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This issue of the *Oxford Energy Forum* is dedicated to Energy in India.

Set against the landscape of an uncertain international energy market and a potential slowing of China's economic growth, the Indian economy stands poised as a hopeful prospect (the IMF forecasts growth of 6.3 per cent in 2015) in an otherwise unsteady global economic recovery. However, India's new government, elected last May, faces significant challenges in implementing energy reforms, given the complex intertwining of physical (supply), fiscal, poverty and environmental issues. This issue draws together key debates on Indian energy.

The issue begins with three articles covering the recent softening of oil prices, and its varied implications. *Amrita Sen* argues that while this fall in prices could result in a possible halving of India's crude oil import bill in 2015, a combination of low oil prices, greater competition for Asian markets amongst crude exporters, and the liberalization of major petroleum product prices in India will, in fact, ensure that India's fiscal balances continue to benefit even when global crude oil prices have started to rise again. India's traditional sources of crude imports in the Middle East face growing competition both from within that region and from Latin American crude exports (displaced by US domestic production), putting India in a favourable bargaining position as an importer. This could reverse the struggle India has had over the last decade with oil and fiscal deficits.

Nilav Bose analyses the sustainability of India's rapid rise as a leading exporter of refined petroleum products. This export 'boom' did not result from a strategic plan, but from private refiners being undercut in India's domestic market by public oil marketing companies receiving government subsidies, leading to the redirection of their refined product output to the export market from 2006 onwards. Genuine product-pricing competitiveness, with private refiners operating new and complex refineries, supported these changes. However, the author argues that a strategic push *will* be necessary if India is to maintain export market share, due to new refining capacity in its traditional demand bases in the Middle East, and an increasingly crowded export market in east Asia (resulting from lower demand – and hence excess refining capacity) in China. Both articles also conclude that these shifts in international market dynamics combined with domestic price reforms imply potentially greater competition in India's downstream oil products sector.

Kapil Narula argues that there has never been a better time for India to build up its Strategic Petroleum Reserve in order to boost its physical (supply) and fiscal

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energy security. The first phase – comprising roughly 38 million barrels – will be ready this year, and India's government, with an eye on reigning in its fiscal deficit to 4.1 per cent of GDP, has been exploring financing options to 'fill up' this reserve. One possibility is to lease out storage capacity to domestic or international crude producers and refiners whilst retaining the 'right to first use' of the oil (at market prices) in the event of a supply disruption. However, the author argues that the government should consider financing the 'filling up' of the first phase itself given the low oil price environment as, if prices do indeed go back to the highs seen before June 2014, it could draw down the reserves and in the process potentially reap a 50 per cent return on its investment.

The issue then opens up into 'big picture' trends in India's energy production and consumption, with three articles. The first, by *Rahool S. Pai Panandiker* and *Urjit R. Patel*, analyses the challenge of meeting India's future energy needs. The article begins by setting out the scale of the challenge: India's primary energy consumption per capita is currently a third of the world's average; its total primary energy consumption is expected to grow at a rate outpacing China's in the period between now and 2030, with fossil fuels continuing to dominate. As domestic hydrocarbon reserves are insufficient to meet this growth, energy imports, which have increased sharply as a percentage of GDP in the last decade, are likely to continue rising, placing a significant burden on the macroeconomy. The article discusses how the current situation can be characterized by a set of factors (including regulatory, administrative, and policy uncertainty) which have combined to dampen investor interest in the energy sector and impeded the development of capacity required to meet India's energy challenge. The authors outline measures towards developing a coherent policy framework for energy, which they argue is necessary to unlock India's potential to meet its future energy requirements.

P. Elango reviews the evolution and current status of India's upstream sector, and its linkages to the downstream economy, set against the context of India's broader energy challenges. The article charts early successes in upstream exploration; the failure to consolidate these has led to a plateauing and then decline in upstream activity in recent years, reflected in the largest volumetric decline in gas production in 2013. The article highlights problems with antiquated data (which frames investors' perceptions of uncertain resource potential) but also discusses recent technological progress in data-gathering, particularly in the private sector. The author argues for greater harmonization between upstream and downstream policy – which in the past have been pursued to different ends – stating that policies should be predicated on strengthening the perception of India as a large potential energy (consuming) market in the minds of potential upstream investors.

Kaushik Deb assesses India's primary energy mix during 2008–13 using average changes in consumption and production to identify important trends. The author argues that broad five-year averages mask a significant shift in the proportion of fuels in India's primary energy basket in the middle of this period. A rapid rise in gas consumption during 2008–11, followed by an almost equivalent decline from 2011–13, was offset by equivalent decreases and increases in coal consumption. However, an increase followed by a decline in gas production during the same two intervals was not matched by an equivalent trend in coal production, which in fact experienced its first volumetric declines since 1999. Increased coal consumption was thus met primarily through coal imports. This implies that Indian coal consumption has responded relatively quickly to broader changes in energy production. The article discusses the implications of these trends for energy intensity and emissions from energy use.

The next two articles delve specifically into key debates over the disappointing performance of India's upstream sector (partially discussed in the previous three articles). *Daniel Johnston* and *David Johnston* review the debate over profits-based structures (production sharing contracts and royalty/tax systems) versus revenue-based structures in the design of a fiscal regime for upstream exploration. In India, this debate is based on a lack of faith in the accounting for costs, the spectre of cost overruns, and concerns over goldplating. The authors argue that revenue-based systems can be easier from an administrative point of view, but are regressive with regard to government take, and discourage investment. A key consequence of revenue-based systems is also the early abandonment of fields. The article examines the issue of goldplating and discusses how the current focus of attention in the Indian debate is misplaced – it is not a systemic problem. The authors conclude that revenue-based systems have been tried and abandoned, while later generation 'R factors' or Rate-of-Return (ROR) mechanisms are more efficient for creating a progressive fiscal system.

Anupama Sen separates the reality from the rhetoric of India's potential role as a major Asian gas market. The article discusses recent gas pricing reform, and argues that it continues to be predicated around managing the price level rather than establishing a logical basis for price formation. It concludes that the prospects for a turnaround in the recent decline in India's upstream gas sector are limited in the absence of further reform on price formation.

The author argues that any potential for LNG imports will be constrained by the lack of infrastructure, and by a potentially shrinking market for gas in certain important consumer segments such as power. The author concludes that the sustainability of pricing reforms will be determined by the ability of major downstream consuming sectors to absorb higher-priced gas, and argues that the only realistic market opportunity for gas lies in the relatively smaller city gas sector – which suggests a much more muted role for gas in India's economic story under present conditions.

The next article in the issue moves away from upstream oil and gas issues, and considers 'the elephant in the room': coal. *Dagmar Graczyk* discusses how coal is fuelling India's economic growth, and will continue to be the dominant fuel up to 2040. Contrary to popular perceptions that this will be fuelled by its coal reserves (the world's fifth largest) the economic viability and suitability of Indian coal for certain uses (for instance, in power and steel) remains debateable. India's coal imports – currently 22 per cent of demand – are expected to triple to 2040, as a result of deeper structural problems in the domestic coal sector. The article analyses the recent controversy over the cancellation of 204 coal block licences, and the implications of the knock-on effect that this could have on India's coal production, and consequently imports. The author concludes that necessary structural reforms (including the reform of the state-owned monopoly Coal India Limited) will only be successful if, among other things, the government engages in closer cooperation with coal-mining states, and develops a much more conscientious approach towards mitigating the environmental degradation of mining areas, given that India will continue to depend upon coal to propel its economic and social development over the next few decades.

Inevitably, the next article focuses on electricity, given that coal forms the majority (roughly 60 per cent) of installed generation capacity. *Rahul Tongia* argues that change is inevitable in India's electricity future, where the traditional social contract to provide 'universal' access to electricity is broadening in its definition to include quality of service and willingness to pay – the latter is arguably already visible in the money spent on back-up power and lighting to combat regular outages (load-shedding). In light of the recent growth in renewable energy, the article also discusses how renewables have long been promoted in India, and how whilst they face similar challenges (intermittency, location, costs) as those deployed in the USA and Europe, there are also further challenges relating to the instability of the grid, along with enormous systemic price distortions which are not reflective of usage patterns. Given these, the author concludes that the nature of the changes brought about by the rise of renewables, along with storage and Smart Grids, will thus be different from the impacts of electricity restructuring in the 1990s – whilst the latter did not affect the 'flow' of power significantly, in contrast the former can be game-changers for Indian electricity, particularly with regards to their potential impacts on the costs of operation of grid-connected utilities.

The next article discusses the potential role for energy efficiency in mitigating India's rising primary energy consumption. *Anil K. Jain* argues that a concerted strategy on energy efficiency could bridge the gap between energy security and climate change mitigation in India – these issues have typically been viewed as separate policies. The article discusses the enormous potential for energy savings using 'India Energy Security Scenarios to 2047' (IESS 2047), a scenarios-based analysis developed by the Planning Commission which estimates that a five-fold rise in India's total primary energy demand to 24,000 Terawatt hours by 2047 could be reduced by between 25–40 per cent through the adoption of economy-wide energy efficiency measures. The article highlights the savings potential through the use of targeted policy measures in industry (the single-largest energy consuming sector), transportation (the second-highest energy consuming sector), the buildings sector (based on an expected doubling of the urbanization rate by 2030), and in agriculture and cooking. The author thus argues that energy efficiency measures could partially substitute efforts towards raising domestic fossil fuel production and dealing with import dependency, in providing a solution to India's 'energy problem'.

Moving momentarily away from the focus on domestic issues, the next two articles address important bilateral and foreign policy aspects of India's energy sector. *Arghya Sengupta* focuses on the prospects for nuclear energy following the Indo-US civilian nuclear agreement of 2008, arguing that these are contingent upon a resolution to the controversy over India's Civil Liability for Nuclear Damages Act, which sets up a specialized compensation mechanism for victims of nuclear incidents containing provisions arguably inconsistent with India's international obligations. Specifically, Section 17(b) of the Act holds suppliers liable for recourse where the nuclear incident is due to patent or latent defects in equipment or material, or the supply of sub-standard services; and, Section 46 of the Act arguably allows suppliers to remain liable under regular provisions of tort law and other general legislation despite having fulfilled their liabilities under the Act. This legislation has stalled potential investments in nuclear power, as suppliers argue that they could be exposed to potentially unlimited (and uninsurable) amounts of liability. The article explores these

two issues and argues for a legislative realignment that ensures safety while incentivizing nuclear investments. While President Obama's recent visit to Delhi resulted in an apparent renewal of cooperation to resolve this issue for US nuclear suppliers, the test lies in whether investments in nuclear power eventually pick up.

Pramit Pal Chaudhuri analyses the contradictions between India's historical stance on the pursuit of energy diplomacy (and energy security) through overseas acquisitions of hydrocarbon assets by its National Oil Companies and the system within which this is executed, which is in fact designed to constrain the effectiveness of this stance. The article points out how attempts at energy diplomacy have been moved forwards in fits and starts and have easily been trumped by domestic political considerations. Key aspects of energy diplomacy are reviewed, such as India's pursuit of overseas energy assets – which are at about a tenth those of China's. The article discusses recent efforts to consolidate energy cooperation in the south Asian neighbourhood via hydroelectricity, and the enormous potential for overseas cooperation and financing (both bilateral and multilateral) of India's ambitious target for building 100 Gigawatts of solar capacity (from 3 Gigawatts at present) by 2022. The author concludes that medium-term energy diplomacy will be about leveraging overseas capital and technology to resolve domestic problems.

Given the breadth of the debates covered in this issue, it is fitting that it should end with an article that seeks to define the multidimensional aspects of India's 'energy challenge'. *Vipul Tuli* writes on the need to establish a broader definition of 'energy security' for India which goes beyond physical (supply) security, given the importance of primary energy consumption in sustaining economic growth. The article sets out four broad factors towards this end:

- *'supply reliability'* focuses on strengthening the physical dimension of energy supply security, including the need to develop strategic oil reserves;
- *'energy access'* focuses, amongst other things, on bringing the 200 million Indians who lack access to electricity onto the system for modern commercial energy;
- *'economic viability for stakeholders'* includes consolidating the fiscal and financial dimension of energy security;
- *'environmental sustainability'* focuses on scaling up renewable energy, alongside measures on the mitigation of carbon emissions.

The author breaks down the key policy initiatives require to operationalize this broader and more pertinent definition of energy security for India into eight areas, arguing that such a measured, yet all-encompassing approach will make India's energy security goals seem achievable and its challenges appear less insurmountable.

The views expressed in this issue are solely those of the authors and do not necessarily represent the views of OIES, its members, or any other organization, company, or government.

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The battle for Asia in crude oil markets: an easier road ahead for India?

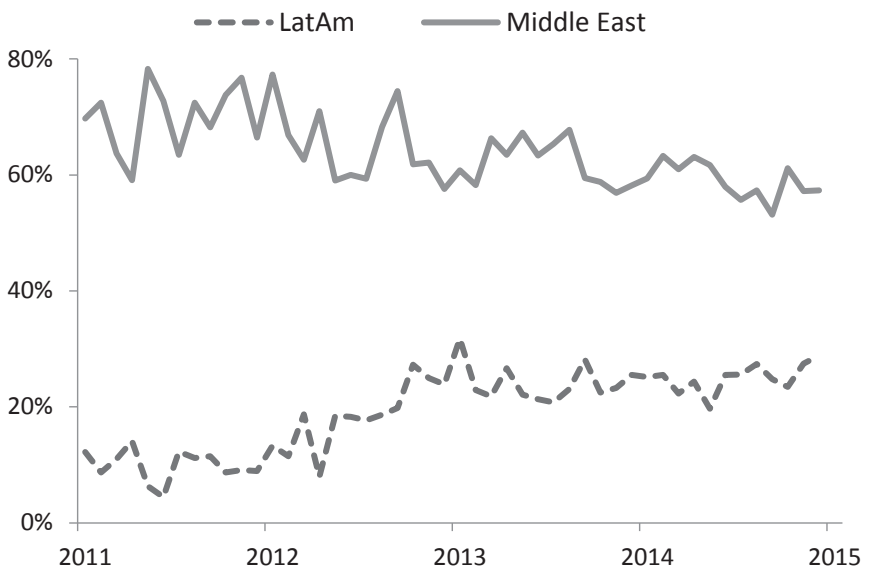
Amrita Sen

Two significant events which occurred in the oil market in 2014 have the potential to reshape India's historical struggle with oil and fiscal deficits. The first is the complete deregulation of major petroleum products prices and the second is the sharp fall in oil prices amidst a fight for market share in Asia among crude producers, implying importing countries like India are now spoilt for choice and in a far better position to bargain for better prices. Even though the drop in prices is unlikely to last (given the high cost on the supply side) and prices are likely to pick back up to at least the US$80–100 per barrel range in the coming years, India will remain in a privileged position compared to a few years ago, as the continued growth of US tight oil means producers from all around the world will still focus on Asia to sell their crude. This, together with the deregulation of product prices, will help boost Indian fiscal balances immensely, in a complete reversal of the trend seen over the past decade.

Growing market share in Asia and falling crude prices

In fact, a large part of today's oil price drop stems from Middle Eastern crude facing growing competition in Asia. Traditionally, Asian crude primarily came from the Middle East, but now sellers to Asia span the FSU, West Africa, Latin America, Canada, and the Middle East. With the centre of gravity for global refining moving to the East of Suez and the tight oil supply growth in the USA backing out imports from traditional suppliers such as Nigeria and Mexico, Asia has become the main destination for current oil exporters. Anecdotally, Latin American crude is being sold to India at a discount to Dubai prices as, following the backing out of West African crudes, LatAm exports to the USA are starting to face the heat from growing US domestic production. Indian imports of LatAm crudes have risen from 10 per cent of total imports in 2011 to 15 per cent in 2012, to 20 per cent in 2014, reaching a record high of 0.88 million barrels/day (mb/d) in December 2014. Venezuela, Brazil, and Colombia are likely to see further gains in 2015, especially with the start-up of the long delayed 0.3 mb/d Paradip refinery in Q2 15, with collective year-on-year (y/y) increases potentially in the range of 0.1–0.15 mb/d. Over the same time period, Middle Eastern exports have fallen from 70 per cent of total Indian imports in 2011, to 59 per cent in 2014. Given a similar trend across Asia, this has forced Middle Eastern producers to discount their crude to Asia, their biggest export market, in order to maintain market share.

But the competition does not stop here. Another strand of growing competition for crude exports to Asia comes from within the Middle East itself. Rising Iraqi production and deep discounts offered by the Iraqi oil marketing company SOMO, partly due to variability in crude quality, have meant rising Iraqi exports to Asia, displacing those from Saudi Arabia. This has become a bone of contention for Saudi Arabia. According to some assessments, China's position in the Iraqi oil industry is such that at least one third of all future production of Iraqi oil will be derived from oil fields operated wholly or partially by Chinese concerns or where they have a stake. Similarly, since the 2012 sanctions, Iran has also discounted its crude heavily, in order to entice buyers such as India and China to continue taking its crude. For example, in 2014, Chinese crude oil imports rose y/y by 0.53 mb/d and yet imports from Saudi Arabia averaged less than 1 mb/d and were lower y/y by 85 thousand b/d. In contrast, China's imports from Iraq rose by 0.1 mb/d, while those from Iran averaged 0.12 mb/d



Changing proportions of crude imports, Latin America and the Middle East, 2011–15

Source: Reuters and Energy Aspects

higher y/y. Similarly, Indian crude imports averaged around 3.8 mb/d, slightly higher y/y, yet those from Saudi Arabia fell while imports from Iran rose by 87 thousand b/d y/y. In fact, since 2012, Saudi Arabia has gained none of the at least 1 mb/d increase in Asian crude imports.

'A SHARP FALL IN OIL PRICES IS A BOON FOR IMPORTING COUNTRIES LIKE INDIA (WHICH … COULD SEE ITS IMPORT BILL HALVE IN 2015)'

In a falling market, there are limits to how much Saudi Arabia is willing to lower its output, especially if the OPEC members that have been taking market share from the Kingdom do not follow suit. This is exactly what we saw in late 2014, as OPEC failed to bridge the gap between GCC members (led by Saudi Arabia) and the others to agree a collective cut in production. History repeated itself as Saudi Arabia did not acquiesce to large Iraqi or Iranian output increases and instead left it to the market to find a floor for prices. At that critical point, Saudi Arabia abandoned the role of the swing producer and is competing to maintain its market share, raising exports in November and maintaining production steady at 9.6 mb/d. Of course, growing competition in Asia was not the only reason for Saudi Arabia to demand a collective cut; there was a broader issue about it simply refusing to take on the burden of the production cut and continue to guarantee a return for the rest of the oil industry at the expense of its own market share. But clearly, the two are linked. So, not only has this led to a sharp fall in oil prices which is a boon for importing countries such as India (which imported nearly 4 mb/d of crude at a cost of approximately US$146 billion in 2014 and could see its import bill halve in 2015), it highlights the extent to which producers now have to discount their crude to gain a foothold in Asia, relative to the premium they used to charge.

At the same time, the move by the Indian government to remove all subsidies when prices were still at US$100/barrel (a move we do not see changing even with the drop in prices) will also help strengthen public finances.

Removal of subsidies

Subsidies on petroleum products have historically made a significant contribution to India's fiscal deficit. For over a decade, Indian policy makers have been grappling with pricing reform, but these efforts have faced challenges. In response to rapid oil price rises since 2004, gasoline prices were liberalized in 2010. However, diesel price liberalization was not taken up for a further two years, largely due to inflationary concerns and potential voter backlash, given a much wider consumer base for diesel relative to gasoline, and its heavier usage, particularly in goods transportation. Indeed, diesel formed roughly 38 per cent of petroleum product consumption in 2010 compared with 9 per cent for gasoline. Estimates suggest the trucking sector represented roughly 37 per cent of diesel consumption, followed by passenger cars at 15 per cent, agriculture at 12 per cent, buses at 12 per cent, industry at 10 per cent, power generation at 8 per cent, and railways at 6 per cent.

But worsening public finances ultimately resulted in the government announcing a 14 per cent increase in the price of diesel (to US$0.89 per litre) in September 2012, which was necessary to bring down the fiscal deficit, and to improve investor confidence, so the current account deficit could be financed increasingly through foreign investment inflows rather than the drawing down of foreign exchange reserves.

By late 2014, the Indian government had fully liberalized diesel prices, allowing the market to set retail prices, and opening the door for some of India's export-oriented refineries to re-enter the domestic market after a six-year absence. Regular increases in regulated prices had brought pump prices in India near international levels earlier in 2014, leading to widespread expectations that the market would be liberalized, following the ending of price controls on gasoline a few years before.

The fact that Indian diesel prices had already been pushed up to near international levels before the formal announcement of a fully liberalized diesel market and the recent fall in international oil prices means there is unlikely to be a material negative impact on Indian diesel demand. In fact, income elasticity in the period between 2005 and 2013 was close to 1 whilst price elasticity was close to zero. This means that, contrary to the popular argument that oil demand in developing countries will fall substantially if petroleum product prices are raised, the removal of subsidies is unlikely to have a big impact on oil demand given the high income elasticity at India's current level of economic development.

