

Economic Analysis

# India is becoming key for world energy demand: What are the main opportunities and challenges?

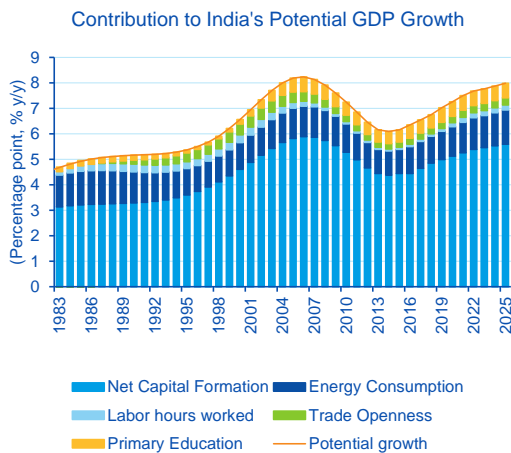
Sumedh Deorukhkar / Alicia Garcia-Herrero / Le Xia

Nearly one-third of India's 1.2 billion people lack any access to electricity. A bulk of the rest endure frequent power outages caused by poor energy infrastructure, which has stifled productivity, abetted inflation and undermined India's economic growth. Plagued by inefficiencies across each segment, from production to end use, India's energy supply chain warrants a complete overhaul through tough executive, legislative and judicial action.

In this context, India's Planning Commission has estimated that corrective steps towards pricing for higher energy efficiency and establishing appropriate regulatory mechanism can reduce India's energy import dependence to 21% by 2047 from 31% currently. However, in a status quo scenario, the commission warns, India's energy import dependence could be as high as 84%, severely constraining potential growth and leading to a ballooning current account deficit. It should be noted that, if we assume no energy imports, India would have run a current account surplus of +4.6% of GDP last fiscal year (FY14) instead of the actual current account deficit of -1.7%. With the economy gradually picking up steam after having suffered two straight years of subdued growth (below 5%), the new government's efforts to enhance energy security are essential to sustain India's growth at higher levels without overheating.

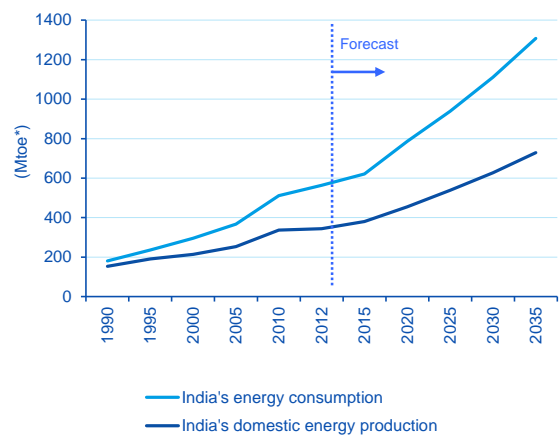
Against this backdrop, we examine India's quest for energy resources and evaluate its implications for global energy trade. We also flag the associated challenges and propose an effective solution to India's complex energy issues, particularly for coal, which is India's largest energy source comprising 55% of total energy consumption and 70% of electricity generation.

**Figure 1**  
Energy consumption is a key driver India's potential growth



Source: BBVA Research. We estimate India's potential growth using a multivariate production function approach

**Figure 2**  
India's energy demand will outstrip domestic supply at an accelerated pace going forward



\* Million tonnes of oil equivalent, Source: BBVA Research, British Petroleum (BP) Statistical Review 2014

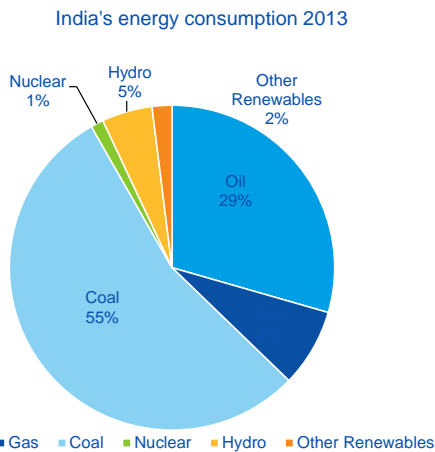
**Understanding India’s energy matrix**

India is the fourth largest energy consumer in the world, ahead of Japan and only behind the US, China and Russia. Even so, what distinguishes India is its fast pace of energy consumption growth and, thereby, its energy demand outlook. The South Asian giant consumed 595 Million tonnes of oil equivalent (Mtoe) of energy in 2013, nearly twice that in 2000 (296 Mtoe), as per data published by British Petroleum (BP). Looking ahead, India’s energy needs are expected to accelerate to 1307 Mtoe by 2035 (3.6% CAGR) in a baseline scenario embedding potential growth for India rising up to 8% in 2025 (See Figure – 1). Within this context, the World Energy Outlook 2013 expects India to overtake China in the 2020s as the principal source of growth in global energy demand. Although India’s absolute energy demand is expected to remain much lower than China’s for the foreseeable future (4671 Mtoe of energy demand estimated for China in 2035 compared to 1307 Mtoe for India), it seems clear that India is becoming increasingly relevant in determining energy price developments given its marginal impact on such prices.

