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# The Future of Natural Gas in India: A Country at a Crossroads

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**Foreword**

The Center on Global Energy Policy at Columbia University, together with NITI Aayog and the Confederation of Indian Industry, organized a day-long workshop on November 30, 2016, in Delhi to discuss the future of natural gas in India. This brief summarizes our key takeaways, observations, and questions for future research.

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**Introduction**

Access to abundant and affordable energy sources was at the heart of the economic development of the major advanced economies during the 19th and 20th centuries. For emerging economies in the 21st century, achieving comparable access to energy remains a challenge, one that has only grown more complex with time. This is, in part, due to our greater understanding of the negative externalities associated with large-scale consumption of fossil fuels. The main challenge for developing countries today is to balance their need for energy security, access to energy at affordable prices, and greater sustainability in their energy use. This last point is especially important, given the severity of air quality problems in key developing countries, including China and India, and the growing threat of climate change.

The World Energy Outlook estimates that 244 million people in India do not have access to electricity. Moreover, a staggering 819 million people rely on traditional biomass for cooking.[1] The country is undergoing a rapid transformation, with official data suggesting GDP growth around 7 percent per annum.[2] Forecasts predict India's urban population will expand from the current level of about 400 million to more than 600 million by 2030.[3] Given the anticipated growth of urban as well as rural populations, manufacturing output, and the overall size of the economy, it is evident that India's energy use patterns will change dramatically in the years to come. It is estimated that more than half of the commercial infrastructure India will need in 2030 has yet to be built. Energy demand is expected to triple over the same period.[4]

What is lacking is an integrated vision for future energy supply that provides affordable energy for the entire Indian population while addressing local air pollution and economy-wide carbon emissions at the same time. The Indian government has thus far followed a broad energy strategy, which includes importing more crude oil, natural gas, and coal. But following a piecemeal approach risks locking India into a high-carbon energy future for decades. Coal, with its attendant environmental impacts, has traditionally been a critical part of India's energy mix, and the country has ranked among the biggest coal producers in the world.

Economic and energy security concerns have led to a buildup of investment in India's domestic coal sector. While there has been an increase in higher-quality coal imports from Australia and Indonesia, domestically

[1] International Energy Agency (2016), World Energy Outlook Energy Access Database, http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/
[2] Official GDP growth estimates for 2016 are subject to uncertainty and possible revisions. See https://ftalphaville.ft.com/2017/03/01/2185261/indias-cash-crunch-gdp-data-and-negative-speculation/
[3] UNFCCC (2015), India's Intended Nationally Determined Contribution: Working Towards Climate Justice, http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf
[4] Ibid.

sourced coal is generally cheaper than imported grades, and the resulting foreign exchange savings can be used to meet other pressing social concerns. In addition, the domestic coal mining sector remains a major source of employment—and a key concern for policy makers—with an estimated workforce of nearly 500,000.[5]

However, the cost advantage of coal—either domestic or imported—quickly disappears when the adverse effects of coal mining and burning on human health, air quality, and water quality are also taken to account. Using traditional biomass for cooking and coal for electricity generation has deleterious consequences for public health.[6] Dense smog has become more prevalent in urban areas and in November 2016 forced the closure of schools in Delhi for several days.[7] Various other factors contribute to poor air quality in India, including agricultural burning (which is mostly left unregulated), intense traffic, and seasonal fireworks.[8] Previous studies in Northeastern China showed that air pollution alone reduced life expectancy by 5.5 years for local residents.[9] Comparable studies are only now starting to emerge in India.[10]

Over the past 20 years, India has attempted to reform the energy sector and shift away from a government-owned and fully regulated system toward a more market-based approach. The results of India's energy sector reforms to date have been mixed. State-owned companies in both the upstream and downstream energy sectors continue to dominate the economy. In the IEA's assessment, India is "trapped halfway along the transition towards an open and well-performing energy sector."[11]

Clearly, India is not alone in facing such difficult challenges when considering the future of its energy system. However, the country's size and importance to the global energy market mean that the decisions made by India's energy policy makers will have implications far beyond the country's borders.