However, rising diesel prices have resulted in a shift away from diesel-powered vehicles towards cheaper gasoline cars as car owners scrap older diesel cars, in a reversal of the trend seen during 2010–13. We expect the share of diesel-powered passenger vehicles to fall from 55 per cent to 35 per cent. So, increasingly, diesel's usage will be concentrated in commercial vehicle

sales (which account for almost 40 per cent of diesel demand), rather than passenger cars, while it will remain the fuel of last resort at the margin at times of blackouts due to coal shortages or poor monsoons, when back-up generators are used for irrigation and power generation purposes.

Interestingly, India's federal government has taken advantage of falling oil prices to boost revenues from fuel taxes four times since November, in the form of consumption tax increases. While the drop in prices has been bigger than the rise in taxes, it is clear that the government is keen to keep consumption growth in check by limiting the impact of the sharp fall in oil prices for consumers. Part of this is driven by environmental concerns, while a larger part aims to boost public finances, and the government is unlikely to reverse these taxes even when prices come back up. Combined, the four tax hikes, which will fund infrastructure construction, have pushed up excise duties on gasoline by 7.75 rupees per litre (US$19.92 per barrel at the current exchange rate) and 6.5 rupees per litre for diesel (US$16.71 per barrel). Yet, this will be supportive for diesel demand going forward, as construction activity picks up.

Indeed, after Indian diesel demand declined across 2013 and was lacklustre in 2014, we expect the new norm for growth to be around 2–3 per cent, primarily supported by improvements in economic growth and construction work, despite the subsidy removal.

Of course, the failure of the previous effort to liberalize the diesel market (after prices soared in 2008) serves as a reminder that this step can be undone and India may revert to a subsidized market in the future. Given the politically sensitive nature of diesel prices – due to its use as a swing fuel during power and water shortages particularly in agriculture – a return to price controls cannot be ruled out, although a more likely option would be for the government to give targeted subsidies to farmers. Indeed, farmers could receive some sort of subsidy if crude oil prices were to experience a sharp rise back above US$100 per barrel, which would be supportive for Indian diesel demand. Diesel is likely to remain a swing fuel at times of droughts and power shortages (thus maintaining its political sensitivity) but we do not expect the return of large-scale subsidies or the removal of the consumption taxes.

'… MARKET LIBERALIZATION WILL INCREASE COMPETITION IN THE DOMESTIC MARKET.'

Finally, market liberalization will increase competition in the domestic market, allowing refiners such as Reliance and Essar to reopen their domestic retail networks and compete for market share – after private refiners had closed networks following previous failed attempts to liberalize diesel prices in 2008. The diversion of some of the supplies from export-oriented refiners to the domestic market is mildly supportive for Asian diesel prices, as we expect these firms to capture a sizeable share of the domestic market (10–20 per cent), displacing supply from some of India's state-owned refiners.

Conclusion

While deregulation of the Indian market began before the decline in oil prices, the government has been able to go further and faster as a consequence. As competition between crude producers for Asian market share is set to continue and the Indian government is unlikely to reverse recent subsidy and tax changes, benefits to the Indian fiscal balance will continue even after global oil prices rebound from the current low levels.

Sustaining India's rapid rise as a major refined product exporter

Nilav Bose

Over the last decade, India has evolved into the world's seventh-largest exporter of refined petroleum products. According to the US Energy Information Administration (US-EIA), India's refining capacity almost doubled during this period to about 4.35 million barrels/day (mb/d) at the end of 2013, making India the second-largest refiner in Asia after China, and the world's fifth largest. According to the 2014 *BP Statistical Review*, in 2013, India imported 269,000 mb/d of petroleum products, and exported roughly 1.24 mb/d, making it the largest product exporter in Asia. It has been a net exporter of refined products since 2001.

Interestingly, many of the constraints on the performance of India's upstream sector are present in refining. Indian refining is characterized by large state participation (public sector refining accounted for about 55 per cent of production in 2013/14) and a highly concentrated market. However, in stark contrast to the

upstream sector (which has not yielded material increases in production despite 15 years of liberalization) the refining sector has not been characterized by disappointing outcomes.

'… THE SUSTAINABILITY OF INDIA'S EXPORT REFINING BOOM IS QUESTIONABLE.'

Generally, government policies have encouraged an expansion in refined product capacity, but India's dramatic growth in product exports has arguably been supported by a domestic situation unconducive towards private sector refined product sales. It has also been supported by trends in international refining, where capacity investments and refined product trading have allowed production from low-cost centres (the IEA in 2013 forecast that global oil trade would decline and give way to more refined product trade, which seems to be playing out), and by overall shortages of refining capacity in the Middle East and Europe. It is therefore unlikely that any well-defined strategic objective, or execution plan to achieve the position of a leading exporter, was in existence, and in this context, the sustainability of India's export refining boom is questionable.

The past was about developing self-reliance

India's government encouraged energy companies to invest in refineries in the 1980s, primarily to build self-reliance in refining capacity and technology, and to reduce expenditure on product imports. Private participation was allowed through joint ventures with public enterprises. By the early 1990s it was acknowledged that precarious government finances would impede public sector oil companies from making significant investments in refining capacity. In line with economy-wide reforms, 100 per cent private sector investment was approved for refining, and independent licences (for wholly owned private refineries) began to be issued.

Since the 1973 oil shock, the Administered Price Mechanism (APM) had aimed at shielding Indian consumers from crude price volatility and despite the liberalization of refining in the early 1990s, product prices continued to be regulated through this system. In order to attract private investments (and achieve other fiscal and upstream objectives), in 1997, the government announced a phased deregulation of the oil industry and the dismantling of the APM. Measures were undertaken to introduce market-oriented pricing by 2002 (these efforts were short-lived as pricing controls were re-introduced in 2004).

Marketing controls on refined products continued, with the issuance of marketing outlet permits tied to oil production or investment milestones (such as a minimum investment requirement of about US$400 million in hydrocarbon infrastructure). In 1998/9, the government began reducing customs duty on imported crude (from 27 per cent to 22 per cent in 1998/9, then from 22 per cent to 10 per cent in 1999/2000, and subsequently to 5 per cent in 2005). Later, in the 2000s, the export potential of Indian refineries was recognized (by 2007, India was exporting more than US$20 billion in refined products) and from 2007 onwards 'Export Oriented Unit (EOU)' status was provided to exporting refineries, with Reliance's Jamnagar refinery becoming the first. EOU status, among other benefits, provided exemptions on customs duty on crude oil imported for refined product exports. A seven-year tax holiday and general exemption on payment of excise duties for export-oriented refinery units (initially set to expire in 2007) were extended for refineries that commenced production before March 2012.

The last decade: private refiners dominated exports

Private participation in India's refining sector was marked by the entry of companies such as Reliance and Essar, who sought to own the end-to-end refining and marketing value chain capabilities by supplying their own retail outlets with products from their refineries. By about 2005 the private sector was estimated to have captured about 20 per cent of India's petroleum retail market. With higher refining margins (primarily due to higher cost efficiencies) than public sector enterprises, the business of operating along the entire production, distribution, and marketing chain made sense for private refiners.

However, such market entry initiatives were short lived. With the increase in global crude oil costs since 2006, the government reversed its policy towards 'market parity pricing' for refined products. Consequently, product sales at subsidized prices by public sector oil marketing companies resulted in private retail outlets being unable to compete in the domestic market. Whereas public refineries were able to receive subsidies for selling products below cost, such benefits were unavailable to private producers. Given this, private refiners stopped product sales through their retail outlets and moved more refined output to the export market (some product sales continued to be made directly to public sector oil marketing companies at trade-parity prices). This trend has continued since 2006 and has supported the rapid increase in refined product exports (in terms of economic value, Indian refined product exports have trebled from

about US$20 billion in 2006/7 to about US$60 billion in 2013).

Diesel is India's primary export product, comprising over 40 per cent of the export basket by value, followed by petrol at 25 per cent, and naphtha at 12 per cent. The Middle East is the largest destination for Indian product exports (followed by east Asia), estimated as taking over 20 per cent. Europe is also an important buyer of Indian products, primarily due to contracting refining capacity over the last several years.

Looking ahead – increased capacity in key markets and among competitors

European demand for refined products is not expected to grow substantially over the coming decade, in keeping with slower projected economic growth. While consumption in the Middle East continues to grow, countries across that region are planning and executing multiple refinery projects (the Yanbu refinery with a 400,000 barrels/day capacity was close to commissioning in late 2014) which will reduce its demand for imports. Oil producers in the Gulf (Saudi Arabia, the UAE, Kuwait, Oman, and Qatar) are expected to add about 3.5 mb/d in refining capacity by 2022. While some of these are capacity replacements for older refineries that will be decommissioned, capacity addition in the Middle East is bound to shrink the market for Indian product exports, as there is little prospect of these large volumes being replaced by growth in product demand from other regions.

Export-oriented Indian refineries have complexities at the higher end of the range than those conventionally seen for refineries (the Nelson Complexity Index for the Reliance refinery is 9.93, while for the overall Jamnagar Complex it is over 14.0), and are thus able to generate greater margins (or provide higher value addition). Even so, it is unlikely that Indian exports will continue to remain competitive with incremental refining capacity from newer Middle Eastern refineries, due to shipping costs for inbound crude and outbound product, together with import (and export) tariffs and charges. Additionally, much of the existing and new Middle Eastern refining capacity has common or overlapping shareholding with upstream entities and is able to secure discounted crude supplies.

On the supply side, while China has traditionally been a net importer of refined products, it has seen huge capacity additions in recent years. According to the US-EIA, China's refining capacity increased by about 7.3 per cent in 2013 and stood at 13 mb/d at the end of 2013. Similar additions were planned in 2014. However, faced with an economic slowdown, Chinese demand has not kept pace with capacity additions, leading to capacity utilization rates of about 75 per cent. The excess capacity is bound to find its way towards the export market – in recent years China has been exporting some refined products, primarily within its neighbourhood.

Assuming broadly similar advantages in capital and labour costs, and refinery complexity, when compared with Indian refiners, Chinese refined product exports are disadvantaged by additional shipping charges when exporting to the larger demand centres of the Middle East. Consequently, Chinese exports currently tend to be oriented towards east Asia and neighbouring countries in the South China Sea. However, this is a crowded market with growing export capacity in South Korea, Singapore, and Taiwan and surplus refining capacity developing in Japan from declining domestic demand. Therefore, with large capacities combined with slowing domestic Chinese demand growth and increased export capacity in the neighbourhood, it is likely that there will be increased competition from Chinese (as well as Korean) refined products for Asian, Middle Eastern, and European market shares – which are currently also served by Indian refineries.

Looking ahead – domestic diesel consumption growth could choke export capacity

A strong correlation arguably exists between economic growth and product demand. Given the revised economic outlook for India (the IMF estimates 6.3 per cent GDP growth this year and 6.5 per cent in 2016), it can be expected that a good portion of the demand for refined products over the next decade will come from the Indian domestic market. As diesel forms a significant portion of India's export basket, the growth in domestic diesel demand will have a significant bearing on the country's refined product export capacity. Global average demand for diesel represents 30 per cent of all refined products, while in India it is around 5 per cent. Under a base case scenario of healthy economic growth and continued liberalization and globalization of the Indian economy, the country's diesel demand could rise towards the global average.

'THE SUBSIDY ON DIESEL ENDED IN SEPTEMBER 2014 AND DIESEL PRICES WERE OFFICIALLY DEREGULATED IN OCTOBER 2014.'

The trajectory of domestic diesel demand is especially important following recent developments in India's diesel pricing policy. Since the late 1990s, successive Indian governments have aimed to achieve the deregulation of petroleum product prices and reduce the petroleum subsidy burden on the government (estimated at about 0.5 per cent of GDP in 2014/15). Petrol prices were

deregulated in June 2010. Beginning in January 2013, diesel prices began to be decontrolled, with a gradual movement towards international levels. The fall in crude oil prices since June 2014 expedited this process. The subsidy on diesel ended in September 2014 and diesel prices were officially deregulated in October 2014.

'… A SUSTAINED AND REGULAR INCREASE IN THE PRICE OF DIESEL HAS NOT REDUCED CONSUMPTION.'

The deregulation of diesel prices will have a two-pronged impact on diesel marketing within the domestic market and, by extension, on diesel exports. While increased diesel prices should logically lead to a fall in domestic demand, the deregulation of prices makes it lucrative for Indian refineries to sell in the domestic market, and thereby avoid potentially reduced margins on diesel exports. In their paper 'Diesel Pricing Reforms in India – a Perspective on Demand' (OIES Energy Comment, 2013) Fattouh, Sen, and Sen, have concluded that while domestic diesel demand growth should fall with the price increases that have followed the deregulation, diesel demand in India is contingent on other factors, such as the relative prices of petroleum products and the impact of differential rates of state taxation. India's domestic diesel demand is unlikely to decline immediately, despite the effects of relative pricing and taxation. An analysis of diesel consumption/demand in India, when compared to the wholesale price of diesel, shows that a sustained and regular increase in the price of diesel has not reduced consumption.

Refined products constitute about 20 per cent of India's non-service exports by value. The growth in exports is a recent phenomenon but has been backed by genuine product pricing competitiveness – exports have been led primarily by India's private refiners operating new and complex refineries. Even so, India faces challenges to its ability to sustain export growth rates, or even to the maintenance of current levels of exports. Growing product demand and price deregulation in the domestic market, combined with greater competition to supply India's current core export markets, could result in a redirection of products into the domestic market, reducing refined product exports. Alternate markets in Africa and Latin America are less lucrative for Indian refiners than the Middle East, as they require higher shipping tariffs. A sustained increase of refining capacity, combined with increased and aggressive international marketing, will be required to continue India's export momentum. If, however, product exports were to fall, while India's foreign exchange earnings would also fall, its domestic market could gain from increased competition and access to products at competitive retail prices as a result of the lower cost bases of the relatively efficient private sector producers.

Time to fill up India's strategic oil reserves

Kapil Narula

Strategic Petroleum Reserve

India's energy consumption is rising, and it is highly dependent on imported crude oil. According to recent estimates, oil import dependence was 77 per cent in 2012; it is forecast to rise to 81–91 per cent by 2027, and reach 96 per cent by 2047 ('Least Effort' Scenario, India Energy Security Scenarios, 2047). In recognition of the risk of interruption to physical supplies, India began working towards a Strategic Petroleum Reserve (SPR) in 2008. The first phase of its oil storage facilities, with a capacity of 5.3 million tonnes (Mt) (38.85 million barrels) is likely to be ready for commissioning in the first half of 2015; construction on the second phase, with a capacity of 12.5 Mt (roughly 90 million barrels) has been approved by the government. The facility is being constructed by Indian Strategic Petroleum Reserves Limited (ISPRL), a 'Special Purpose Vehicle' owned by the government's Oil Industry Development Board. While the cost of construction of the first phase has been US$635 million, the second phase is likely to cost US$2.2 billion.

Strategic Petroleum Reserves (SPR) guard against short-term energy supply disruptions and are therefore considered a leading way of enhancing a country's physical supply security. IEA member countries are required to keep minimum oil stocks equivalent to 90 days of oil imports. Although oil stocks are generally not released to manage oil prices (the IEA's intention is to stabilize the market and release stocks only in case of physical shortages), it may be possible to use the stored oil to offset a spike in oil prices, especially for developing countries which have administered oil prices.

Energy supply disruption and releases of strategic reserves

The IEA collectively responded during

two recent supply disruptions:

- during September–December 2005, in response to hurricane Katrina, when it released 60 million barrels of oil,
- during June–September 2011, in response to the Libyan crisis, when it released 40 million barrels of crude and 20 million barrels of oil products.

An SPR undoubtedly provides a hedge against short-term oil supply disruptions.

Funding mechanism for India's SPR

Although storage facilities are almost ready at three sites – Mangalore, Padur (Udupi District, Karnataka), and Vishakhapatnam (Andhra Pradesh) – the mechanism to fill, maintain, and operate the SPR is still being deliberated. Although one option is for the first phase of the SPR to be funded through the central government budget, its cost, estimated at US$3.9 billion (at the budgeted cost of US$100 per barrel, for the Indian basket of crude) is considered prohibitive. Analysts agree that with the price of crude oil (average price for the Indian crude basket) at US$61 per barrel in December 2014, followed by a further slide to US$50 per barrel (WTI prices) in January 2015, there has never been a better time to build up India's SPR. However, the financial implications are likely to be carefully considered by India's Ministry of Finance, which is targeting a fiscal deficit of 4.1 per cent for FY 2014/15.

Against this context, the Indian government is exploring alternative models of financing to fund the purchase of oil to fill its storage tanks.

Potential users of storage capacity

One viable option that is being discussed is to lease out the storage capacity to refineries as well as to oil suppliers. It is reported that 0.3 Mt (approximately 2 million barrels) of oil storage facilities have already been booked by Mangalore Refinery and Petrochemicals Limited (MRPL) at Mangalore and a further 0.3 Mt by Hindustan Petroleum Company Limited (HPCL) at Vishakhapatnam for storing crude oil for their respective refineries. However, these companies have cited financial constraints which prevent them from leasing the remaining storage capacity. The Indian government is thus exploring other options, including renting out the storage facilities to international oil supplying firms.

Talks on such a deal, with Abu Dhabi National Oil Company (ADNOC), are at an advanced stage. One possible arrangement would allow ADNOC to use the Indian facility for crude oil storage and pay only for the operations and maintenance cost. In the event of a supply disruption, India would have the 'right to first use' of crude oil; however, this oil would be billed at the market price or the official selling price of crude during the period of withdrawal. A precedent for this sort of deal was set between Korea and ADNOC for the storage of 6 million barrels of oil reserves in Korea.

The Indian Government is also exploring the option of leasing out storage capacity as 'transit storage' with Aramco of Saudi Arabia, Kuwait Petroleum Corporation, and National Iranian Oil Company. While such an arrangement has its advantages (such as the possibility of 'rupee trade' between India and the oil supplying country, thereby saving foreign exchange), it also has its drawbacks. Primary amongst these is that while such an arrangement would hedge against physical oil disruptions in an emergency, it would not be able to guard India against the impact of a spike in the price of oil. India would therefore be unable to leverage the economic advantage of filling the oil reserves now, while market prices are significantly lower than those seen in the past few years. Further, the Indian economy will continue to be subject to oil price volatility and high prices, which are bound to accompany any physical supply disruption. Taking action to subsidize the sale price of petroleum to provide relief to consumers at such a time would be an expensive proposition for the Indian government.

Opportunity for government to fill SPR

The prevailing low oil price offers a unique opportunity to fill up the existing capacity with government-funded capital; it also makes economic sense. Such an arrangement will cost approximately US$2.37 billion at the price of US$61.2 (average price for the Indian crude basket for December 2014) for a barrel of oil. This represents only around 2.2 per cent of India's net oil import bill (approximately US$108 billion) for 2012/13. More importantly, it is estimated that if the crude oil price increases by US$1 per barrel, India's net oil import bill increases by approximately US$1 billion.

'THE PREVAILING LOW OIL PRICE OFFERS A UNIQUE OPPORTUNITY TO FILL UP THE EXISTING CAPACITY …'

Therefore, the cost of filling the existing capacity now is not enormous, given that storing oil now may reap rich dividends in the future. Consider a scenario in which the price crawls up to US$112 per barrel (average price for FY 2011/12, for the Indian crude basket) within a year. In such an eventuality, the Indian Government may decide to draw from the stored reserves – in doing so it would reap a 50 per cent return on its investment. However, if it leases out the storage to an international oil supplying company, it will have to pay approximately US$4.34 billion to the oil company for using oil which is stored in tanks on Indian territory and which were constructed using national funds.

The decision on how to finance the initial cost of oil purchase is therefore one which is based on a perceived assessment of the future price of oil. It is clear that the Indian government is looking to defer the cost of oil purchase to leverage the time value of money, which is short-term thinking. While the government's concern on financing the initial cost of oil purchase is genuine, the advantages of initial filling of crude oil storage tanks using government funds will far outweigh the costs in the long run. Many options exist for the Indian government to fund this oil purchase, and other countries have done so already.

- ISPRL could approach banks for a loan to fund this investment. Such a loan could be backed by guarantees from the Indian government and the arrangement would allow ISPRL to borrow at lower interest rates than those prevailing in the market, due to sovereign backing.
- Bonds could be issued by the stockholding agency (ISPRL) to raise money from the domestic or international market. Such bonds could have government backing and may be sweetened with additional tax breaks to attract large institutional investors.

The running expenses for maintaining storage facilities will be small in comparison with the initial cost of oil purchase and can easily be funded from the central government budget, although options exist to levy either a fee on downstream Oil Marketing Companies (OMCs), or a direct tax on the final product (which will eventually be paid by the customer).

Importance of energy security

In the present scenario, the building of strategic oil reserves by India is an important component towards achieving 'energy security' in both the physical and fiscal sense. Market conditions have offered a unique opportunity to Indian energy planners to fill the strategic storage facilities with cheaper crude oil. India should ride on this crest of low oil prices and inch towards matching the emergency response mechanisms which are mandated for IEA member countries.

Meeting the challenge of India's energy needs

Rahool S. Pai Panandiker and Urjit R. Patel

Growing energy needs

In the coming decades India will be one of the key drivers of world energy consumption. Its current energy consumption per capita is 0.47 tonnes of oil equivalent (toe); this is approximately 15 times lower than the per capita consumption of the USA (about 7.1 toe), four times lower than that of China, and it is also only a third of the world average (1.5 toe). Based on the experience of other economies, one can safely assume that India's per capita primary energy consumption will, analogous to a 'normal' trajectory, rise as its per capita GDP increases.

