National Energy Security - *Coal and Beyond*

A PHD Chamber and Arthur D. Little viewpoint

10th July 2013

PHD House, New Delhi

Table of Contents

श्रीप्रकाश जायसवाल
SRIPRAKASH JAISWAL

कोयला मंत्री
भारत सरकार
शास्त्री भवन, नई दिल्ली-110001
MINISTER OF COAL
GOVERNMENT OF INDIA
SHASTRI BHAVAN, NEW DELHI-110001

2nd July, 2013

MESSAGE

I am happy to know that PHD Chamber of Commerce and Industry is organising a Conference on "National Energy Security – Coal and Beyond" to highlight the issues and challenges pertaining to the energy sector to attain industrial and commercial development of the country.

I am further pleased to note that PHD Chamber in association with Arthur D. Little India is bringing out a Research paper presenting all aspects of energy sector. While congratulating the publishers for their efforts, I sincerely hope that this will benefit all stakeholders concerned with the sustainable development of energy and its security.

I wish the conference all success.

(SRIPRAKASH JAISWAL)

Message
Mr Suman Jyoti Khaitan

The demand for energy has increased substantially in the recent decades and the supply to that is restricted. Rapid industrial and urban development has inflated the use of energy, to meet the rising demand of energy we have to depend largely on coal as it is the best and the cheapest source of energy. Also we will have to explore new arena for meeting our energy needs and to ensure energy security for the country.

With the aim of developing better technology, policies and strategies to meet domestic energy needs in order to address global climate change, there is a need to provide energy security to the country, guaranteed supply of coal with Better quality is a primary requirement.

On this backdrop, PHD Chamber in association with Arthur D Little is coming out with the research report presenting various aspects of Energy sector.

I wish success for the conference.

Mr. Suman Jyoti Khaitan,

President, PHD Chamber of Commerce and Industry

Message
Mr. Sharad Jaipuria

There is an increasing demand of energy for sustaining the country's economic growth and development. This can be met by a combination of renewable, nuclear and conventional sources of energy. The primary requirement is to provide guaranteed supply of coal with better quality for securing energy security of the county.

This conference provides a platform to the stakeholders, private players and policy makers to formulate the strategies and solutions for energy sector of the country.

I acknowledge the efforts of Arthur D Little for bringing out this publication and putting across the key issues pertaining to Energy Security.

I wish all the best and success for the conference.

Mr Sharad Jaipuria

Senior Vice President, PHD Chamber of Commerce and Industry

Message
Mr. Alok Shriram

India's energy sector is struggling to deliver a secure supply of energy. Growing demand, fuel imports and lack of sufficient capacity to make timely and adequate investments gives reason to fear that we are heading towards energy crisis. To eradicate the energy poverty and to ensure sustainable growth, energy must be secured.

Energy supply security can also be pursued through a much more vigorous effort to deploy renewable energy and nuclear power. Energy security is meant to protect energy consumption. This is where the issue of equity becomes central. For obtaining optimum sustainable economic development and desirable economic growth, there is a strong need for an assured access to energy resources at affordable prices.

PHD Chamber of Commerce and Industry in association with Arthur D Little is bringing out the research paper covering various aspects of Energy security. I acknowledge their efforts in coming out with this publication and wish the conference a great success.

Mr. Alok B Shriram

Vice President, PHD Chamber of Commerce and Industry

Message
Mr. Bimal Sareen

Securing the Energy of the nation is of utmost importance and the issue must be properly addressed so as to contribute for the sustainability and economic development of the nation. This conference provides a platform for improving energy efficiency and augmenting transfer of advanced technologies along with providing effective Solution to the industry by enhanced coal production and procurement needed for the growing demand of the economy.

PHD Chamber in association with Arthur D Little is presenting this report on Securing Energy. This report will highlight the strategies and solutions for energy security of the country and will help us to work towards a common understanding

I wish the Conference all the success and assure that such conferences shall continue to be held for the benefits of all segments of the industry and commerce.

Mr. Bimal Sareen

Chairman, Energy Committee, PHD Chamber of Commerce and Industry

Message
Dr. Srini Srinivasan

We are proud to be associated with the PHD Chamber as their Knowledge Partner for the Conference on "National Energy Security – Coal & Beyond" on 10th July, 2013. Based on our 127 years of global experience in the Energy Sector, we are confident that India will be able to achieve energy security for a sustainable economic future.

We wish the Conference much success.

Dr. Srini Srinivasan
Managing Director, Arthur D. Little India

Energy Security in India

Executive Summary

For sustainable economic growth and development, energy security of a nation is of utmost importance. Future is brighter for countries which are energy secure. Every nation would like to secure itself from being dependent on external factors for its energy consumption. We are witnessing Governments across the globe striving to be energy secure.

India has been struggling to become an 'Energy Secure' nation. The reasons for this situation range from inconsistent access to a resource pool to outdated technology to inefficient operations. Over and above dependence on coal, increasing demand for energy and irresponsible consumption have added to the woes.

As one of the world's top economies, we have lot to learn from both larger and smaller economies on how to achieve energy security. We have not been able to bring in the best practices, advanced technologies and efficiencies in operations to the energy sector to achieve this goal.

However, all is not lost, as there are ways we can salvage the situation. The advent of new technologies for accessing resource pools, efficient transmission and innovative ways of consumption have given the nation a ray of hope. Support of private initiatives, allocation of capital for setting up renewable energy operations, and a helping hand to overall efforts in this area are few of the steps that the Government of India has taken to move towards a solution to the energy security problem.

Arthur D. Little suggests a "prescription" for goals and aspirations for a successful energy policy for India, based on learning from global successes and failures:

- Promote a Stable Investment Climate
- Provide R&D Support
- Create Effective Taxation Policy
- Send the Right Price Signal through effective and efficient pricing mechanism
- Develop a coordinated Government-wide effort
- Perform effective change management

At this crucial juncture, it is important for corporates, industry experts and policy makers to work together to create a healthy environment for the energy sector. India, in spite of its complexities, can set an example to the world that it can solve this problem faster, cheaper and better than other countries.

Introduction

While India is the 5th largest consumer of fossil fuels in the world, India's energy production accounts for just 4% of the global energy production.

Despite skyrocketing demand, access to energy in India is still the preserve of a small minority of the population: 404 million people lack even rudimentary access to electricity, and 855 million people are dependent on rudimentary biomass and other traditional energy sources for cooking. This uneven access to energy has a direct negative impact on economic growth and inhibits poverty alleviation.

The pursuit of achieving sustained economic growth at a rate of even 5% impacts India's energy demand. That demand is exacerbating the already strained commercial energy supplies. Use of coal is increasingly being critized because of its negative impact on the environment. Furthermore, India's coal logistics system – including both production and transport – is so inefficient that in some cases it is cheaper to import coal and transmit electricity than to move coal by rail across the country.

On the other hand, oil, which is required to meet India's growing demand for automobiles, is increasingly imported, leaving the country with an ever-growing balance of payment deficits. Recent discoveries of large offshore natural gas fields along India's eastern coast don't provide much consolation, since India has not encouraged domestic exploration and production activity.

