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Reforms Needed for Power Sector in India

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By

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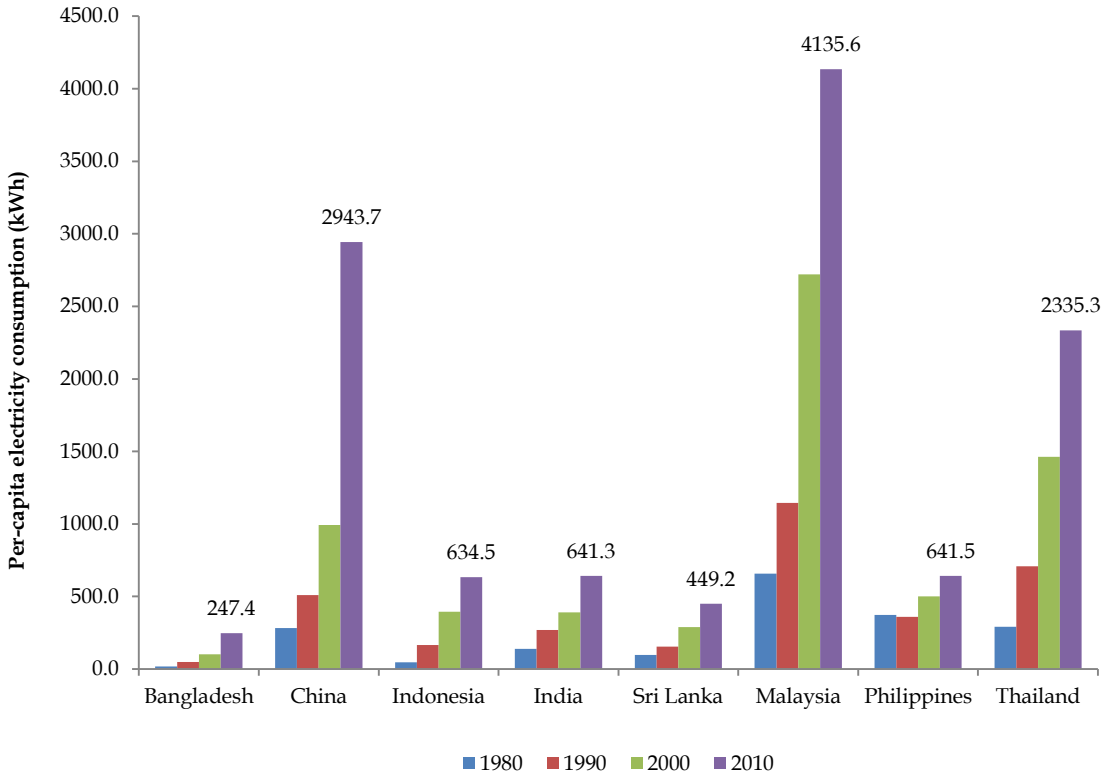
Introduction

Adequate and stable supply of electricity is an important component of economic health of a nation. India's position in this respect has been dismal, much worse than that in its East Asian neighbours, though generally better than most of its South Asian neighbours. India's per capita electricity consumption is close to 917 kWh[1] per year in 2014. China had a per capita electricity consumption of 3,300 kWh as per the World Development Indicators released by World Bank in 2013, which is more than three and half times as compared to India. It is notable that India is far behind not only China but also Thailand and Malaysia in this regard, though it is ahead of Bangladesh and Sri Lanka. While China, Thailand and Vietnam have almost universal access to electricity, in India only 75 percent has that access. Even Sri Lanka where per capita availability of power is less than India's 85.4 percent of population has access to power.

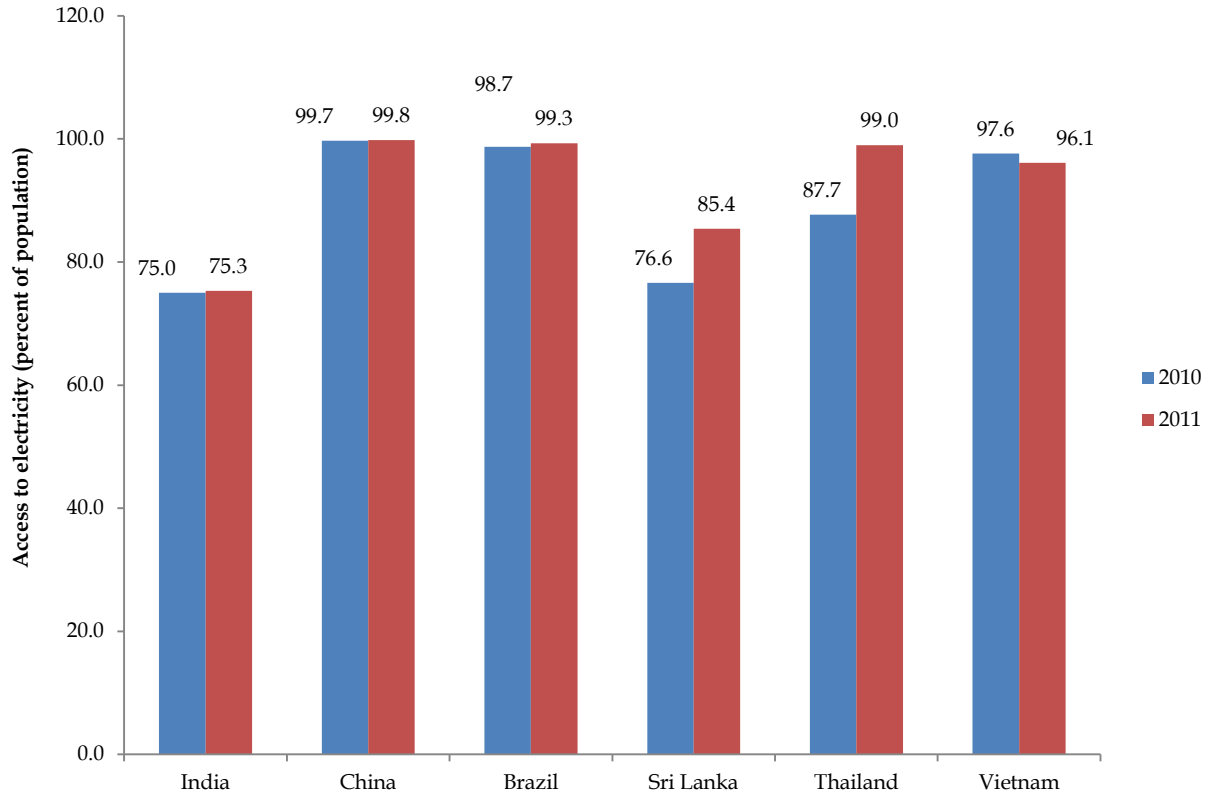
Chart 1: Per-capita electricity consumption (kWh)



What is striking is that the rate of growth of availability of power in per-capita terms has been declining during the last three decades. This rate of growth was 6.8 percent per year during the 1980s. It declined to only 3.8 percent per year after the big-bang reforms of 1991 to recover only moderately during 2000-2010 to 5.1 percent per year when GDP growth accelerated strongly. Even this meagre supply of power is not accessible to all or on 24x7 basis.