'IN THE COMING DECADES INDIA WILL BE ONE OF THE KEY DRIVERS OF WORLD ENERGY CONSUMPTION.'

In fact, even with a 'modestly robust' growth performance in the near to medium term, India's primary energy consumption is expected to grow at a rate higher than that of other rapidly developing economies (including China) in the period between now and 2030.

India's total primary energy consumption is expected to increase to 1,522 million tonnes of oil equivalent (Mtoe) by 2030 (from approximately 600 Mtoe currently), with coal continuing to dominate. The share of renewables is expected to treble (albeit from a low base), to 6 per cent in 2030 from about 2 per cent in 2013, as a result of government impetus on wind and solar. Consequently, the share of coal in the overall energy mix is expected to decline (modestly) to 52 per cent in 2030 from 56 per cent currently, and for oil, to 24 per cent in 2030 from 27 per cent. Over the next two decades or so, conventional energy sources will nevertheless continue to dominate the economic landscape.

Estimates of current proven Indian hydrocarbon reserves are insufficient to meet India's demand even at a modest Compound Average Growth Rate of, say, 6 per cent. At existing production levels, it is estimated that oil reserves will last approximately 18 years (only four years if all demand was met by domestic reserves). As for gas reserves, it is estimated that they will last approximately 33 years (25 years if the entire demand were to be met by domestic reserves). Clearly, this is a dour scenario for India's energy independence.

India's energy import bill has increased sharply as a share of its GDP (from 3.7 per cent in 2003/4 to 9.7 per cent in 2013/14), and it is no exaggeration to

Indian hydrocarbon imports under different GDP growth assumptions (in Mtoe)

	Business as usual (GDP at ~6%)			Slow growth (GDP at ~4%)			Aggressive growth (GDP at ~7.5%)		
	Demand	*Supply*	*Imports (%)*	*Demand*	*Supply*	*Imports (%)*	*Demand*	*Supply*	*Imports (%)*
Coal	824	573	30%	641	426	33%	1,087	739	32%
Natural gas	163	78	52%	92	53	43%	201	83	59%
Crude oil	357	51	86%	282	45	84%	474	53	89%

Source: International Energy Agency; BCG Analysis

say that it will further increase; this will contribute to a deterioration in external vulnerability indicators as larger current account deficits will have to be funded by foreign capital flows. India's external indebtedness has increased appreciably in recent years, and its net international investment position is becoming more negative (Reserve Bank of India, 2014).

In a scenario where no significant policy initiatives are urgently put in place, India is expected to import a cumulative amount of energy worth US$3.6 trillion (undiscounted) between now and 2030; this amounts to one and three-quarter times its current GDP. India's import dependence in both more and less optimistic growth scenarios (see the table 'Indian hydrocarbon imports under different GDP growth assumptions') will continue to be a significant burden on the macroeconomy.

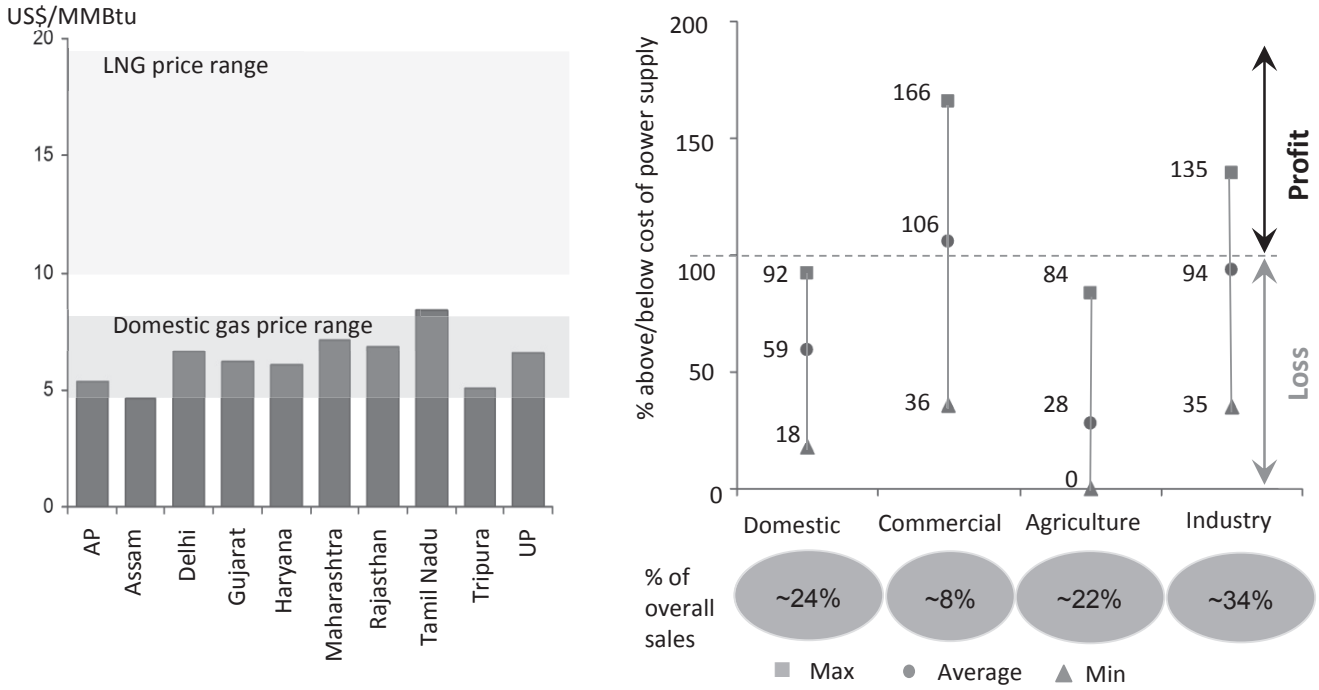
Limited domestic fossil fuel supplies, together with increasing demand, thus make it imperative for the government to regard energy security as a fundamental enabler for future growth. Yet, a number of factors acting in combination have repeatedly put the brakes on developing the capacity required to meet the 'energy challenge'. These are discussed below.

The 'UN'-manageable sector?

Regulatory miasma, administrative disputes, and policy uncertainties (including those regarding the pricing of gas and coal) have dampened investor interest. The current situation can be characterized by a set of descriptors that conflate to create an untenable situation, thus making large segments of India's energy sector relatively unattractive for investment.

- *Unknown*. There is no comprehensive understanding of India's oil and gas resource potential. Current oil and gas basin data stems from the mapping of only 20–25 per cent of potential basins; similarly, there are highly variable estimates of unconventional resources such as shale, and also of coal for gasification. This has resulted in a perception amongst investors of 'low prospectivity' and thus of elevated investment risk.
- *Uncertain*. Policy uncertainty and lack of assurance in the roles of different decision makers has impeded the smooth governance of energy. As examples one can cite uncertainties in policy relating to the extension of hydrocarbon production licences beyond the tenure of the contract (even in the case of economically viable fields), policy uncertainty regarding gas-based power plants, and uncertainty related to gas pricing for deep water and ultra-deep water fields.
- *Unstable*. Multiple occasions when discussions on contractual structures and fiscal regimes have moved backwards and forwards have led to a perception that stability and predictability (central to investment decision making in sectors that require long-term horizons) are lacking.
- *Unwieldy*. The dearth of trust between multiple actors in the energy field has led to complex bureaucratic and administrative mechanisms that have, over time, hampered the development of the energy sector.
- *Underpricing*. Government intervention in setting (administered) prices at producer and consumer levels has produced outcomes where private players lack incentives to invest further; this has also led to an opaque system where the true beneficiaries of subsidies – as well as who pays for them – remain hidden. For example, the average cost of acquisition of power is significantly higher than the average revenue from it. Consequently, the commercial losses of the state government-dominated distribution segment in power have, almost invariably, been of the order of 1 per cent of GDP annually. It can be argued that the case for gas producers is not dissimilar, wherein administered prices are significantly below comparable imported LNG prices. (See the figure 'Under-pricing of gas and electricity' on page 14.)

These 'UNs' have contributed significantly to a heightened perception of risk associated with Indian energy



Under-pricing of gas and electricity

Source: For gas – Ministry of Petroleum and Natural Gas; Petroleum Planning and Analysis Cell (PPAC); BCG Analysis. For electricity – Central Electricity Authority

and have added considerable attendant risk premia. The risk–reward balance has thus been skewed to disincentivize investments in a sector that undoubtedly calls for more funding. It is extremely telling that a large percentage of oil exploration fields are relinquished by domestic and international players; this highlights the difficulty of attracting investments into the sector. The percentage of relinquished fields post the preliminary exploratory stage is appreciably higher for India than for other countries (see the table 'Percentage of relinquished fields post preliminary exploratory stage').

A coherent policy framework is required to unlock India's energy potential

The economics of the energy sector inevitably require a long-horizon perspective, even one of several decades. Concomitantly, this requires policies with a long-term vision and inbuilt stability in contractual practices related to fiscal and regulatory matters.

- *The oil, gas, and coal sectors require clarity* in institutional mechanisms of regulation, roles of regulatory bodies, and other governmental institutions. For example, there is a significant overlap between the functions of the Ministry of Petroleum & Natural Gas (MoPNG) and the Directorate General of Hydrocarbons (DGH). The DGH and MoPNG play the roles of regulator, administrator, and 'arbitrator' for all issues related to the sector in a manner that conveys (an impression of) ad hoc-ism. Given the strong presence of the government in production (through ONGC) it is necessary to put in place, inter alia, independent regulation and dispute resolution mechanisms to ensure a level playing field. DGH's capacity needs to be strengthened, and access to international expertise may be warranted. The role of the National Petroleum Directorate (NPD) in Norway is an example that India should examine. It is noteworthy that those nations that have been successful in implementing effective governance for the sector have not only

Percentage of relinquished fields post preliminary exploratory stage

	Total blocks (including open acreage)	Relinquished blocks	% of blocks relinquished
Australia	1,583	18	1%
USA	13,899	1,917	14%
UK	1,697	49	3%
Norway	688	36	5%
Indonesia	317	23	7%
India	254	124	49%

Source: Rystad; SKK Migas; Directorate General of Hydrocarbons

recognized the significant uncertainty that characterizes it, but have also placed equal emphasis on the spirit and on the letter of the law in governing it, for example, with regard to contract management.

- *A streamlining of administrative procedures is needed*, including the resolution of the federal–state–local government 'trichotomy'.
- While independent regulation in power exists in principle, *de-politicizing regulatory decisions* is critical to the effective functioning of pricing mechanisms, and to the commercial viability of a persistently loss-making distribution segment.
- It is necessary to clearly understand (and separately examine) *pricing at the 'producer/generator' level and the 'consumer' level*. This is critical to ensure healthy investment levels on the supply side and to inject transparency into consumer subsidies with respect to (in a manner of speaking) the 'demand' side. The move to market-determined pricing for producers/generators will go a long way towards instilling confidence in the investment community, as it will give a transparent understanding of top-line risks.
- In specific situations, the *government may need to intervene financially to help embed open access infrastructure* (such as pipelines, storage facilities, and hubs) ahead of the resource development curve, to catalyse marketplaces for energy resources.

Additionally, key initiatives required in the main resource sectors can further help to improve matters.

Coal

India is endowed with an estimated 300 billion tonnes of coal reserves, the fifth largest globally. The sector is dominated by the public sector monopoly Coal India Limited (CIL), which accounts for 80 per cent of production. The company is widely perceived to be inefficient by international standards. According to the last available report on coal, CIL productivity, in output-per-man shift, was 4.92 tonnes; this figure (about a third of the world average) was below the company's target of 5.54 (Government of India, 2011). CIL has habitually come up short in stepping up production to meet growing demand. As a consequence, India has become the world's third-largest importer of coal. The new government, to its credit, has taken some steps in the right direction. For example, commercial coal mining will be opened up to the private sector, which should boost domestic production and inject competition. A regulator for the coal sector is also planned, and measures towards faster administrative processing and approvals are being put in place.

Natural gas

Although uncertainty over resources is a potential reason for low production, uncertainty over gas pricing has also had an effect. Investors have been procrastinating over investment decisions (which include some Coal Bed Methane projects) due to the delay in announcing a clear long-term pricing policy. In October 2014 the government announced an increase in gas prices to US$5.61 per MMBtu at the well head; while this figure is up from US$4.2 per MMBtu, it is much lower than the figure of US$8.4 per MMBtu which had been intended in 2013. India has to transition to market-driven prices for natural gas in order to incentivize investments for the sector, which include production from deep water fields, and unconventional resource formations.

Oil

Domestic oil production meets about one quarter of India's oil demand and this share is expected to decline to 14 per cent by 2030. A recent significant policy reform has been deregulation of diesel prices at the retail level.

The government is also working towards capping the LPG subsidy, which will not only help to reduce the fiscal burden for the government (and its subsidiaries in the entire value chain) but also inject competition into the Indian downstream market, thus opening up the potential for efficiency gains to the final consumer.

'… DEPOLITICIZING REGULATORY DECISIONS IS CRITICAL TO THE EFFECTIVE FUNCTIONING OF PRICING MECHANISMS …'

Conclusion

While the scale of India's energy problem is visible and can be reasonably measured in terms of its fiscal and macroeconomic balances, the solutions are largely structural and institutional, and much harder to quantify. There is an immediate need to put in place measures to unlock the network of impediments constraining the development of India's energy sector. The two broad areas requiring immediate attention include putting in place:

- a stable regulatory framework and market-oriented pricing mechanisms,
- governance and administrative structures that impart confidence among all stakeholders.

There is also, however, a wider necessity for a national debate and resolution on the role of national energy resources in India's development. An informed dialogue could set the tone in constructing a more coherent hydrocarbon and energy policy, one which would also incorporate the growing significance of renewables. This is a necessary, non-partisan endeavour, which would create familiarity amongst different constituencies around the larger developmental benefits associated with the responsible exploitation of India's natural resources.

All the usual disclaimers apply; in particular, the views expressed here are personal and do not necessarily reflect those of the institutions that the authors are affiliated to.

Lessons from a retrospective look at India's upstream sector

P. Elango

In May 2014, a general election in India resulted a single party holding a parliamentary majority for the first time in 25 years. This has rekindled hopes of a revival in India's domestic oil and gas sector, which has had an erratic history of performance and decision-making. However, the realization of these hopes will depend on policymakers' ability to harmonize upstream and downstream policy in the energy sector. This article provides an overview of the evolution and current status of India's upstream sector and its linkages to the downstream economy, set against the context of India's broader energy challenges.

'TODAY, IT IMPORTS OVER TWO THIRDS OF ITS OIL, A THIRD OF ITS GAS, AND ROUGHLY 22 PER CENT OF ITS COAL REQUIREMENTS.'

Three decades ago, India was able to meet 75 per cent of its oil consumption through domestic production, and was importing neither gas nor coal. Today, it imports over two thirds of its oil, a third of its gas, and roughly 22 per cent of its coal requirements, resulting in an energy import bill in excess of US$150 billion per annum (p.a.). Oil is the single largest imported commodity, and government data shows that India's growth in oil demand has closely followed its economic growth, implying that its oil requirements may need to double in order to achieve growth rates in excess of 7 per cent p.a. in the future. Importantly, a more general about-turn – reversing India's recent decline in upstream (oil and gas) investments – will rest upon altering investor perceptions of India, away from regarding it as a small potential resource producer towards seeing it as a large potential energy market.

Underexplored upstream potential

India's first oil discovery was made in 1867 in the north-eastern state of Assam just a few years after Edwin Drake had drilled the world's first commercial oil well in the USA. Yet, while the first US oil strikes led to a frenzied search for 'black gold', India has remained largely underexplored to date. India's 26 sedimentary basins are spread over an area of over 3 million square kilometres covering on-land, offshore, and deep water areas. The government of India estimates a 'prognosticated' hydrocarbon resource potential of over 200 billion barrels of oil equivalent. Thus far, volumes of 80 billion barrels have been established as 'hydrocarbons-in-place' through limited exploration, implying that 120 billion barrels are potentially 'yet-to-be-found'. These volumes are estimates of the 'size of the pot' (the oil and gas resources that the Indian sedimentary basins potentially hold), but have yet to be proven.

Unlike many other countries where National Oil Companies (NOCs) were set up following the discovery of hydrocarbon resources by International Oil Companies (IOCs), India's efforts at upstream exploration began with the establishment of the Oil and Natural Gas Corporation (ONGC) in 1956. Its early ventures were relatively successful, with oil and gas discoveries onshore in the Cambay Basin in Gujarat in the early 1960s, further boosted by a large offshore oil and gas discovery (Bombay High) in the 1970s. Domestic production went up from 62,000 barrels/day in 1965 to roughly 700,000 barrels/day in 1989. The Indian Oil Company (later Corporation) Limited was established in 1959 to handle marketing and refining requirements. These initiatives arguably laid a strong institutional foundation for India's oil and gas sector.

However, these early successes were not consolidated, and production began plateauing in the 1990s. This inertia was due to the shortage of risk capital in the sector as it was dominated by the NOCs – still the case today despite liberalization. The situation is reflected in the statistic that just 15,000 wells have been drilled in 60 years of upstream exploration compared with one million wells on production at present in the USA.

In recognition of this and as part of economic liberalization in the 1990s, some offshore fields containing undeveloped discoveries were auctioned to the private sector (IOCs) on the basis that NOCs retained a 40 per cent carried interest. This strategy was relatively successful; for example, the redevelopment of the Ravva ('diamond') shallow water field resulted in an increase in its production from 3,000 barrels/day to over 50,000 barrels/day and it has produced oil and gas valued over US$25 billion.

A major step forward in upstream exploration occurred with the liberalization of the sector in 1999 through the New Exploration Licensing Policy (NELP), under which NOCs and private companies competed for acreage under a transparent bidding regime based on Production Sharing Contracts (PSCs). On paper, the NELP has attracted US$20 billion in investments over nine auction rounds and logged 130 oil and gas discoveries – including three major discoveries by the private sector: India's largest onshore oil discovery in Rajasthan and two major deep water gas discoveries in the eastern offshore basin. The figure (Upstream Investments and Oil and Gas

Discoveries in India, 2000–11) illustrates that major spikes in investments have coincided with spurts in discoveries.

However, few of these discoveries have translated into higher production. Although private sector gas production briefly overtook that of NOCs in 2010, there have been no significant new oil discoveries under the NELP and India experienced its largest volumetric decline in gas production in 2013/14 (*BP Statistical Review of World Energy*). Further, investment has been falling both in absolute terms and in terms of attracting a diverse portfolio of investors – a closer look at the distribution of acreage auctioned under the NELP shows that most acreage is split between the two largest domestic exploration companies, with IOCs showing very little interest in the bidding rounds.

There have been two main constraints affecting upstream performance. The first relates to problems in the administration of the contractual regime, with bureaucratic procedures taking precedence over the original objective of encouraging exploration in order to boost domestic production. Contractual impasses and frequent arbitration have been partially responsible for the slowdown in production and the attempted exit of some international firms from their Indian acreage holdings. These have related to controversies over the extension of exploration periods, procedures for the approval of operating decisions, and, most importantly, pricing (for gas). A recently proposed reform to the upstream contractual regime – potentially changing it from a PSC to a Revenue Sharing Contract (RSC) – risks repeating some of these negative outcomes. The RSC makes the sharing of revenues with the government mandatory at varying levels of production, as opposed to the sharing of profits from production; this is likely to discourage investors from sinking risk capital into the Indian upstream sector.

The second constraint relates to India's struggle to operationalize its national geo data repository, although technological advancements are progressing this endeavour.

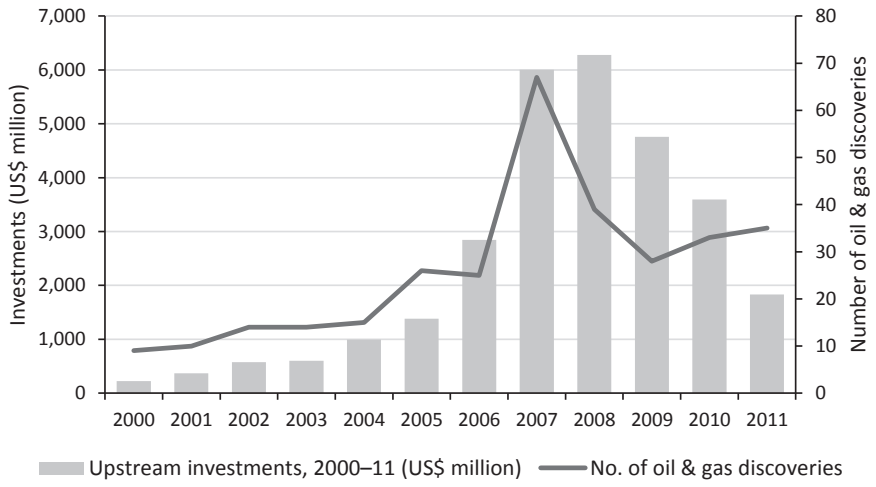
Technology – slow progress, substantial opportunities

Most survey data is antiquated, having been collected by NOCs in the pre-liberalization era. This data is released to bidders by the Directorate General of Hydrocarbons, the upstream regulator, prior to each bidding round, but an updated and consolidated database has yet to be established. This is further reflected in the fact that 3D seismic surveys have been conducted in just 15 per cent of the entire sedimentary basin.