To create a better understanding of the complex economic, social, geopolitical, energy security, and market factors influencing India's energy future, the Center on Global Energy Policy at Columbia University convened a series of high-level meetings with government officials, NGOs, academics, and corporate executives in India. Given the dramatic changes underway in global natural gas markets and the potential for

[5] Coal India Limited, which is the largest state-owned coal company that mines and processes around 80 percent of the domestically produced coal, is believed to have a workforce of around 350,000 as of 2015.
[6] Tim Boersma and Stacy D. VanDeveer (2016), "Coal After the Paris Agreement – The Challenges of Dirty Fuel," *Foreign Affairs*, June 6, 2016, https://www.foreignaffairs.com/articles/2016-06-06/coal-after-paris-agreement
[7] http://www.bbc.com/news/world-asia-india-37887937
[8] http://www.nytimes.com/2016/11/03/world/asia/farmers-unchecked-crop-burning-fuels-indias-air-pollution.html?_r=0
[9] http://www.pnas.org/content/110/32/12936
[10] http://thelancet.com/journals/lancet/article/PIIS0140-6736(16)00015-5/fulltext
[11] International Energy Agency (2012), Understanding Energy Challenges in India, September 2012, p.7, https://www.iea.org/publications/freepublications/publication/India_study_FINAL_WEB.pdf

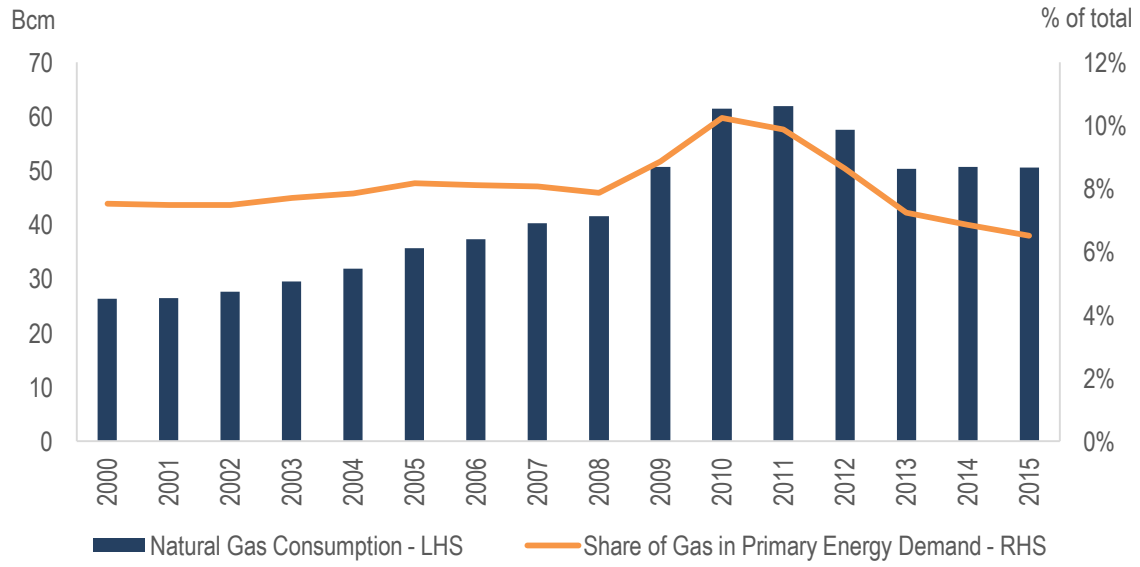
gas to address some of India's most pressing energy and environmental challenges, a workshop was held to discuss the future role of natural gas in the Indian energy system.

**The Role of Natural Gas in India's Energy System**

While natural gas has historically been a part of India's energy mix, it has never played a prominent role. The share of natural gas in India's primary energy consumption rose steadily until 2011, when it reached around 10 percent, or an estimated 62 billion cubic meters (bcm) per annum. By 2015, however, the share of natural gas in India's energy mix fell to around 6.5 percent, a decline that is illustrative of the pressures natural gas is facing amid the Indian authorities' ongoing energy market reforms. Natural gas plays a modest role in electricity generation, struggling to compete with coal—and to a lesser extent with fuel oil—without a strong carbon price signal, such as a carbon tax. The other substantial market for natural gas is the heavily subsidized and highly regulated fertilizer industry, which is responsible for about 25 percent of India's gas consumption. Historically, most natural gas consumed in India has been produced domestically, predominantly from offshore reservoirs, and the country's reserves could potentially support much higher production levels. However, the Bombay High gas field, one of India's two main producing fields, reached peak production around 2010, while production from the other major field, the KG-D6, remained well below the initial expectations due to smaller actual reserves, technical challenges, and slow government action when the operator wanted to take measures to stem the production drop.[12]