[1]Executive Summary, Power Sector, CEA, Feb 2014
http://www.cea.nic.in/reports/monthly/executive_rep/feb14.pdf

Chart 2: Population with Access to Electricity (percent)



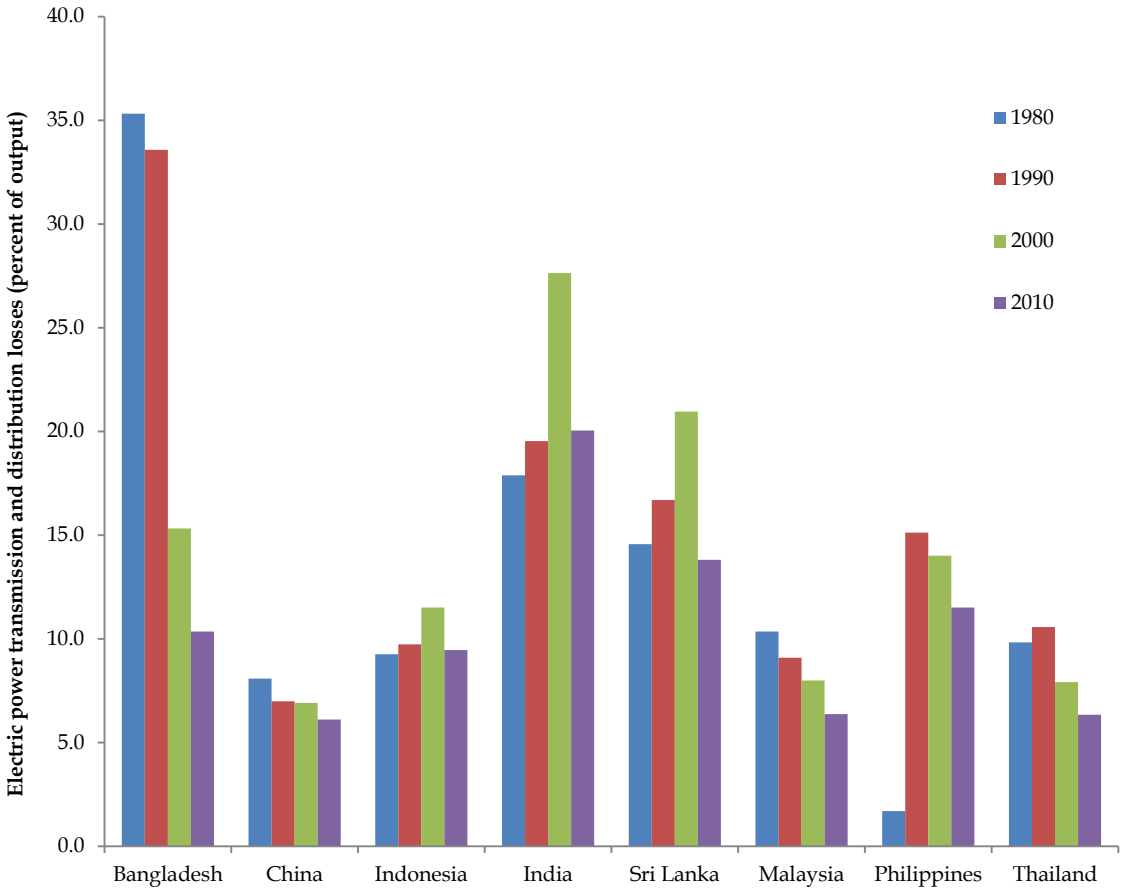
India's power sector is in bad shape owing to a number of reasons. Debt servicing has become quite difficult for the power companies. During the year 2011-12, all utilities taken together accounted for booked losses to an amount of $ 14 billion (approximately Rs. 14,000 crore). Around 28,000 megawatts (MW) of thermal capacity in the country is stranded due to reasons such as the inability of the state electricity boards to purchase power[2]. According to a study conducted by World Bank[3], Power sector after-tax losses, excluding state government support to the sector, were Rs 61,800 crore in 2011, which was equal to nearly 17 percent of India's gross fiscal deficit and around 0.7 percent of GDP. The T&D losses in India in 2010 at 20 percent were the highest among the South Asian and East Asian countries and India is the only country (with the exception of the Philippines) where these losses were higher in 2010 that they were in 1980.

Though there is a large emphasis on the Open Access in the Electricity Act 2003, the mechanism is not yet implemented in a proper way. Energy prices should be supervised on a regular basis and adjusted by independent regulators in such a way that prices must reflect changing costs.

[2] http://www.livemint.com/Industry/fshhRC4YdxhfxklvUrDNSP/India-debates-creation-of-power-sector-fund-to-bail-out-proj.html?utm_source=copy

[3] "More Power to India",2014 World Bank accessed at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/06/20/000456286_20140620091641/Rendered/PDF/889060PUB0978100Box385252B00PUBLIC0.pdf

Chart 3: Electric power transmission and distribution losses (percent of output)

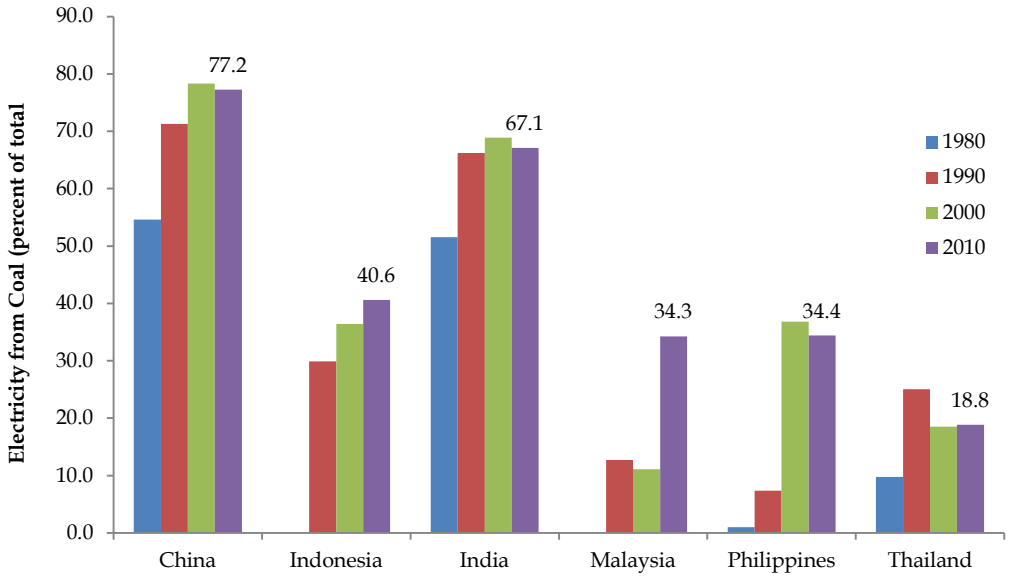


In India, regulators including CERC and SERCs operate in a very rigid way. The rigidity results from political considerations, thereby jeopardizing the operational profitability of companies.

Most of India's power is generated through coal, which has high carbon content. Except China, India has the highest share of coal in generation of electricity. While the share of coal is 67.1percent for India, it is comparatively lower for countries like Indonesia (40.6 percent), Malaysia (34.3 percent) and Thailand (18.8 percent). The share of clean energy is low in India. The share of hydro is only 11.9 per cent compared with China's 17.9 percent. The total share of renewables[4] in India's energy mix is just 12.7 per cent, which is quite low. In terms of total installed wind capacity, China leads the way. China boasts of 25.7 percent of total wind energy installations of the world as compared to India at 6.7percent.

