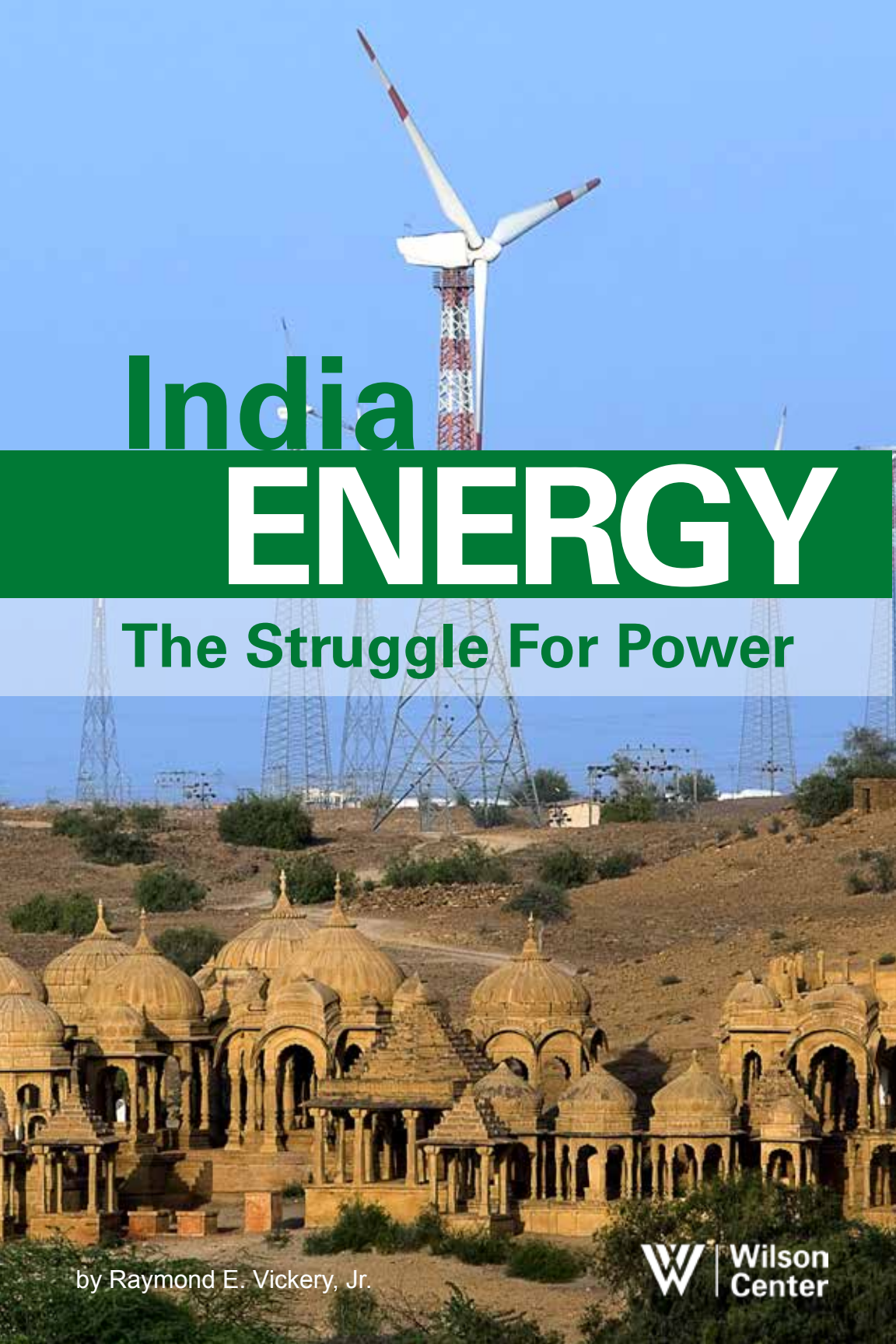

India ENERGY

The Struggle For Power

by Raymond E. Vickery, Jr.