Hydropower is becoming harder to develop because of land title disputes, resettlement issues and water usage conflicts. Nuclear energy capacity buoyed by a recent cooperation agreement with the United States is projected to grow substantially over the coming years. Wind and solar power will also see growth, but on a smaller scale.

Therefore, one of India's bigger worries in today remains Energy Security!

What is Energy Security?

At the basic level, energy security means having access to the required volumes of energy at affordable prices. This also implies that sufficient alternative supplies are readily available at reasonable prices.

From the government's perspective, this definition also includes the energy policies and standby measures that can be implemented in the event of a supply disruption to mitigate its impact, to the extent possible, at a cost that its citizens consider reasonable. In addition, supply diversification by source, volume and substitutable resources can contribute to an effective energy security program under such definition. Energy security would also encompass government's ability to manage macroeconomic effects of major supply disruptions.

The Integrated Energy Policy (IEP) report of the Planning Commission, Government of India, defines Energy Security as: "We are energy secure when we can supply lifeline energy to all our citizens irrespective of their ability to pay for it as well as meet their

effective demand for safe and convenient energy to satisfy their various needs at competitive prices, at all times and with a prescribed confidence level considering shocks and disruptions that can be reasonably expected."

"The Asia Pacific Energy Research Centre (APERC) emphasizes the 'four A approach' of ***Availability, Accessibility, Affordability and Acceptability****, for energy security. APERC defines energy security as "the ability of an economy to guarantee the availability of the supply of energy resources in a sustainable and timely manner with the energy price being at a level that will not adversely affect the economic performance of the economy. According to that view, security of energy supply is affected by factors such as the (physical) availability and the (geopolitical) accessibility of energy sources, the (price and cost of infrastructures) affordability of energy as well as the (environmental) acceptability."*

Energy Security…. Beyond the Obvious

The energy industry directly affects the economy by using labour and capital to produce energy. This role is particularly important when economic growth and job creation are such high priorities around the world. In addition to the energy sector's economic contributions in general, relatively lower and stable energy prices help stimulate the economy.

First, lower energy prices reduce expenses for consumers and businesses, increasing disposable income that can be spent in other ways. Second, lower energy prices reduce input costs for nearly all goods and services in the economy, thus making them more affordable. The converse is also true: relatively higher energy prices place a drag on economic growth everywhere except in economies that are dominated by energy production.

Having said that, high growth in energy production and consumption is creating problems beyond just the depreciating rupee and dwindling forex reserves. The share of GDP that must be spent on oil supplies is also limiting growth in the sector. At times, the price of oil is limited only by the strain it places on the world economy. It has been observed that high and rising oil prices precede an economic downturn.

During the downturn, oil prices can drop to levels that, along with a weak economy, discourage investment in new oil production. When strong growth returns, we generally see the cycle repeated.

These events are not surprising because energy, especially oil, has a very low elasticity of demand and supply with respect to price. That means very large price changes are required to increase supply or decrease demand. In addition, oil has a very high elasticity of demand with respect to income. That means economic growth strongly increases oil demand. Lastly, energy expenditures can be a large enough component of GDP to adversely affect economic growth if they grow too large. Added together, these interactions can produce the following "vicious cycle":

- High GDP growth drives oil prices to high levels since high income elasticity increases oil demand, while low price elasticity requires high oil prices to balance demand and supply
- The resulting high share of GDP spent on oil reverses GDP growth
- With lower GDP growth, high income elasticity reduces oil demand
- With lower oil demand, low oil price elasticity sharply lower oil prices
- Low oil prices reduce oil production investments but encourage high GDP growth

"The current situation demands a comprehensive energy policy at sectoral and aggregate level, in sync with other policies critical for the Indian growth story to continue, and implemented systematically"

Challenges Related to Energy Security in India

Pricing continues to remain a key concern in the India energy sector, both in terms of hydrocarbon and coal sector. Since domestic energy prices are disconnected from the global trends, there is limited signalling mechanism for active demand-side management. Resource allocation and fuel side concerns bring in another dimension to challenges faced by the Indian energy Sector. There is a pressing need to bring in an independent regulator in the coal sector and create regulations around development of coal blocks at an improved pace.

A new framework could be evolved for domestic captive coal mine based projects, linkage based projects and imported coal based projects. A few of the concerns are mostly cutting across the sectors: For instance, delays in land acquisition, rehabilitation and resettlement and obtaining environment and forest clearances have proved to be the prime concern in the development of most energy sector projects. Finnacial health of distribution utilities is another element which requires attention of policy makers. Most of the private generating companies perceive increased payment default risk when negotiating PPAs with these utilities. This has a snowballing impact with commercial banks perceiving higher risks in these projects making cost of financing higher. *(refer to our previous PHD Chamber report on Discoms here)*

Similarly, the investment environment in the oil & gas upstream sector is getting affected due to regulatory uncertainties. At the moment, the Government is involved in contract administration, monitoring and review of investments and pricing decisions. The independent regulator could take up these roles, as recommended under the IEP. Pricing of major share of gas supplies in the Indian market is controlled, not market driven, and multiple pricing regimes exist. Controlled pricing may result in disincentivizing investments in the sector in terms of limited participation from foreign players, who have access to technology, much required in deep-water E&P activities.

The downstream sector is evolving in terms of policies and powers of the regulatory board, and the bidding framework for gas distribution. Controlled Pricing of certain petroleum products is another key issue faced by the Indian oil and gas sector, and as a result most

of the Oil Marketing Companies (OMCs) are currently operating under heavy burden of under-recoveries. Due to policy and regulatory challenges, India may lose on foreign investment, especially in areas like deep water E&P, shale gas, CGD, fuel retailing, etc, despite being an attractive market in terms of demand. Stable and consistent regulatory environment and need-based intervention from the state are required to attract investment.

India has faced significant challenges in the past in securing international supplies. There is an increased pressure on India to reduce its dependence on Iran due to Iran's non-participation in NPT; the Iran- Pakistan-India pipeline project has been stalled. In terms of gas supplies from The U.S., rules are not favourable for exporting gas to non-FTA countries. In addition, India has lost out to China for securing supplies through a transnational pipeline from Myanmar, and also in securing assets in countries like Khazkhistan, Nigeria, Angola, Russia, etc.

China has been able to use diplomatic channels to increase its chances of winning the bids. It has covered energy acquisition under layers of integrated packages of aid, concessional or low-interest loans as well as direct financing of infrastructure projects. Chinese companies like CNPC, CNOOC, Sinopec, on the other hand, also focus on makes social and economic impacts in the region.

Can a Country Truly be Energy Self – Sufficient?

Some countries can reach self-sufficiency in either electricity production or in the transportation sector. For example, the United States' electricity sector is practically self-sufficient. Nuclear power generates 78% of France's electricity, and renewables are responsible for 82% of Brazil's power. But of the world's 195 countries, very few are truly self-sufficient. Even energy-rich countries like Russia, Saudi Arabia, Venezuela, Brazil and Canada,which are well endowed in hydrocarbons, import some of their energy due to insufficient refining capacity.