[4]http://powermin.nic.in/JSP_SERVLETS/internal.jsp

Chart 4: Electricity from Coal (percent of total)



Even though India is well endowed with coal reserves, the country is becoming increasingly dependent on imported coal. According to the 12th Five year Plan, import dependence for coal is also estimated to increase from 18.8 percent in 2011–12 to 22.4 per cent by the end of the Twelfth Plan and 25.9 per cent by the end of the Thirteenth Plan. India's dependence on coal exports has been increasing over the years amounting to 5,036 thousand short tonnes in 2011[5] increasing at a compound annual growth rate of 16 percent since 1996.

According to the Economic Survey 2013-14, the country imported about 146 MT (million tonnes) at a cost of INR 92,538 crores during 2012-13 and about 169 MT at a cost of Rs 95,175 crores during 2013-14. It produced over 566 million tonnes of coal annually against a demand of 739.4 million tonnes as of March 31,2014.

India's coal reserves are 302 billion tonnes, of which proven reserves amount to 126 billion tonnes and indicated reserves as 143 billion tonnes. One tonne of Indian coal generates 1.6 tonne of CO_2. Thus, even if we use 200 billion tonnes of coal, it would generate 320 billion tonnes of CO2, which would be about 25 percent of the cumulative CO_2 emission in the world since 1850 (1,322 billion tonnes), more than Europe (15) has done since 1850 (268 billion tonnes).

Long-term perspectives on power requirements and sources of supply

If India wants to become a high middle income country by 2025, it needs to catch up with China of 2010 by 2025. For that purpose, it has to increase its electricity consumption by about 3.5 times between 2014 and 2025. As the restrictions on CO_2 emission become more and more binding, India will not be able to use more than 1 billion tons of coal per year for power generation. At that rate, even by 2100 India

[5] http://www.indexmundi.com/energy.aspx?country=in&product=coal&graph=exports

will be able to use only about 80 to 90 billion tons of its coal. Unless India can find ways of exporting some of its surplus coal, a large share of our coal reserves will be worthless. **Coal age will be over before we run out of coal.**

For our coal, the theme is**: use it or lose it. Using native coal will promote "Make in India" initiative as set out by Prime Minister Narendra Modi.**

The need to focus on long-term perspectives:

First, in order to improve our living standards, the supply of power has to be increased even faster than GDP. Second, the coal age will be over before we run out of coal. We should use up our coal as quickly as we can and should not be burning other people's coal. Third, the power sector has to be increasingly de-carbonized and only a small proportion of our power supply should come from coal. We have to rely increasingly on renewable sources of power.

Reforms Proposed for Indian Power Sector:

Increasing Coal Production by Introducing the Concept of "Contract Mining"

As Coal India cannot meet this target on its own, merchant mining should become the norm. Transformational reforms are needed. Mere tinkering will not do. According to the Economic Survey 2013-14, the country imported about 146 MT (million tonnes) at a cost of Rs 92,538 crores during 2012-13 and about 169 MT at a cost of Rs 95,175 crores during 2013-14. There was a growth of almost 16% in the imports of coal. Coal India Limited produced over 566 million tonnes of coal annually against a demand of 739.4 million tonnes as of March 31, 2014. Therefore, we need to devise solutions on increasing coal production. The domestic coal production in 2006-07 was approximately 431 million tonnes and 554 million tonnes by 2012 and the demand for coal has grown at a CAGR of 7% over the decade. The use of Indian power plants capacity is also dismal and stands at a figure of just 55% and calls for streamlining of its supply chain, so as to meet short- term electricity needs.

One of the possible solutions could be introducing the concept of **"contract mining"**. The mining contractors would be selected through a transparent bidding mechanism. The mechanism would be quite similar to the EPC contractors who build highways for NHAI or State PWD departments. Introducing private companies at this stage would help increase the coal productions as they would bring in the latest technology to ramp up the output. This will help increase production of the coal while retaining the ownership with the state enterprises.

Contact mining would bring in its own set of advantages to both the owners and the contractors:

- Discounted purchase and better availability of mining equipment
- Use of a standard fleet for mining activities
- Sharing experience of mines across and other synergies

- Contract mining offers operating efficiencies
- Contract mining offers scale efficiencies
- Contract mining offers deployment of private resources to increase production and profitability of Coal India Limited.

The process can actually reduce the cost of mining to the mine owner. Of late, mine owners have not been able to mine scientifically complying with the clearances required to carry out mining. Such a move would call for the creation of a nodal agency which would be responsible for getting in private companies for digitization activities. To make this mechanism of "contract mining" more attractive, there should be an initiative for the mining companies.

Minerals Resource Rent Tax (MRRT)[6] — Australia

Australia has developed this kind of mechanism which is called Minerals Resource Rent Tax (MRRT). The minerals resource rent tax is a tax on certain profits generated from the extraction of coal and iron ore.

- The basic MRRT rate is 30%.
- The headline rate is reduced by an extraction factor of 25% in recognition of the specialist skills that miners employ to extract the resources, to produce an effective MRRT rate of 22.5%.
- The taxable profit of a miner (referred to as 'MRRT profit') is calculated as follows:
    a) 'Mining profit': which is equal to 'mining revenue' less 'mining expenditure' (mining revenue and expenditure are determined by reference to a taxing point, which is typically when the taxable resource leaves the 'run-of-mine' stockpile); less
    b) 'MRRT allowances' (which includes allowances for state royalties, certain losses incurred before and during the life of the mine, investment expenditure on pre-existing mines and transferred allowances from other mining projects).

The 'MRRT profit' is then multiplied by the effective MRRT rate to determine a miner's 'MRRT liability'. If there is no MRRT profit then there will be no MRRT liability.

Moreover, there could be different approaches to increase the participation of private companies into this contract work regime:

i. A contract for conducting mining activities in a commercial mining area reserved only for large-scale mining
ii. A contract for mining in an area that has a limited potential. This would promote small-scale mining and would be available only to domestic investors
iii. It should be followed by close monitoring by government agencies in each mining project. This would help to crosscheck progress of each mining project in terms of percentage extraction from a block
iv. Tax rebates for the mining contracting companies, once they reach a pre-decided level of extraction.

[6] http://www.nortonrosefulbright.com/files/a-guide-to-developing-mining-projects-a-guide-to-developing-mining-projects-in-australia-58441.PDF

The engineering, procurement and construction activities in this case will be done by contractors and therefore, the government could focus more on the administrative part. **In short run, it is not politically feasible to amend the Coal Nationalization Act and therefore, contract mining is the answer for an increased coal production and improvement of coal linkages.**

Denationalization of coal industry

The Coal Mines Nationalization Act needs a drastic amendment to allow private players into coal mining area. Even if Coal India is allowed to manage the coal mines under it, others should be allowed to own and operate new mines. The theme should be using up coal reserves as fast as we can.

Breaking up of Coal India into smaller units

Breaking up of Coal India limited into smaller units would help achieve efficiency.

a) This could be done by converting various units of Coal India into independent companies. The respective state government equity holders should be responsible for speeding up land acquisition and other such processes. They should be able to submit a target annual plan of coal production and must be submit a report regarding their achievements throughout the year.
b) Set up an incentive structure for increased participation of states in the independent companies.
c) Set up an independent regulatory body to oversee the working of independent companies formed out of CIL. This would make the companies accountable to regulatory body and enhance their performance.
d) The Mines and Minerals Development and Regulation Act[7] needs to be amended to provide for bidding blocks to commercial purposes.
e) CMPDIL can be restructured as a consulting body with the sector's planning department.
f) Set up a separate body for coal exploration activities.