Wilson Center

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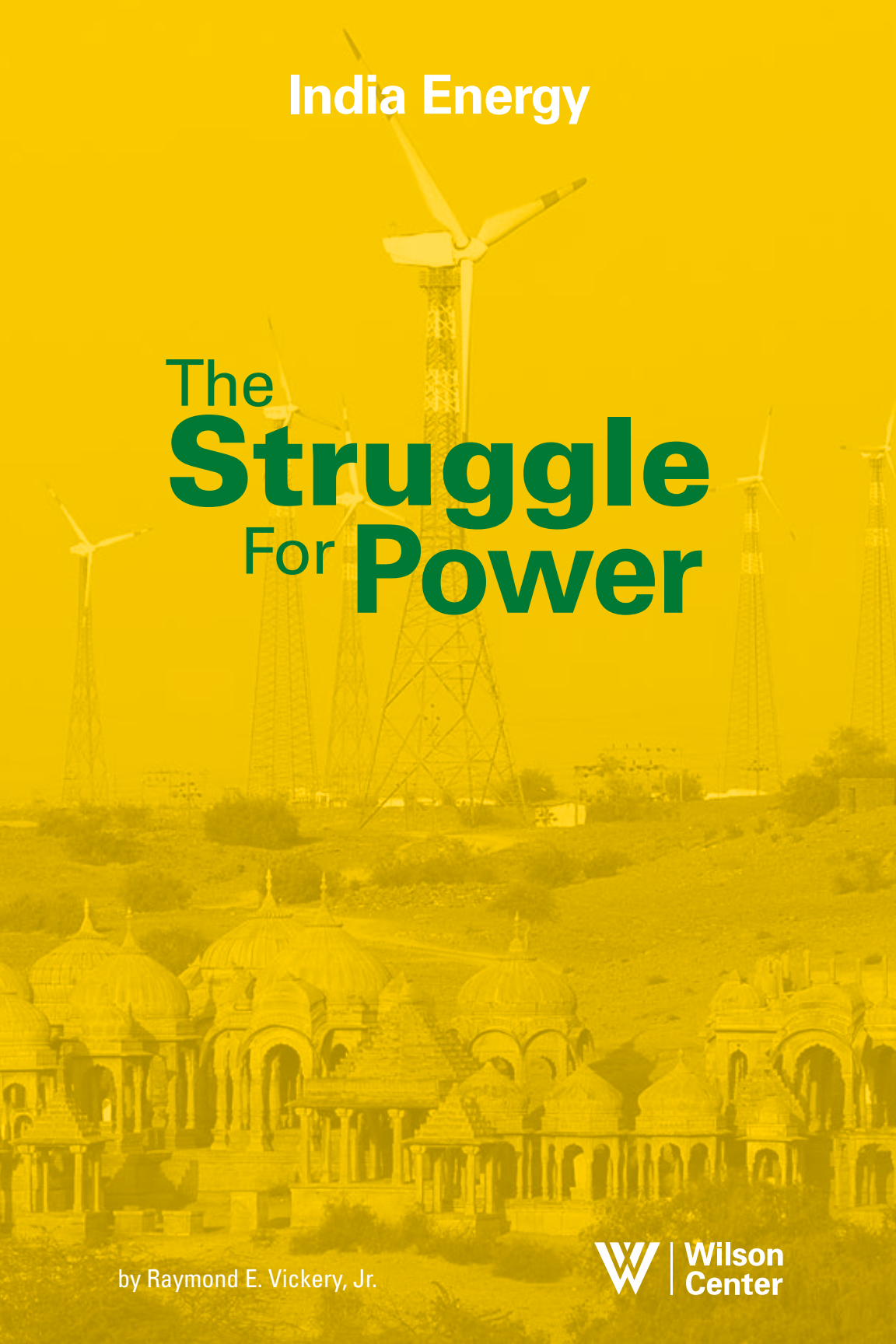