On the subsurface front, advanced spectral decomposition technology, useful in surveying thin and isolated reservoirs, has been successfully applied in Ravva (a shallow water offshore field) to highlight drilling channels. An advanced method of acquiring, processing, and interpreting repeated 3D seismic surveys at different time intervals – the 4D seismic survey – is a relatively young technology in India. A 4D Ocean Bottom Cable (OBC) seismic survey was executed for the first time in India in the Ravva field, enabling it to achieve a recovery rate of more than 50 per cent, while the average for other fields in India is less than 35 per cent.

'MOST SURVEY DATA IS ANTIQUATED, HAVING BEEN COLLECTED BY NOCS IN THE PRE-LIBERALIZATION ERA.'

Similar to its independent foray in space technology, Indian NOCs have largely had to develop their maiden offshore oil and gas discoveries without international partnerships. Following the liberalization of the upstream sector to private investment, domestic companies have made visible gains through the adoption (through procurement as well as partnerships with international firms) of world-class technologies. A large oil and gas field with a billion barrels of recoverable liquids (valued over US$100 bn) was developed in the desert region of Rajasthan, while D6 (a deep water gas development) was executed in record discovery-to-delivery time by the private sector. India is also home to the world's longest heated crude



Upstream investments and oil and gas discoveries in India, 2000–11

Source: Directorate General of Hydrocarbons; Ministry of Petroleum & Natural Gas

oil pipeline system (600 kilometres); this system generates 32 Megawatts of power to continuously heat and keep the waxy and high pour point crude flowing through the pipeline.

One of the world's largest Enhanced Oil Recovery projects is underway in Barmer basin in Rajasthan; it is being undertaken by Cairn India Ltd, targeting recovery rates close to 50 per cent, and its success is expected to be replicated elsewhere in India.

Linkages with the downstream sector

Historically, the downstream sector has been developed without regard to upstream policy objectives and the upstream sector has, in fact, long been used to support downstream objectives related to poverty reduction, through the pricing system. Indeed, the slow progress in upstream exploration is partly attributable to constraints posed by its historical linkages with downstream policy. Subsidies on petrol, diesel, kerosene, and LPG to retail consumers were borne by the NOCs, Oil Marketing Companies, and federal government, at a significant fiscal cost. This also reduced the capital available to the NOCs for investments in upstream exploration.

'INDIA EXPORTS OVER 60 MILLION TONNES OF PETROLEUM PRODUCTS … 20 PER CENT OF TOTAL EXPORTS.'

However, an unprecedented reform of this system is currently underway. A series of reforms aimed at the removal of petroleum subsidies has resulted in the total elimination of subsidies on petrol and diesel and their liberalization at the retail level. This has brought petroleum subsidies as a percentage of the total subsidy bill down to 33 per cent in 2013 from 38 per cent in 2012, and as a percentage of GDP from approximately 1 per cent in 2012 to 0.75 per cent in 2013. These figures are expected to fall further to 24 per cent of total subsidies and 0.5 per cent of GDP in 2014. Additionally, a social security system has been put in place in which all citizens are assigned a unique social security number; this system separates subsidies from the pricing system and ensures that subsidies will be paid directly to eligible recipients. The 2014 decline in international oil prices expedited these reforms as the government liberalized diesel prices at the retail level, and it is estimated that every US$10/barrel reduction in the oil price adds US$15 billion in annual savings to India's import bill.

Despite fiscal constraints, there has been tremendous growth in downstream infrastructure and capacity in the oil sector – specifically in refining – facilitated by a targeted programme of expansion through government funding. India has built a very robust refining sector by establishing over 20 refineries across the country to refine 215 million tonnes (Mt) of petroleum products. India consumes over 150 Mt of liquid petroleum products every year. Over 70 per cent of diesel is consumed in transportation, with the 65,000 km railway network accounting for much of this. Over the last five years, a space has been created for private refiners to import crude for product exports. Thus India exports over 60 Mt of petroleum products, constituting 20 per cent of total exports. The boom in refining has also led to the construction of over 150,000 km of liquid pipeline transportation networks, a large fleet of oil tankers, and a vibrant domestic downstream services sector

The success of the Indian oil sector's expansion of downstream infrastructure has yet to be replicated in natural gas, where expectations for a transformation of the country's natural gas landscape, following its largest offshore gas discovery (in the eastern offshore basin), have failed to be met. The use of natural gas through imports has met similar outcomes – of a total of eight LNG terminals (operating, under construction, and planned), just two are currently in full operation. The potential for natural gas arguably lies in the city gas sector, and particularly in transportation. However, in the absence of nationwide environmental legislation (such as that enacted in Delhi, where the entire fleet of public transportation runs on CNG), this potential will remain unfulfilled.

Arguably, the state with the greatest success in natural gas is Gujarat, which has successfully harmonized its downstream and upstream sector policies. It has India's best developed City Gas Distribution network, over 3,000 km of gas pipelines, and access to two LNG terminals – Dahej and Hazira. This robust gas infrastructure has driven the share of gas in Gujarat's energy consumption to 24 per cent, the highest of any Indian state and higher than the share of gas in India's primary energy consumption (roughly 10 per cent). India's new government, led by former Gujarat Chief Minister (now Prime Minister) Modi, is keen to replicate the 'Gujarat model' across India through the construction of a national gas grid, via Public–Private Partnerships.

High expectations

With 0.3 per cent of the world's oil reserves and 0.7 per cent of its natural gas reserves, India can hardly be described as a 'resource rich' country. But with 17 per cent (1.2 billion) of the world's population, it cannot be ignored as an important and growing player on the international energy market. Perhaps the biggest lesson from past experience comes from the lack of harmonization between upstream and downstream sector policies, which have been pursued to different ends. This is slowly changing, but much is contingent upon the speed with which India's new government pushes through reforms.

An assessment of India's energy landscape: 2008–13

Kaushik Deb

As the global economy spiralled into the worst financial crisis since the great Depression in 2008 (according to Nouriel Roubini, Kenneth Rogoff, and Nariman Behravesh, in a press release reported in Reuters, 27 February 2009), India seemed to be bucking the trend. A five-year average GDP growth rate of 8.6 per cent per annum (p.a.) over 2003–8, more than twice that of the world average of 3.8 per cent p.a., and a full percentage point higher than the rest of the non-OECD countries (7.6 per cent p.a.), had arguably set India up for what was expected to be a period of high growth, rivalling that of China. For a while it did appear that this promise would be realized, before India hit another roadblock in its growth story and GDP growth slowed down around 2011.

India's energy markets followed economic growth, albeit more slowly. The transition in the energy sector in India is echoed not just in volumetric increases, but, more significantly in the proportion of different fuels in its primary energy mix. This paper traces the evolution of India's primary energy mix during 2008–13, using average changes in consumption and production to identify important trends in its energy landscape over these five years.

Consumption

India's energy consumption increased by 6 per cent p.a. on average during 2008–13, with India accounting for 4.7 per cent of the world's energy consumption by 2013. Coal (54.5 per cent of total consumption) was, and remains, the dominant fuel in India and its share of the energy mix as of 2013 was the highest since 1996. Oil (29.5 per cent) was the second-largest fuel, with natural gas (7.8 per cent) and non-fossil fuels (8.2 per cent) far behind. Coal also led the growth in primary energy consumption during 2008–13 (meeting 63.3 per cent of the total increase in consumption), with oil far behind (meeting 20.6 per cent of this increment), and non-fossil fuels (nuclear, hydro, and renewables) adding another 10 per cent.

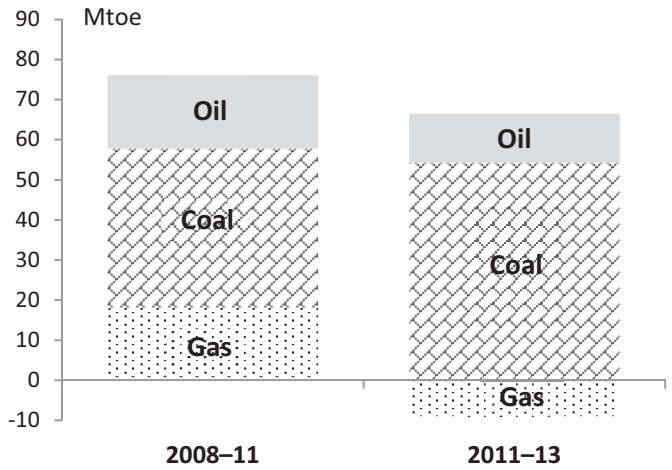
This five-year average, however, masks the significant shift in the proportion of fuels in India's primary energy basket that took place right in the middle of this interval.

Gas consumption, which had steadily started to gain market share and was growing by 6.9 per cent p.a. on average during 2003–8, lost that momentum. Between 2008 and 2011, gas consumption rose by 20.1 Bcm (14.2 per cent p.a.) with rising domestic gas supplies which were cheaper than other fuel substitutes or imports. However, a fall in domestic production from 2011 onwards resulted in a decline in gas consumption by 10 Bcm (–8.5 per cent p.a.) between 2011 and 2013. The gas story is mirrored in coal, where growth slowed down from 7.9 per cent p.a. during 2003–8 to just 5.5 per cent in 2008–11. Subsequently, to compensate for the falling gas consumption, coal consumption rose by 9.6 per cent p.a. during 2011–13. Coal consumption rose by 7.6 per cent in 2013 alone, the second largest volumetric increase on record. In fact, coal consumption has more than doubled over the last decade in absolute terms.

Production

India's energy production increased by 3.5 per cent p.a. during 2008–13, much slower than the previous five-year average growth of 5.1 per cent p.a. In 2013, India's production was just 2.7 per cent of the world's total. This slowdown is solely attributable to coal, which comprises more than 65 per cent of total energy production in India. Growth in coal production fell from 6.2 per cent p.a. during 2003–8 to just 3.2 per cent p.a. during 2008–13.

'INDIA'S ENERGY CONSUMPTION INCREASED BY 6 PER CENT P.A. ON AVERAGE DURING 2008–13.'



Change in fossil fuel demand

Oil and gas production each grew by a modest 2.1 per cent and 2 per cent p.a., respectively, during 2008–13; these figures are much larger than the 0.3 per cent p.a. for oil and 0.6 per cent p.a. for gas in the previous five years (2003–8). Thus, both maintained their shares in India's energy production: about 9 per cent for gas and 12 per cent for oil.

An interesting wrinkle here is the dramatic rise in the share of gas in total production during 2008–11, and its subsequent fall. The share of gas rose from 9 per cent in 2008 to 12 per cent in 2011 before falling to 9 per cent again in 2013. Again, mirroring this is the fall in the share of coal from 66 per cent in 2008 to 62 per cent in 2011 before coming back to 65 per cent in 2013. Both these trends can be explained by regulatory constraints.

'THE REGULATION OF ENERGY PRODUCTION IN INDIA HAS STALLED INVESTMENT AND MUTED PRODUCTION GROWTH.'

The regulation of energy production in India has stalled investment and muted production growth. After significant increases all through 2003–8 (6.2 per cent p.a.), coal production growth stalled during 2008–13 with a growth of only 3.2 per cent p.a. as mentioned earlier. In fact, coal production in India fell twice in these five years, the first volumetric declines since 1999. This slowdown was largely due to expansion plans and investments getting mired in environmental clearances and significant delays in land acquisition for new mining areas. This period also saw record increases and declines in gas production. New gas discoveries were brought online, increasing production by 14.8 per cent p.a. during 2008–11. Subsequently, gas production started to fall from 2011, with the new fields starting to decline much faster than expected and no new investment in the sector having been seen in the previous years. The decline in gas production during 2011–13, by 14.5 per cent p.a., was almost as rapid as its rise in the previous three years. This led to the largest decline in gas production in any country in the world during 2013 (–6.7 Bcm). The lack of a viable pricing policy and commercial flexibility continues to constrain growth in this sector.

Implications

The slowdown in India's energy consumption was accompanied by a slowdown in its economic growth. GDP growth slowed from 8.6 per cent p.a. during 2003–8 to 6.6 per cent p.a. in 2008–13, while the growth in energy consumption slowed from 6.8 per cent p.a. to 6 per cent p.a. Consequently, the rate of improvement in the energy intensity of GDP also slowed down. In addition, relative changes in the primary energy mix had implications for CO_2 emissions from energy use.

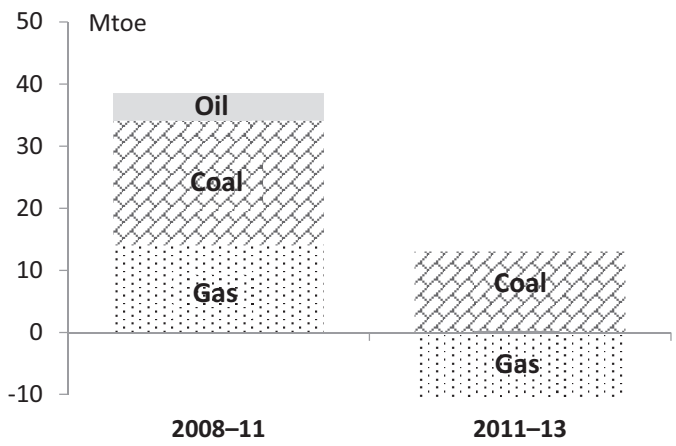
More significantly, the sharper slowdown in domestic production in comparison to consumption implied that the share of India's energy consumption met by domestic sources fell to 59 per cent by 2013, the lowest on record.

Rising import dependency

India's net energy imports increased by 10.1 per cent p.a. on average during 2008–13. Coal led the trend with imports rising by 22.5 per cent p.a. during this period, while gas imports and oil imports rose by 10.6 per cent p.a. and 4.6 per cent p.a. respectively. More striking is the rise in the growth rate of coal imports, from 16.2 per cent p.a. in 2008–11 to 32.6 per cent p.a. during 2011–13. Underlying this rapid increase is the trend in domestic gas production during this period (described above) and the tight Asian LNG market at the time. The increase in relatively cheaper domestic gas supplies during 2008–11 offset the rise in coal imports to an extent. However, as domestic gas production collapsed in 2011, energy demand shifted to coal imports. Indian imports of LNG, on the other hand, entered a three-year supply growth lull in 2011, as the Fukushima nuclear disaster pushed Asian demand (and prices), to record highs and made gas imports much more expensive than coal imports. The result was a much more dramatic increase in coal imports during 2011–13.

Higher energy intensity and emissions from energy use

Energy markets are sluggish in their response to economic drivers. As a result, GDP growth slowed more sharply than energy consumption,



Change in fossil fuel production

thus slowing improvements in India's energy intensity as well. From a decline of 0.8 per cent p.a. on average during 2003–8, energy intensity only fell by 0.6 per cent p.a. during 2008–13. These gains in energy efficiency were made during the early part of this period (2008–11) when GDP growth was faster than the increase in energy consumption; GDP rose by 8 per cent p.a. during 2008–11 while energy consumption increased by 6.3 per cent p.a. (This was in line with trends in the previous five years (2003–8) when GDP growth of 8.6 per cent p.a. was matched by an increase in energy consumption of 6.8 per cent p.a.) This resulted in an improvement in energy intensity of 1.5 per cent p.a. in 2008–11; however, in the following two years (2011–13) the slowdown in GDP was larger than that in energy consumption. GDP growth came down to just 4.7 per cent p.a. while energy consumption growth declined by to 5.5 per cent p.a. This led to energy intensity increasing by 0.8 per cent p.a.

In line with this broad improvement in energy intensity, the rate of growth of CO_2 emissions from energy consumption has continued to decline in India – from 6.7 per cent p.a. during 2003–8 to 6 per cent p.a. during 2008–13. However, the fuel mix has also played a role in these figures. With the rising share of gas in the energy mix during 2008–11, CO_2 emissions increased more slowly – by 5.7 per cent p.a. on average during these three years. But the subsequent increase in the share of coal in the energy mix raised the growth rate of CO_2 emissions to 6.6 per cent p.a. on average during 2011–13.

'… THE RATE OF GROWTH OF CO_2 EMISSIONS FROM ENERGY CONSUMPTION HAS CONTINUED TO DECLINE IN INDIA …'

This assessment of India's energy landscape during 2008–13 therefore shows not just a short-term resurgence in, but also a longer-term growing dependence on coal, both domestically produced as well as through imports, brought on by underlying changes in the relative proportions of fuels which make up the primary energy mix. It also shows that Indian coal consumption has responded relatively quickly to changes in energy production and supplies. Perhaps the most significant implication of this is the impact on CO_2 emissions. Going forward, India's emissions of CO_2 will be dependent on the relative proportions of cleaner fuels in primary energy, and on India returning to higher GDP growth.

Fundamental petroleum fiscal considerations

Daniel Johnston and David Johnston

Business relationships between international oil companies (IOCs) and governments are among the most dynamic in the world. There is a heated debate – currently particularly intense in Mexico and India – over a fundamental feature of global agreements. On one side are those who believe basic 'profits-based' structures – found in the world's production-sharing contracts (PSCs) and royalty/tax systems (R/Ts) – are the best. Others, however, propose a structure based simply on the division of production, or of revenues (revenue-sharing contracts or RSCs).

The overriding concern behind this initiative is a lack of faith in the accounting for costs, and the spectre of cost overruns, goldplating, or even cheating. In India the positions have been formalized and explicitly articulated by two committees: the Rangarajan Committee and the Kelkar Committee. The impetus for this debate stems from controversies associated with the KG-D6 gas development, and the way PSCs and cost-recovery mechanisms function.

1 A revenue-sharing system can be somewhat easier administratively, while not necessarily eliminating oversight requirements.
2 Revenue-based systems discourage investment.
3 RSCs are extremely regressive. Successful precedents do not exist.
4 Over the past five decades, revenue-based systems have become, for all practical purposes, extinct, as contracts and systems have evolved and improved.
5 Over 90 per cent of governments with existing petroleum operations use profit-based systems. (Exclusions are: big OPEC producers, most of Russia and until recently Mexico.)
6 The KG-D6 controversy is multidimensional and complex but one aspect relates to unsubstantiated claims of goldplating. Bullish industry-wide cost increases in the early 2000s strongly influenced KG-D6 development costs. All parties were disappointed with the results.
7 The current focus of attention is misplaced and needs to be properly framed. It is not a systemic problem.

Revenue-sharing ('Peruvian model')

The model proposed by the Rangarajan Committee typically splits

Rangarajan Committee	Kelkar Committee
Proposed changing fiscal regime to simpler revenue-sharing system.	Contests proposed changes. No need to move away from PSCs which they say are more investor-friendly.
Government to share in revenue as soon as production starts.	Contractor should recover all costs before sharing profits with the government.
Cost-recovery mechanism is disincentive to cost reduction and at root of problems with current fiscal regime.	No incentive exists for investors to goldplate, spend excessive sums, or curtail production.
Revenue-sharing systems require much less oversight.	Current audits should not include oversight of performance or efficiency.

gross production or revenues between the government and the IOC, which is expected to recover costs and earn a profit out of its gross production share. Such systems, in their purest form, eliminate the need for audits or the oversight required in typical profits-based systems (PSCs and R/Ts).

Regressiveness of RSCs. A large royalty-equivalent is required to achieve a government take comparable with that traditionally received by India. For example, government take worldwide is roughly 70 per cent or more (undiscounted) while in India a typical figure is nearer 80 per cent. For India to obtain roughly the same revenue share in a relatively profitable environment, a royalty of around 60 per cent (i.e. full-cycle costs as a percentage of gross revenues around 25 per cent) will be required in a royalty-equivalent scheme. However, as profitability increases (with this royalty level) government take declines significantly, approaching 60 per cent.

Inefficiency. Progressive fiscal elements are needed to offset the regressive effect of 'royalties'. Such elements must 'adjust' to variations in profitability (inevitably a function of costs, prices, and timing). The RSC's objective is to avoid dealing with 'costs'. Therefore, a 'proxy' for profitability is required – global experience with 'proxies' (such as production-based systems and price-based windfall profits-based systems) has been unfavourable. India would effectively be ignoring over 50 years of contract evolution.

Disincentive to high cost or marginal projects. Given a 60 per cent royalty (or the equivalent as created by a RSC-structured government share) and a less profitable field (where costs as a percentage of gross revenues approach 40 per cent), government take approaches 100 per cent. IOC incentive to invest disappears long before that point.

Cost recovery rate reduced. If the government has a share of production 'off-the-top', the investor's cost recovery rate is reduced dramatically.

Early abandonment. The economic limit in its strictest sense occurs when operating costs equal one minus the royalty rate. With a royalty of 60 per cent, a field becomes uneconomic when costs as a percentage of gross revenues are 40 per cent; any incentive to invest further begins to disappear long before that point. From a project perspective, economic profits of nearly 40 per cent of gross revenues would still remain, but these profits are (by definition) inaccessible to the IOC. Thus, the economic limit is not a true economic limit (in the project sense) but one artificially manufactured by the fiscal structure. Peru abandoned this approach years ago as did, Algeria, and Trinidad & Tobago in the mid-1970s.

Profits-based systems have a solid foundation

Most governments rely heavily on profits-based rent extraction mechanisms.

In most of these categories it is important to be able to monitor, oversee, audit, and trust the expenditures that are claimed as:

- netback costs (for determination of royalty),
- cost recovery (for PSCs and service agreements), and
- tax deductions.

Government revenues from petroleum operations	
	%
Signature and other bonuses	1–2
Royalties	15–18
Profits-based mechanisms	70–80
Government participation	7–10
Other	1–2

Profits-based systems align the interests of all parties

Oil companies have a strong incentive to keep costs down in order to maximize profits – in maximizing their profits they typically also maximize government profits.