One region that experienced meaningful natural gas demand growth is the western province of Gujarat, where local authorities incentivized infrastructure expansion and the construction of gas-fired electricity generation capacity and fertilizer plants. Several preconditions were present to support this initiative, most importantly a large population and offshore natural gas reserves. However, once local natural gas consumption rose, investments in LNG regasification capacity followed to further increase supply options. Imports of liquefied natural gas, initially from Qatar and later from other countries, became available after 2004, with volumes rising from 10 bcm in 2006 to 24 bcm in 2016.[13] Thus, Gujarat today is one of the epicenters of natural gas consumption in India.

[12] Charles Ebinger and Govinda Avasarala (2013), "Natural Gas in India: Difficult Decisions," James A. Baker III Institute For Public Policy, Rice University, October 2013, http://belfercenter.hks.harvard.edu/files/CES-pub-GeoGasIndia-102513-3.pdf
[13] International Group of Liquefied Natural Gas Importers (GIIGNL), LNG Industry in 2016, http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_2017_annual_report_0.pdf




Natural Gas Consumption and the Share of Gas in Primary Energy Demand in India

Source: BP Statistical Review of World Energy 2016

**The Opportunity**

Workshop participants discussed the air quality and climate benefits of natural gas relative to other fossil fuels—particularly coal and oil—at the roundtable, including its substantially lower $SO_x$, $NO_x$, mercury, and particulate emissions as well as the lower greenhouse gas emissions associated with gas burning, assuming that methane emissions along the natural gas supply chain can be effectively mitigated.

In considering the future of natural gas in India's energy mix, it is important to note that unlike a decade ago, natural gas is no longer considered a scarce resource globally. This is largely due to the advent of shale gas in the United States, major offshore discoveries and the development of coalbed methane in Australia, and the overall maturing of the liquefied natural gas (LNG) market.[14]

The growth of shale gas production in the United States has freed up large volumes of LNG supply that had been expected to sail to North America from the Atlantic Basin and the Middle East. In addition, the ramp-up of US shale gas production and the development of Australia's vast offshore and coalbed methane

[14] Tim Boersma and Akos Losz, "The New International Political Economy of Natural Gas," in Andreas Goldthau, Michael Keating and Caroline Kuzemko, editors (2017), *Handbook of International Political Economy of Energy and Natural Resources*, Edward Elgar Publishing (forthcoming)

resources have incentivized investments in additional liquefaction capacity. In January 2017, about 115 million tons per year (156 bcm) of liquefaction capacity was under construction, a significant addition to the 340 million tons (462 bcm) of installed nameplate capacity.[15] Importantly, the LNG trade is becoming more flexible. While traditionally, trade has been tied into long-term contracts with destination clauses, in 2016, close to 30 percent of LNG trade was done under short-term contracts.[16] In addition, the average duration of contracts signed in 2016 dropped to about 8 years from nearly 19 years a decade ago.[17]

There are also ongoing discussions about importing natural gas to India via pipeline. However, it is unclear whether major trunk lines would be feasible due to the high upfront costs and major geopolitical risks associated with the dependence on Pakistan and Afghanistan as transit countries. In addition, the IPI pipeline from Iran to India, touted by some as the most promising of potential projects, may remain elusive. Even though Iran holds some of the world's largest proven natural gas reserves and may open to international investment after decades of isolation, most of those resources will likely be earmarked for domestic consumption rather than export.[18] It is uncertain whether new opportunities will emerge to attract supplies from the East. Myanmar, for example, seems increasingly focused on exporting natural gas to China rather than India.

Still, the availability of natural gas should not be an issue for the foreseeable future. The significant additional supplies coming to the global market represent a major opportunity for countries seeking to fuel their economic development while limiting coal consumption.

Infrastructure already exists in India to accommodate such a transition. The effective utilization of existing gas-fired electricity plants in the country was just over 20 percent in 2015.[19] Thus, there is room to increase the share of natural gas even without the addition of new gas-fired power plants in the near term.

Most forecasts call for natural gas consumption in India to grow significantly as overall energy demand climbs. However, other fuel sources, from solar to nuclear and coal, will grow significantly as well. The question, as pointed out by workshop participants, is whether the Indian government would like natural gas to remain a peak-load fuel in electricity generation or play a more prominent role in electricity generation alongside other well-established gas-consuming sectors, notably fertilizer production and petrochemicals.