It should be noted that India’s fast growth in energy demand is bound to happen notwithstanding foreseeable improvements in the efficiency of energy use. In fact, India’s energy intensity<sup>1</sup> is expected to continue trending lower thanks to the substitution of traditional fuels such as wood and cow dung cakes with cleaner ones.

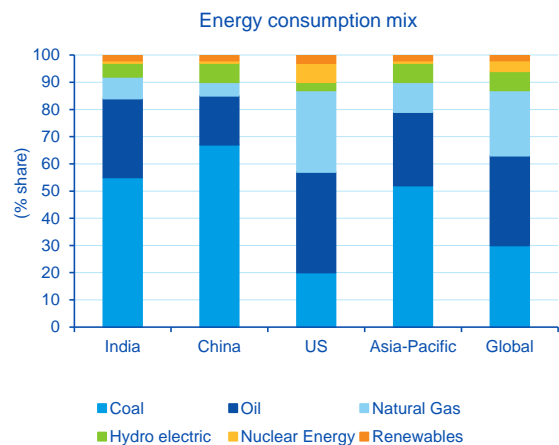
However, India does not produce enough energy to meet its domestic requirements. Its energy deficit is expected to balloon over the next two decades from around 232 Mtoe in 2013 to 578 Mtoe by 2035 according to estimates by British Petroleum (See Figure – 2). An increasing recourse to energy imports is thus inevitable. Such high import dependence for energy is a sub-optimal solution in as far as India is concerned given that it has a structurally high current account deficit. In the next section, for a better understanding of India’s energy problem and arriving at specific solutions, we first parse India’s energy mix and delve upon each energy source in detail.

Figure 3  
**Bulk of India’s energy needs are met through coal**



Source: BBVA Research, British Petroleum Statistical Review 2014

Figure 4  
**India’s reliance on coal for energy is well above global average, while that on gas is much lower**



Source: BBVA Research, British Petroleum Statistical Review 2014

<sup>1</sup> Energy intensity is an (imperfect) indicator of the energy efficiency of an economy. It is measured as energy consumed (tonnes of oil equivalent) per thousand dollars of GDP, measured at market exchange rates in the year-2011 dollars (WEO – 2012).

## India's energy consumption mix – King Coal leads the pack

The bulk of India's energy demand - about 55% in 2013 - is met through coal. Excluding coal, the energy consumption mix comprises oil (29%), natural gas (8%), hydroelectric (5%), nuclear energy (1%) and other renewable energy sources (2%) (Figure 3). More interestingly, and quite different from other countries, the share of coal in the energy mix has increased over time from 49% in 2000 to 55 in 2013 by substituting oil, which saw its share decline from 36% in 2000. India's reliance on coal is well above the global average (of 305) and accounts for 21% of global growth in coal consumption (Figure 4).

The dominance of coal in India's energy consumption basket can be attributed to its extensive use in producing electricity in the country<sup>2</sup>. Coal powered thermal power plants (TPPs) account for 70% of total electricity generated in the country and represents 60% of the installed power capacity (Figures 5 and 6).

Cost considerations are an important driver of the choice of energy source for electricity generation or industrial use (Appendix: Table 1). In addition, India has an abundance of coal reserves, larger than any other fossil fuel in the country. In fact, India is the world's third largest producer of coal but, ironically, it relies heavily on imported coal to fire its thermal power plants thanks to structural inefficiencies and bureaucratic bottlenecks at every stage of coal exploration, production, transportation and power generation (Figure 7). Finally, and even more ironically, India's coal imports haven't grown enough to close the domestic shortfall (Figure 8). The reason is two-fold.

The first is the pricing policy. Despite recent sharp fall in global coal prices<sup>3</sup>, India's domestic coal prices (around USD 50 a ton) remain below international prices (in the range of USD 60 to USD 70 a ton). The price gap makes it difficult for coal importing companies to compete in the Indian electricity market, where retail energy prices are heavily regulated and power companies cannot freely transfer higher costs to customers. An optimal solution, we believe would be for the Government to fix a single price for coal, rather than the dual price that currently exists. This can be done either by pooling import and domestic prices together based on a viable formula or adopting import parity pricing. A single coal price, which is partially linked to global market price, would help streamline the supply chain, enhance transparency, cut red tape and improve quality of coal available in India. Companies would be free to choose their own coal source, either imported or domestic, without worrying about the price differential and being dependent on Coal India Ltd (CIL) for a fuel supply linkage which now meets more than 80% of India's coal needs. On the flip side, the single price formula would inadvertently raise coal prices in India by increasing input costs for power plants. However, excess profits generated by CIL by selling higher priced coal could be used to soften the price impact through targeted subsidies and ensure a smooth price transition.

