, technology gains and learning by doing, it can be conservatively estimated that the installed cost of solar (and hence cost of solar electricity generation) will decline by another 10% annually over the next three years. This is consistent with the five year strategic roadmap outlined and updated by First Solar in Mar'2014. This would see a further 28% reduction in the cost of generating electricity from solar, such that for solar farms commissioned in 2018 it is fair to expect a cost of electricity of around Rs4.00/kWh, 30% below the required cost of imported-coal fired power generation.

It is noted that solar tariff assumes a continuation of the 30% capital grant by the Gol, but note that coal is likewise subsidised through the non-pricing of externalities (relocation of traditional owners, huge

water demands, air pollution, and the associated health costs), plus the provision of subsidised land, water and diesel (used for both coal extraction and transportation).

Electricity Cost Escalation – 4% pa for Imported Coal, Zero for Wind and Solar

A key difference between coal fired power generation and that from renewable energy is the issue of inflation. Equitorials' financial modeling shows that with an estimate 1.5% pa increase in the nominal cost of US\$ thermal coal prices, 2% increase in annual shipping costs and with a 4% pa annual depreciation of the Rupee vs the US\$, the 10 year average price escalation requirement of imported coal equates to 4.0% pa in Rupee terms.

The standard terms of Indian solar and wind PPAs is a fixed price contract with zero inflation escalation over the 25-year life.

To illustrate the impact of inflation of electricity costs over time, the study contracts the expected cost of Carmichael sourced coal-fired power generation of Rs5.73p in 2018, rising to Rs5.99 by 2020, Rs 6.85 by 2025 and Rs 8.31/kWh by 2030. By contrast, wind commissioned in 2015 would be flat throughout at Rs4.60/kWh, meaning electricity costs would be 20%, 23%, 33% and 45% cheaper than the Carmichael sourced coal-fired power generation in 2018, 2020, 2025 and 2030 respectively.

For solar commissioned in 2018 would be flat at Rs4.00/kWh, electricity costs would be 30%, 33%, 42% and 52% cheaper than that produced from imported coal in 2018, 2020, 2025 and 2030 respectively. This illustrates the massively underestimated deflationary impact of renewable energy.

At the sametime, the Reserve Bank of India (RBI) has announced it is actively targeting CPI of 8% by end-2014, and 6% by end 2015 and 4% in the third year as a key priority. Building thermal power generation capacity that is more expensive than the current retail price of electricity and that locks in a 4.0% pa inflation-linked increase for the next decade is only going to make the RBI target harder to deliver, while the increased cost of imported fossil fuels will likewise increase pressure on the current account deficit and hence the exchange rate.

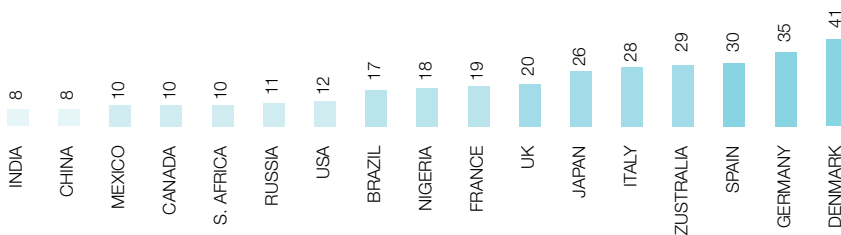


Figure 2: Average National Electricity Prices Globally [2011, US c/kWh]. Data: average prices from 2011 converted at mean exchange rate for that year.

Rising imports of Oil, Gas and increasingly Coal

A key strain on the current account deficit for India has been the reliance on imported fossil fuels. Historically, India has imported 80% of its oil needs. With strong economic growth, crude oil imports reached US\$144bn in 2012/13.

In a bid to diversify its electricity system over the last decade, India has built over 20GW of gas-fired electricity capacity. However, with a rapid decline in domestic gas production since 2011, half of this newly installed generating capacity stands idle, and the domestic shortfall has seen gas imports rising to 40% of total consumption.

Slower than expected growth in domestic coal production

Over the last four years, India's domestic coal production has been growing at 3.2% pa (exceeding 500Mtpa in 2013/14); insufficient to keep up with total coal consumption growth of 6-7% pa.