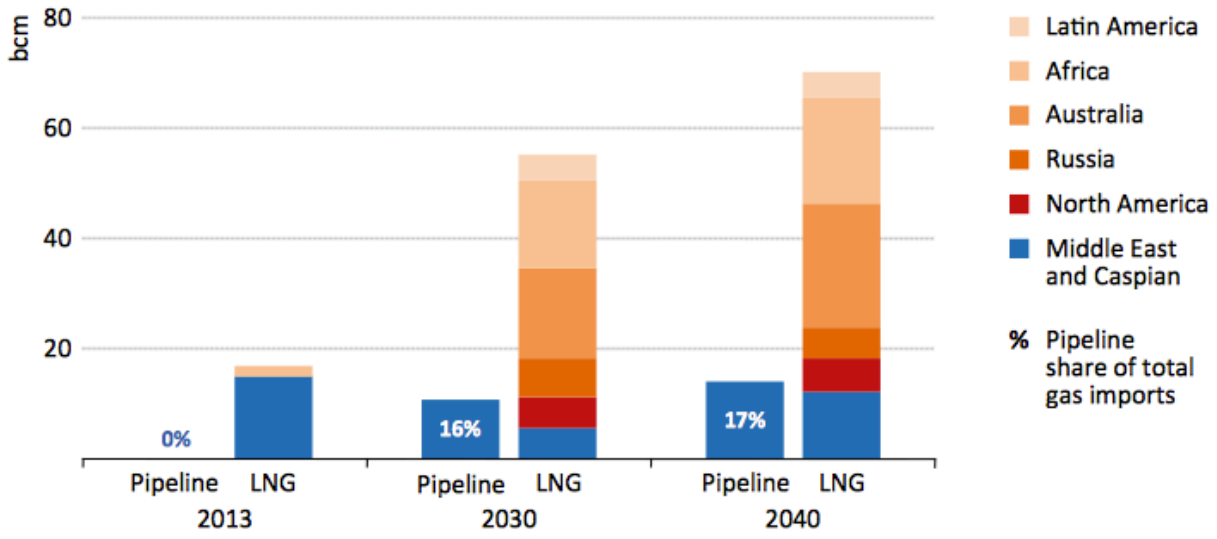
[15] International Gas Union, 2017 World LNG Report, p.5, http://www.igu.org/sites/default/files/103419-World_IGU_Report_no%20crops.pdf
[16] Defined as contracts with a duration of less than 5 years
[17] http://www.lngworldshipping.com/news/view,giignl-study-highlights-lng-growth_47063.htm#.WN0EDYaJlk4.twitter
[18] Gulmira Rzayeva (2016), 'Post-Sanction Iranian Natural Gas Production and Export Potential: Challenges and Opportunities," Cedigaz Insights No.19, November 2016, http://geostrategy.org.ua/images/Iran_G_Rzayeva.pdf
[19] http://www.ey.com/Publication/vwLUAssets/EY-gas-market-in-india/$FILE/EY-gas-market-in-india.pdf

Most reports suggest that, for the time being, gas will only play a secondary role to coal in the power generation sector due to a number of complicating factors.[20]

**The Obstacles**

*Reliance on Imports for Future Gas Supply*

There is no doubt that India will increasingly need to depend on imports to meet its growing energy requirements, even with the substantial potential of the nation's domestic natural gas reserves or the possibility of a major import pipeline being developed in the medium-term.