Of the world's top ten economies, only Brazil and Canada, can theoretically reach self-reliance. The rest are poor in resources in relation to their needs, and their dependency on energy imports is growing by leaps and bounds. This means that as long as hydrocarbons dominate both electricity and transportation systems, most nations will never be able to achieve self-sufficiency, and will continue to rely on the global energy trading system.

While efforts to achieve energy self-sufficiency have led to solutions like increase in domestic production, devising energy efficient technology and increasing production efficiency, they cannot counter the impact of global crude prices. A price of a barrel of oil is more or less equal to every consumer, and when the price spikes, it does so for everyone, regardless of where their supply comes from. Thus, contrary to popular belief, the move towards greater self-sufficiency does not necessarily lead to cheaper energy prices. All countries, irrespective of whether they are importers or producers, are part of the global energy market.

Instead of rooting for energy self-sufficiency, countries like India should aim to diminish

the strategic importance of oil, which gains prominence because of its virtual monopoly over transportation fuel. For the most part, automobiles sold throughout the world can run on nothing but petroleum fuels, and thus energy commodities from which competitive fuels can be made are effectively barred from competing against oil. Because of this oil is not substitutable, so consumers cannot shift on the fly to competing products when oil prices become too high.

Just as the grid is agnostic as to what type of energy is used to generate the electricity it transmits, our vehicles as well as our fuel distribution system should be open to a diversified fuel mix. A variety of liquid fuels like ethanol, methanol and butanol can be made from natural gas, coal, biomass and municipal waste. Such fuels, in addition to gasoline, can power flexible fuel vehicles (FFV), which cost manufacturers an extra $100 or less to make, compared to gasoline-only cars.

Though, each of the fuel sources have pros and cons (for instance, some impose a higher premium on vehicle cost, others require expensive infrastructure, and yet others are not cost-competitive except when oil prices are high), the uncertainty over future oil prices requires that the transportation sector opens up to these options as a shield against the economic and security challenges posed by a volatile oil market.

Recipe for a Successful Energy Policy

As per a report issued by US Chamber of Commerce, Brazil provides an example of a country that has changed its energy security picture dramatically for the better. One of the biggest turnarounds has been its changing oil import posture. In 2009, after many years of steadily increasing domestic production, Brazil became a net oil exporter. Brazil's large ethanol industry—the world's second biggest—has contributed to this by displacing some of the demand for petroleum-based liquid fuels (though recent declines in ethanol output have had to be made up with imports from the U.S.).

Hydroelectric power dominates Brazil's electricity generating sector, accounting for about three-quarters of total capacity. While new hydroelectric capacity is being installed, Brazil is looking to diversify to avoid disruptions that could occur in the case of drought. Recent "pre-salt" finds in deep water off Brazil's coast are significant. So in addition to improving its own energy security, Brazil promises to reduce the reliability and diversity risks attached to global oil supplies.

A look at the Nordic region (Finland, Sweden, Norway, Denmark, and Iceland) energy security is one of the best case studies to be followed by other countries and regions. For instance, Finland and Sweden are two of the leading bioenergy-using countries in the world. Norway,with hydro power development, Denmark, with high growth in wind power utilization, and Iceland, with geothermal, are the successful examples of the utilization of renewable energy resources.

While Iceland was one of the Europe's poorest countries during the 20th century, with dependence upon peat and imported coal for its energy, it has developed into a country with a high standard of living in which roughly 86.3% of primary energy is derived from

indigenous renewable energy resources.

The share of oil in energy supply has been substantially reduced in the last three decades in the Nordic countries, especially in Finland and Sweden. This reduction is important because, at the same time, the population and the penetration factor of personal automobile have multiplied too.

Finland and Sweden have the top diversified energy portfolios compared to other countries. As they are two countries without significant domestic resources, the level of diversification in those countries is noteworthy for us in India.

Arthur D. Little suggests a "prescription" for a successful energy policyfor India, based on learnings from global successes and failures:

- **Promote a Stable Investment Climate.** The energy sector is a very capital intensive industry and developing the infrastructure involves long lead times. As a result, the stability of the market and red tape-free governing rules and regulations attract capital for energy infrastructure investment. Tax rebates could be offered to encourage private sector participation for developing special sources of energy at a minimum scale.
- **R&D Support.** Government should set aside funds, which could be in the form of a sovereign wealth fund, to invest in projects involved with development and commercialization of renewable energy technologies, technologies related to energy efficiency and conservation, and clean tech
- **Effective Taxation Policy.** Tax incentives including tax rebates, direct production support, environmental bonuses, etc. are important schemes to ensure the diffusion of renewable energy. Effective taxation policy must aim to curb the growth of energy consumption ("efficiency and conservation") and steer the production and use of energy towards alternatives with less emissions. Taxation on use of primary sources or energy for industrial use could increase price competitiveness of alternative sources of energy
- **Provide the Opportunity to Earn Adequate Returns.** It is important to provide investors with ongoing opportunities to earn an adequate return on investment. For example, policies that avoid adjusting tax and royalty regimes in response to short-run market conditions are more conducive to attracting and maintaining investment.
- **Send the Right Price Signal.** Prices provide powerful signals to organize the productive use of energy in the economy. However, to do this, prices need to reflect real underlying costs. Attention needs to focus on retail energy prices that are held well below production costs because political concerns trump economic efficiency. For example, when retail energy prices are below costs, consumers enjoy paying less and fail to appreciate the benefits of investing in energy efficiency and hence, invest less than what is economically justified. On the production side, when retail energy prices are too low, producers cannot recover their costs and subsequently lose the ability to attract additional capital and produce as efficiently as possible. Compounding these problems are governments

that get fiscally hamstrung trying to counteract these distortions through tax expenditures or subsidies from general funds.

- **Appreciate the Complexity.** The energy sector is complex. The rules and institutions that govern this sector need to reflect this complexity, and also resist policy changes based on simplistic solutions that underestimate the time and cost of altering the industry. More often than not, these initiatives cause unintended consequences that delay sustainable progress in the long run because of the inevitable negative reaction to unexpected costs.
- **Pace of Change.** Effective energy policy aligns change with realistic cost and technology assessments. For example, policies designed to force technological innovation need to initiate enough activity to create scale, push innovators up the learning curve and allow for the evolution of technology to lower costs. If the pace is too slow, then technology does not advance and when the pace is too fast, additional costs accumulate with few additional benefits.
- **Coordinated Government-wide Effort.** Any successful policy requires the entire system to work in tandem and complement each other. This requires a comprehensive effort that involves all the ministries and institutions to be part of the initiative right from the pilot-test phase to implementation phase. All other considerations, from regulatory and tax policies to infrastructure implications, need to be examined in sync with one another in order to short-circuit barriers to the future implementation of pilot programs that prove to be economically, socially, environmentally and even politically viable.

Enhancing Energy Security in India

Reducing vulnerability to external shocks: fuel and source diversity

Reducing vulnerability to external shocks through diversifying fuel types and sources is akin to the portfolio diversification well known to investors. India thus needs to not only evaluate the security of individual supply chains, but also the riskiness of its energy supply portfolio against the vagaries of energy markets. Government also needs to avoid a false sense of security through ill-advised domestic ventures, such as maintaining inefficient local refineries based on imported oil feedstock in preference to rationalized fuel products procurement in regional markets. The contribution of new and renewable resources should also increasingly be seen from an energy security perspective.