- Domestic Indian coal production growth has been below plan because of a number of pressure points:
- Resistance to new coal mines due to the environmental implications on traditional owners, forests, pollution and the risk to water catchments;
- Poor regulatory planning structures, with different Government Ministries working at cross-purposes;
- Legal challenges to coal block allocations, plus associated claims of corruption in the allocation process;
- The exhaustion of the higher quality, shallower coal resource deposits; and
- Poor railway infrastructure, limiting capacity to move coal from mines to power stations.

The recent failure of Coal India (CIL) to complete the next phase of its privatization effort suggests that its investment rationale has deteriorated since its successful 2010 IPO. CIL was unable to raise a

planned US\$3bn in new a stock offering. Instead the company paid out US\$3bn in a special dividend to its shareholders. The fiscally troubled Government of India is the majority owner and received short term relief from the distribution.

Since the dividend was announced the stock price of Coal India has continued to perform poorly and the company has once again announced it will fail to meet its production targets.

As such, in just four years India has seen imports of thermal coal double from 54Mt or 10% of India's total consumption in 2009/10 to over 20% share in 2013/14, resulting in a US\$12bn annual import bill. On the Coal Ministry's current forecast, coal imports could double again to approach US\$24bn by 2016/17 (say US\$80-100/t @ 200-240mtpa).

India's Retail Electricity Price, Low and Subsidised Government subsidies for Electricity

India has one of the world's lowest retail electricity prices as well. At US8c/kWh in 2011, this is 50% lower than electricity prices in Europe.

Within the Indian electricity market, the agriculture and domestic residential prices for electricity are half the rate charged to industrial and commercial users in India. Agriculture and domestic consumption combined accounts for one third of all Indian electricity usage. In order to stem distribution company losses, the State governments have been significantly reducing the electricity price subsidy to the agricultural and domestic sectors over the last few years. This is increasing the financial stress on those least able to afford it.

Grid Transmission and Discom Losses

A key difficulty in examining the Indian Electricity Sector is the inconsistency of data, and the significant inter-regional variances across the Indian States. The Ministry

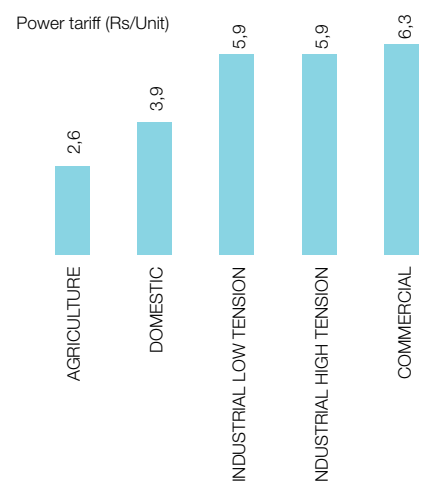


Figure 3: India's Commercial and Industrial Sectors subsidise Agriculture and Domestic Electricity Supply [2013/14 Estimate].

of Power published a Feb'2014 overview of the Power Sector that detailed the average cost of power supply was Rs3.78/kWh in 2010/11, and that the average price realised on sale was only Rs3.01/kWh, a 20% discount to the purchase cost.

If the cost of supply estimate of Rs3.78/kWh is net of grid transmission losses of 23.2%, then the gross power purchase price in 2010/11 averaged Rs2.90/kWh across India across all generation types.

The key point is that retail electricity prices in India are considerably lower than the level required for the profitable generation of imported coal-fired power, particularly when that coal is sourced from isolated deposits with none of the required infrastructure in the middle of Queensland. The inflationary consequences, both immediately and locked in over the life of the 15-25-year PPA are prohibitive.

Consideration of the deflationary impacts of renewable energy, plus a greater focus on energy efficiency and reduced grid transmission losses, provide an increasingly economically rational alternative.

Given the relatively low penetration of renewables in India to-date, intermittency of electricity supply is not a material constraint. Increased solar in particular is likely to improve the supply demand balance given the co-incidence of solar and peak demand, particularly as it pertains to industry and agriculture. With the rapid cost reductions evident in storage, any perceived barrier of intermittency as a cap to renewable energy penetration is likely to be removed within the next three years <<