The value of benefits for each party can be measured. The 'savings index' is a direct measure of a company's incentive to reduce costs. From an undiscounted point of view, a simple calculation shows how much a company keeps if it saves US$1.00. Only the profits-based fiscal elements affect this statistic.

The example below has two profits-based mechanisms: a 50 per cent government profit oil share and a 30 per cent income tax. A dollar saved means there will be an extra dollar's-worth of profit oil:

US$1.00	Profit oil
– 0.50	Government share
0.50	IOC share of profit oil
– 0.15	Income tax (30%)
35¢	IOC cash flow

Here, the 'savings index' is 35 per cent. For every dollar saved the IOC benefits by an increase in profits of 35¢ and the government 65¢. A 35 per cent index is a healthy incentive for a company to keep costs down. All parties benefit, but the government benefits more.

The same outcome would have resulted from a R/T system with two layers of tax (50 per cent and 30 per cent in series).

Similarly, added costs affect all parties, in similar proportions. An added US$1.00 of expenditure reduces profit (ultimately divided 65/35 per cent in favour of the government). Furthermore, when the time value of money is factored-in the contractor's incentive is often magnified. With a typical system the incentive goes from 35¢ on-the-dollar (or 35 per cent) to upwards of 50 per cent (discounted at 10 per cent).

A company could gain substantially from cheating. If a company could recover costs that were actually not spent (over-invoicing), or otherwise dishonestly inflated, this could provide a windfall equalling 65 cents on the dollar (65 per cent). Such behaviour is extremely risky, difficult to conceal, and the penalties are severe. Governments have numerous means and opportunities to oversee, monitor, verify, and exercise control over costs.

The realities of goldplating

The claim of 'goldplating' (where a company spends more than it otherwise would because the over-expenditure enhances its profitability – the savings index is negative) is a central issue in India. However, inflammatory claims of goldplating are usually false, grossly exaggerated, or apply to problems other than true goldplating. There is almost always an incentive to 'cheat' (over-invoicing or improperly procuring goods and services through an affiliate – manipulating the transfer price), but these actions are different from 'inflating costs' (true goldplating). These kinds of potential fraud are not unique to PSCs or R/T systems, nor are they unique to the petroleum industry.

Over-invoicing. A form of cheating technically unrelated to goldplating. For an operator to over-invoice, it must either delude its partners or involve them. It is difficult to hide from auditors, and the risks are great.

Transfer pricing. A legitimate concern regarding the acquisition of goods and services and for oil or gas sales. However, most governments have specific laws and regulations and contract provisions that deal with non-arms-length purchases or sales. Also, procurement laws and regulations or PSC provisions establish a procurement framework for avoiding transfer pricing; this type of activity can be disclosed by an audit.

Cost recovery mechanisms. These are virtually universal and do not inherently encourage goldplating. PSCs do not encourage goldplating; R/Ts are not dramatically different from PSCs from a mathematical/financial point of view. With R/Ts, companies can 'take deductions' (consisting of operating costs and depreciation of capital costs) in order to calculate taxable income. Deductions for tax calculation purposes are thus essentially the same as 'recovering costs' in a PSC prior to dividing profit oil. Any claims of inefficiency associated with cost recovery could thus apply to nearly any system.

'Strategic goldplating'. The type of operation typically recognized as goldplating – where a system is designed so inefficiently there is an incentive to goldplate from day one, during development planning. This is rare in newer contract designs, but some instances in the past were fostered by some early R-factor-based systems or ROR-based sliding scales promoted by the World Bank.

Low savings indices. These can attract claims of goldplating. The old standard contract for oil in Indonesia had a savings index of only 15 per cent. Some analysts believed there was insufficient incentive to control costs but companies worked hard to do so within those contracts. (With present value discounting the incentive was magnified.)

'THE CLAIM OF "GOLDPLATING" … IS A CENTRAL ISSUE IN INDIA.'

Uplifts, or investment allowances. The incentives most commonly associated with claims of goldplating. For example, a company may spend US$100 million on capital expenditure and the government/contract may allow an uplift or allowance of 20 per cent. This means that the company could recover or deduct US$120 million (for cost-recovery or tax calculation purposes). This appears to create a clear potential for goldplating, however:

1 When an uplift or allowance flows through cost recovery, the profit oil of which the IOC gets a share is reduced.
2 They are 'taxable'.
3 There could be considerable time lag between expenditure and recovery.
4 There is no guarantee that sufficient production or expected oil prices will justify the risk of added (goldplated) expenditures.

These factors eliminate most or all incentive to goldplate in this way unless the allowance is particularly large, in which case they should be evaluated in light of the above considerations.

Goldplating risks. The unexpected risk associated with strategic goldplating. A company engaged in goldplating could experience far greater financial exposure due to deliberate overspending and unexpected cost inflation. This could magnify catastrophically if production rates or oil prices do not meet expectations.

Opportunistic goldplating

This form of goldplating occurs with some of the older 'stair-step' R-factor or ROR scales. As a company approached a 'trigger point' (where taxes or government share of profit oil increased) added expenditure could be beneficial. By manipulating costs or production prior to a 'triggering' event (pushing it into the future) company NPV could be improved at government's expense. However, modern designs have removed old 'stair-step' structures – using smoother formula-based (interpolated) sliding scales instead; shortening accounting periods has also been helpful. Both strategic and opportunistic goldplating can be a risk with the more dramatic stair-step sliding scales, but such problems were recognized from the late 1980s and early 1990s.

'… "R FACTORS" OR RATE-OF-RETURN (ROR) MECHANISMS ARE NOW USED TO CREATE A PROGRESSIVE FISCAL SYSTEM.'

Adjustment factors (R-factor and ROR systems) uplifts

The later-generation 'R factors' or rate-of-return (ROR) mechanisms are now used to create a progressive fiscal system. An 'R-factor' is generally a formula based on the ratio ('R') of the IOC's accumulated receipts divided by accumulated expenditures (usually both capex and opex). Thus, typical R-factors are a measure of 'payout'. When an R-factor equals one, payout (the point at which the IOC has recouped all costs and expenses) is represented. R-factors therefore 'adjust' fiscal elements such as profit oil share percentages or a tax rate (and therefore the government 'take') according to the IOC's 'payout status'. Similarly, ROR systems 'adjust' on the basis of the internal rate of return. The Indian investment multiple (IM) is a variation on the 'R-factor' theme. India also has ROR-based PSCs.

In many respects, and for good reason, these systems are considered superior to alternative 'adjustment factors' such as:

- production-based sliding scales,
- price-based mechanisms,
- technical factors such as crude gravity or gas composition, or
- combinations of these.

Unfortunately, R-factor and ROR designs can allow goldplating. However, it is not fair to claim that all such systems have this flaw.

The most reasonable and legitimate place to seek an example of goldplating associated with these elements is with some R-factor or ROR-based systems based on early designs, where the triggered tax rates are high and the threshold rates of return are also set high, leading to an incentive to spend more.

An R-factor-based system could use similar scales, but rather than ROR thresholds, R-factors such as <1, 1–2, 2–3, and >3 would be used. Some early designs (such as the stair-step scale) could provide both strategic and opportunistic goldplating incentives. Some of the most notorious systems were those with rate-of-return features with large tax differences between tranches, such as some old contracts in West Africa which had huge differences – up to a 40 per cent profit oil differential between the share under the first tranche and the next (i.e. from 0 per cent to 40 per cent). Opportunistic goldplating is nearly eliminated with a smooth curve (interpolating between points).

ROR systems

A new kind of sliding-scale formula, based on the IOC internal rate of return (ROR) from a project, was introduced in the 1970s. Systems using this approach are often referred to as an 'ROR system' or 'ROR contract'. Adjustment mechanisms based on this approach are sometimes referred to as 'resource rent taxes' (RRTs). Approximately 10–15 per cent of countries use an ROR feature in their fiscal system or PSC. Many (particularly African) countries using this formula were associated with the 1980s World Bank-financed petroleum promotion initiative; new contracts and petroleum legislation were developed as part of this in 40 countries – particularly non-producing, developing countries. A central feature of these ROR formulas is that the rate-of-return is actually received by the IOC.

The theory and logic behind rate-of-return systems was solid and well-intentioned. Adjustment mechanisms were essentially based on *true* measures of profitability (not a proxy such as production rates). The advantage of a ROR system over an R-factor is that it takes into account the time value of money. The relative quality and efficiency of these systems depends on 'rates', trigger point thresholds, and effective tax increases.

Summary

Around 95 per cent of governments use fiscal systems based on division of profits, regardless of whether or not they use R/Ts or PSCs. Revenue-sharing

Stair-step scale		*Interpolated scale*	
IOC ROR	Government share Profit Oil	IOC ROR	Government share Profit Oil
<10%	20%	<10%	20%
10–20%	40% 1st trigger	10–30%	Interpolated
20–30%	60%	>30%	80%

systems have been tried and abandoned. If designed properly, the advantages of progressive mechanisms (like R-factors and ROR mechanisms) outweigh the risks, which can be significantly mitigated with more modern designs. When oil prices increased five-fold from 2002 through 2010, government take percentages in most countries fell because most systems were regressive, especially with respect to oil prices. The exceptions to this generality were systems with R-factors or ROR features, together with a few systems which included specific mechanisms designed for variations in product prices (such mechanisms are often called 'windfall profit taxes').

Governments and IOCs continually learn from the unintended consequences of new, untested contract provisions. Because of this, true goldplating is rare; even where it once had the potential to exist, most problems have been, or are being, 'designed out'. Most countries believe they are better off with existing, fairly highly evolved, industry best practices, rather than trying to establish a new framework based on what is essentially a failed system. The revenue-sharing foundation is weak.

This article is a summary of 'Fundamental Petroleum Fiscal Considerations', Oxford Energy Comment, February 2015. Please refer to the Comment for the full version.

India's 'gas renaissance' – rhetoric versus reality

Anupama Sen

Most general discussion on the future of the market for internationally traded gas focuses on the 'swing towards Asia' – specifically, China and India are highlighted as major drivers of demand. But in reality, there is considerable ambiguity over the assumptions underpinning this outlook for India.

In its New Policies Scenario, the International Energy Agency (IEA) predicts that non-OECD demand will continue to constitute the majority of world gas demand, growing from 53 per cent (1,806 billion cubic metres) in 2012 to 61 per cent (3,035 Bcm) in 2035. However, within this figure, while the share representing China and India combined will grow from 11 per cent in 2012 to 24 per cent in 2035, India's share will grow from 3 to 7 per cent (as opposed to China's, which will grow from 8 to 18 per cent) while as a percentage of world demand, it will grow from 2 to 4 per cent. The proportion of gas in India's primary energy consumption will rise from 7 to 9 per cent, but this will be nowhere near enough to displace either coal or oil (44 per cent and 25 per cent) by 2035. These projections suggest that India's contribution to world gas demand is lower than perceived.

Despite these conservative forecasts, Indian policymakers have tended to be very optimistic on gas's potential to displace coal and oil in electricity, cooking, and transportation. As the use of these fuels is supported by controlled pricing and subsidies, it is ambiguous at best as to how these potential markets for gas could materialize.

In fact, despite relatively high economic growth in the last decade, it is difficult to make a confident and accurate assessment of India's potential as a major gas market. Government forecasts carried out within a central planning framework tend to be overly optimistic, whereas projections by multilateral organizations tend to be cautious, but confused. The reason for this incongruity is because the Indian gas sector is characterized by two moving parts: one where prices and quantities are set by the government, and another which utilizes gas at market (import) prices. Additionally, there is some overlap between the two, complicating attempts to assess these as separate markets. The lack of a clear price signal has therefore made it difficult to determine future levels of demand.

Gas pricing reforms– a 'halfway' position

In recognition of this issue of fundamental importance, governments have attempted to reform gas prices, but with limited impact. Broadly, prices are set according to the fiscal regime governing a producing field. The current regime ('New Exploration Licensing Policy') has been operational since 1999 – the pricing formula for this had until recently pegged gas prices to Brent crude.

'… GOVERNMENTS HAVE ATTEMPTED TO REFORM GAS PRICES, BUT WITH LIMITED IMPACT.'

A 2013 reform proposal suggested breaking the link with Brent and instead linking prices to a 12-month trailing, volume-weighted average price of international benchmarks including Henry Hub, National Balancing Point (NBP), netback of LNG prices to Japan, and netback of India's spot and contracted LNG imports. Under this proposal, prices would have risen from US$4.20 per MMBtu to over US$8 per MMBtu for most domestic gas. The government at the time did not push through the reform due to political

concerns over the impact on major consuming sectors such as power and fertilizers, to which gas has historically been supplied at lower prices.

The new government elected in May 2014 implemented a modified version of the formula from 1 November 2014. This removed the (higher) Japan LNG and Indian import netback price markers, and included the Alberta Hub and Russian gas prices instead, resulting in a lower increase to US$5.61 per MMBtu (US$5.05 based on Gross Calorific Value).

The nature of the formula – and the inclusion of non-market, negotiated prices (such as the Russian price to FSU countries) – suggests that reform continues to be predicated around managing the price level, rather than establishing a logical basis for price formation. It reflects the longstanding dilemma faced by policymakers around gas pricing reform: whether to reform prices to revive domestic exploration and production whilst risking price rises downstream and the potential loss of electoral support, or, to continue to control gas prices whilst importing LNG at nearly three times the domestic price, to make up the deficit between production and consumption.

The big question– will reforms revive the upstream sector?

The upstream gas sector has been stagnating, following a brief renaissance in the 2000s (see the figure 'Gas Production by Sector') after the discovery of offshore gas in the KG-D6 block operated by Reliance Industries Limited. The start of production from KG-D6 in 2009 signalled a potential game-changer – it overtook production from the National Oil Companies (NOCs) in 2010. However, this was short-lived and by 2013 KG-D6 production had declined to a third of the original targets. This sparked an intense debate over pricing and the administration of India's fiscal regime for exploration. Domestic production fell from a peak of 50 Bcm in 2010 to just over 30 Bcm in 2013, and has continued declining.

Annual upstream investments have also fallen, from a peak of roughly US$6 billion in 2008, to US$1.8 billion in 2011, according to a 2013 parliamentary committee report. Some international firms have attempted to exit their upstream oil and gas assets, citing procedural hurdles.

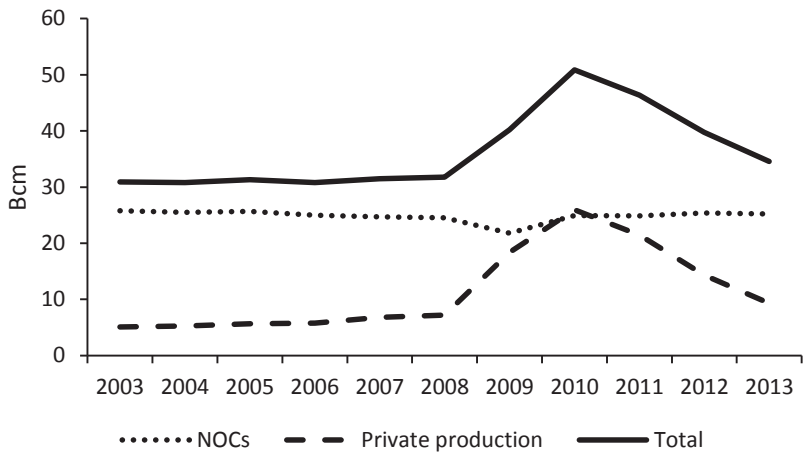
Despite this stagnation, India's Twelfth Five Year Plan targets an increase in production to over 60 Bcm by 2016/17, with the majority of this (around 39 Bcm) coming from the NOCs – mainly ONGC – which in January announced that it was targeting production of 40 Bcm by 2019/20, an 80 per cent increase from current levels. While this is plausible, as ONGC holds the majority (over 50 per cent) of India's total proven reserves of 1.4 trillion cubic metres, in practice it is dependent on price. Whilst a proportion of ONGC's marginal and offshore fields can reportedly be brought into production at prices of U$6 to US$7.15 per MMBtu, higher prices of US$10.72 to US$12.63 per MMBtu are reportedly required to commercialize its larger deep water fields.

Although the lack of new private sector investment is partially due to uncertainty over India's resource potential – 50 per cent of its sedimentary basin is classified as 'poorly explored' – it is also due to price. This is reflected in a 2013 study carried out by IHS-CERA, which estimated that prices of at least US$8 per MMBtu were required to commercialize at least 30 trillion cubic feet of onshore, shallow water, and deep water reserves, while prices of US$8 to US$10 per MMBtu, and US$10 to US$12 per MMBtu were required to further commercialize most deep and ultra-deep water gas reserves, respectively.

The prospects for a revival in India's upstream gas sector are limited in the absence of reform on price formation, and of a decision on the future of the upstream fiscal regime – a debate is on as to whether it should be profits-based or revenue-based.

Falling production is unlikely to be offset by LNG imports

The flipside to upstream stagnation is, however, an increased potential for LNG imports – which feeds into the 'swing towards Asia' story. India imported 13.3 million tonnes of LNG in 2013. An analysis of government and IEA forecasts suggests a theoretical



Gas production by sector

Source: Ministry of Petroleum and Natural Gas

opportunity for around 100 Bcm of LNG imports by 2030, which would require the equivalent of 147 million tonnes per annum (Mtpa) of regasification capacity. As of 2013, India was reported to have contracted, or to be in negotiations to contract, imports equivalent to 20 per cent of this.

In reality, however, falling production, the lack of price reform, and the lack of infrastructure (pipelines and terminals) will constrain this potential. Even by the most optimistic projections India may have only built 83 Mtpa of capacity by 2030 ('Vision 2030', Petroleum and Natural Gas Regulatory Board, 2013), although from past experience regasification infrastructure projects are subject to long delays in completion.

But a more immediate constraint is a drop in gas consumption within the economy; in 2013 this was roughly 12 per cent lower than in 2014 (BP Statistical Review, 2014). Whilst this is partially attributable to idle power capacity resulting from supply shortages, it also indicates a shrinking market for gas under present conditions.

The sustainability of reforms will be determined downstream

The future of India's gas story will, in fact, be determined by the ability of the fertilizers, power, and city gas sectors (which collectively account for over 70 per cent of domestic gas consumption) to absorb higher-priced gas. This is dependent on the structure and dynamics of the demand for gas.

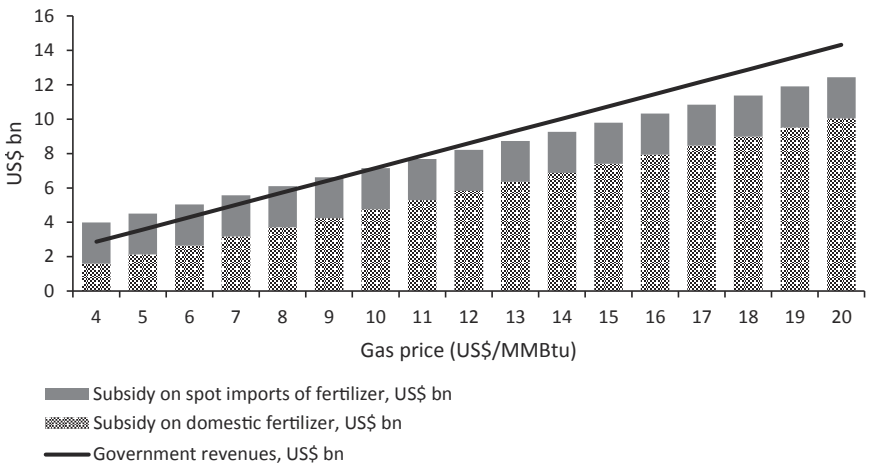
India's 'Gas Utilisation Policy' has led to a two-tiered structure of demand. Domestic gas is first released in order of priority to: fertilizers, power, and city gas (for households and transportation), with the remainder then released to a second tier comprising: refineries, petrochemicals, merchant/captive power plants, and city gas for commerce and industry. Some tier one consumers also use LNG at lower prices (obtained by pooling it with domestic gas), while tier two consumers are able to purchase LNG at import prices.

Demand is therefore set in the fertilizer sector, where low-priced gas is used to manufacture roughly 22 million tonnes (Mt) of urea each year. A further 8 Mt is imported on the international market (about 6 Mt through spot purchases and 2 Mt on long-term contracts). Urea retails at around half of its cost price, and in 2013 a total subsidy of around US$6 billion was provided for fertilizers. A main impediment to gas price reform is therefore the impact of higher prices on fertilizers – the largest consuming sector – and by extension, on farmers, as they form an important part of the electorate. Fertilizer subsidies are therefore likely to continue, although the method of delivering these is being reformed.

One proposed solution has been to utilize the revenues that will accrue from royalty (10 per cent) and corporate income tax (around 34 per cent) on production valued at the higher gas price, to finance the fertilizer subsidy. An analysis of the cost of urea at different gas prices compared with government revenues (from royalty and taxes) based on 2014 gas production targets shows (see the figure 'Fertilizer Subsidy versus Government Revenues') that the total subsidy bill could potentially be offset at prices of US$8 to US$10 per MMBtu. However, this is contingent upon private sector production targets being achieved, unless there is an equivalent increase in NOC production (although the latter has plateaued throughout the 2000s). An alternative to sustainably 'managing' the subsidy bill would be for India to replace its spot imports of urea with lower-priced long-term contracted imports, requiring a strategic reform of fertilizer policy.