Recent work extending modern portfolio theory to renewables shows that the reduction in risk through the introduction of a modest amount of renewables often outweighs the direct costs of even non-least-cost renewable sources. Significantly, these same analyses indicate that the optimal proportion of renewables is higher than current levels of deployment in many countries.

Moderating end-use energy requirements: increasing supply- and demand-side energy efficiency

It is clear that India will need to increase its energy consumption to meet economic and

social development needs. Nevertheless, energy is typically produced, transported, and used inefficiently in countries like India. Globally, it has been estimated that the developing countries could improve their energy efficiency by 10 – 30%, given the right set of policy and market incentives.

Such "win-win" energy efficiency measures could reduce energy demand growth at no loss of useful energy services, and free up economic resources in the process. Moderating end-use energy requirements allows a higher proportion of needs to be secured through domestic and renewable sources, and the corresponding reductions in energy imports normally enhance energy security.

Reducing energy infrastructure vulnerability: distributed energy

Centralized energy infrastructure efficiently exploits economies of scale in construction and operation, and when adequately designed and maintained, it has compiled an enviable record of technical reliability and environmental compliance. However, large-scale centralized facilities are also perceived to be vulnerable to large-scale catastrophe and loss. In addition, technological change is redefining the scale at which efficiency and economy can be captured—initially in the form of combined-cycle gas turbines, but in the longer term through efficient micro turbines, fuel cells, and sunlight-to electricity converters as complements to large central facilities. In parallel, these distributed energy resources provide inherent security advantages through their modularity and geographic diversity. The effect is similar to that overtaking mainframe computers and dedicated communication tie-ups; these are increasingly by-passed by distributed microcomputers linked by the Internet. In this connection, it is interesting to recall that the Internet itself was initially developed as a fault-tolerant, distributed network to provide highly secure communications.

Reducing political and social divisions: promoting good governance and equitable energy sector rent distribution

Mismanagement of energy resources and their uses is a contributor to impoverishment and inequity that breeds unrest and violence and ultimately threatens sustainable energy delivery. This vicious circle takes many forms, including draining of government resources for health, education, and welfare that go instead to subsidize inefficient energy monopolies; capturing of benefits by urban elites at the expense of energy-poor rural populations,; and dissipation of energy-generated rents through corruption and diversion for private gains.

Conclusion

Energy security will remain an the intersection of demand and supply scenarios, which in themselves are influenced by a number of factors which need careful evaluation and consideration over the long-term. The Integrated Energy Policy document needs to be made more dynamic to reflect the changes in the global energy environment, and also revisit some of the challenges related to policy making and implementation for the Indian energy sector. A truly integrated energy policy should clearly articulate implementation along with continued reforms and dynamism to accommodate rapidly changing global energy environment. Some of the factors which are critical to ensure long term energy security of the nation are listed below:

- Diversification of Energy Sources and avoiding overdependence on any one fuel
- Supplier Diversity in terms of limited reliance on one supplier/ region/ country
- Security of Trade Flows/ crucial trade corridors instrumental in sourcing various forms of fuel
- Management of Geo-politics and international economic/ political factors affecting supplies of energy
- Control of the level of imports and developing indigenous capabilities
- Reliability of physical infrastructure facilitating energy flows
- Management of Market/Price volatility
- Affordability of energy to various consumer segments
- Energy efficiency and feasibility of energy supplies

At this crucial juncture, it is important for corporates, industry experts and policy makers to work together to create a healthy environment for the energy sector. India needs to collectively seek answers to some key questions and work at multiple levels to have long term energy security:

- What are the changes required in the Policy and Regulatory Environment in the energy sector?
- What could be done to establish a fair resource allocation and pricing mechanism of domestic resources?
- What could be done to secure international assets/ supplies through energy diplomacy?
- How could India address the technology and skill related challenges with respect to the energy sector?
- What steps could help India to achieve desired level of energy efficiency?
- How could India facilitate fast paced infrastructure development?
- What are the options for India to address financing-related challenges in the sector?

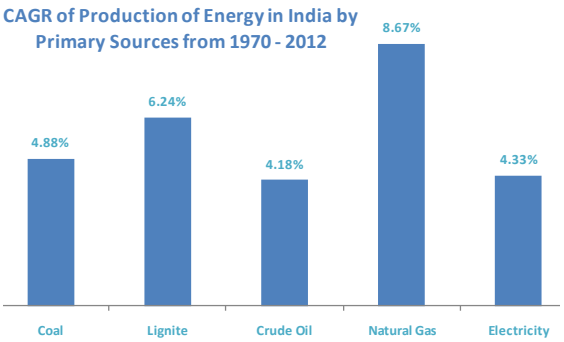
However, all is not lost as there are ways we can salvage the situation. Advent of new technologies for accessing resource pools, efficient transformation and innovative ways of consumption have given the nation a ray of hope. Support to private initiatives, allocation

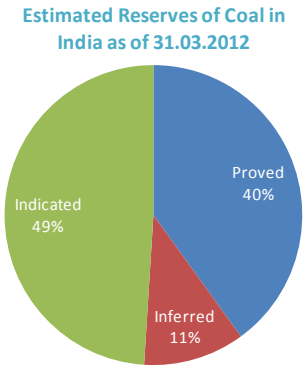
of capital for setting up renewable energy operations and providing a supporting hand to overall efforts are few of the steps taken by Government of India. Initiatives like Jawaharlal Nehru National Solar Mission, Solar cluster projects and Special Area Demonstration Project Scheme are the ones which will help the country move towards the solution to the energy security problem.

Appendix

Coal Energy

India ranks third in the world in consumption of coal and the demand has grown almost at a CAGR of 7% during 2001 to 2011, while production has grown by only 5%. Coal is the mainstay of India's energy sector accounting for over 50% of primary commercial energy supply in 2010-11.





(*Source: India Energy Statistic 2013*)

Reserves

In terms of total hard coal resources, India has the world's 7th largest with 171 Bt or 1% of the world's share. India's hard coal resources are estimated even greater at 248 Bt to a depth of 1,200 meters, of which 60% lie within 300 meters of the surface, making them potentially exploitable by surface mining technology. Together the states of Jharkhand, Chhattisgarh and Orissa account for 70% of the country's coal resources. This geographical mismatch between major coal mines and high demand markets in western and southern India, as well as coal transportation by railroad, are some of the major challenges facing India's coal sector.

Production

Current mining in India is limited to a depth of less than 300 meters while 40% of India's reserves are beyond this depth and, as a result, nearly 90% of CIL's coal mines are opencast. Opencast mining typically has lower production costs and is less dangerous for workers. But it also causes considerable environmental destruction of the surrounding ecosystem, acid mine drainage, erosion of soil and particularly deforestation of the mining area. However, India's coal industry does not have advanced technology to explore and produce underground beyond 300 meters at the moment. India will need to accelerate the adoption of advanced underground mining technology to increase its productivity and output.