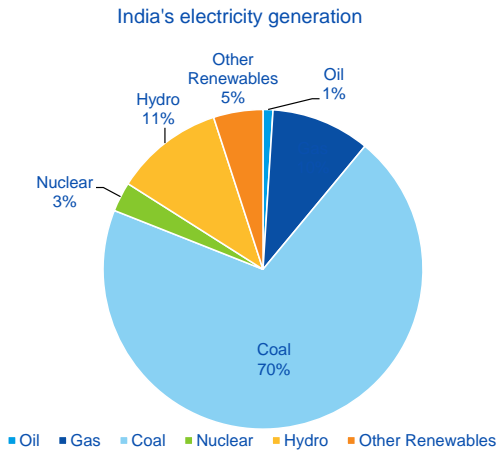
The second problem is more structural. India's power grids, as well as its electricity turbines, are technically constrained so that they only operate and burn domestic coal, which is of inferior quality or low grade (See Figure 9). Also, poor transport infrastructure makes it unviable for power utilities far off from ports to import coal.

Against this backdrop, India's new government led by Mr. Modi is undertaking a raft of measures with several objectives: first, enhance domestic coal production to 1 billion tons annually by 2019 (from 571 million tons in 2013-14); second, ensure uninterrupted and timely supply of quality coal to power plants; third, reduce red tape by leveraging technology and; finally, promote clean coal technologies (Appendix: Table 2).

<sup>2</sup> Industry accounted for 45% of electricity consumed; agriculture for 17%, domestic use for 22%, commercial use for 9%, railway traction for 2% and other uses for the residual 5% (CSO 2013)

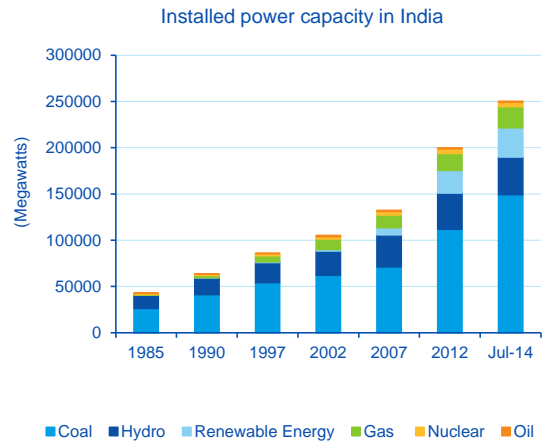
<sup>3</sup> Price of imported coal over the last six months fell to their lowest in years for all Gross Calorific Value (GCV) 6500, 5800, 5000, 4200 and 3400.

**Figure 5**  
**Coal is the principal source of electricity generation in India**



Source: BBVA Research, Gol 2013

**Figure 6**  
**India's reliance on coal for power generation has increased consistently over the past decade**

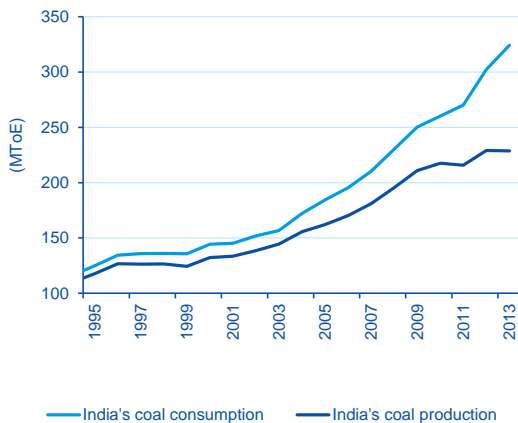


Source: BBVA Research, Gol 2013

**Fixing India's coal woes warrant long lasting reforms**

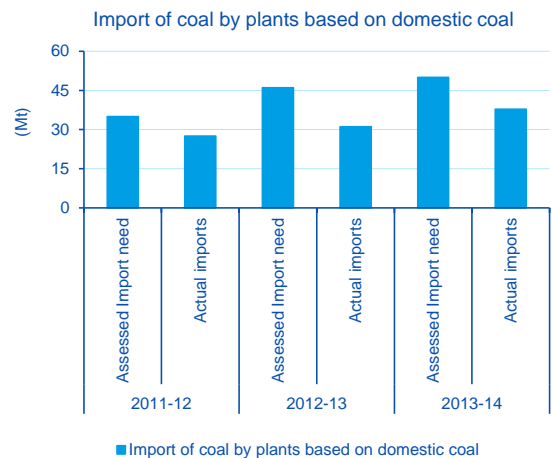
While the government's moves are encouraging, we think bolder actions may be needed. The bulk of issues impeding coal production and availability in India are either directly or indirectly linked to India's chief coal miner – Coal India Limited (CIL); and are relate to pricing, entitlements and allocation of coal (See Box 1). As mentioned, above, coal price reform is essential to move away from dual pricing into a single, market driven one. Breaking India's chief coal miner (CIL) into independent smaller companies with ownership rights allocated amongst respective state governments would probably be necessary to achieve the single price objective as well as to expedite coal production by speeding up environmental clearances and removing other bottlenecks.