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Wilson Center

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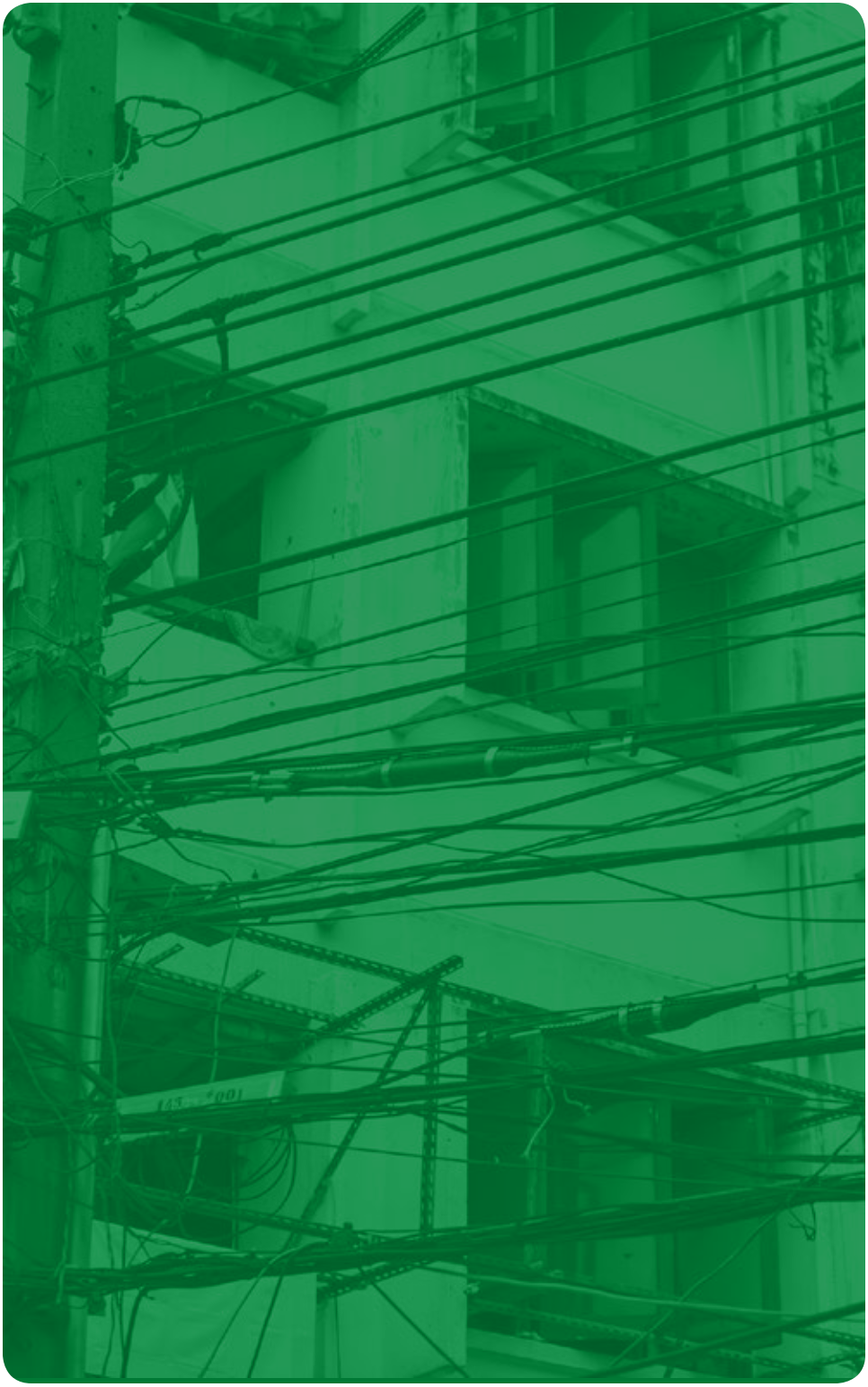

PREFACE

In recent years, much ink has been spilled about India's power: its rising clout in the world; its military modernization; and, spurred by Bollywood and a large diaspora, its strong cultural influence worldwide.

Considerably less has been said about India and a different type of power: The kind that electrifies households, fires up factories, lights up buildings—and, overall, sustains nations and their economies.

And on this count, India faces great challenges. In a nation of 1.2 billion people, about 400 million are off the grid. In areas that are on the grid, periodic power failures are frequent—meaning that even in the nicest five-star hotels, the air conditioning can suddenly stop humming and elevators can come to an abrupt stop. In the summer of 2012, India suffered two immense and paralyzing outages: The first one affected seven states in the north (home to more than 300 million people), while the second deprived about half the country's population of electricity.

Fortunately, India's government is actively engaging the energy issue. It was a chief priority for prime minister Narendra Modi when he was chief minister of Gujarat state, and he aggressively pursued policies that resulted in many villages being brought on to the grid. Modi has continued to emphasize energy since becoming premier in May of 2014. He has made changes in the pricing of diesel and natural gas, and he has given particular attention to the importance of renewables.

And yet the challenges remain—and shall remain—formidable. Given its immense population—one that is soon expected to become the world's biggest—and large economy, energy demand in India will continue to be insatiable for the foreseeable future. Determining how to source, produce, deliver, and manage energy resources will be a matter of great public policy import in India.

The Wilson Center's Asia Program is delighted to be publishing *India Energy: The Struggle for Power*. The volume seeks to make a contribution to understanding India's energy challenges, and to considering what policies India might pursue to promote greater energy security. Written by Raymond E. Vickery, a foremost expert on India's energy situation and a former Wilson Center Public Policy Scholar, *The Struggle for Power* brings some much-needed attention to an issue that will go a long way toward determining India's future trajectory as a global player.