Demand

It is estimated that India will become the second largest coal consumer around 2025 surpassing the United States, with primary coal demand more than tripling from 280 Mtoe in 2009 to 618 Mtoe in 2035. This enormous coal demand will predominantly come from the power sector, representing over 60% of coal demand growth between 2009 and 2035.

Consumption

The power sector consumed over 73% of India's coal in 2009, which increased notably from a share of 61% in 1991 (IEA database). The second largest consumer was the steel and iron industry, representing about 9% in 1991 and 6% in 2009. The cement industry was the third largest coal consumer, using 6% of coal in 1991 but only 2% in 2009. This trend can be explained by the substantial demand increase for coal in the expanding power sector, as well as through substitution with other forms of energy, namely electricity, within the industry sector.

Import

It is projected that India's dependence on imported coal will increase to 30% or 280 Mt (178 Mtce) of coal demand in 2020 and to 34% or 460 Mt (294 Mtce) by 2035. Increasing import dependence is generally due to rising demand and stagnating domestic production. More specifically, the expansion of supercritical power plants requiring higher quality of coal will lead to greater imports.

Increasing coal imports has led Indian coal companies to invest in overseas coal assets. The Indian government established co-operative relations for coal sector investments with countries including the United States, Indonesia and South Africa. Few companies have invested in assets overseas to secure the coal supply. However, most of these projects are still at the early stage and how much physical coal would be actually shipped back to India to ease the supply shortage is unclear.

Issues

Stagnating domestic production - During the 11th Five-Year Plan, India's coal demand increased at CAGR of 8.5%. However, CIL's domestic production has increased at a CAGR 4.6% during this period. The cause for slow production growth is two-fold. First, as pointed out by MOC and CIL, the rigid and time consuming procedure to obtain environmental and land permission from MOEF and state governments incurred considerable delays on coal mining projects. Second, CIL's production was stalled by its own low productivity due to frequent strikes and strong unionization. Another concern is that any additional coal requirement for new power plants would be unlikely met from CIL, hence finding alternative sources is unavoidable.

Import dependence - The direct outcome of sluggish domestic coal production is the considerable increase of imported coal. Growing coal import dependence creates several major complications. First is that coal imports are not easy due to limited supporting infrastructure. Second, different characteristics of coal typically allow Indian power plants to blend imported coal with domestic coal only up to 10% to 15%. As such, the Indian

government requires new power plants to be able to take up a greater portion of imported coal. Furthermore, the price disparity between Indian domestic and international coal posit a considerable difficulty for both CIL and consumers. Finally, the recent movement of coal exporting countries, including Indonesia, towards banning the exports of lower quality coal indicates that India's growing coal imports expose the country more to external political risks and raises questions about its energy security.

Infrastructure - India requires a well-integrated infrastructure for its coal supply chain, which includes railroads, importing ports and washeries. Delayed construction of railways by Indian Railways, to connect mines, dispatch centres and end-use destinations, has already created a considerable bottleneck in coal supply in recent years.

The supporting infrastructure – India's domestic manufacturing capacity of mining equipment and machinery – is a cause of concern as well. The limited supply capacity and poor quality of equipment of Indian suppliers can hinder mining productivity. To meet the growing need for mining equipment, potentially for underground mining, CIL and BEML formed a consortium with another power PSU and acquired Mining and Allied Machinery Corporation (MAMC) in 2010, a PSU that was set up to manufacture underground mining equipment and that had been shut down two decades ago.

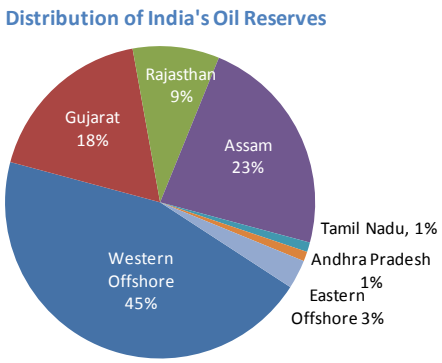
Investment - The most troublesome aspect in the coal sector is this lack of private investment. If CIL and SCCL fail to achieve production targets, there is no reliable alternative source to make up the losses other than imports. This has resulted in enormous constraints to both the coal and power sector. Private sector companies have few financial incentives to augment their coal production without access to an open market. The participation of private coal mining companies with technical expertise and experience would be essential to boost the volume of investment and production, especially for mining in underground and geologically challenging areas.

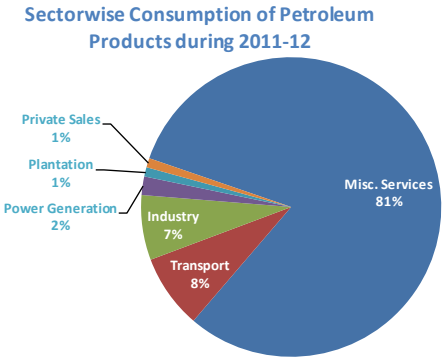
It is increasingly evident that CIL alone cannot increase coal production adequately to meet the current and future demand. To open the coal sector to the private sector, the enactment of the Coal Mines (Amendment) Bill 2000 is the first step. The liberalization of the coal sector would help make it more modern and competitive. Furthermore, the Indian government must implement consistent and clear policies to assure fair competition between public and private, and national and foreign companies. Only then will India's coal sector be able to increase its production substantially and deliver adequate energy to meet the growing demand of the population.

Oil Sector

In 2012, India was the world's fourth largest oil consumer and was also the fourth largest importer, as per IEA reports. India's domestic hydrocarbon reserves are relatively small resulting in increasing dependence on imports and concerns over energy security. Since the liberalization of the upstream sector and subsequent reforms in the downstream, the oil and gas sector is comparably more open and competitive than other energy sectors in India. It is open to 100% FDI and a number of private and foreign private companies are

actively operating. However, persisting issues remain unresolved, including a distorted pricing mechanism, under-utilisation of domestic resources, and lack of investment from major international oil companies.





(*Source: India Energy Statistic 2013*)

Demand

WEO 2011 projects that with a demand of 7.4 mb/d, India would be the third-largest crude oil consumer by 2035 after China and the United States. Its rapid demand growth of a CAGR of 3.4% from 2010 to 2035 would be one of the highest in the world, driven primarily by the transport sector.

Supply

As of 2010, India had 0.8 billion tonnes of petroleum reserves, which accounts for approximately 0.3% of world reserves. One recent discovery was made in Rajasthan by Cairn India in 2009. India's oil reserves are mostly located in the western part of India. Offshore production accounts for about 53% of India's crude production in FY 2011-12.

India's relatively small resource endowment and its offshore location require greater upstream technical expertise to fully exploit its potential. India's domestic crude production has stagnated, growing very slightly from 0.7 mb/d in 1990 to 0.89 mb/d in 2011 at a CAGR of 1%. This is attributable to declining production from mature oil wells and insufficient production from new fields to offset the shortfall.