**Figure 7**  
**India's coal deficit has widened significantly**



Source: BBVA Research, Gol

**Figure 8**  
**Indian plants based on domestic coal aren't able to raise enough imports to plug coal shortage**



Fiscal year ending March; Source: BBVA Research, Gol

Greater foreign participation in coal exploration should also help. While, full privatization of CIL may not be feasible, the Indian Government has proposed to disinvest 10% equity, which is already an important step. Finally, the government's measures to boost domestic coal production must be dovetailed with efforts to improve efficiency in India's coal and power sectors and a strategy to shift towards greater use less polluting sources of energy.

### **Box 1: Restructuring Coal India Limited is crucial to enhance India's coal output**

Coal mining in India is a monopoly of the state controlled Coal India Limited (CIL). CIL meets more than 80% of India's coal needs, is the chief setter of coal prices and also responsible for organizing e-auctions for surplus coal. CIL has established 21.7 billion metric tonnes (BMT) of reserves and produces around 430 million metric tonnes (mt) of coal annually.

While the government has also allocated coal blocks for captive mining to power, steel, sponge iron and cement producers, bulk of these reserves remain under developed. Acquiring a coal supply linkage with CIL is mandatory for public and private sector power plants in India. However, CIL is often unable to fully honour its existing fuel supply agreements (FSAs) owing to production and transportation related constraints (such as law and order problems hampering coal transportation and dispatch, less wagon supply, seizure of coal transportation trucks at coal fields), thereby supplying only 80% to 90% of committed quantity of coal (See Figure 10).

This forces companies to import coal, which is much more expensive than domestic coal even after accounting for its higher calorific value. For those unable to sign an FSA, importing coal is inevitable. The dual pricing confers an implicit subsidy on companies having a stronger claim on CIL's coal produce. Furthermore, surplus coal produced by private miners has to be sold back to CIL at a pre-determined price. A highly restricted coal market driven by a too-big-to-operate state owned behemoth has fuelled black marketing and created disincentives for legal sale of coal in India. Also, overdependence on underground mines, which incur a higher cost of production compared to opencast mines and delays in technology upgrade, has hurt the finances of CIL. Over the last 10 years since 2004-05, CIL has incurred a loss of USD 7.9 bn from underground mines.

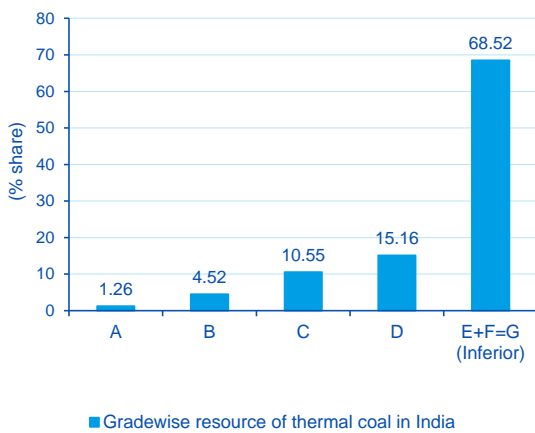
### **India's effort to secure its coal needs**

According to IEA, India will be the world's second largest consumer of coal by 2025 after China. India's total coal imports have more than doubled during the last 3 years; 62% of its coal imports come from Indonesia, followed by Australia (19%) and South Africa (14%). The share of Indonesia in India's coal imports have increased steadily from 52% in 2010, while that of Australia and South Africa has subsequently declined from 23% and 16% respectively in 2010 (See Figure 11). This points to a strategic partnership between Indonesia and India which is still in the making.

Looking ahead, we expect India's coal imports to pick up substantially in the near term given the recent directive on coal block allocations by India's Supreme Court. In a big jolt to captive coal production, India's Supreme Court last month ruled that 152 coal blocks allocated for captive mining since July 1993 to various private (47) and public (105) sector companies, mainly for power production, were arbitrary and illegal. While only 30 of the 152 coal blocks are operational so far with estimated capacity of 37mt, several were expected to start production by 2017. As per official figures, India would need to import up to 38 million metric tons of additional coal if the mines in question remain shut for long. That is equal to 88% of the excess capacity in sea borne thermal coal as per Wood Mackenzie estimates. We perceive the blanket ban as a 'hard choice' but a right decision for the long term as it would enhance transparency in coal block allocation (through competitive bidding) and foster efficiency in coal usage. Illegal grant of blocks is estimated to have cost the public exchequer USD 4.8 billion. In the short term however, the costs are high. Apart from jeopardizing the coal production rate, cancellation of coal blocks could increase burden on CIL to supply coal to such projects and also increase India's reliance on coal imports.