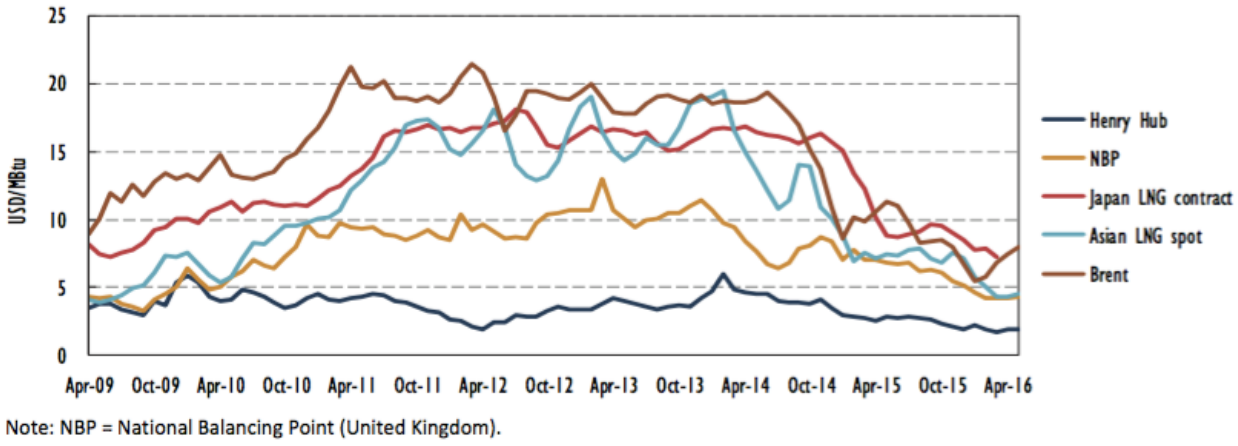



Natural Gas Imports in India in the New Policies Scenario of the IEA

Source: IEA India Energy Outlook, 2015

Participants in the workshop discussed the demand implications of possible natural gas price volatility. Take the cases of Japan and Korea. Both countries are entirely dependent on global LNG markets for gas and have paid a high price for these imports in the aftermath of the nuclear disaster in Japan, when authorities shut down all nuclear reactors in the country for inspection and turned to alternative fuels. The scramble for LNG drove prices up, forcing the governments in Korea and Japan to develop diversification strategies, including progressive renewable and energy efficiency support schemes, as well as investments in new highly efficient ultra-supercritical coal plants for electricity generation.[21]

[20] The IEA Medium Term Coal Outlook 2016, for example, foresees steady demand growth for coal in electricity generation throughout its forecast period.
[21] See Boersma and Losz (2017), forthcoming




Note: NBP = National Balancing Point (United Kingdom).

Gas Prices in the United States, Asia, and Europe
Source: IEA Medium-Term Gas Market Report 2016.

There are other areas of concern. Some analysts warn that the looming LNG market oversupply in the coming years could cause widespread investment delays and sow the seeds for a period of sharp price increases in the next decade as the market tightens again. In addition, were India to pursue a more aggressive policy with gas, it would require a costly buildout of natural gas infrastructure. Such investment could help natural gas remain competitive against alternative fuels in price-sensitive industries like electricity generation.[22] Without such infrastructure, however, India could be on a path to repeat the situation that has occurred in Germany. This scenario entails the creation of a very ambitious development plan for renewable energy combined with a primarily coal-fired baseload capacity fueled mainly by domestic coal. A key question going forward is what the incremental costs would be of embracing a more substantial role for natural gas in the electricity sector under various price scenarios. This calculation should not solely take marginal fuel costs into account, but it should also consider the added benefits in terms of air quality and health costs for the Indian population.

*Slow Progress toward Market-Based Pricing*

Presently, the natural gas sector is fully regulated in India, with preexisting price setting mechanisms and tax and subsidy structures. This has created substantial distortions in the market and disincentives for increased energy efficiency and usage of cleaner fuels. To give an example, India's fertilizer industry cannot absorb high

[22] U.S. Energy Information Administration (2016), Country Analysis Brief: India, http://www.ieee.es/Galerias/fichero/OtrasPublicaciones/Internacional/2016/EIA_Country_Analysis_Brief_India_14jun2016.pdf

gas prices, because that would result in higher food prices for the poor. As a result, the industry receives priority access to domestically produced natural gas. The electricity sector, in turn, has to depend more on imported natural gas, which is relatively expensive. These distortions are the primary reason why gas is unable to compete with coal in power generation. If the Indian government intended to increase the share of natural gas in its energy mix, then an important step would be to create a comprehensive market-based pricing mechanism for natural gas across all sectors of the economy.

Some steps have already been taken in this direction. The Indian government has initiated several rounds of the New Exploration Licensing Policy (NELP), now the Hydrocarbon Exploration Licensing Policy (HELP), to stimulate investments in upstream activities. Since 2016, all gas production from new discoveries can be sold at market-based prices, although even this new production remains subject to a price ceiling, which is based on the landed price of competing fuels.[23] Over time, these reforms could stimulate further upstream investments and encourage the entry of private players to the Indian natural gas market. However, choosing the right path to market-based natural gas pricing will require an examination and analysis of the experiences of other countries that have already undertaken similar reforms.