Import

To meet fast growing demand, India's crude oil imports are increasing. In 1990, India imported only 37% of its oil demand. However, oil imports are expected to reach 2.7 mb/d or 75% of demand in few years. Increasing reliance on imported crude has been a serious concern to Indian policy makers, both in terms of increasing energy insecurity and financial burden because of exposure to the fluctuation of international oil prices and exchange rate.

Overseas upstream investment

To mitigate risks from growing import dependence, India has encouraged oil PSUs to acquire overseas upstream assets. The IEP viewed equity oil investment as a risk management tool to mitigate oil supply risk and the market volatility of oil prices hurting the national economy. OVL is the only company that has overseas oil production. Its largest assets are GNOP block in Sudan, which contributes 27% of India's total equity oil production, and Sakhalin I in Russia, which contributes 22%. The combined equity oil production in FY 2010/11 was 6.75 MMT or 10% of India's domestic production.

Refining

As of April 2012, India's refining capacity was approximately 4.2 mb/d or 213 million metric tonne per annum (MMTPA), making it the third largest in Asia after China and Japan. India's refining sector underwent a significant transformation from a net product importer to a major regional exporter in one decade. India was a net importer of oil products until 2001, relying on imported products for almost 20 to 25% of total oil demand in 1990s. With the commissioning of export oriented refineries of RIL and Essar Oil in Jamnagar, India turned into a net exporter of petroleum products in 2001. The 11th Five-Year Plan aimed to promote India as a regional refining export hub, targeting 4.9 mb/d of refining capacity by 2012. The 12th Five-Year Plan aims to increase refining capacity to 6.2 mb/d or 310 million metric tonne per annum (MMTPA) by 2017. Due to growing domestic demand, export-oriented refineries were converted to domestic refineries in 2009, which helped to ease a domestic shortage of petroleum products. Some products, namely kerosene and LPG, are still imported.

It should be noted that the refining industry plays an increasingly important role in the Indian economy. Its total export value reached nearly USD 40 billion in FY 2010/11, representing 16% of India's total exports.

Issues

Import dependence - India spent about USD 92 billion on importing crude oil in FY 2010/11, which was a record amount and represented about 25% of its total import bill. The challenges from India's import dependence will increase at least in the short term: first, India's demand is still growing, hence further import increase is inevitable: second, India is a price taker in the global oil market, so any international price hike will have a direct impact on India's current account and: finally, as seen recently, a depreciation of Indian currency will also push up the import bill.

The Indian government is well aware of risks associated with growing import dependence. India needs the participation of E&P companies with advanced technical expertise and know-how, particularly for offshore E&P and improvement of Enhanced Oil Recovery (EOR) in existing fields. Equity oil acquisition could hedge the market risks to a certain extent, but its effect would be minor, given its current share of 10% of domestic production, just 2% of India's total demand.

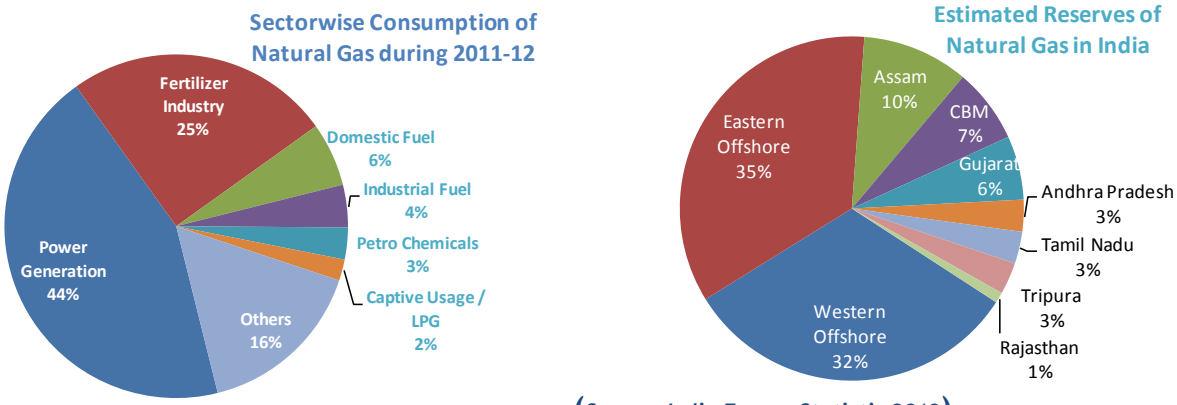
Pricing - The current pricing system poses problems to all stakeholders. For the government, even if total tax revenue earned on petroleum products is more than the

compensation for OMCs, maintaining the current system is very costly. The complexity of the system entails considerable administrative costs and resources for monitoring the scale of under-recoveries, transferring funds among PSUs and arranging the issuance of oil bonds by the Finance Ministry. Consumers already pay a relatively high price for at least gasoline, especially given India's low per-capita income level, due to heavy taxation. And the current subsidy system fails to effectively reach those who are in need, while untargeted subsidies benefit mostly middle and upper income classes. Furthermore, the system results in rampant adulteration of fuel, which creates artificially greater demand for subsidised fuels. The current pricing structure does not send the right signal to incentivise consumers for efficient use of fuels.

Gas Sector

Demand

India's gas demand is expected to triple to 180 bcm by 2035 at a CAGR of 4.5% and this growth will be primarily driven by the power sector. The share of gas in total TPED is expected to increase from 7% in 2009 to 11% in 2011. Gas demand is highly price sensitive, especially for power and fertilizer. Only about 30% of projected demand is expected from sectors with low price elasticity.



(*Source: India Energy Statistic 2013*)

The demand of natural gas during the Twelfth Plan is likely to grow by about 19.2% to meet the incremental requirement of power, fertilizer and other industries. The CNG and city gas sector will also see a quantum growth in natural gas use. It is expected that by the end of the Twelfth Plan about 300 cities are likely to be covered under city gas distribution.

Domestic production

India's share of proved global natural gas reserves stood at 0.6%, or 42.4 trillion cubic feet (tcf), at the end of 2011. Proved reserves increased from 25 tcf to 29 tcf between 1991 and 2001 but grew by 50% between 2002 and 2011. This increase is in large part the result of exploration success in fields offered under India's NELP.

Production from India's maturing gas fields is largely stagnating. In March 2012, production was at 34 mcm/d, instead of the projected 80 mcm/d. Of the total 128 mcm/d produced in March 2012, ONGC contributed 53%, OIL 6%, and private producers 41%, and the share of KG-D6 accounted for 26%. Domestic production of natural gas during the Twelfth Plan will depend upon the output from gas fields discovered under NELP by various operators. As majority of new gas prospects are in deep water, the investments, technology and pricing of gas for developing these fields would be important. However, the projected production from Private/JV producers may need to be reviewed during the Plan period, as the production profile from their exploration acreage gets approved by the Directorate General of Hydrocarbons.

Pricing

India's natural gas prices are regulated and set at different levels for gas originating from different producers. Gas from fields allocated to PSUs by the government is sold under prices set by the government under the APM. Joint venture (JV) gas producers are paid based on formula pegged loosely to international prices as per their PSCs but de facto the government maintains close oversight of price adjustments. Gas from NELP fields was supposed to be sold at market-base prices set through a so-called price discovery process. However, re-gasified LNG is priced based on different supply contracts, long- and short-term supplies as well as spot prices. Short-term supplies and spot cargos carry substantially higher prices than domestically produced gas and long-term supply contracts for LNG.