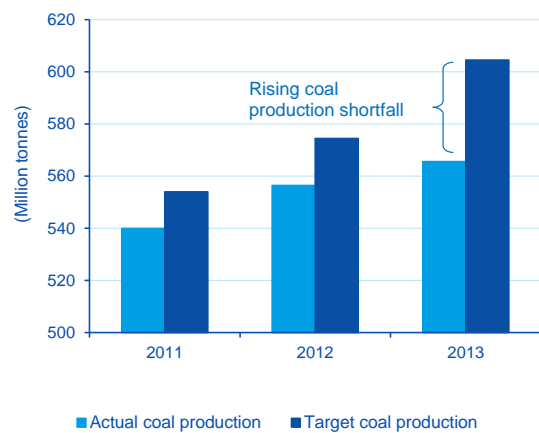
Meanwhile, Indian companies are aggressively pursuing coal resources abroad in a bid to secure raw material supply for running their power, steel and cement plants in India. CIL, in particular, is currently mulling over 17 investment proposals from overseas mining companies, of which as many as 5 are located in Indonesia. However, converting such proposals into concrete deals is the key. CIL's past record has not been so encouraging. The mining giant had backtracked on the purchase of two coal blocks in Mozambique in 2009. However, things may be different this time around with the new government promising speedy reforms to enhance India's energy security.

Figure 9  
**Nearly 70% of coal available in India is of inferior quality (Grade A has the highest heat value/price)**



Source: BBVA Research. Geological Survey of India

Figure 10  
**India's coal production has increasingly fallen short of official target**



Source: BBVA Research, GoI

**Oil – Rationalising domestic demand is the key**

India imports 80% of its crude oil requirements with oil imports accounting for nearly 32% of India's total import bill. The Government is determined to reduce the share of crude oil in India's energy production basket from 12% currently to 7% by 2021, substituted by Natural Gas (from 13% currently to 16% by 2021), Nuclear power (from 2.5% to 5% by 2021) and renewable energy (from 1.5% to 3%).

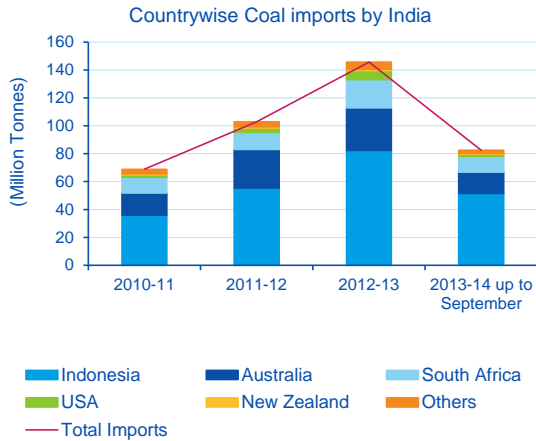
India has diversified its crude oil import basket with increasing recourse to Latin America: Recent geopolitical conflicts in the Middle-East have raised concerns over India's energy security given that the region still remains India's main provider of oil but the share of Middle-East in India's oil imports has fallen from 69% in 2011-12 to 61% in 2013-14; substituted mainly by Latin America, whose share has risen from 8.5% to 17% during the corresponding period (Figure 12). Indian oil companies have been aggressively investing in overseas exploration and production (E&P) assets over the last three years in as many as 24 countries to enhance India's energy security<sup>4</sup>.

All said, India's domestic oil reserves are well below demand so the new government should, not only continue to find new sources of oil, but also announce tougher demand rationalization measures including a complete deregulation diesel prices.

<sup>4</sup> See our previous [Economic Watch](#) on India's Overseas Direct Investments.

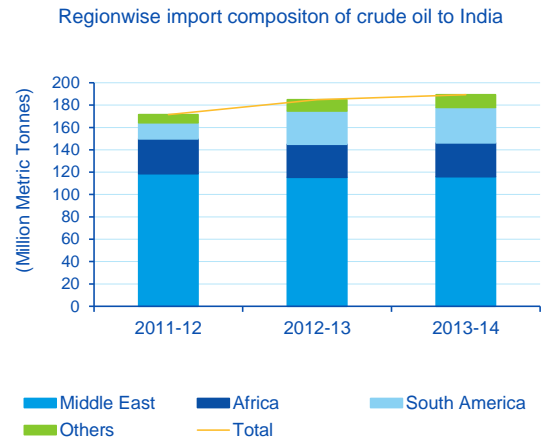


**Figure 11**  
**Indonesia is India's chief coal exporter followed by Australia and South Africa**



Source: BBVA Research

**Figure 12**  
**Share of Latin America in India's crude oil import basket is increasing**



Source: BBVA Research

**Natural Gas – India needs to make a decisive shift towards natural gas**

India should shore up its usage of natural gas given that it is much less polluting than coal or oil and efficient to deliver. However, India's indigenous natural gas production fell sharply in 2013 by 16.3% y/y and so did consumption (-12.2% y/y). Furthermore, India's gas deficit has widened with imports creating energy security issues (Figure 13 and 14). Currently, India imports 25% of its natural gas requirement mainly because of a lack of pipeline infrastructure has constrained access to natural gas in India.