Similarly, an analysis of the cost of power at different gas prices suggests that under India's merit-order dispatch system, gas becomes uncompetitive with coal at between US$5 and US$6 per MMBtu. At a higher gas price, the difference will either need to be passed on to consumers, or be subsidized. As states have relative autonomy over electricity policy, there is unlikely to be a consensus solution. The market for gas in power will, in this case, be limited to those segments (such as industry) which can pay higher power prices.

It is therefore the city gas sector which represents the most realistic market opportunity for gas. However,



Fertilizer subsidy versus Government revenues

Source: Author's analysis

it is much smaller relative to fertilizers and power. City gas entities operate at the level of Indian states and are technically able to pass through price rises, although state governments have occasionally stepped in to prevent this. As consumers of piped gas are predominantly urban households, the justification for price controls for this segment is economically weak. Subsidized LPG is the main competitor to piped gas for households, but its prices are also being reformed.

Diesel is the main competitor to gas for transportation. However, the deregulation of diesel prices in October 2014, along with a growing awareness of the need to curb vehicular pollution in cities (reinforced by a recent agreement between the USA and India to monitor data on air quality) is likely to ensure the relevance of gas in transportation. Perhaps the most significant indication of the future potential for city gas is that in July 2014, city gas for households and transportation was moved to the top of tier one consumers under India's Gas Utilisation Policy. This is likely to influence the structure of demand as it displaces the fertilizer sector, which, as argued above, has long set the demand for gas. The potential of city gas will, however, be limited by the amount of gas it can absorb at 'market' prices, unless supporting infrastructure is targeted at it to grow its consumption.

India's gas renaissance may not be over yet; however, under present conditions the reality indicates a much more muted role for gas in India's economic story than the rhetoric would suggest.

The coal sector: fuelling economic growth and testing India's ability to reform

Dagmar Graczyk

'… COAL WILL REMAIN THE DOMINANT FUEL TO 2040, WITH DEMAND DOUBLING OVER THE PERIOD.'

Coal is fuelling India's economic growth. In 2012, it accounted for 45 per cent of total primary energy demand and 72 per cent of generated electricity, making India the third-largest coal consumer in the world (*IEA Medium-Term Coal Market Report*, 2014). Energy demand in India is set to more than double from 2012 to 2040. Despite substantial investments in other energy sources, especially in renewables, coal will remain the dominant fuel to 2040, with demand doubling over the period.

This dominance is in large part due to India's vast proved coal reserves – the world's fifth largest (*BP Statistical Review*, 2014). Domestic production was 605 million tonnes (Mt) in fiscal year 2012/13 and is expected to increase to 736 Mt by 2019.

However, the actual economic viability of reserves and their suitability for high-tech applications, especially in the power and steel sector, remain debated among experts. For example, untreated Indian coal has only limited suitability for super-critical power plants that are to become the norm for all coal-based generation starting from 2017. Consequently, the share of imported coal will increase sharply over the next decades. In FY 2012/13, India imported 135 Mt (22 per cent of total demand). Imports are expected to triple to 2040 and import dependency to rise to nearly 40 per cent (all data from *IEA World Energy Outlook*, 2014; *IEA Medium-Term Coal Market Report*, 2014). Given coal's crucial role, the sector faces some important challenges that have implications for India's economic development.

Status of India's coal sector

One such challenge is the structure of the Indian coal sector, which acts as a constraint on production. When India opened its economy in 1991, substantive reforms were undertaken in the energy sector, but these bypassed coal. Nationalized in 1973, the coal sector is today dominated by three state-owned companies, one of which, Coal India Limited (CIL), accounts for over 80 per cent of domestic production. The vast majority of production is obtained through opencast mining and this has inherent environmental and social problems.

Observers are sceptical about whether domestic coal production can meet future demand, as CIL has repeatedly failed to meet its production targets. The company has limited access to state-of-the-art mining technologies, and production is highly labour intensive. Its productivity per employee, measured in tonnes per year mined, is less than one tenth that of its Chinese competitors. This is not entirely CIL's fault as the process of land acquisition and of inter-ministerial coordination for obtaining statutory clearances (such as environmental clearances) can take several years. However, the operational performance of CIL is also a reflection of the larger challenges preventing the Indian coal sector from reaching its potential.

Limited private mining for self-consumption is permitted, and accounts

for about 6 per cent of domestic production. Any surplus production from these so-called captive mines must be sold to CIL, as coal trading is not permitted. There is no sector regulator and CIL is in charge of substantial operational, regulatory, and commercial functions, including pricing. The IEA World Energy Investment Outlook 2014 projects that India will need to invest US$53 billion from 2014 to 2035 in mining alone, and another US$41 billion in transport links. This amount is unlikely to be raised by CIL alone, even if all revenues from the recent 10 per cent sale of the Government's stake in CIL were to be reinvested exclusively in the coal sector. (The sale brought in revenues of about US$3.9 billion.) Strategic partnerships with foreign companies would not only facilitate investment but also the flow of technology, expertise, and management skills that is urgently needed.

The Government is preparing to restructure CIL and three options are under discussion. The first would be to separate CIL's subsidiaries into large independent regional companies. CIL would cease to be the holding company. The second option would favour a gradual transition towards the creation of several small independent entities. CIL would remain as the holding company during the transition process. The third option would favour internal organizational changes of CIL without any fundamental changes to the corporate structure. Whichever option is chosen, it will be critical to bring employees and labour unions on board and make them constructive partners in this important undertaking.

'Coal Gate': The CAG report and Supreme Court decision

Some of the most urgent challenges facing the coal sector result from decisions made long ago. In 1993 the Government amended the Coal Mine (Nationalization) Act, 1973 to allow private mining for captive use by end-users in the power, iron and steel, and cement sectors, and for coal washing. This decision was driven by the urgent need to ramp up coal production in a constrained financial and regulatory environment to meet growing demand.

India's Comptroller and Auditor General (CAG) issued a report in 2012 that examined all the coal block allocation processes that had taken place since 1993, and the process of monitoring the operational performance of allocated blocks. The report noted that the process of allocating blocks was riddled with regulatory shortcomings. No transparent and objective allocation criteria had been developed; the procedure for allocation changed frequently and lacked transparency; and there was no comprehensive record keeping of the meetings in which mines were allocated.

The CAG also noted the almost complete absence of physical monitoring to ensure that promised investments were made in the timeframe agreed and to verify actual progress versus progress reported on paper. Consequently, out of a total of 218 allocated mines since 1993, only 42 are operational today and another 32 are sufficiently advanced to start operation soon. However, as in the case for CIL, a considerable number of delays are due to the time-consuming process of land acquisition and obtaining statutory clearances.

The CAG argued that the Government's actions had caused a financial loss to the country of over US$30 billion (albeit on rather debatable assumptions). 'Coal Gate', as it became known, was one of the key factors for the defeat of the incumbent Government in general elections in 2014.

Based on public interest litigation following the CAG report and after a two-year long investigation, the Supreme Court of India issued a verdict in September 2014 cancelling 204 blocks allocated since 1993. The verdict confirmed that the allocation of blocks was done arbitrarily, lacked transparency, and hence was both illegal and unconstitutional.

Coal block re-allocation

The Supreme Court decision has thrown a complex challenge at the Government, which has been given a six-month period to come up with an action plan, after which the coalfields and all related assets, including land, statutory clearances, and infrastructure, are to be transferred to the Government/CIL.

'COAL GATE … WAS ONE OF THE KEY FACTORS FOR THE DEFEAT OF THE INCUMBENT GOVERNMENT IN 2014.'

Prolonged uncertainty about the future of the 204 mines will likely add to the existing shortage of coal (especially for fuelling the power and steel sector) with negative implications on overall economic activities. India is already facing power shortages; additional disruption in supply would further aggravate the situation. Impacts from the cancellation of the coal blocks will also trickle down to affect the construction schedule of power, steel, and iron projects that had been linked to the de-allocated blocks. Several project promoters have already expressed concern that financial institutions might either stop loan disbursements or become reluctant to provide additional loans. And the financial institutions might face an increase of non-performing assets in their portfolios.

At the downstream end, coal users might now look overseas, leading to a faster increase in imports than expected, inflating the import bill. Equally, the judgement could result in increased investment in overseas coal mining projects. Both would aggravate Indian infrastructure bottlenecks along the value chain, ranging from ports to railways and

related facilities. Also, investments in India that support economic and social development and, more importantly, create employment, could be lost.

Already NTPC, India's largest power producer, has announced plans to import an additional 7 Mt of coal during the ongoing fiscal year. Increased imports will also impact end-user prices and the question is who will carry the burden: producers or consumers? Equally, it is unclear how any increase in coal prices, resulting from imports or higher domestic production costs, might impact the viability of new projects in the iron and steel sector.

'THE OVERALL STRUCTURAL PROBLEMS IN THE COAL SECTOR WILL NOT BE EASILY REDRESSED.'

The Government reacted quickly to the Supreme Court decision by issuing the Coal Mines (Special Provisions) Ordinance, 2014 last November; this aimed to introduce coal sector reforms and to ensure a smooth transition so that the mines can continue operations. This is also important from an employment perspective as the jobs of workers at de-allocated mines would otherwise be in jeopardy.

The Ordinance proposes auctioning off at least 74 blocks that are either already operational or ready to start operating in a first phase by mid-February 2015. Eligible bidders will need to be engaged in the production of one of a number of so called 'specific end use' industries: iron and steel, power (including captive power), and cement. The previous owners of the blocks are free to bid unless convicted of irregularities in the original allocation process, and after having paid a levy laid down by the Supreme Court on each tonne of coal produced. The Government has identified an additional 25 mines for the first phase. The target is to complete the first bidding round by March 2015, to comply with the deadline set by the Supreme Court.

The ordinance also includes provisions to allow the private sector to mine and trade coal in India. Not unexpectedly this has provoked opposition from coal sector unions, who called for a five-day strike in early 2015. The coal minister himself intervened and agreed to set up a panel consisting of senior officials from the ministry and CIL, together with union representatives; this resulted in the strike being called off early. Open and transparent communication with all stakeholders will be important for the Government to succeed in taking the Coal Mines (Special Provisions) Bill, 2014 through both Houses of Parliament. The Bill has already been approved by the lower House of Parliament, where the Government holds an absolute majority.

Approval in the upper House of Parliament, where the Government does not have a majority, is far from certain. Opposition across parties appears to be resisting the proposed reforms, wanting to keep the coal sector firmly under government control.

It is critically important to win over the opposition as the consequences of non-approval of the Bill (prolonged uncertainty about the 204 mines and exclusion of private mining in the coal sector) could have repercussions on India's economy for decades to come.

What next?

The overall structural problems in the coal sector will not be easily redressed. However, several steps can be taken by the Government.

First, closer cooperation with the governments of those Indian states where mining is undertaken. This must include a more even sharing of benefits from coal mining, and also an increase in the responsibility of state governments for the timeliness of land acquisition and other state-level statutory clearances, and for increased oversight of social and environmental impacts. Such an increased level of accountability for the states in the future could be considered as part of the restructuring of CIL.

Second, upgrading mining technologies to bring India up to international standards. This will not only result in operational improvements but should also improve both safety standards and working conditions of miners and better protect the local and (eventually) global environment. Coal currently accounts for 70 per cent of total Indian CO_2 emissions and for 94 per cent of CO_2 emissions in the power sector. Rapid deployment of more efficient coal-fired power plants will depend on the supply of coal having the required specification.

Third, re-introduction of the Coal Regulatory Authority Bill into Parliament. A Bill with the purpose of establishing an independent sector regulator had already been introduced but lapsed once parliament was dissolved in 2014, due to elections. The approval of such a Bill would send a strong signal that India is ready to further liberalize its coal sector. The Government has already announced that it is considering the re-introduction of such a Bill.

And finally, development of a much more conscientious approach to mitigating environmental degradation of mining areas. Whether India's largest natural resource will be exploited by the public or the private sector, for captive use or for trading purposes, a thorough modernization of the mining industry along the entire value chain is urgently needed. The same goes for a much stricter enforcement of environmental standards once the coal has been extracted. No company, whether public or private, should be allowed to leave behind an ecological wasteland. Rehabilitation of the affected

populations and the environment before, during, and after mining must be a priority. Other countries that have transformed their coal sectors successfully have shown what can be achieved and how coal mining can be made more environmentally and social acceptable. India can benefit from their experiences.

There is no doubt that India will continue depending on coal to propel its economic and social development over the next decades. Hence, there is urgency in addressing the challenges in a comprehensive manner, bringing all stakeholders on board. The Government has already taken important steps in the right direction and hopefully it will be supported in this critical endeavour across the political divide.

The author works as South Asia Programme Manager at the International Energy Agency (IEA). The content of this article reflects the author's personal view and does not necessarily represent the views of the IEA Secretariat or the IEA Member countries.

India's electricity future: change is inevitable – how much, how fast?

Rahul Tongia

Background: moving towards markets but with a social contract

In India as in many other nations, electricity regulation and policies have often stemmed from a view that it was a vital public good, and perhaps a natural monopoly; government control was therefore not only important, but helpful. Even as commercial viability gained importance, most regulation was based on costs-plus (rate of return), instead of unfettered market systems.

Implicit, if not explicit, in Indian policies have been steps towards universal access and pricing that makes electricity affordable for the poor. Other social contract aspects, such as environmental concerns, have also been important, especially for mining (coal) and, more recently, carbon.

Historically, the utilities were integrated government monopolies (State Electricity Boards, or SEBs); these were jokingly referred to by then Prime Minister Rajiv Gandhi as State Employment Boards. While not necessarily bloated they are still, for the most part, government bodies, despite the unbundling of generation, transmission, and distribution into separate companies. Generation is predominantly coal-based, for which India has significant reserves. Coal represented 60 per cent of the 255 GW capacity on 31 December 2014, and has a greater share in terms of generation. However, due to mining difficulties, transport (railways) bottlenecks (with coal concentrated in a few areas, mainly the east), and issues of quality (high ash content, often 30 per cent), imported coal is on the rise, especially for coastal power plants.

Utilities, especially distribution companies (DisComs), have had limited success with maintaining their social contract or viability as enterprises. They lose significant money for every unit (kilowatt-hour) they sell (on average) and cannot meet demand; this results in regular outages (feeder-level load-shedding). Rather than procuring peak power, they treat load-shedding as a regrettable but viable balancing option. While this lowers the average cost of supply on paper (!) it passes on costs to consumers – both from the outage and from the need to secure back-up power or lighting (roughly US$1 billion is spent on kerosene annually).

The fundamental problem today has resulted from a system of compromises. Shortfalls in supply are distributed neither equitably nor efficiently, and prices have become (for decades) a highly political issue. Selected consumers (especially commercial and industrial) pay far more than cost, cross-subsidizing other consumers. Theft is a major concern, estimated at over 10–15 per cent of consumption. One major issue is the measurement of 'theft', since agriculture has special status (for irrigation pump-sets which consume about a quarter of the nation's electricity). Not only are agricultural tariffs extremely low (ostensibly to keep food prices down), but most pump-sets are unmetered, so no one knows exactly how much they consume. This results in assumptions-based accounting for agriculture consumption, technical losses, and 'commercial losses' a.k.a. 'leakage'.

'SELECTED CONSUMERS (ESPECIALLY COMMERCIAL AND INDUSTRIAL) PAY FAR MORE THAN COST, CROSS-SUBSIDIZING OTHER CONSUMERS.'

On the demand side, we have additional drivers for change. The population is young (median age being about 25 years), and while urbanization is growing rapidly, 60 per cent of the population is still in the villages (predominantly in farming, even though agriculture's GDP share is some 14 per cent and falling). A population with roughly one mobile phone per adult (and amongst the

lowest tariffs in the world), with strong competition in such areas as airlines, cars, and telephones, could become impatient. Indeed, there is likely a willingness to pay for better quality power. This is already evident in the money spent on back-up power and lighting.

Changes, big and small – past, present, and future

Restructuring, a.k.a. 'reforms'

Post-independence, electricity was part of Nehru's 'commanding heights' of the public sector, and remained predominantly under government control for decades. In 1991, facing a balance-of-payment crisis, the Indian Government opened up electricity to the private sector – especially generation, where foreign capital was sought for adding capacity. Over the next decade or so, most SEBs were unbundled into separate generation, transmission, and distribution functions. For the most part, distribution utilities remained government companies (except Odisha and Delhi, which are privatized), but they now had to procure power from separate generators, both public and private. States also set up Electricity Regulatory Commissions to handle tariffs. The 2003 Electricity Act aimed to usher in more private participation and better operational performance, however, there were only limited signature breakthroughs in the Act (especially its implementation).

'… ELECTRICITY WAS PART OF NEHRU'S "COMMANDING HEIGHTS" OF THE PUBLIC SECTOR …'

In general, there is a push towards more competition and private participation, but few states have pushed to privatize their DisComs. What we do find are cities on the anvil for privatization, as well as a model of franchisees, which take over operations to help improve efficiencies, but the licence still remains with the incumbent.

Open Access, a.k.a. 'retail competition'

The government recently tabled proposed amendments to the 2003 Act; these aim to transform how utilities operate, through 'Open Access' or structural separation. As in the UK, in parts of the USA, and in some other countries, electricity *retail* would separate from ownership of the common distribution *wires*, ushering in retail competition and private participation.

In fact, the 2003 Electricity Act allowed 'Open Access' for large consumers (over 1 MW), and Mumbai allowed retail competition for all users. But realizing change is harder than drafting legislation. Will private players even want to take up 'unviable' areas? It is worth emphasizing that private participation is not the same as competition (and even market systems need regulation).

In Mumbai, retail competition saw cherry-picking (plus disputes), requiring regulatory intervention in transactions with poorer consumers. Even worse, states resisted meaningful open access (for large consumers) though various mechanisms; some of these were overt (including cross-subsidy surcharges) and some covert (such as invoking Section 11 of the Act, 'extraordinary circumstances', to prevent sale of surplus power outside the state, or treating consumers as temporary customers when they wanted power from the incumbents).

Most fundamentally, whenever we have a system with extreme pricing distortions, both within and across consumer segments (subsidies and cross-subsidies), what would new entrants want to do? Most likely, *cherry-pick the best consumers*, leaving someone else as a provider of last resort. There are other issues policy-makers must address including: lack of good wholesale markets, continuation of cross-subsidies, incorrect price signalling, and calculations based on average costs and book values – not reflecting such factors as time-of-day pricing or marginal costs. In addition, the way in which improved service on a per consumer level is operationalized (via new entrants and new retail offerings) is unclear, given that load-shedding and supply quality are determined at a distribution feeder level; this creates difficulties in providing a service to thousands of small consumers, at least until smart meters are deployed.

Green, clean, and smart

India has promoted Renewable Energy (RE) for decades – it even has a separate Ministry for New and Renewable Energy. But the question remains: how much more, if any, are consumers willing to pay for so-called green power, especially when they face shortfalls in supply?

In a move to augment clean energy, the Government recently announced ambitious plans to add 100 GW of solar power by 2022, increasing previous targets (under a Central National Solar Mission) fivefold. Ambitious, yes, but are there hidden costs or implications? Drawing insights, or even small portions verbatim, from chapters in a recent book (*Blowing Hard or Shining Bright? Making Renewable Power Sustainable in India, Brookings India*, 2015), we can see a few issues that are not adequately addressed in a more simplistic generation-oriented policy thrust.

Renewables in India are different from renewables deployed in places such as the USA and Europe; understanding these differences is key to viable policies. The triad of 'usual' challenges of renewables remains in India, such as:

- *intermittency/variability*,
- *location-specific potential* (sometimes concentrated in areas distant from consumers or the grid),
- *higher costs*.

In addition, India's grid is weak and unstable, and rather than having a reasonable reserve margin (typically

15–20 per cent in the west), there is a shortfall in the grid, officially in the range of 5 per cent or so, but actually much higher.

There are other technical reasons why the Indian grid is weak; these include a lack of ancillary services (systems designed to keep the grid stable, instead of just pricing kilowatt-hours), and even a lack of time-of-day pricing for bulk procurement of power. There are few peaking plants (which would operate only some 5–10 per cent of hours in a year), since there is insufficient incentive for these. Without incentives for plants that can ramp up (or down) quickly but which may not get used much, how will the grid handle 20 per cent renewables? Even worse, the types of plants capable of fast ramping are limited in near-term growth in India:

- *hydropower* (due to land and social/environmental challenges),
- *natural gas* (due to supply constraints).

Hydropower has an additional constraint when considering peaking or storage – its additional duty for irrigation limits when water can be stored versus released. Overall improvements in the grid, including better balancing without resorting to load-shedding, should be key areas of effort, which would facilitate increased RE penetration.

How much RE can the grid handle? There is seldom a technical limit (with storage, it could be 100 per cent) but it is more an issue of techno-economic optimization. Depending on what else is available (hydro is ideal, since it includes both storage and the ability to ramp up/down quickly), as well as the strength of the grid in terms of interconnections, a number of utilities in the world have found they can handle 20–25 per cent RE without major system upgrades. However, this is not India's initial bottleneck – shorter-term problems remain.

First, RE does not meet peak demand (India's peak is lighting-heavy, in the evening when the sun is down and wind is often reducing). This means that RE does not solve the capacity problem (kW), but instead addresses the energy problem (kWh).