Issues

Declining domestic production - In addition to a substantial reduction of output from KG-D6, the question of overall reserves in KG-D6 is now being posed. The uncertain medium-term future of Indian domestic gas production has cascading effects on the overall role of gas in the country's energy sector. The first impacts have already been felt in the power sector where the PLF of gas-fired plants averaged only 54% in March 2012 due to unavailability of gas, India is, therefore, contemplating the import of more LNG, but this again raises the question of affordability.

Affordability - The two largest gas consumers, power and fertilizer, are highly price-sensitive as they operate in tightly regulated output markets and fuel is not a pass-through cost. Thus, it is unlikely that they can substitute domestically produced gas with LNG in light of the substantially higher costs, at least in the short term.

However, for other potential customers – industry, captive power production, refining and petrochemicals – affordability is considered high, although no alternative cost benchmark has yet been established. One possible benchmark could be alternative fuel prices based on calorific value, as unmet gas demand is currently substituted with liquid fuels.

Gas utilisation policy

The central government's Gas Utilisation Policy, in practice, negates the right of the NELP

producers to sell gas on purely commercial basis. Instead gas is allocated by the government. Priority is given to the fertilizer, LPG and power sector. One of the side-effects of the Gas Utilisation Policy is that the latent gas demand in India is difficult to discover as industrial consumers and IPPs rank at the bottom of the priority list. Furthermore, the policy limits further upstream investments as the high cost of off-shore exploration cannot be recovered from the priority sectors that are highly price sensitive.

Infrastructure

India is still far away from having a fully integrated national gas grid. Especially, the Southern and Eastern parts of the country suffer from a lack of connectivity. A fully developed grid would allow gas-fired power generation, especially high efficient CHP (Combined Heat and Power) units and industrial use to spread throughout the country and provide anchor load for other users like citygas and CNG. Particular attention should be paid to last-mile connectivity as many potential and solvent gas consumers are unable to access the gas due to lack of regional infrastructure.

However, the absence of clear and effective third-party access conditions both to distribution and transmission grid needs to be resolved urgently to encourage much needed investment.

Pricing of Natural Gas

Gas price for NELP Blocks is supposed to be determined through an arm's length process by contractor, and is subject to approval by the Government. The NELP provides freedom to price the gas by the operator at a market-determined price for gas produced from the NELP blocks, subject to the Government approving the pricing formula. However, questions have arisen regarding the interpretation of various clauses in the existing contracts. There is a need to review the provision of pricing under PSC to clarify the extent to which producers will have the freedom to market the gas. Clarity is obviously essential if private investment into exploration and production is expected. Ideally, private investors would expect freedom to price the gas at a level at which there are willing buyers, which in turn will be determined by the price at which consumers can import. On the other hand, the CBM policy envisages a different contractual regime. In order to encourage this emerging source of gas, its pricing should be left to the market without the need for Government approval.

There are a number of other issues regarding existing PSC. First, questions have been raised regarding investment multiple which determines the profit share of Government and the investor after allowing recovery of investment cost. It has been argued that this incentivises greater capital intensiveness, and a stronger profit share based on production would be better. This assessment needs to be weighed against the argument that the IM enables Government to insulate the contractor at higher levels of investment, which increases the possibility of oil/gas being discovered. There are also concerns on the need to improve the provisions under the PSC to make them more transparent and also fully safeguard the interests of the stakeholders. Second, the existing management system has

not led to an effective supervision over the projects. There is a need to consider alternate mechanisms. Several other issues have been raised also. Government has, therefore, appointed a Committee under the chairmanship of Dr. C. Rangarajan, Chairman, Economic Advisory Council to the Prime Minister to review existing PSCs and recommend changes for the future.

Finally, the Twelfth Plan is likely to see a continuation of high oil and gas prices in the world markets and our dependence on imports for both oil and gas is also likely to increase. There is an urgent need to align domestic oil and gas price to market price for sound development of the sector and to send the right signals to consumers and producers. This would also enable the oil PSUs to generate internal resources to fund new projects and create growth momentum. Price reform along these lines would also permit entry of private companies for marketing of petroleum products which would help expand competition. Price adjustment in the petroleum sector has to be carried out keeping in mind the need for ensuring affordability for the poor and vulnerable sections. This can be done in various ways. It does not require generalized subsidies.

Nuclear Sector

India has had a long commitment to nuclear energy since the establishment of the Atomic Energy Commission in 1948 and the Department of Atomic Energy in 1954. India was one of the few countries to achieve the complete fuel cycle – from uranium exploration, mining, fuel fabrication and electricity generation, to reprocessing and waste management – by the 1970s.

The country's nuclear industry is viewed with strong pride and considered an instrument to achieve "energy independence," "fossil fuel free future" or "self-sufficiency". However, India's nuclear power capacity remains small despite continuous commitment and advances in indigenous technology. India's current nuclear generation capacity is 4.8 GW and ranks 13th in the world, which account for only 1.2% of global nuclear capacity. The share of nuclear was 1% in India's total energy mix in 2009 and 2% in electricity generation capacity in 2012. This is the result of India's long isolation from the global nuclear energy regime and its emphasis on a thorium-based nuclear development programme.

Nuclear energy could play a critical role in addressing India's energy challenges, meeting massive energy demand potentials, mitigating carbon emissions and enhancing energy security through the reduction of dependence on foreign energy sources. This is why India remains devoted to nuclear power even after the Fukushima-Daiichi accident in 2011.

Supply

India has limited uranium reserves of 80 000 tonnes or 1.5% of the world's recoverable reserves; the resources are of low grade, however, and located in remote, insecure areas in the eastern states. Based on India's current uranium demand of 937 tU, the uranium R/P ratio would be about 85 years. However, India is known to have the world's fourth largest thorium resource, which however, requires a complex process to convert it to

fissile material.

Installed capacity and targets

The earliest nuclear power plants were purposely constructed along the western, northern and southern coasts of India, as these regions are far from coal mines and coal transportation was difficult at the time. India has 20 nuclear reactors that operate with a total of 4.8 GW capacity. An additional 4.8 GW capacity is under construction, including two reactors in Tamil Nadu, two in Gujarat and the remainder in Rajasthan. In terms of generated electricity, nuclear represented 4% of total generation in FY 2011/12.

The 11th Five-Year Plan targeted an additional 3.38 GW of nuclear capacity, of which only 0.88 GW was achieved. This is due to delayed construction of nuclear plants because of public protest and also safety audits undertaken after the Fukushima accident. The 12th FiveYear Plan envisages increasing nuclear capacity by 2.8 GW.