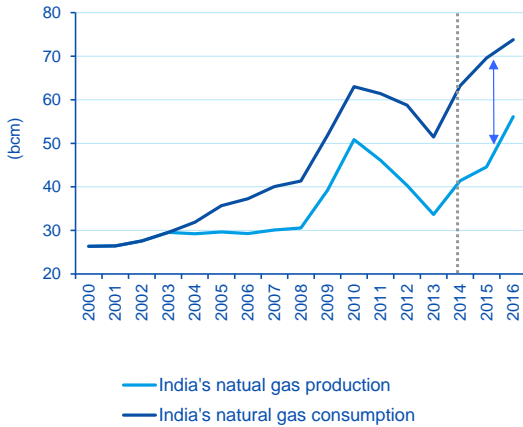
Looking ahead, the Indian government estimates domestic natural gas output to jump 67% in the next three years due to a ramp up in production, especially from the Reliance industries and new gas discoveries in North Eastern India. The Indian government and the exploration and production (E&P) companies have undertaken several measures to enhance oil and gas production in India (Appendix: Table 3). The good news is that government is set to revise the natural gas pricing formula in the coming months. A meaningful hike in gas prices would monetize discoveries that were earlier not commercially viable. Yet, India's domestic gas deficit is projected to widen substantially over the next two years.

**Hydroelectric and Nuclear Energy – Inherent issues make expansion difficult**

The share of hydroelectric in India's installed power capacity has fallen sharply from 34% in 1985 to just 16% today. Progress in exploiting India's hydro-electric resources on a large scale has been constrained by environmental and land acquisition issues, poor infrastructure facilities, resettlement and rehabilitation problems and security restrictions in border areas.

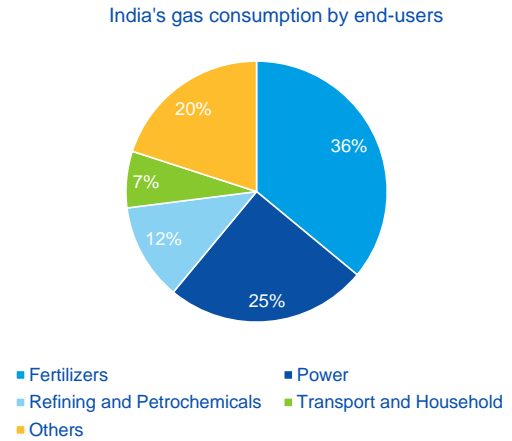
Meanwhile, India's new government led by Mr. Modi has particularly focused on Nuclear power to plug India's energy shortage. Since assuming office, Mr. Modi has discussed civil nuclear cooperation with Japan and signed a deal Australia to sell uranium to India. The government plans to add 30 more reactors from 20 at present. However, the cost of additional nuclear capacity is way too high at USD 85 billion, especially given India's weak public finances so it does not seem plausible without foreign financing.

**Figure 13**  
**India's Natural Gas deficit is expected to widen despite a ramp up in gas production**



Source: BBVA Research, Gol estimates

**Figure 14**  
**Power and fertilizer constitute the bulk of India's natural gas consumption**



Fiscal year ending March; Source: BBVA Research, Gol

**Renewable Energy – the best way forward**

The role of renewable energy sources, which includes wind, solar, small hydro and bio-power, is central towards reducing India's energy import dependence. Besides being clean, electricity generation from renewable energy sources is cost competitive in remote areas where extension of conventional fuel grid is uneconomical. Meeting unmet demand for electricity in rural India, which constitutes 47% of 1.2 billion populations, through renewable sources, especially solar and biomass based gasifiers can greatly reduce India's kerosene subsidy bill and minimize resource intensity of the economy.

Encouragingly, ongoing efforts to promote renewable energy sources (excluding large Hydro projects) by providing various fiscal, financial and other incentives (Appendix: Table 4) have boosted India's renewable energy capacity over the past two years. In fact, the share of renewable energy in India's total installed power capacity has jumped from just 2% in 2002 to 13% currently. The bulk of India's renewable energy generation comes from wind (59%), followed by biomass (23%), small hydro (11%) and solar (6%) (Figure 15).