Second, we have a system of enormous price distortions. A number of so-called paying customers (larger users, or commercial and industrial) are faced with electricity rates higher than the cost of opportunistic (take-it-when-available, without a battery) solar energy – this encourages self-generation. The consumer still keeps the grid connection for parts of the day, and back-up. Current pricing schemes do not factor in this issue, where a consumer compares his/her generation cost versus retail costs (which are always higher even without any cross-subsidy surcharges, because of the cost of the distribution grid, which provides such services as balancing, stability, and back-up.).

Continued technological improvements (including storage) will make this issue even starker (solar has experienced a learning curve improvement of 20–40 per cent in recent years). In addition, 'traditional' electricity continues increasing in cost, even before factoring in any carbon tax or price. While RE started out as niche, not only is the scale no longer niche, its disproportional impact on the grid, finances, and consumer participation make this a topic demanding deeper and more holistic analysis.

One of the proposed improvements to the grid that will facilitate increased RE is the deployment of Smart Grids. What are Smart Grids? There is no single technology or design, but this is a general term for the transformation of the power grid using digital communications and control to enable functionalities such as increased monitoring, resiliency, flexibility, efficiency, and enhanced renewables integration. Definitions and functionalities abound, but for India, the killer apps are likely to be different. In the west, the drivers have been:

- labour costs for meter reading and connections/disconnections,
- pressures due to renewable energy and electric vehicles,
- concerns on handling the peak on aging infrastructure (especially in the USA).

'… THE SHORT-TERM NEEDS INCLUDE REDUCTION OF LOSSES (BOTH TECHNICAL AND FINANCIAL) AND KEEPING THE GRID IN BALANCE …'

In India, the short-term needs include reduction of losses (both technical and financial) and keeping the grid in balance (especially given shortfalls).

Smart Grids are an enabling infrastructure for broader reforms – there is no single solution, but they can be designed to enable a multitude of policy and operational changes. Retail time-of-day pricing is just a start. One could offer:

- *guaranteed lifeline supply* (in place of today's load-shedding),
- *demand response* (a dynamic form of demand-side load management) could be enabled, whereby rather than procuring additional peak power when there is an impending gap in supply–demand, the utility could incentivize consumers to reduce their load.

Big shifts are underway with Smart Grids; some have more focus worldwide (like demand response). In India, a Smart Grid can also help reduce theft, since the utility would inherently be able to measure and monitor power flows.

The challenges with Smart Grids are more than financial (with large up-front capital outlays), or even of technology and standards (which are a work-in-progress, if not a moving target). The fundamental challenge is likely to be one that impacts all change and transformation – one of changing mindsets. As long as utilities are free to load-shed, no peaking power or smart meter will be cost-effective.

Changes – from inside or outside? Big or small?

India's central government, like previous governments, is pursuing 'electricity for all'. More than just a wire to the village (or home), there is now a push towards the actual service of electricity (the end of load-shedding). In addition, there are major programmes underway for financial/operational reforms, Smart Grids, and other related areas. Most of these are being driven outside the DisComs. Even peak and time-of-day pricing is being considered. However, the biggest reforms – of unleashing full market forces, including privatization of utilities – have not taken central attention in recent years. While new entrants for retail may add in some private participation, true competition for private participation may take some time.

In addition to changes under the purview of the Ministry of Power, other factors could make a major difference to India's grid. In the short run, how coal is (or is not) available will have a profound impact, and the government is keen to increase private participation (and productivity) in coal mining.

Taking a broader perspective of electricity worldwide, unbundling and restructuring was a major shift in the industry in the 1990s, but this did not impact the flow of power significantly (apart from the power that often began to be procured from newer generators, changing transmission patterns). In contrast, the rise of renewables, storage, and Smart Grids, which can be 'game-changers', portend a 'Utility Death Spiral' where edge-based generation (plus storage and demand response) prompts consumers to reduce, if not eliminate, supply from the broader grid; this raises the utility's costs (as it still needs to serve 'expensive' customers and also keep the grid stable), which further prompts others to exit the grid, and so on.

India is not quite there yet, but existing distortions in pricing make RE disproportionately attractive to larger consumers, and the technology will only improve over time. Just as mobile phones began as an expensive niche product, before completely overwhelming landlines in India, so rooftop solar power, having begun in the same way, will inevitably grow in importance. While small changes are more palatable, both operationally and politically, it is difficult to address a subset of the issues (such as: time-of-day pricing, links to renewables, storage, supply fuels, and theft) alone, due to their interdependency. The fundamental question then becomes: to what extent will the change be a managed one?

All views are personal.

Energy efficiency: low-hanging fruit for India

Anil K. Jain

At the Copenhagen Conference of Parties (COP) in 2009, India voluntarily committed to reducing its emissions intensity of GDP by 20–25 per cent from 2005 levels, by the year 2020. Although it is currently on track to meet (and perhaps even overachieve) this target, India faces challenges in sustaining this momentum; its population is rapidly urbanizing, but over 50 per cent still work in agriculture, and a third currently lack access to any form of modern commercial energy. Several factors – such as subsidized energy, delays in the adoption of efficient technologies, a large unorganized industrial sector, and the lack of mandatory building codes – pose further impediments to this target. In this context, energy efficiency could arguably be the biggest determinant of whether, and of the extent to which, India will achieve its target.

Policy vacuum

Globally, most policy attention on the energy sector is concentrated on select areas such as 'energy security' (typically taken as 'security of supply'), pricing, absolute reductions in carbon emissions, and facilitating energy access. The efficient use of energy has not featured very highly on this priority list, although it is linked to the achievement of all of the aforementioned areas.

The IEA *World Energy Outlook Special Report, 2013* ('Redrawing the Energy–Climate Map') in fact argues that four key policy measures can keep the door open to the 2 °C target before a new climate agreement comes into force in 2020. These are:

1 Adopting energy efficiency measures.
2 Phasing out inefficient coal-fired power plants.
3 Minimizing methane emissions from upstream exploration.
4 Partially phasing out fossil fuel subsidies.

Of these, energy efficiency alone could account for 49 per cent of the emissions reduction required to stay on course. Further, investments in the right technologies and low-carbon energy pathways can substantially avoid and reduce the requirement for additional investments up to 2020 and thereafter.

About 93 per cent of the global growth in energy demand between 2010 and 2030 is predicted to come from non-OECD countries (*BP Energy Outlook, 2030*). Within this, India is likely to register the second-highest

growth after China. The IEA estimates India's energy intensity at one of the highest in the world at over 0.4 tonnes of oil equivalent per US$1000 GDP. While there are a number of reasons – including the steady devaluation of the Indian rupee by over 33 per cent over the last three years – why this estimate may not be accurate, India compares poorly on this front. Therefore, incorporating efficiency into India's modern commercial energy systems is essential. Yet, no comprehensive policy agenda exists on this vital aspect of India's energy economy.

A recent scenarios-based analysis undertaken by the Planning Commission – 'India Energy Security Scenarios 2047' (IESS 2047) – has estimated that India's total energy demand could be reduced by 25–40 per cent over the next three decades through the adoption of economy-wide energy efficiency measures. The IESS 2047 estimates that India's total primary energy demand could rise five-fold by 2047 to approximately 24,000 Terawatt hours (TWh), in a scenario where there is a failure to act on policy. But this figure could be 40 per cent lower if 'heroic' measures were adopted: encouraging the widespread uptake of technologies such as ultra-super-critical power generation, Electric Vehicles (EVs), and process improvements in the manufacturing sector.

Whilst India grapples with high import dependence (currently a third of consumption, but predicted to double over the next three decades), and strategizes to raise its domestic fossil fuel production, efficient energy use could partially substitute these efforts as a solution towards the country's energy problem. Based on the IESS 2047 analysis, there are several areas where gains from energy efficiency could be achieved.

Scope for savings

Industry is the single largest energy consuming sector in India, using over 2,200 TWh (2012) of primary energy out of total primary energy consumption of 4,905 TWh, with steel and cement accounting for 30 per cent of this. The Specific Energy Consumption of the steel sector compares very poorly with global averages, while that of the cement sector is about average. With urbanization and the expansion of infrastructure, these two construction-linked industries will continue growing. India's current building stock is estimated as representing just 30 per cent of the floor space area that will be in existence by 2030. Steel manufacturing capacity is expected to grow from 90 million tonnes per annum (Mtpa) in 2012 to over 600 Mtpa by 2047. If cement and steel were to adopt more efficient technologies, primary energy consumption from industry could be brought down by 30 per cent from its projected level in 2047 (from 11,326 TWh to 7,960 TWh). India launched an incentive programme under its Energy Conservation Act in 2001; this included an efficiency trading scheme to encourage large industrial units to adopt energy efficient processes. However, it is the unorganized sector (including brick kilns, refractories, and small-scale units) comprising nearly 50 per cent of the total energy consumed in industry, that holds the key to savings. The challenge is therefore to deliver efficient technologies, together with finance for such investments, and to regulate these units.

The *transport* sector accounts for the second-highest energy consumption (850 TWh) but also has the potential for the largest energy savings; these savings could be brought about through policy measures encouraging transit-oriented urban development, shifts towards public transport, and the adoption of EVs. Freight is an important driver of energy consumption in transport, as current policies aim at increasing the share of manufacturing in GDP from 16 to 25 per cent by 2022 (in comparison, it is 34 per cent in China). Therefore, logistical planning and modal shifts could be of assistance in the management of freight and the moderation of energy thus consumed. These measures could reduce the demand for energy in transport by nearly 50 per cent in 2047 (from 6,085 TWh to 3,035 TWh). Efficiency savings measures in transport potentially have positive externalities, in terms of reducing the dependence on liquid fuels, and reducing air pollution in cities. Arguably, policy initiatives encouraging these savings are already in place – for instance, India's 'National Electric Mobility Mission' – but need scaling up.

'… URBAN PLANNERS EXPECT A NEAR DOUBLING OF THE URBANIZATION RATE FROM 30 TO 60 PER CENT …'

India's population is expected to stabilize at nearly 1.7 billion by 2050. On the back of this, urban planners expect a near doubling of the urbanization rate from 30 to 60 per cent of the population, as early as 2030. Urbanization has led to the emergence of the *buildings sector* as a growing energy consumer, using 480 TWh of energy in 2012; however, this consumption could rise nearly 13 times to 6,350 TWh (2047). Efficiency measures could reduce this by 42 per cent to 3,688 TWh. Potential areas for savings in this sector include Heating, Ventilation & Air Conditioning (HVAC), lighting, and domestic appliances. The buildings sector will also continue to be a major electricity consumer, as nearly 25 per cent of the current global figure of 1.3 billion people without access to electricity live in India. Consequently, efficiency measures in buildings, such as in the phasing out of incandescent lamps (similar to the EU and Japan), in lighting and cooling, through LEDs and variable speed compressors in air conditioners – will have positive externalities, aiding the phasing out of kerosene. India has

done extremely well in 'star rating' its domestic appliances and has achieved major efficiency gains though this. However, Energy Conservation Building Codes, which present an opportunity to scale up these benefits in the sector, have yet to be mandatorily applied to new constructions.

'SUBSIDIES ARE ENTRENCHED IN INDIA'S POLITICAL ECONOMY …'

Agriculture and cooking together account for roughly 30 per cent of total primary energy consumed. Energy consumption in these sectors is influenced through indirect pathways, such as socio-economic factors and access to infrastructure. Seventy per cent of the population live in rural areas, where the primary energy source is often non-commercial energy (wood, dung) or subsidized liquid fuel (diesel, kerosene). Subsidies are entrenched in India's political economy – diesel helps support pumped irrigation and farm mechanization (mainly tractors), while kerosene supplements biomass in cooking and lighting. The importance of biomass to this constituency is highlighted by the fact that roughly 25 per cent of India's primary energy consumption comes from non-commercial fuels. Due to the poor availability of modern cooking fuels and limited grid connectivity, the agriculture and cooking sectors present both a challenge and an opportunity in terms of energy efficiency. It is difficult to engage with this constituency, due to wide dispersal and large numbers, but nevertheless there is large scope for energy savings. The IESS 2047 argues that the expansion of the electricity grid and the availability of cleaner cooking fuels can potentially lead to the phasing out of biomass. In agriculture, electric irrigation pumps could replace inefficient diesel pumps. Agriculture and cooking hold the potential for a reduction in energy consumption from 2,855 TWh to 1,830 TWh in 2047, or a 35 per cent saving.

Energy, development, and environment

A decision on India's 'energy pathways' could allow policymakers to pursue the goals of economic development in an environmentally sustainable manner. On an aggregate basis, India's energy consumption could rise five-fold from 4,905 TWh in 2012 to 23,679 TWh in 2047 in the 'Least Effort Pathway' in the IESS 2047 scenarios analysis. However, in the 'Heroic Effort Pathway' (discussed above), consumption could rise to a figure of just 14,732 TWh, which is 40 per cent lower than the figure in the 'Least Effort Pathway'. This presents challenges, but the size of the 'prize' of efficiency gains makes the effort potentially worthwhile.

The IESS 2047 scenarios discussed above have not delved into the supply side, where there are challenges that risk constraining or neutralizing the potential efficiency gains discussed above. India's per capita energy consumption in 2011 was approximately 614 kilograms oil equivalent (kgoe) against the global average of 1,890 kgoe (according to the World Bank), indicating scope for India to step up energy supplies to its citizens. Specifically, coal, which comprises two-thirds of electricity generation, remains the 'elephant in the room'. The efficiency of India's coal-based thermal plants (on a Higher Heating Value basis) was just 33 per cent (2012), which is substantially lower than the plants in China and the USA (IEA Energy Technology Perspectives, 2014). India's energy-related emissions (which comprise two-thirds of its total GHG emissions) could rise from the present 1.4 tonnes/capita to 7.6 tonnes (in 2047) in the 'Least Effort Pathway'; this rise could be limited to a lower level of 3.3 tonnes, if policy action to usher in renewables (alongside other measures) is taken on the supply side.

Energy efficiency as energy security

India has arguably responded to domestic concerns over climate change through the adoption of various policy measures. In 2008, the Indian Government announced eight National Missions as part of its National Action Plan on Climate Change, in the areas of energy efficiency, solar energy, water, sustainable habitats, and agriculture, amongst others. India's Bureau of Energy Efficiency (BEE) has statutory powers to implement the Energy Conservation Act across economic sectors, and has earned global recognition for launching schemes aimed at market transformations, efficiency labelling and star rating, and efficiency trading certificates. India's large thermal generation capacity augmentation programme after 2017 will be solely based on super-critical, and later, ultra-super-critical technology. India has also announced Corporate Average Fuel Economy standards for passenger vehicles, effective from 2016.

However, thus far energy efficiency is recognized more as a response to climate change, and separate from the issue of energy security, which is perceived as a bigger challenge. The IESS 2047 scenarios, however, reinforce the validity of energy efficiency as a key dimension of energy security. While 'clean energy' investments in climate change mitigation may be subject to movements in the prices of fossil fuels and national income considerations, energy security is typically placed by nations on a higher pedestal.

On the one hand, India's energy imports are rising, its current account is stressed, and its industries are uncompetitive (the price of power to industry on a Purchasing Power Parity basis is among the highest in the world). On the other, the adverse effects of climate change are increasingly visible with recent unprecedented floods in its Himalayan Rivers, and frequent coastal storms. These twin challenges call for a concerted strategy – with the efficient use of energy at its centre.

The future of nuclear power in India: a question of liability law

Arghya Sengupta

In 2008, as a result of a joint Indo-US agreement on civil nuclear cooperation, India gained access to the Nuclear Suppliers' Group, allowing it to access civilian nuclear technology and fuel from other countries despite not being party to the Non Proliferation Treaty (NPT). Following this, in 2011 India announced ambitious plans to expand its installed nuclear power generation capacity to 63 Gigawatts (GW) (out of over 800 GW) by 2032 through civil nuclear trade. However, several years on, much of this envisaged trade and investment has yet to come to fruition. Nuclear power remains on the agenda; India's new government (elected in May 2014) urged the Department of Atomic Energy to triple nuclear power generation capacity from the current 5.7 GW (out of a total installed capacity of over 200 GW) to 17 GW by 2024. In the longer term, India's Atomic Energy Commission expects a far more ambitious 500 GW of nuclear power capacity to be in place by 2060. However, the quantum of domestic and foreign investments required to achieve these targets has remained elusive. This has largely been put down to the passage into law of the Civil Liability for Nuclear Damage Act, 2010 ('the Act').

The Act, which sets up a specialized compensation mechanism for victims of nuclear incidents, contains provisions arguably inconsistent with India's international obligations. Additionally, it has been held to be excessively onerous on the suppliers of nuclear equipment and materials. Two specific provisions are particularly contentious:

- Section 17(b) which holds suppliers liable for recourse when a nuclear incident results from either a patent or a latent defect in the equipment or material supplied, or as a result of the supply of substandard services; and
- Section 46 which arguably allows suppliers to remain liable under regular provisions of tort law and other general legislation despite having fulfilled their liabilities under this Act.

This article explores these two issues and argues for a legislative re-alignment that ensures nuclear safety while incentivizing participation in the nuclear industry. Though several other issues are relevant for operationalizing the Act, specifically the establishment of the India Nuclear Insurance Pool, recently announced by the Government of India for insuring operator and supplier liability, they are incidental to the core legal concerns that currently impair the growth of nuclear energy in India, and are consequently not dealt with in this article.

Recourse liability of suppliers

Section 17(b) of the Act resulted from a protracted consultative process in Parliament. With India marking the twenty-fifth anniversary of the 'Bhopal Gas Tragedy' – arguably its worst industrial accident – at the time the Bill was being debated, the demand to hold all suppliers, especially foreign companies, strictly liable weighed strongly with parliamentarians. At the same time, the Convention on Supplementary Compensation for Nuclear Damage, 1997 (CSC) – a multilateral treaty that provides a pool of funds to which resort can be taken by Contracting Parties in the event of a nuclear incident – which the Government of India had expressed an intention to sign, contains extremely circumscribed provisions on recourse to suppliers. Article 10 of the Annex to the CSC allows recourse to suppliers in the event of a nuclear incident if it is either provided for by contract or if the damage is caused by an act or omission of an individual with intent to cause damage. A precondition for ratifying the CSC is the need to have a domestic legislation in compliance with the Annex.

Faced with divergent pulls, the Parliament arrived at Section 17(b) as a workable compromise solution. Thus while Section 17(b) holds suppliers liable for both patent and latent defects in equipment or materials supplied, or for substandard services, there is no liability for negligence or wilful defects. A key principled argument justifies this formulation – it is the public policy of India to ensure that those at fault are held liable for their actions. If the supplier thus provides defective equipment or material, insulating him from liability would not only be unprincipled, but also fail to provide adequate incentives for the supplier to ensure safety.

'THE ACT … HAS BEEN HELD TO BE EXCESSIVELY ONEROUS ON THE SUPPLIERS OF NUCLEAR EQUIPMENT …'

However, two key countervailing arguments may be raised – *first*, the fault-based provision on recourse liability leads to the pyramiding of insurance costs and a consequent rise in the costs of nuclear energy. This is because if every supplier has to take out insurance in order to cover himself in the event that a defective part causes nuclear damage and passes the same (or some portion thereof) to the operator, who in turn, passes it on to the consumer, nuclear energy could become unaffordable and consequently non-competitive relative to other forms of energy. *Secondly*, the incorporation of such a provision is inconsistent with Article 10 of the Annex to the CSC and other internationally accepted principles of civil nuclear liability (in the earlier Paris and Vienna Conventions) though the Government of India believes otherwise.

Whether indeed the provision is inconsistent with international principles is a complex question of international law that must be enquired into elsewhere. However, as far as the former issue of pyramiding insurance is concerned, the government, cognizant of the criticism, introduced Rule 24 in the Civil Liability for Nuclear Damage Rules, 2011 to address the situation. Rule 24 provides that it will be a standard term in the supply contract that recourse liability will be limited to the duration of product liability of the equipment supplied, or the duration of the initial licence issued under the Atomic Energy (Radiation and Protection) Rules, 2004 (five years), whichever is longer. At the same time, it will be limited in amount to the extent of operator's liability or to the value of the contract itself, whichever is less.

This rule which seeks to limit liability for suppliers is *prima facie* sensible. However, two caveats are relevant: first, there has been no evidence-based study of the extent to which the price of nuclear energy will increase if suppliers have additional recourse liability foisted on them. Given that the maximum amount of liability that a supplier will, in any event, be liable for is Rs1500 crore or US$250 million (since that is the cap on liability on the operator which the supplier may have to bear) it will be essential to marshal evidence to determine the actual rise in price of nuclear energy as a consequence. This will be particularly useful in determining if a one-size-fits-all rule should be in place for suppliers based on the value of their contracts, irrespective of the nature or significance of the equipment or material supplied.

Second, the limitation of recourse liability in this manner, through a rule, raises serious issues of administrative law. In India, while delegated legislation (rule-making) is permitted, there are two principles circumscribing it:

- an essential legislative function cannot be delegated (vice of excessive delegation),
- the rule cannot go beyond the statute from which it derives its legitimacy (doctrine of *ultra vires*).

Rule 24 prescribes a limitation in liability and time that is not contained in the statute. Though it is formulated as a standard term in any supply contract, the terms themselves are contrary to Section 17(b) of the Act which prescribes no restrictions on recourse liability on suppliers. Thus the Rule is liable to be struck down as illegal by a court of law for violating basic principles of administrative law; further, in pursuance of the said rule, any contract might also plausibly be voided for being against public policy, since it runs contrary to a statutory liability that a supplier must bear. Greater thought is necessary to incorporate the practically relevant limitations on supplier liability in a legally justified manner.