Check on coal theft of coal and coal burning: Preparation of a database that would have collection of intelligence reports about illegal coal depots and illegal movement of coal and informing district authorities of the same for taking preventive action.

What can be done to control coal theft?

1) Preparation of a database that would have collection of intelligence reports about illegal coal depots and illegal movement of coal and informing district authorities of the same for taking preventive action.
2) Construction of watch towers. The coal stacking areas should have sufficient lighting arrangements.
3) Increase the personnel in the Railway Protection Force.
4) Sealing of abandoned mining spots.

[7] mines.nic.in/File_link_view.aspx?ltp=1&lid=145

5) Use of RFID tags: Passive RFID tag reduces weighing process and identifies the location of each vehicle in mines. In tandem to the RFID tag will be the RFID reader that would read RFID tags from authorized vehicles.
6) Vehicle barrier will prevent transit of untagged vehicles from authorized routes and regulate weighbridge traffic.
7) Use of an automated weighing bridge that would include weight details, along with date and time in and time out.
8) Global Positioning System in the vehicles carrying coal to continuously track them vehicle inside mine as well as transportation routes.

Suppression of burning coal fires:

The underground fires in Jharia coalfields have been wreaking havoc on local residents since 1916. Such untapped coal fires are a threat to life in the nearby areas and must be suppressed in order to maintain ecological balance and limit emissions.

The North Dakota Badland of the United States

One such suppression of coal fires was successfully done in North Dakota Badland of United States following a methodical approach in November 2003. The approach comprised of following steps[8]:

1) Removal and stockpiling of topsoil or suitable plant growth material from around/within the defined project areas.
2) Excavation of intercept trench or burial trenches at prescribed depths for burial of burning materials.
3) Excavation and emplacement of burning materials into the burial trenches. Blending or intermixing of the burning/hot materials with clay. Excavation of the active burn face is considered complete when the coal seam is cool to the touch. Water quenching was performed by U.S. Forest Service personnel.
4) The backfilled trenches were covered with approved material. It must be ensured that all buried materials are isolated from other combustible materials. Any combustible material removed from trenches or borrow areas must be covered or mixed with inert soil material.
5) Grade area was blended with surrounding topography and drainage was re-established.
6) Re-spreading of salvaged topsoil (where available) over disturbed areas.

It took seventeen working days to complete suppression activities at eight project sites at a cost of $37,000.

Limiting new coal plants to supercritical variety

Using new technologies, like supercritical, advanced supercritical boilers and Integrated Gasification Combined Cycle would help achieve higher efficiencies and lower carbon emissions. There are two types of coal used in Indian industry which

[8]"Coal Outcrop Fire Suppression In The North Dakota Badlands", Bruce Beechie, accessed at http://www.psc.nd.gov/docs/amlarticles/coal-outcrop-fire-suppression-paper.pdf

are: bituminous and sub-bituminous coal. The gradation of Indian coal based on its calorific value is as follows[9]:

Table 1: Grades of Coal in India

Grade	Calorific Value Range (in k Cal/kg)
A	Exceeding 6,200
B	5,600 – 6,200
C	4,940 – 5,600
D	4,200 – 4,940
E	3,360 – 4,200
F	2,400 – 3,360
G	1,300 – 2,400

In India, the D, E and F coal grades are available and therefore, the net energy generated is lower as the calorific value is low. The raw coal ash in Indian coking coal varies from 25 to 30 percent. The efficiency of a coal power plant can be increase by using 'clean coal' technologies, which use a range of technologies from high-efficiency generation systems to the ultimate, zero emission power production. Improvements beyond 40 percent efficiency for conventional pulverized fuel stations can be achieved with advanced combustion chamber technology with "Supercritical" (40 to 45 percent efficiency) and "Ultra-supercritical" (greater than 45 percent efficiency) systems. With the use of advanced ultra-supercritical technology, efficiencies in excess of 50 percent can be achieved.

Table 2: Comparison of carbon emissions from different technologies for power plants:

	CO_2 intensity factor(Efficiency)	Coal consumption
A-USC (700° C) and IGCC (1500° C)	670-740 g CO_2/kWh(45-50 percent)	290-320 g/kWh
Ultra-supercritical	740-800 g CO_2/kWh(up to 45 percent)	320-340 g/kWh
Supercritical	800-880 g CO_2/kWh(up to 45 percent)	340-380 g/kWh
Subcritical	greater than or equal to 880 g CO_2/kWh(up to 45 percent)	greater than or equal to380 g/kWh

Source: VBG, 2011

[9]http://www.productivity.in/knowledgebase/Energy percent20Management/c. percent20Thermal percent20Energy percent20systems/4.1 percent20Fuels percent20and percent20Combustion/4.1.3 percent20Properties percent20of percent20Coals.pdf

More transparent system of coal allocation to avoid repetition of coal scams

It is necessary that data or information regarding coal sector should be available readily. This would help citizens to demand accountability from the sector. A periodical publication of the information related to all the aspects of the coal sector taking into account, reserves, production, displacement and rehabilitation, transportation, linkages and consumption would help improve accountability.

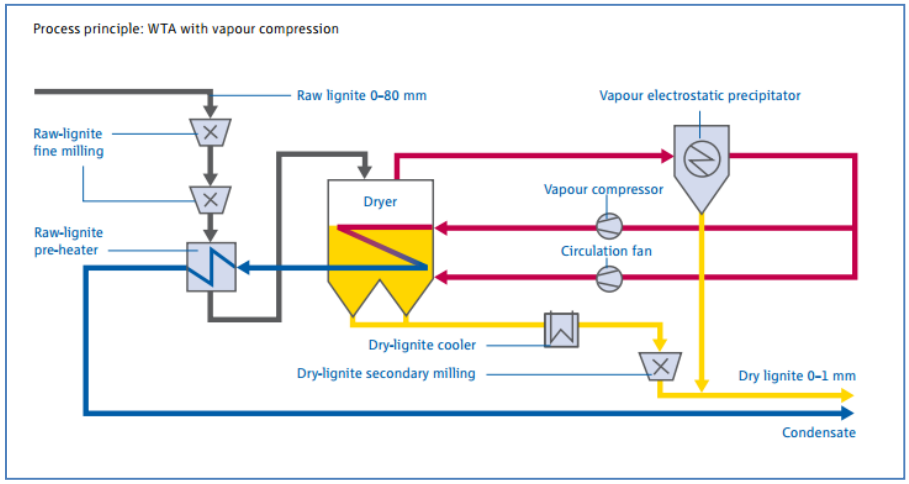
Technological innovations for dealing with poor quality of coal in India

India has large amount of low grade coal we need to consume it before we lose it. Adopting technologies providing more efficient burning of such low grade coal would decrease our dependence on imports and provide more energy per unit of coal.

Power generation from low grade coal:

Power generation from low grade coals can be increased by using advanced lignite pre-drying in pulverized coal combustion. RWE, a German electric utilities company, has installed a full-scale prototype drier to dry 25 percent of the fuel feeding its 1, 000 MW Ultra Super Critical lignite unit at the Niederaussem plant in Germany. The energy required for drying comes from in-bed tubing in which low-pressure steam is condensed. The waste heat is recovered from the condensate. The altered heat balances in the boiler bring about to make the changes to the furnace size, heat-transfer surface area and flue gas recirculation[10]. Boiler cost savings are largely offset by the cost of the drier. The energy needed for drying is injected via heat exchangers integrated into the fluidized-bed dryer and heated with steam. The technology works on the principle of fluidized-bed drying utilizing the internal waste heat.