*Opposing Views and Interests within the Indian Government*

India's last integrated energy policy was developed in 2006. Since then, a variety of structural and economic reforms have changed the growth trajectory of the country. Today, energy policy is spread among five major ministries and departments (namely coal, power, renewable energy, petroleum and natural gas, and atomic energy) and a multitude of ministries that deal with matters related to energy demand (such as urban development, road transport, railways, and agriculture, among others). The absence of an integrated energy ministry leads to policies that are at times complementary but at other times contradictory.

There are also seemingly conflicting ambitions within the aforementioned energy departments with respect to India's future energy mix. The Ministry of New and Renewable Energy is driving a very ambitious renewable support scheme, which is part of India's Nationally Determined Contribution (NDC) under the Paris Agreement. At the same time, the Ministry of Power is supportive of the domestic coal sector, aiming to more than double coal production to 1.5 billion tons by 2020, even though the ambitious buildout seems to be at odds with India's NDC. The Ministry of Petroleum and Natural Gas supports the development of the domestic gas industry, but it is unclear how much clout it has relative to other ministries. A powerful coal

[23] Press Information Bureau, Government of India, March 10, 2016, http://pib.nic.in/newsite/printrelease.aspx?relid=137661

lobby, which is closely intertwined with local politics, further complicates the picture, especially given India's substantial international commitments toward mitigating global climate change.

*Data Quality Remains a Key Obstacle to Effective Policies and Robust Energy-Investment Decisions*

The poor quality of data remains a challenge in India for both policy makers and for prospective investors in the private sector. Reliable data is often difficult—if not impossible—to obtain, creating major obstacles to economic forecasting and planning. Similar problems in China may have led to overly optimistic assumptions of future growth and a significant misallocation of resources over the past decade.

Workshop participants emphasized the need for a more structured method for government data collection. Ensuring the independence of economic and industry data is of critical importance, but administering a robust, integrated system in a country of 1.3 billion people poses inevitable difficulties.

**Conclusions**

As discussed previously, natural gas faces a competitive disadvantage relative to cheaper coal in the Indian energy system, at least on strictly market-based terms. Any strategy that seeks to promote gas over coal will require some form of government intervention.

Policy tools to this effect range from mandating a certain proportion of gas in the electricity sector to banning the use of coal in urban areas altogether. Some market participants have indeed advocated for such direct market intervention by the government.

While government mandates and bans can be highly effective in the short term, such policies can introduce and perpetuate serious market distortions and rigidities in the energy system. A better approach to addressing air quality problems and carbon emissions could be a combination of standards, mandates, and market-based instruments that collectively allow market participants enough flexibility to meet various emission and efficiency targets without prescribing the use of specific fuels or technologies.

However, a more flexible approach would greatly benefit from a concise, integrated national-level energy policy that defines—and clearly demarcates—the role of natural gas in India's energy mix. A well-defined role and clear priorities around environmental sustainability versus affordability would help shape market design and provide guidance for the government in choosing the appropriate policy tools to achieve its objectives.

India is at a crossroads, but not because the country has a fundamental choice to make between coal and other fuel sources. There is no doubt that coal will play a prominent role in India's energy economy. In some instances—when coal stoves replace traditional biomass in cooking applications, for example—this could even constitute progress. Rather, the country is facing a choice in how to create an integrated long-term energy policy that balances energy access and affordability with sustainability, health, and good governance. Failure to develop such a plan risks locking India into an energy pathway that jeopardizes the interests of its citizens.

**Areas for Further Research**

Based on the topics covered in the workshop, we have identified the following key questions to guide future research.

1. How should India reconcile various—often conflicting—interests within the Indian energy economy and develop an integrated national energy strategy over time?
2. What role should natural gas play in India's future energy mix, and what policy instruments could provide the most stable institutional framework for long-term future investments?
3. What is the relative cost of coal vs. gas in power generation when fully accounting for the health and environmental externalities associated with coal burning?
4. Based on experience in other parts of the world, what price reform trajectory should India follow to move toward a more market-based gas pricing regime?
5. What role can liquefied natural gas play in the Indian energy mix, and how will a more integrated global gas market impact India?
6. What role can differentiated electricity tariffs play in terms of energy conservation, and what would their impact be on the role of natural gas in electricity generation?