Plant Load Factors (PLF)

It is noteworthy that Indian nuclear plants have suffered from low PLF due to a shortage of fuel supply. PLF was as low as 40% to 50% in FY 2006/07, before India agreed on the nuclear deal with the United States. The import situation eased after the NSG waiver in 2008, and average PLF improved to 65% in FY 2010/11 and to 76% in FY 2011/12. However, considering that nuclear generation is generally for base load, this is still a relatively low level. More interestingly, nuclear plants running on imported fuel had nearly 95% of PLF, much higher than the 67% PLF of plants operating on domestic fuel. This is attributable to delays in some projects for uranium mining and also to a labour-management dispute of UCIL, India's only uranium mining entity. India will need to improve the reliability of uranium supply, especially domestic, to fully utilise its existing nuclear power capacity.

Issues

Technological challenge

Currently, India remains "the only country currently developing the potential of thorium fuel cycles". Against the backdrop of the Fukushima-Daiichi accident, India argued that thorium-based nuclear generation is safer than uranium-based, with "a passive cooling system that operates naturally if the reactor shuts down". This commitment might bring more international attention to thorium-based technology. However, thorium fuel cycles have not yet been fully demonstrated at large scale and several important technical challenges remain, particularly in the reprocessing of thorium fuel. After nearly half a century of commitment to a thorium-based nuclear programme, India is now entering into the second stage of operating the fast-breeder reactor. The feasibility of its vision of deploying prototype thorium plants by 2050, assuming no technical barriers in the way, remains challenged. As such, India should carefully assess what different roles thorium- and uranium-based nuclear energy can play in resolving short and long-term energy supply.

Anti-nuclear public sentiment

The Fukushima-Daiichi accident resulted in growing concern over the safety of nuclear plants in India. The construction of a nuclear plant in Kudankulam, Tamil Nadu, brought the issue directly into the public domain in 2012. The plant consists of two reactor units, each with 1 GW capacity, which could help ease power shortages in the region. However, final completion was delayed owing to public protests; residents, relying on fisheries within the vicinity, feared that the nuclear plant would damage the surrounding ecosystem and their fishing activities, and endanger the local community. The central government offered a considerable compensation package of reportedly INR 5 billion (≈ USD 90 million) to local areas for infrastructure development. Public fear is not limited to nuclear plants, but also includes concerns about India's uranium mines. In 2011, the discovery of a uranium reserve in Maghalaya, located in north-east region, led to fierce opposition from the local community on the grounds that "it would degrade the environment, cause health hazards besides open up flood gates for influx of outsiders into the predominantly tribal state".

The public opposition to nuclear power will most likely continue and site selection and construction will become even more lengthy and costly. Therefore, for nuclear sector development, the government must ensure transparent and thorough safety measures and effective public communication.

References:

- India's Twelfth Five Year Plan (2012-2017)
- GNESD report on Achieving Energy Security in Developing Countries
- U.S. Chamber of Commerce report on International Index of Energy Security Risk: Assessing Risk in a Global Energy Market 2012
- Department of Energy and Climate Change, U.K: Energy Security Strategy
- Journal of Renewable and Sustainable Energy: Comparative analysis of energy security in Nordic countries – the role of renewable energy resources in diversification
- Economic Development, Climate Change and Energy Security – the World Bank's Strategic Perspective
- World Economic Forum – Energy for Economic Growth: Energy Vision Update 2012

Other sources include:

- Arthur D. Little Global Research Centre
- Journal of Energy Security
- Forbes
- Economist
- Economic Times
- Business Standard
- European Energy Review
- Bloomberg

About PHD Chamber of Commerce

PHD Chamber of Commerce and Industry is 108 years old proactive and dynamic multi-State apex organization working at the grass-root level and with strong national and international linkages. PHD Chamber serves 12 North and Central Indian States along with Bihar, Jharkhand in the Eastern region and UT of Chandigarh. It has direct and indirect membership of about 48,000. PHD Chamber acts as a catalyst in the promotion of industry, trade and entrepreneurship. PHD Chamber, through its research-based policy advocacy role, positively impacts the economic growth and development of the nation.

We are globally connected through institutional linkages with over 60 important foreign Chambers of Commerce. Government of India has authorised us to issue certificate of origin (non-preferential) to Indian exporters. We also attest commercial documents of various types. Recommendation letters for visas for business promotion to foreign diplomatic missions in India are also issued for representatives of Indian companies.

In its endeavour towards capacity building in the country, PHD Chamber organises focussed entrepreneurial development training programmes in cooperation with the Konrad Adenauer Foundation of Germany. Through the support of its members, the Chamber has been regularly contributing in cash and kind towards relief and rehabilitation of the victims of natural calamities and disasters. In keeping with the motto adopted 'Ethics is Good Business', PHD Chamber confers Awards for Excellence annually.

At last but not the least PHD Chamber's offices at New Delhi and Chandigarh provide modern conferencing and catering facilities for corporate events, board meetings, training programmes, etc. With a modern auditorium, several conference and meeting rooms to suit different requirements and also a business centre, while the ambience is international, the cost is economical.

About Arthur D. Little

Arthur D. Little, founded in 1886, is a global leader in management consultancy; linking strategy, innovation and technology with deep industry knowledge. We offer our clients sustainable solutions to their most complex business problems. Arthur D. Little has a collaborative client engagement style, exceptional people and a firm-wide commitment to quality and integrity. Arthur D. Little has successfully completed its Management Buy-Out on December 30th, 2011.

In its 125th anniversary year, the world's first management consulting firm has once again become a Global Private Partnership with 100% of the ownership of the company now held by its partners. The firm has over 30 offices world-wide. Arthur D. Little is proud to serve many of the Fortune 100 companies globally, in addition to many other leading firms and public sector organizations.

For further information please visit www.adl.com

About the authors

Dr. Ranjeet Mehta

Dr. Ranjeet Mehta is a Gold Medalist with Ph. D. in Management. He is currently heading Infrastructure, Energy, Housing and Urban Development Sectors as a Senior Secretary at PHD Chamber of Commerce and Industry, New Delhi. He has a broad spectrum experience of around 26 years in Public Policy, leadership development, public relations, organizational capacity building and Strategic Management.

Dr Ranjeet Mehta is empanelled as a Member in various Committees, Working groups in Central and State Government departments. He is also an eminent author and his publications include five books, more than 45 research papers and articles in various National and International Journals of repute, Leading Magazines and Newspapers like Hindustan Times, Times of India and Financial Express. He has presented more than 18 research papers in International Seminars. He is also a frequent speaker in many Seminars, Symposia, National, International Forums and Electronic Media.

Madhav Bissa

Madhav is a Consultant at Arthur D. Little. He has more than thirteen years of experience, with seven years in consulting. His industry focus areas are Energy, TIME (Telecom, Internet, Media and Entertainment) and Healthcare & Life Sciences.

Swati Parashar

Swati Parashar is an Analyst at Arthur D. Little. She has over eight years of industry experience. Her industry focus areas are Energy and TIME (Telecom, Internet, Media and Entertainment).

PHD Chamber of Commerce and Industry
PHD House, 4/2 Siri Institutional Area, August Kranti Marg
New Delhi - 110 016
Web: www.phdcci.in

Arthur D. Little India Pvt. Ltd.
Business Centre, Radisson Blu Suites
B-Block, Sushant Lok, Phase-1
Gurgaon -122002, Haryana
Web: www.adlittle.com