Figure 1: WTA Technology



Source: RWE

[10]WTA technology, RWE accessed at http://www.rwe.com/web/cms/mediablob/en/247962/data/235578/2/rwe-power-ag/lignite/WTA-Technology-A-modern-process-for-treating-and-drying-lignite.pdf

Improving the quality of coal:

1. Use of online coal analyzers to help achieve proper sorting, and subsequent blending of coal
2. In 2002, the Ministry of Environment and forest mandated power stations to be located at a distance of over 1000 km from mines to use coal with the ash content not exceeding 34 percent. Upon a revision in October 2013, the distance was revised to 500km, but ash content stipulation remained the same. This needs to be revised.
3. Use of cross belt elemental analyzers and fixed geometry analyzers which can be fully optimized with blending software that uses the analysis and calculations from the on-line system to sort the coal into the correct locations to be blended for various applications. With the help of these tools mines can improve recovery, increase direct ship coal and meet customers' requirements for specific blends.

Case Study[11]: U.S

"A coal mine located in West Virginia uses an on-line analyzer to monitor the preparation plant production stream. Based on data from the analyzer, coal is sorted by adjustable parameters, such as ash. Any coal with an ash percentage less than 16 percent is sent directly to the stockpiles; the raw coal greater than 16 percent is sent to the preparation plant. Once the coal is washed, the analyzer evaluates the coal and sorts it even further into its correct locations, allowing the mine to use more of the lower quality coal by blending while still meeting their customers' quality requirements. Another mine, also located in West Virginia, is another example of the advantages of an analyzer system combined with blending software. The mine produces products ranging from 10 to 33 percent ash, 0.5 to 2.5 percent sulfur, and 9,200 to 13,000 Btu/lb. The blending system at this mine can make automatic feeder adjustments as frequently as each minute to satisfy the quality requirements of a shipment. This system was the first in the world to blend automatically on two control variables; in this case, both sulfur and ash".

Using native coal will promote "Make in India" initiative as set out by Prime Minister Narendra Modi.

Expediting environmental and forest clearances

Reforms needed:

1. Standard ToR for Opencast and Underground mines should be formulated.
2. No public hearing in case of projects already having EC and fresh EC is required because of increase in production and projects having only forest land.

[11] http://acceleratingscience.com/mining/coal-blending-strategies-reduce-costs-improve-quality/

3. In cases where state pollution control board does not complete its processes within stipulated time, EIA or EMP should be considered.
4. In case of the underground mining projects, public hearing should not be done. These projects cause minimal environmental degradation.
5. Coalfield-wise environment clearance to be granted.

Suggested measures for expeditious FC

1. The process of scrutiny should be transparent for any proponent and the reply should be expeditious.
2. Forest conservation rules must be taken into account while granting any clearances and the forest department should maintain updated record of forest lands. This would help avoid resubmission.
3. There is a need to strengthen land and R&R Department of Coal India Limited.

Single-window clearances for power projects

As mentioned in the previous section, the clearances for the power projects consume a lot of time, a single-window clearance mechanism is needed to ramp up the generation capacity and moving towards the aim of "Power to all". The clearances for the subjects related to power projects, such as land, water, mineral, environment and forest are administered by different ministries and independent departments both at state and central level. The process of getting clearances reveals that the departments and ministries granting them are dependent on each other. Therefore, a single-window clearance system is required to streamline approval process and increasing transparency for the same. The system should involve a speedy and concrete action on the clearances sought by project developers. The clearances required in the process of a coal mine are: Grant of Mining lease, Environment Clearance and Forest Clearance.

The time frame for grant of clearances and approvals is less than one year. Still, it takes more than the specified time to obtain the lease. It Enumeration of trees has to be provided and cost benefit analysis has to be carried out by the state forest department, usually a time-consuming process. As of June 2014, there were about 63,395 mining clearances pending with state governments.[12]

[12] :http://www.livemint.com/Politics/nuyoouWgH2WDWNJ8m2xGEN/63395-mining-clearances-pending-with-state-governments.html?utm_source=copy

Table 3: Clearances required for thermal power projects in India

Clearances Required	Authorities involved in granting clearance
Mining Lease[13]	
Approval of the Geological Report	Central mine Planning and Design Institute Limited (CMPDIL), Directorate General of Civil Aviation and Ministry of Defence (for unexplored blocks if aerial reconnaissance is conceived)
Mine Plan	CMPDIL, Coal Controller
Mine Safety	Directorate General of Mine Safety
Mining Technology & Conservation Measures, and Coal Categorization	Coal Controller (under the provisions of Colliery Control Rules[14]) and the Coal Mines(Conservation & Development Act[15])
Mining Lease	State Government (Mining Department), Ministry of Coal – Reviewed at various levels within the Departments at the State & Central Government level
Environment Clearance	
Environmental Impact Assessment/ Environment Management Plan	State Pollution Control Board (SPCB), State Environmental Impact Assessment Authority, State Water Resource and Water Supply Department, District Administration, Coal Controller[16], MoEF
Forest Clearance	
Forest Clearance & Valuing Compensatory Afforestation	Committee to Advise GoI, Office of Chief Conservation of Forests, State Forest Department & District Authority, MoEF, State Revenue Department, Honorable Supreme Court
Land Acquisition	Ministry of Coal and State Department of Revenue
Infrastructure	Appropriate Departments of the State Government & Ministries of Central Government

[13] http://mines.nic.in/rdprpl.html
[14] http://www.coalcontroller.gov.in/
[15] http://www.coal.nic.in/ccda6.pdf

Case Study: Australia

In Australia, the states are fully empowered to grant mining lease unlike India. The single-window clearance process in Australia involves four agencies:

- Department of Minerals & Energy
- Department of Environment
- National Native Title Tribunal
- Land Acquisition Authority in Local Government

Mining Lease in Western Australia

a) The maximum area for a mining lease applied for before 10.02.2006 is 1000 hectares. Beyond that, the size applied for is to relate to an identified ore body as well as an area for infrastructure requirements.
b) Mining leases must be marked out. The time taken for grant of mining lease is 1-2 years.
c) Application is made at any Mining Registrar's office, or lodged electronically via the Department's website using "Mineral Titles online".
d) An application fee and rental is payable.
e) Application for a mining lease shall be accompanied by either a mining proposal or a statement in accordance with mineralization report that has been prepared by a qualified person. The mining proposal shall include:
    - ✓ When mining is likely to commence
    - ✓ The most likely method of mining
    - ✓ The location, and the area, of land that is likely to be required for the operation of the plant, machinery and equipment and for the other activities associated with those mining operations.
f) There is no limit to the number of mining leases a person or company may hold.
g) The term of a mining lease is 21 years and may be renewed for further terms.
h) The lessee of a mining lease may work and mine the land, take and remove minerals and do all things necessary to effectually carry out mining operations in, on or under the land, subject to conditions of title.

Minister of Minerals and Energy is the final approving authority for grant of mining lease.

Proposing a single-window clearance system for India

- Nodal agency at state level under the Department of Mines. The agency will be represented by members from concerned ministries and departments. The agency will be responsible for the whole process on acquiring mining lease.