Concurrent liability under other laws

The Act is envisaged as a special mechanism for speedy compensation for victims of a nuclear incident. By incorporating the principle of legal channelling of liability that channels all liability to the operator, irrespective of fault, the Act seeks to ensure quick compensation for victims without getting entangled in complex legal and evidentiary issues. It should be only natural that, given the existence of such a special mechanism, a victim's right to claim compensation under other legislations or provisions of law would be barred. This is especially so, since there is no envisaged limit on the total compensation that can be claimed by a victim under this Act. While there are caps on the liability of the operator and the total liability in respect of a nuclear incident, it is clearly provided that for claims over and above the latter, the Central Government shall take necessary measures for paying compensation.

However, Section 46 of the Act states that this Act shall be in addition to, and not in derogation of, other laws in force, and nothing contained in the Act shall exempt the operator from any other proceedings under other laws. A conjunctive reading of the two parts of Section 46 suggests that provisions of other laws governing compensation would continue to be applicable and operators may be held liable under any of those provisions. This would include criminal liability, which in any event cannot be excluded under this Act.

However, a disjunctive reading of the two parts – a reading used by several foreign suppliers – suggests that other laws pertaining to compensation continue to remain applicable *in totality*. This means that the victim of a nuclear incident can proceed against a faulty supplier as a result of whose supply he suffered damage. There is nothing in the Act which prevents such action. On the contrary, the second part of Section 46 (which discusses only concurrent liability of operators) can be interpreted as being silent on, and hence not governing, questions of concurrent liability of suppliers. This leaves suppliers (as well as operators) open to potentially unquantifiable amounts of liability.

That liability should be capped, and consequently quantifiable, for the purpose of taking insurance is a platitude. The Government of India, at the time of the recent visit of President Obama has committed to issuing a 'memorandum of law' clarifying its position. Such a clarification is welcome since section 46, as per the disjunctive reading above, creates considerable uncertainty as to the sanctity of liability caps under the Act. This is an insurmountable deal-breaker, as both suppliers and operators are open to unquantified amounts of liability. Given the fact that operators of nuclear plants in India are owned and controlled by the Government of India, and the government is the last

resort for compensation, this problem is particularly acute for suppliers who, in the absence of this provision, would have their liability solely determined under this Act. Further, such a provision which was passed without much discussion in Parliament, would defeat the *raison d'être* of the Act itself, which is intended as a special mechanism to deal with questions of nuclear liability. An amendment to this provision, underlining the overriding nature of this Act and allowing the concurrent continuance of criminal liability proceedings alone, thus needs to be considered.

Conclusion

Nuclear power presents a significant opportunity to provide a cheap and low-carbon energy source for India – specifically in comparison to coal. However, there is currently a mismatch between India's ambitious plans for nuclear energy and the cautious drafting of its legislative and regulatory framework. If the targets in the former have to be met, the conceptualization of the latter will have to be pragmatic, without compromising on safety. A failure to do so has meant that in the last four years, since the coming into effect of the Act, the expected bilateral deals pertaining to nuclear power co-operation have not materialized. This is particularly the case with companies from the USA and Japan, which do not enjoy a sovereign guarantee from their respective governments. If this situation is to change, it is essential that the liability legislation is clarified or amended, as the case may be, to ensure that nuclear power provides a safe and viable source of energy to meet India's burgeoning energy requirements. President Obama's recent visit to Delhi resulted in a renewal of cooperation to resolve this issue for US nuclear suppliers. The orientation of a general solution with particular suppliers in mind raises several concerns. Further, the manner of resolution even for US suppliers leaves much of the detail to be worked out through contractual discussions. Relevant legislative clarification and amendments are necessary if investments in nuclear power have to pick up.

'… A MISMATCH BETWEEN INDIA'S AMBITIOUS PLANS FOR NUCLEAR ENERGY AND THE CAUTIOUS DRAFTING OF ITS LEGISLATIVE AND REGULATORY FRAMEWORK …'

Fragmented and fitful: India's energy diplomacy

Pramit Pal Chaudhuri

Since the 1991 introduction of economic reforms that signalled the end of a highly regulated, socialist economic system, India has struggled to inject market reforms into its energy sector. This has not been an easy process and the recently elected Narendra Modi government is just the latest regime to announce ambitious plans for reform. There are numerous reasons for this having proved to be such an onerous task: natural resources are treated as government assets, energy regulation is divided between the federal and state governments, and the domination of inefficient state-owned enterprises has resulted in a sector shot through with corruption and political interests. Strong populist traditions also mean that there is an entrenched policy of fuel subsidies and energy price controls which has led to chronic underinvestment in power infrastructure and technology. Even where there has been considerable Indian private sector involvement, notably in natural gas, there has been a sense that policies are determined by influence-peddling.

The degree to which these domestic policy issues overwhelm the debate on the Indian energy sector cannot be underestimated. New Delhi gives only fleeting consideration, normally just rhetorical, to the external aspect of its energy policies. Another reason why the country's foreign policy and energy security do not overlap is that, barring the 1970s OPEC oil crises, no international energy rupture has shocked its political system sufficiently for it to integrate external policies with domestic energy reforms in a systematic manner. India's external energy policy has therefore revolved around peripheral or transient issues. Attempts at energy diplomacy have been moved forward in fits and starts and are easily trumped by domestic political considerations.

The purchase of overseas assets

There has been a constant political refrain, repeated recently by the Minister of State for Petroleum and Natural Gas, that India's energy security can be assured by the buying of oil, gas, and more recently coal, assets overseas. This narrative argues that this will provide both security of supply and fuel price stability, while easing India's chronic balance of payments problems – fossil fuels are the country's largest import. This belief has been strengthened by China's more aggressive quest for foreign resources.

But India's actual policies have been designed to constrain such asset buying. The state-owned oil and gas firms are financially squeezed by large subsidy payments, but are required to raise funds in the capital market and must realize fixed returns on their investments. While New Delhi does use diplomacy to facilitate such purchases, the result is that India's overseas energy assets are about a tenth those of China's. A 2010 Confederation of Indian Industry study concluded that India's overseas equity oil holdings translated into 65 million tonnes (Mt) of oil in 2009–10, versus 800 Mt for China. Similar figures arise for the amount of money invested by Indian versus Chinese firms in most years. The last Indian Prime Minister, Manmohan Singh, an economist by training, insisted that overseas energy purchases should be seen as purely commercial decisions. The current Modi government has spoken of the need to buy such assets, but has not reversed any of the regulations that constrain state-owned firms.

'INDIA'S OVERSEAS ENERGY ASSETS ARE ABOUT A TENTH THOSE OF CHINA'S.'

The Indian private sector has generally not been active in this field, though recent overseas oil and gas acquisitions by Essar and Videocon (two of India's large private sector energy firms) in Africa (most notably Mozambique), and off Vietnam's South China Sea coast, may indicate a growing appetite. Their activities, however, have no strategic content and New Delhi's role in concluding private sector deals is often minimal. Private Indian firms have been far more active in buying coalfields in Africa, Indonesia, and Australia, reflecting the dismal shape of domestic coal production.

The Modi government has begun exploring the possibility of using foreign policy to reform longstanding distortions in India's energy system. For example, spurred by the tight-oil revolution, India has sought to shift from the JCC price for its natural gas imports and adopt cheaper Henry Hub prices. Hence its efforts to try and secure an open-ended US commitment for gas exports to India and a new dialogue with Japan on the issue of Asian gas pricing. Attempting to rejig the global gas market is something new for India. At present, this is an effort that is unlikely to succeed – given the country's dependence on Qatar and the lack of an integrated gas market at home (due to a lack of infrastructure).

Investments in power

Since economic reforms began in 1991 there have been successive waves of foreign investment in India's power sector, in answer to various policy promises and market-friendly legislation enacted by state and central governments. New Delhi has encouraged this because it cannot hope to generate sufficient capital at home for the enormous investments India needs, and will continue to need, in this sector. Commerce Ministry figures show that US$9.27 billion worth of FDI entered the power sector during the period April 2000 to August 2014 – a figure that would not include institutional equity investment.

The record of such foreign investment, however, has been mixed. The initial investments in the 1990s came to grief because New Delhi was unable to introduce the market-based electricity prices needed to make the foreign-funded power projects viable.

More recently, the previous Manmohan Singh government encouraged a huge expansion of gas and coal-fired power plants. But the government's inability to provide promised domestic coal and gas supplies at rates lower than those prevailing on international markets has left the current Modi government with thousands of Megawatts of idle power capacity and billions of rupees in bad debts.

Foreign investment is presently more interested in the renewable energy field – notably wind and solar – a flow of capital that has only accelerated since Modi has been elected.

Modi has sought to leverage Indian foreign policy to bring in more overseas capital and technology in the power sector, especially in the form of aid or subsidized loans, from countries including the USA and Japan. As multilateral finance institutions such as the World Bank and the ADB have increasingly shifted their focus to renewable energy, India has signed up with new Chinese-dominated multilateral financial institutions (such as the Asian Infrastructure Investment Bank and the New Development Bank) in part because of their willingness to consider fossil fuel-based investments.

Nuclear energy – a thorny foreign policy issue

The most successful foreign policy accomplishment of the previous Manmohan Singh government was to persuade the USA to lift international sanctions against India's nuclear power sector, a process that began in 2005 and was completed in 2008. This was in anticipation of an expansion of nuclear energy from the 5.7 Gigawatts (GW) of installed capacity at present to 63 GW by 2032.

However, in 2010 India passed a nuclear liability law whose provisions on component suppliers' liability were out of sync with international norms and considered too onerous by suppliers. US firms were unable to sell their reactors and other equipment to India, as were almost all nuclear power firms. New Delhi has struggled to find a compromise that does not require new legislation. The latest such gambit is to set up a national insurance pool to cover the liability – and to have the cost partially financed by the Indian government. This issue has also affected Indian component manufacturers, who

have been reluctant to provide nuclear parts since the law has been passed.

Modi has warmed to nuclear power since he came to office. But uncertainty – over its cost due to onerous liability legislation, the shadow of Fukushima, and a general reticence towards nuclear power by India's religious right – has meant that reactors have, so far, not been a priority. However, there is a growing sense that the prime minister's climate change ambitions will only be possible if nuclear is added to his energy agenda.

Hydroelectricity – opportunities for South Asian energy cooperation

Since 2008 India has invested in developing the infrastructure for hydroelectric power in the mountain kingdom of Bhutan and buying back the power. Bhutan exports about 6000 kilowatts a year, earning about US$250 million. New Delhi has sought to persuade Nepal, which has an estimated 40 GW of economically viable hydroelectric potential, to accept a similar model, but it has been hampered by Kathmandu's political instability and a broader Nepalese suspicion regarding India's intentions. India has smaller dam plans with Myanmar, but these are designed to help stabilize the insurgency-ridden border area between the two countries. Ambitious plans for a pan south Asian regional power grid have been encouraged by the Asian Development Bank, but have thus far yielded very slow progress thanks to a paucity of connecting infrastructure and, until recently, to India's lack of a single national power grid – every south Asian nation connects to the other via Indian territory. India's National Thermal Power Corporation (NTPC) has also been pursuing the possibility of power cooperation with Sri Lanka, again with little effect.

The promise of renewables

India began taking wind power seriously in the late 1990s and the past decade has seen the country install over 21 GW of wind power. Two successive national solar power missions have been launched since 2010 – both programmes have attracted considerable overseas assistance, but have been bedevilled with regulatory and grid linkage issues. Nonetheless, India is negotiating a 1 billion euro soft loan from Germany and even larger loans from the World Bank.

Prime Minister Modi, however, is an enthusiastic devotee of renewable energy, especially solar power. This partly reflects his personal interest in climate change but also the electoral dividends he earned from promoting solar power when he ran the state of Gujarat. Two-thirds of India's 900 MW of photovoltaic capacity was built in Gujarat under Modi's rule. While his government has focused on reviving the coal-fired power system, this seems to be seen as a short-term economic necessity. Modi's speeches are largely about renewables.

In his two major bilateral foreign policy visits – Japan and the USA – Modi has made investment, technological assistance, and financial help in solar energy a core part of the joint statement. It formed a key part of Barack Obama's visit to India in January and is likely to be the focus of Modi's upcoming visit to Germany.

Modi's government has also massively upped the target for solar power to an improbable 100,000 Megawatts by 2022. In addition, he has ambitious plans for off-grid solar, using that as the electricity gateway for the 300 million Indians who are without power. Renewable energy is also integrated into his plans for smart cities, reviving manufacturing and addressing climate change in general.

'PRIME MINISTER MODI IS AN ENTHUSIASTIC DEVOTEE OF RENEWABLE ENERGY, ESPECIALLY SOLAR POWER.'

The government's energy policies are still a road under construction. The many problems, both regulatory and financial, that bedevil the Indian domestic energy sector, together with the prime minister's own bias towards renewables, means that medium-term Indian energy diplomacy will be about leveraging overseas capital and technology to resolve these problems on the home front. New Delhi has had relative success on this front, especially in terms of overseas interest in the country's nascent renewable energy sector. India continues to endorse the idea of fossil fuel security rhetorically, through the purchase of assets overseas, but official restraints on state-owned energy firms, and the commercial objectives of private Indian firms, will probably continue to limit this policy in real terms. Notably, there has so far been no change regarding India's outward passivity on political developments in the Persian Gulf – its predominant source of oil and gas imports.

Towards a broader definition of 'energy security' for a growing India

Vipul Tuli

India is the fourth-largest energy consumer in the world, with an annual primary energy consumption of over 700 million tonnes oil equivalent (Mtoe). It could soon also become the world's largest energy importer. Estimates from McKinsey & Company suggest that by 2030, in a 'business as usual' scenario, India will consume over 1,500 Mtoe of primary energy each year, and will need to import over 50 per cent of this requirement. Not surprisingly then, energy supply security is high on the agenda of Indian policymakers and industry. Opportunities to supply India have also caught the attention of global energy exporters looking for stable markets, especially as surpluses in oil and coal grow.

While 'supply security' (or the reliability of supplies) is a critical factor, energy security for India involves more than just supply. The country has nearly a fifth of the world's population, and its per capita energy consumption is less than one third of the global average (614 kilograms oil equivalent (kgoe) for India versus a global average of 1,890 kgoe in 2011). As India strives towards its target of 8–10 per cent economic growth and its aspiration of becoming a manufacturing powerhouse, the country is likely to see massive growth in energy demand, which in turn will require large investments in upstream energy, refining, power generation, transportation, and consumption infrastructure.

In India's context, therefore, ensuring energy security will require a focus on three factors in addition to the reliability of supply, namely: energy access, economic viability, and environmental sustainability. As described below, India has made some notable progress in recent years on some of these dimensions, but on the whole faces a grave set of challenges to its energy security as defined above.

- *Supply reliability.* The development of India's domestic energy resources has simply not kept pace with demand. Exploration in oil, gas, and coal has been extremely slow. This is evident in India's reserve-to-production ratios, which have declined from 19 years for oil and 435 years for coal in 2000 to 17 years for oil and 185 years for coal. As a result, India's energy imports have grown from 20 per cent of consumption in 2000 to over 30 per cent today. India has also been unable to diversify its import sources. The majority of its crude oil imports of roughly 3 million barrels per day (mb/d) continue to be sourced from the Arabian Gulf, and its rapidly growing coal imports have largely been from Indonesia, South Africa, and Australia. Meanwhile, fossil fuel safety stocks have steadily decreased over the past three years, although they are expected to increase going forward, given lower crude oil prices and the commissioning of India's crude strategic storage facilities, currently about 5 million tonnes (Mt), or roughly 38 million barrels.
- *Energy access.* This has been steadily improving every year. Household access to electricity has increased from around 60 per cent in 2000 to nearly 80 per cent today. In the same period, household access to modern cooking fuels (LPG, gas, kerosene, and biogas) increased from 23 per cent to 35 per cent. Despite the improvement, however, the shortfall is staggering – over 200 million Indians do not have access to electricity, and nearly 700 million still use non-commercial energy for cooking. This remains one of India's largest energy security challenges.
- *Economic viability for stakeholders.* High global energy prices and a sluggish Indian economy resulted in India's energy imports growing from a figure representing 26 per cent of its total exports in 2010 to one of nearly 40 per cent in 2012. In the same period, energy subsidies rose from under 3 per cent of government expenditure to nearly 5 five per cent. While India's economic indicators for energy will improve dramatically with the recent fall in global prices and reduction in subsidies, the lesson is clear: India needs to make its economy less vulnerable to global energy shocks. However, financial returns to investors in India's energy sector continue to be a serious concern. Return on capital at India's top 20 energy companies has hovered around 10–12 per cent, well below the cost of capital of around 15 per cent.
- *Environmental sustainability.* India's share of renewables in primary energy has more than doubled from 1.6 per cent in 2000 to 3.7 per cent today. India has also set new global benchmarks for low-cost renewable power generation, receiving bids for solar development at 11–12 US cents per kilowatt hour (kWh). The energy intensity of the Indian economy has also improved, from 0.77 Mtoe/GDP (US$ bn) to 0.57 Mtoe/GDP (US$ bn), thanks partly to concerted efforts on energy efficiency. However, CO_2 emissions continue to rise due to the increasing share of coal in primary energy, as the country consumes more electricity. An environmentally sustainable energy sector with benchmark energy efficiency, cleaner hydrocarbons, and reliable, affordable renewables will be crucial for India's energy security.

In order to improve its energy security, India will need to address all four dimensions in fairly short order. The magnitude and range of initiatives needed is vast, requiring efforts akin to a national movement rather than incremental policy

changes. There are many initiatives that India can consider, in particular, the following broad measures:

- Aligning policymakers around an aspiration of achieving *energy independence for India by 2030*, with energy imports no more than 15–20 per cent, through a combination of domestic resource development, energy efficiency, renewables, and global investments in resources and supply infrastructure. Garnering true commitment to an ambitious goal of this nature is perhaps a necessary first step for India, given the number of energy sources, initiatives, and decision makers in the country.
- Launching a comprehensive national initiative on *resource mapping, exploration, and resource development* across India's coalfields and oil and gas sedimentary basins. This would require government funding for the initial data gathering effort, and corporate investment once prospectivity is more firmly established.
- Moving towards *market pricing for coal and gas, and competitive pricing for power* (market pricing for crude oil and most refined products is already well established). This would help remove distortions in inter-fuel pricing, for example between coal and gas. Specific consumer segments can continue to be protected through the direct transfer of subsidies to consumers and by selectively applying caps on prices, as required. Competition in power distribution is also necessary to introduce efficiency and eliminate pricing anomalies. For example, millions of urban Indian households are forced to use expensive diesel generating sets for power supply during peak hours, even though it would be cheaper for power distribution companies to generate and supply peaking power using LNG, hydro, or solar resources.
- Creating *'local energy ecosystems'* for innovation, technology development, manufacturing, and services. An energy ecosystem would be a cluster of energy companies, users, service providers, technology providers, and research institutions working in collaboration to achieve lower costs, higher productivity, access new resources, and establish local manufacturing. In particular, four types of ecosystems could be a priority to begin with:
  - unconventional hydrocarbons (tight reservoirs, high pressure/ high temperature reservoirs and deep water),
  - clean coal (underground mining, ultra-super-critical generation, ash control),
  - renewables (solar, wind, energy storage),
  - energy efficiency.
- The government can play a catalytic role in supporting these ecosystems through fiscal measures such as incentives for research, physical infrastructure (land, for example), grants to attract talent, and by creating demand for new innovation among its own energy companies.
- Using the current surplus in global energy supply to *forge new international bilateral relationships and resource access arrangements* with Africa, the Middle East, Latin America, and the FSU countries. These could include new contractual arrangements, inventory holding and backup contracts, complementary upstream and downstream investments, and shared transportation and storage infrastructure. The current oil price downturn is a unique opportunity for India to create long-term sustainable infrastructure solutions with energy suppliers in the region and beyond.
- *Accelerating rural energy access* through distributed systems as a priority initiative. Several companies are already experimenting with rural distributed renewable energy systems at a pilot scale. However, issues related to the eventual integration of these systems with the state grids, building capability among rural communities to operate and maintain the systems, and catalysing industry partnerships (for instance, renewables developers and telecom operators) will need to be addressed.
- *Strengthening Indian energy institutions* across the board. India's state-owned enterprises, for instance, need to build stronger capabilities for global growth. They also need approximately five times their current investments in R&D and technology to be able to access tougher and deeper resources. Similarly, regulatory independence needs to be ensured in the power sector, especially in tariff-setting. The governance of the energy sector would also benefit from a greater degree of integration; currently more than 10 ministries have a material say on investments in the sector.
- Finally, *rallying public opinion and raising awareness on energy issues*, especially on pricing, will be necessary. The popular narrative on energy in India has so far largely related to subsidies, allocations, and patronage. The narrative needs to change to unlocking India's resource potential, improving quality of supply, and ensuring energy access, technological innovation, and energy efficiency.

The challenges for India's energy security are real but not insurmountable. There are several recent examples of countries that have succeeded in materially shifting their energy security outlook in a matter of 10–15 years. The shale oil and gas revolution in North America, Brazil's massive effort to develop its subsalt resources, and China's global energy acquisitions and diversification of supply routes all show what a clear strategic purpose, aligned policies, and the development of integrated energy systems can achieve.

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