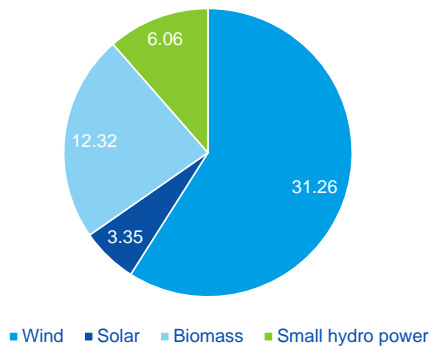
Accelerating renewable energy production is a priority for the Indian new government, which has set an ambitious target of 29800 MW of capacity addition between 2011-12 and 2016-17 (7189 MW achieved so far). To achieve this, India needs to unlock its huge solar energy potential<sup>5</sup> (See Figure 16) Authorities should first tackle key impediments to solar power development in India, which includes policy and regulatory barriers, land acquisition issues given the vast spaces of land required, operation and storage issues given the challenges to grid stability, reducing transmission and distribution losses and managing the high cost of installation of solar systems.

<sup>5</sup> The theoretical potential of solar energy in India is 5 trillion kwh/year. Most of the area of the country receives more than 4 kwh/m<sup>2</sup> per day of solar energy for more than 300 days a year. Even if 1% of the land area were to be used to harness this at an efficiency of 10%, 492x10 raised to 6 million kwh/year of electricity can be generated (Deo 2011).



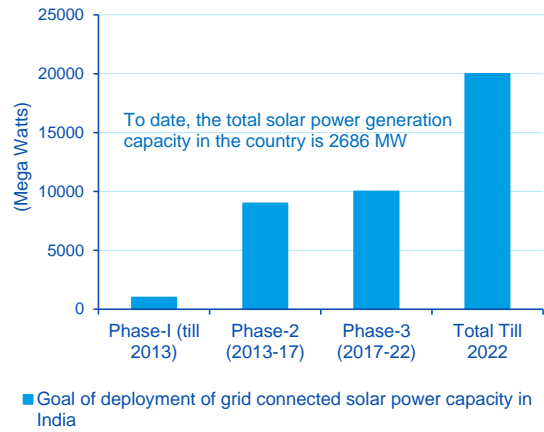
Figure 15  
**Wind power is the principal source of renewable energy in India**

Electricity production in India from renewable energy sources (Billion units produced)



Source: BBVA Research, Gol

Figure 16  
**India needs to unlock its huge solar energy potential**



Source: BBVA Research, Gol

**Box 2: How can India benefit from the shale gas revolution?**

The remarkable success achieved by United States in unlocking its shale gas<sup>6</sup> potential presents important lessons for an energy starved India. Shale gas reserves are well diversified across the world and largely enough (at 6622 trillion cubic feet) to satisfy global gas demand for the next six decades. This has inspired several economies such as China, South Africa, Argentina and Poland to take steps to harness shale gas by developing the necessary technical, regulatory and physical infrastructure.

India's recoverable shale gas reserves are low although further exploratory drilling may lead to new discoveries in future. However, India needs to overcome several challenges before it can successfully tap domestic shale gas reserves. The new government should take tangible steps towards 1) formulating a favourable regulatory and tax regime that boosts investments in shale gas industry, 2) developing India's oil field service sector capacity, 3) removing technology restrictions, 4) a liberal import policy for equipment needed for hydraulic fracturing and horizontal drilling, 5) quicker land and environmental clearances 6) strengthening transport infrastructure and 7) enhance foreign and domestic private investments in India's oil and gas industry. If the above mentioned issues are effectively addressed, nurturing shale gas resources holds long term promise for lowering India's energy deficit, besides increasing investments, shoring economic activity and boosting government revenues. At the initial stage, however, given the high cost of shale gas production, it would be viable to limit shale gas usage as a substitute for expensive liquid fuels and a source for reducing the peak power deficit. To develop technical capabilities in shale gas exploration, Indian oil and gas companies are vigorously scouting for opportunities abroad for participating interest in shale gas acreages. Gas Authority of India Ltd (GAIL) recently acquired 20% interest in a shale gas asset in the Eagle Ford basin in the US. All said, notwithstanding India's shale gas potential, we believe that India's natural gas industry has much to learn from US shale gas success. Stronger gas infrastructure capabilities would lower India's dependence on more polluting fuel sources such as coal and oil and contribute to India's economic growth.

<sup>6</sup> Shale gas is natural gas found trapped within shale rock formations. Technological advancement that allowed horizontal drilling and hydraulic fracturing, known as fracking, has made it possible to access large volume of shale gas that was previously uneconomical to produce

## Appendix

Table 1

**Comparison of electricity generation options in India**

Source: Prof Rangan Banerjee, IIT Bombay;

<http://cornerstonemag.net/coal-based-electricity-generation-in-india/>

Source	Capital Cost (Million/MW)	Gestation Period (years)	Availability (Maximum capacity factor)	Cost of generation (INR/kWh)	Land Area (m <sup>2</sup> /MW)
Coal	USD1/MW	5	92%	6 US cents/kWh	2000
Gas	USD0.8/MW	3	95%	7 US cents/kWh	N/A
Nuclear	USD1.4/MW	7	80%	8 US cents/kWh	1200-4700
Hydro	USD1.2/MW	6	50% to 60%	5 to 7 US cents/kWh	222000
Solar PV	USD2.4/MW	1	25%	20 US cents/kWh	12000
Solar Thermal	USD3.0/MW	2	26%	30 US cents/kWh	20000
Wind	USD1.2/MW	1-2	30%	8 to 12 US cents/kWh	100