- The Ministry of Environment and Forests may conduct a research regarding the coal fields on the basis of ecological sustainability and the amount of forest cover.
- Setting up a small environment clearance team within the Ministry of Mines will reduce a great amount of work to be carried companies who have to go through the sequential process, which is time consuming.

Updating of land records at state level will also help in expediting the process.

Improved system of financing of power projects

Funding schemes like Mezzanine Finance for power projects and "Crowd funding" for renewable energy power projects would help solve the financial viability issue of funds.

a) PPP model in the power sector—the majority of Generation, Transmission and Distribution capacities are with either public sector companies or with State Electricity Boards (SEBs). This calls for deregulation and PPP mechanism in the power sector to improve efficiencies. The favorable Indian government policies include: 100 percent FDI permitted in Generation, Transmission & Distribution and income tax holiday for a block of 10 years in the first 15 years of operation; waiver of capital goods import duties on mega power projects (above 1,000 MW generation capacity). Also, the timelines for documentation for creation of security coverage should be doubled i.e., at least 12 months. This would provide sufficient time for creation of security.

b) Elimination of fossil fuel subsidies—A reduction in fossil fuel subsidies for power generation would lower the costs of financing renewable energy projects. Such a reduction would send strong market signals and improve the competitiveness of renewables.

According to the IRENA's Remap 2030 analysis[17], doubling the share of renewables in the global energy mix will require annual financial support of USD 315 billion in 2030. Whereas, the global fossil energy consumption subsidies amounted to USD 544 billion in 2012, at least five times that of renewables (IEA,2013).

c) Contingent grants—These are grants under which the loan is provided without interest or repayment requirements until technologies and intellectual property (IP) have been successfully exploited. These grants can help to cover some of the costs during the stages that have the highest risk, thereby increasing the investor's confidence. The UK Carbon Trust's R&D Open Call Scheme for research, pre-commercial development and demonstration offers contingent grants of up to £250,000. Technologies

[17] RE Map Analysis 2030, IRENA accessed at http://irena.org/remap/REmap_Report_June_2014.pdf

such as photo catalytic conversion of sunlight to hydrogen, wave and tidal energy, energy efficiency technologies and various industrial processes that reduce CO2 and energy use has been supported[18].

d) Soft loans for power projects: The project developers for power projects are unable to access finance at pre–commercial stage. This is due to lack of immediate revenue-generation potential to repay the loan and technology development risk. These loans offer short-term interest deferral periods and payback grace periods without requirement of any collateral. Pre-development financing could cover costs related to siting, environmental impact analysis and assessment, permitting, facility design, financial and legal analysis, and marketing activities.

In the Indian context, the National Clean Energy Fund was formed to increase the renewable energy technology applications. Under the national clean energy fund, a cess of INR 100 per tonne of coal is charged on coal producers as well as coal importers. As of June 2014, the government has collected Rs 40,000 crores as cess on coal through the NCEF, but only 1 percent of this amount has been disbursed to MNRE[19]. State-wise sharing of revenue from NCEF has not been planned well. The funds should be utilized in a proper manner. In the Union budget of 2015-16 the clean energy cess has been increased from INR 100 to INR 200 to finance clean environment initiatives

Open access to distributors and consumers

Open Access in India will allow for multiple power supply contracts which are flexible enough to take advantage of diversity in load and time, thus leading to an efficient operation. This would help in improving the power factor and potentially reduce the tariffs.

An Efficient Open Access Mechanism in India

For an Open Access mechanism to work in a proper way, unbundling of transmission from generation is necessary. The transmission operation should receive the revenues that are related to provision of grid service. This would incentivize to an improvement in the service and maximizing the throughput. Most Open Access cases in India call for transparency, which would be possible through a real-time website. A complete unbundling of distribution from the retail business is quite difficult to achieve due to the default service obligation of the distribution company. As a result, a distribution company will always have a double license.

[18]Technologies supported include Focus and Consider categories on the UKCT the Low Carbon Technology Assessment at www.thecarbontrust.co.uk/carbontrust/about/publications/Low_Carbon_Technology_Assessment.pdf

[19]http://articles.economictimes.indiatimes.com/2014-06-13/news/50564444_1_the-ncef-national-clean-energy-fund-rs-500-crore

Open Access has led to increased reliability of supply in Manesar, Haryana. The power supply in India is characterized by poor quality of power supply and frequent load shedding. The cost of power adds to the operating expenses on any industry. It is one of the highest inputs in the manufacturing industry. For an automotive industry, the cost of power is the second largest input cost and therefore the revenue depends upon the uninterrupted power supply. These industries earn a profit margin owing to economies of scale and therefore, uninterrupted power supply makes the business more competitive. According to a data collected by a survey, the average outage time for the city's industrial units was about 15 percent during the month of January 2012, whereas the outage time faced by open access consumers was almost negligible. This indicates the value of open access in Indian context.

Factors leading to a successful Open Access Mechanism: There is a list of enabling factors for the countries that have successfully implemented open access regimes[20]:

1. "Strong sustained political commitment to liberalization and competition in the electricity sector. The government should be committed to allowing multiple generation companies, including private generators, to operate in the sector. The benefits of open access-induced competition for the consumer should be well understood by the government and effectively communicated to the public
2. Legislation that mandates open access, supports competition, and allows separate contracting for energy and network services. The law should grant the generators and wholesale buyers the right to nondiscriminatory access to the power grid. Additional legislation is often needed to prevent grid companies from abusing their natural monopoly position
3. A market structure that
   (a) Supports ownership separation (legal unbundling)
   (b) Includes a competitive wholesale market component
4. A professionally strong, autonomous, and credible regulatory body committed to promoting and protecting competition
5. An independent and efficient transmission system operator neutral to all sellers and buyers
6. Transmission and distribution pricing that is cost reflective, efficient, transparent, and separate from the cost of energy being transported
7. Open access implementation sequenced to proceed from wholesale-to retail-market participants over time
8. Provisions at the retail level:
   (a) Open access implementation is largely revenue neutral for the distribution utilities
   (b) Dispute resolution is simple and efficient
9. A transmission system planning process that is transparent and open, including inputs from independent power producers, multiple buyers, demand responders, and other relevant stakeholders

[20]"International Experience with Open Access to Power Grids", Synthesis Report, Knowledge Series 016/13, ESMAP, Worldbank

10. Transparency of information on the real-time availability of transmission capacity
11. Open access regime can trigger greater supply diversification through small distributed generation connecting to the power grid at the distribution-voltage level. This is quite useful for the renewable energy power generators.

To avoid conflict in dispatch decisions, there should be an independent system operator who is independent from generation and supply interests. Also, the transmission businesses should not intervene in electricity sales.

Integration of smart grid and open access: Demand Response Market in U.S.

A demand response market allows energy users to bid for demand reduction in the marketplace in direct competition with supply. Demand response market allows for an alteration in the usage of electricity by the consumer. In a voluntary alteration in usage, consumer makes a decision to help maintain grid reliability which is triggered in response to directives sent by the utility. The consumers can change their usage pattern to avail incentives offered by the utility.

The factors that enable these activities are nodal prices (these are the prices that reflect location-specific energy costs) and use of smart grid technology which helps in responding to real time price signals. Such an approach helps in taking off the inefficient generators out of the market. The electricity markets get transformed into consumer product markets. The buyers will respond to the prices by changing their electricity consumption patterns.

Pricing in an open access mode

Pricing in an open access regime calls for separate pricing in terms of "carriage" and "content". The "content" here refers to the energy or power, which is a tradeable commodity with free market incentives. "Carriage" refers to grid services in reference to transmission and distribution. We have presented a few transmission pricing mechanisms commonly, which are used internationally in Table 12. The pricing can be done in such a way that technical losses should be allocated to the wire operator and commercial losses to the retailer.

The T&D pricing should be separate from the cost of transported energy, cost-reflective, efficient, and transparent. The "cost-reflective" component in the pricing refers to capital, operation, and maintenance cost recovery by the operator and the incorporation of location-specific congestion costs in the price signals. Transmission prices should reflect three sets of costs of transmission network operations[21]:

[21]"International Experience with Open Access to Power Grids", Synthesis Report, Knowledge Series 016/13, ESMAP, World Bank

(a) Capital, operation and maintenance expenses incurred by the system operator in building and operating grid assets
(b) Costs of system operation and wholesale market administration
(c) Location-specific congestion costs. These are the costs imposed on generators who are required to reduce their output to accommodate other system users. This also ensures system security.

Table 4: Some of internationally used Transmission Pricing Mechanisms

	What It Is	Who Pays	Who Receives	Charging Methodologies
Connection	Grid costs related to the physical connection of the customer to the grid	Users: generators, distributors, large end users	Transmission Company	Shallow (pay only the connection cost to the nearest connection point) or deep (also includes grid reinforcement costs)
Use of Transmission System	Grid costs related to capital expenditure and operation and maintenance	Users: generators, distributors, large end users, marketers	Transmission Company	Payment based on MW, postage stamp, or locational
Congestion	Opportunity costs of energy due to suboptimal dispatch of the power system	Ranges from pure socialization (all market participants) to zonal (all in a zone) to nodal (participants in a particular node)	Generators and ancillary service providers in constrained on and constrained-off situations	Socialized via a system service charge across all customers, zonal (few spot prices)

Source: "International Experience with Open Access to Power Grids", Synthesis Report, Knowledge Series 016/13, ESMAP, World Bank

Making distribution companies more efficient

Over the years, the distribution companies in India have been in great losses and are unable to raise the tariffs owing to political pressure. The discoms in Rajasthan have been facing huge losses which go as high as INR 50,000 crores. But the banks have

been ever-greening loans to discoms, because they view it as lending to the government. This results in the creation of Non-Performing Assets. The solution to this is to force discoms to lower their losses and a directive from the Union Government to all the banks to stop lending to those discoms that have high aggregate technical and commercial losses. The exercise could be carries out on a regressive scale over the years. As an example, for the first three years, the discoms with AT&C losses more than 50% should not be getting any loans. The baseline percentage can then be lowered down to 40% over the next two years and then to 30%. Such a ratcheting would force discoms to take necessary measures to become more efficient. Also, if the discoms need money, they will have to get it from the state's budget. The state budget is limited; therefore, the amount of funding will be limited too. This would force discoms to become more efficient.

Discoms could become more efficient in any of the three ways:

a) **PPP mechanism in the power sector:** In a Public Private Partnership (PPP) Model for the distribution of electricity, all functions and obligations relating to distribution of electricity in a licence area are to be carried out by licensee. In the PPP route, the concessionaire is selected through the process of competitive bidding and is responsible for maintenance of the distribution networks, operation and upgrade and maintains the supply of electricity to the regulated consumers. A Design, Build, Finance, Operate and Transfer (DBFOT) model would be most suited under PPP regime.

b) **City-based franchising of retail electricity markets:** A retail electricity market is a demand response market. In a retail electricity market, the suppliers are continuously at a threat of losing customers to competitors. This creates competitive incentives to transfer the efficiency dividends from competition. It also leads to more cost-effective prices and more innovative products and services. The countries that have implemented full retail market and customer choice in Europe include United Kingdom, Netherlands and the Nordic market which includes Denmark, Finland, Norway and Sweden. In a demand response market there can be a variety of pricing arrangements. The common ones are listed below:

   i. **Time of use or TOU** pricing refers to a flexible pricing structure incorporating different unit prices for usage during different time periods within a day. The rates under TOU reflect the average cost of generating and delivering power during those time periods.
   ii. **Real-time pricing or RTP** refers to pricing based on real-time movements in electricity prices based on trade in spot markets, balancing markets or other electricity exchanges. Under the RTP regime, hourly or half-hourly prices are linked to corresponding changes in real-time or day-ahead power costs. Therefore, the customers are notified of expected RTP prices on a day-ahead or hour-ahead basis.

iii. **Critical peak pricing or CPP** refers to a combination of time of use rates and real time pricing design. In a CPP design, a provision is made for replacing the normal peak price with a much higher pre-determined critical peak pricing event price under specified trigger conditions, such as when system reliability is compromised, supply prices are very high or high and low temperatures are forecast

> ***Electricity retail market approach for India***
>
> An electricity retail market approach for India would require improved tariff comparability for the consumers. This would help them in making a prudent choice of switching from one electricity supplier to another. To develop a retail electricity market in India, following are the basic requirements:
>
> 1. An increased exposure to real-time pricing
> 2. Ready access to detailed, real-time customer information. This would help to stimulate competition and facilitate competitive entry
> 3. Market processes for contracting, switching and billing should be designed in a simplistic way to a minimum
> 4. Proper Legal and regulatory governance frameworks
> 5. Use of technologies that provide cost-effective, real-time metering information and verification.

c) **Parallel licensing:** The concept of parallel licensing refers to operation of multiple licensees within an area. We would cite the case of parallel licensing in Mumbai region of the Maharashtra to elaborate further on the advantages of this process. There are four distribution licensees who hold the licence to distribute electricity within the areas specified in their respective licences and within the ambit of the orders of the Maharashtra Electricity Regulatory Commission (MERC) and various judgments of the legal bodies.

i. BrihanMumbai Electricity Supply and Transport Undertaking (BEST)
ii. Reliance Infrastructure Ltd. (RInfra–D)
iii. The Tata Power Company Ltd. (TPC-D)
iv. Maharashtra State Electricity Distribution Co. Ltd. (MSEDCL).

Of the four, Tata Power is licensed to distribute power in the entire Mumbai region excluding the Mira-Bhayander area served by RInfra-D and excluding all the areas served by MSEDCL. Under the Universal Service obligation, each licensee has an obligation to supply electricity to all consumers, who demand electricity supply from them. There were some interventions made by MERC in the USO context, in order to enable the discharge of the supply obligation by the distribution licensees. In the Tariff Order dated 15 June, 2009, MERC directed Tata Power to explore the possibility of utilizing the distribution network of existing distribution licensees,

which in this case was Reliance-Infra in order to optimize the cost. Following this, Tata power entered into discussions with Reliance Infra to finalize an arrangement to effect the changeover of customers, who would then receive supply from Tata Power on Reliance-Infra's distribution network. This resulted into an order from MERC to go ahead for the changeover.

On the issue related to the supply of power by TPC through the common network of RInfra-D, the Supreme Court held that introduction of the concept of wheeling is against the contention that not having a distribution line in place disentitles TPC to supply electricity in retail directly to consumers. The court also observed that the concept of wheeling was introduced in the Electricity Act, 2003 to enable distribution licensees who are yet to install their distribution line to supply electricity directly to retail consumers, subject to payment of surcharge in addition to wheeling charges as determined by the State Commission.