Table 2

**Indian government measures to enhance domestic coal production, curb red tape, promote clean coal technologies and tap Coal Bed Methane reserves**

Source: Government of India and BBVA Research

<b>Measures by Modi Government to enhance indigenous coal production</b>
- In-principle decision to purchase 250 additional rakes (for Rs. 5,000 crores) to evacuate more coal.
- Expediting build-out of 3 critical railway lines
- Automatic transfer of linkages is being allowed from old & inefficient plants (>25 year old plants: ~32,500 MW) to ultra-modern super-critical plants in order to maximize power generation
- Coal linkage rationalization is also underway (Gujarat and Chhattisgarh swap completed) which aims to link power plants to the nearest mines.
- Ensuring speedy environmental clearances (cluster based approach, with time-bound monitoring) and steps to protect the environment.
- To ensure quality coal, Coal India Ltd has allowed 3rd party sampling, and by installing washeries and crushers to clean and grind coal.
- Steps to clamp down on coal pilferage are also being taken, in a systematic manner by leveraging technology
- Illegal mining is a critical concern for Coal India Limited and the government has taken steps to prevent such illegal mining activities.
- Pursuing with state governments to help expedite land acquisition
<b>Steps taken by Coal India Limited and its subsidiaries to augment coal production:</b>
- Capacity addition from new projects
- Use of mass production technologies
- Stringent monitoring of development of coal blocks
- Issue of low quality of coal produced in India is being addressed by third party sampling and analysis at loading ends.
<b>Reforms in Coal Sector</b>

- Allocate area containing coal for specified end uses through auction by competitive bidding
- Augment coal production in the country through Public Private Participation. In this regard, a Model Concession Agreement (MCA) for engagement of mine developer cum operators in CIL and its subsidiary companies has been finalized
- The Government is planning to amend the the Coal Mines Nationalization Act 1973 to allow Indian companies in the private sector to mine coal in the country without the existing restriction of captive mining.
<b>Promoting clean coal technologies:</b>
- Washing coal
- Coal bed methane recovery and commercial utilization
- Assessment of prospects of shale gas
- Pilot scale studies of Coal-to-liquid conversion technology
- Coal dry beneficiation
- Development of online coal washability analyzer
- The Indian government has signed MoU's with the US, Japan, European Union and Australia for cooperation in research in various areas to promote clean coal technology.
<b>Proposed measures to accelerate production and exploitation of Coal Bed Methane (CBM) reserves:</b>
- Use of modern technology to revive old or closed wells is being explored to maximize production from such fields
- So far, the government has awarded 33 blocks for exploration and exploitation of CBM, out of which, 8 blocks are under development phase.
- The projected CBM production is likely to reach to the level of 4.0 MMSCMD by 2016-17 from 0.58 MMSCMD currently.

**Table 3**

**Steps taken by the Indian government and the exploration and production (E&P) companies to enhance oil and gas production in India**

Source: Government of India and BBVA Research

<b>Measure to boost India's oil and gas production</b>
- Offering of exploration blocks under New Exploration Licensing Policy (NELP) – so far 254 exploration blocks have been awarded
- Implementation of improved oil recovery and enhanced oil recovery schemes by E&P companies for ageing fields
- Development of unconventional sources of hydrocarbon such as Coal Bed Methane (CBM) and Shale Gas
- Policy for geo-scientific data acquisition through public funding
- Pursuing various E&P opportunities in India and abroad to have a balanced portfolio of exploratory, developing and producing oil and gas assets
- Pursuing transnational oil and gas pipeline projects
- Construction of strategic crude oil reserves of 5.33 million metric tons capacity

**Table 4**

**Steps taken by the Indian government to enhance renewable energy production in India**

Source: Government of India and BBVA Research

<b>General:</b>
- Publication of booklets on solar energy and wind energy
- Articles in magazines on renewable energy including special issues on solar energy and wind energy
- Organization of awareness and capacity building programme through state nodal agencies

- Regional rural banks and manufacturers/suppliers of solar systems

**Financial and fiscal incentives for installation of off-grid and grid connected solar power plants.**

**These include:**

- Preferential tariffs/generation based incentives
- Accelerated depreciation
- Concessional/nil excise and custom duties
- Provide capital subsidy of 30% to 90% of project cost for installation of off-grid PSV power projects

**For promoting wind power projects through private sector investment by providing fiscal and promotional incentives such as:**

- Concessional import duty on certain component of wind electric generators
- Excise duty exemption to manufacturers
- 10 years tax holiday on income generated from wind power projects
- Loans for installing windmills
- Wind resource assessment
- Preferential tariff
- Generation based incentive

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