To quote[22]: —

"75. (...) It is no doubt true that Section 42 empowers the State Commission to introduce a system of open access within one year of the appointed date fixed by it and in specifying the extent of open access in successive phases and in determining the charges for wheeling having due regard to the relevant factors, but the introduction of the very concept of wheeling is against Mr. Venugopal's submission that not having a distribution line in place, disentitles T.P.C. to supply electricity in retail directly to consumers even if their maximum demand was below 1000 kVA. The concept of wheeling has been introduced in the 2003 Act to enable distribution licensees who are yet to install their distribution line to supply electricity directly to retail consumers, subject to payment of surcharge in addition to the charges for wheeling as the State Commission may determine. We, therefore, see no substance in the said submissions advanced by Mr. Venugopal."

Existence of Multiple Distribution Licensees and the process of parallel licensing induces competition amongst the incumbent discoms and allows the entry of a new discom into the market only if its tariffs are lower that of the incumbents'. Therefore, it gives rise to competition and ultimately a regression of the tariffs takes place, which is beneficial for consumers.

Increased emphasis of solar power and wind power

Increasing solar installations in India

a) The policy mandates for the buildings could be drafted and incorporated in the building code of India, wherein each building destination needs to abide by a certain percentage of the electricity demand to be met by solar power as described in the building code (as mentioned for Spanish Technical Building Code).

[22] http://www.mercindia.org.in/pdf/Order%2058%2042/Appeal_36of2011.pdf

b) In India, 35,000 km² area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 GW to 2,100 GW. In the same way, the Aravali hills area could be used to install solar panels so as to supply electricity to the nearby villages. Rooftops in India should be used to installation of solar panels with the help of a policy mandate.
Meisen, Peter and Pochert, Oliver (2006), in "A Study of Very Large Solar Desert Systems with the Requirements and Benefits to those Nations Having High Solar Irradiation Potential", July,2006, Global Energy Institute calculate that the Thar desert can potentially provide for 17,000 GW of electricity capacity. As a conservative estimate, we assume that by 2050, we can aim at generating 1,000 GW from the Thar Desert.
c) Policy makers need to take into account the solar rights for the end-consumers. On the lines of the United States, we need to draft laws such as solar access. Since the upfront costs are still so large in PV systems that a normal household would not be willing to put it up on the rooftop, but a law similar to solar access will definitely convince house-owners that a certain percentage of their energy consumption would be fulfilled by the solar power.

Increasing solar rooftop installations

a) Making the rooftop solar installations mandatory will provide a boost to the solar cell manufacturers and there would be an increase in demand of solar cells, which would result in a production at a very large scale that would further reduce down the costs of the solar cells.
b) Utilizing the marine terminals area for rooftop solar installations is another option. One such step taken in this direction is the Gloucester Marine Terminal by the United States. The Marine Terminal area of Chennai, Mundra, Nhava Sheva, Vishakapatnam and Cochin sum up to 108.6 hectares (1,086,000 square metres) or 11.736 million square foot. Solar installation on such a large amount of area would roughly generate 100 MW. It would cover a large amount of electricity requirement of these terminals and reduce their dependency on grid.
c) To give a push to the solar rooftop installations, the 100,000 solar roof program of Germany could be imitated, focusing such kind of program in a high population density and shade free area.

Revamping the wind industry

a) Developing interconnection standards: Wind power is variable in nature and the conventional electricity network is tuned to the radial mode of power flow as in conventional generation. This poses challenges to the reliability and efficient of interconnected systems and calls for development of an interconnection standard that would be able to sustain the variability without affecting the power quality
b) Development of Green Energy Corridor—The "green energy corridor" concept was envisaged in 2012 with the purpose of strengthening the intra-

and inter-state transmission systems strengthening for grid integration issues of large scale renewable energy generation

c) Use of smart grid technology, which helps in responding to real-time price signals. The electricity markets get transformed into consumer product markets
d) Repowering—there is a huge potential for the repowering of older wind farms. Currently, there are no national or state level policy guidelines for repowering. In northern Jutland, Denmark, the number of turbines at the 20 year-old Nørrekær Enge facility has been cut by 83 percent, yet energy production has doubled[23] due to repowering initiatives
e) There is a need for extension of timeframe for Renewable Energy Certificates Mechanism. Due to its limited timeframe of five years, it faces the challenge of acceptance as a revenue stream by the financial institutions. The timeframe should be extended to at least 8 to 10 years
f) Removal of duality on determination of Feed in Tariffs - CERC issues guidelines for determining the feed-in-tariff for renewable energy based power generation. These guidelines are applicable to central government power generating stations and to those stations that transmit power in the inter-state corridor. Still a large number of producers are covered by the tariff determined by the SERCs. This duality is not useful, as the tariff determined by the SERCs are not equivalent to CERCs

Conclusion

Though India is faced with a number of challenges related to energy security, energy access and large T&D losses, a number of reforms are required to improve the health of the power sector. With the recent Coal Mines (Special Provisions) Ordinance, companies engaged in specified end use plants such as steel, cement and power, including ones having a coal linkage, also qualify to participate in the e-auction, which is a welcome to increase private participation in coal mining. A check on coal theft and coal burning through preparation of a database of intelligence reports about illegal coal depots and illegal movement of coal and informing district authorities of the same for taking preventive action would help curb losses of thousands of crores of rupees. New techniques for suppression of coal fires would reduce the environmental impact due to emissions.

The new coal power plants should be limited to supercritical and advanced supercritical variety that would ensure higher efficiencies and lower carbon emissions. The Integrated Gasification Combined Cycle is able to take care of fuels which are high in metals, nitrogen and sulphur. The process has an advantage in terms of simplification of CO_2 recovery, particularly with the use of pressurized, oxygen-blown gasification systems. A single-window clearance system for power projects and removal of redundant forms would expedite the setting up of new coal power plants. There is a need to consume the coal reserves to our maximum

[23]Nørrekær Enge Wind Farm, Vattenfall, November 2008, p.2, accessed March 14th 2011, http://www.vattenfall.dk/da/file/Norrekaer_Enge___eng_7841607.pdf

capacity, or else we would run in a situation of losing the large reserves of coal with increasing binding targets on curbing carbon emissions.

Allowance of multiple suppliers for power distribution is yet another reform that has been proposed by the high-level advisory panel appointed by the present government. This would eliminate the territorial distinction existing among the power distribution companies by giving power to consumer to decide the supplier. Discoms ought to be broken into wire companies and intermediate supply companies allowing multiple supply licenses. The next step in ensuring energy security for India is to increase the share of renewables in its energy mix. The focus should be on increase of solar installations through introduction of policy mandates for rooftops and commercial buildings. The Modi government plans for installation of 100GW by 2019, which is a fivefold multiplication of an already ambitious target. This would need introduction of new business models that would allow private solar power developers to take the initiative ahead.

All this should result in not only cleaner power, but also cheaper power which will help make our economy more competitive

What India needs, is a cleaner and better tomorrow!

About PIF

Pahle India Foundation (PIF) is a not for profit, financial, economic and political research think tank, dedicated to the task of making India first by putting India first. Over the years, we have learnt that there is no universally accepted development model. Each country has to take into account its people, its resources and its socio economic and cultural legacy for effective policy formulation and implementation. At PIF, we work towards this objective of creating the necessary paradigm shift in development thinking and practices in India to achieve this aspirational goal. PIF currently has an analytically strong team of dedicated researchers who are self motivated. PIF's highly qualified team specialises in analyzing India's political economy and its engagement with the global flows in finance, trade and technology.

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