Michael Kugelman
Senior Associate for South Asia, Asia Program
Woodrow Wilson Center

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SECTION I

INTRODUCTION AND SUMMARY OF RECOMMENDATIONS

Narendra Modi has come to power as prime minister of India. In addition to navigating the traps and intricacies of governmental power on national and international levels, he is faced with a power problem of a different sort–the need to resolve India's energy security challenge.

When I first went to India many years ago, I was struck by the ubiquity of Indian tea sellers. Later, during my time as a U.S. official, I often envied the ability of my Indian counterparts to summon providers of tea ("chai") as a mark of hospitality and setting for serious policy discussions. In part, the ready availability of tea in India depends on the lower economic status of lightly compensated tea providers. Prime Minister Modi began his professional life as a tea seller and has risen to the most politically powerful post in India. In hierarchical India, his triumph is remarkable on a personal level. His personal triumph should bode well for overcoming such serious policy challenges as energy security.

And yet Modi is not the first Indian prime minister to experience such a rise from humble beginnings. Modi's predecessor, Manmohan Singh, began life in a dirt poor farming village of Punjab, British India, in what is now Pakistan. For his early studies, he had no electricity to power lighting and labored beneath the flicker of a kerosene lamp, as did Modi.[1] Singh survived the mayhem of partition and became acclaimed as an economist educated at Cambridge and Oxford. Singh was the father of India's 1991 economic reforms that launched India on a new path to economic development. However, as prime minister, Singh failed to solve India's energy security problem.

Will Modi also fail to come to resolve India's struggle for the power necessary to a modern state? Modi's energy experience as the chief minister of Gujarat indicates that this time the efforts of the government of India may be more successful. When I first interviewed Modi's Gujarat secretary for energy, D.J. Pandian, he could point to a record of state governmental action in bringing electricity to all of Gujarat's villages. Also he pointed to integrating energy policy–from petroleum and natural gas to non-discriminatory solar and wind initiatives–into state policy as significant triumphs.[2] One of the most significant differences between Gujarat and much of the rest of India has been that elected officials in Gujarat do not use the energy/power system as a fund from which to reward political interests. For this, Chief Minister Modi deserves much of the credit.

However, running Gujarat is not leading India. The first national government led by the Bharatiya Janata Party (BJP) lasted only thirteen days and the second less than two years. The third was unable to win re-election even though it had a stellar macro-economic record. With an absolute BJP majority in the Lok Sabha (the lower house of Parliament), this government appears to be set for a long run.

An accomplished prime minister with an absolute, single party majority in the Lok Sabha should make an enormous difference in regard to energy policy. India's energy conundrum is primarily political. For at least the last three decades, the reason often given for policy inaction has been the inability of a single party to obtain a strong parliamentary majority. The need to hold together disparate factions to form and keep a government in power was often cited as one of the primary characteristics of the Indian democratic model. Supposedly, this need necessitated slowness in making policy changes. Although the BJP will experience delays by virtue of its minority status in the Rajya Sabha (the upper house of Parliament), the Lok Sabha is by far the more powerful body. Prime Minister Modi's majority there combined with his popularity provides an enormous public policy lever that has not existed in some thirty years.

Energy will be a key test of whether the Modi-led government can be successful in meeting India's national goals. Because Indian energy reform is so dependent on political power, the Prime Minister's Office should be the focal point for developing a comprehensive energy policy and administering it through a streamlined and consolidated ministerial system.[3] Early signs are good as Modi has pushed through changes in the pricing of diesel and natural gas.

U.S.-India engagement on energy can be a driver in the U.S.-India relationship for decades to come. Specifically, what happens in India and the United States in regard to natural gas can be a key to resolving India's struggle for energy and power. From an Indian perspective, the natural gas issue entails the pervasive issues of pricing, allocation, and governmental regulation of fuels. These issues are fundamental to India's bridging the gap between the energy it has and the energy it needs. What happens in regard to natural gas also affects the issues of whether and how fast India may move away from the most polluting hydrocarbon sources–coal, non-commercial biomass, and oil.

Using this lens of natural gas policy, the Modi government's new found political power could be employed to take the following steps in regard to energy:

1. Change the process whereby natural gas prices and allocations are set to make the greatest possible use of market derived factors and the private sector. Reforming gas pricing and allocation can lead to similar reforms for the other fuel sources.
2. Use a reformed pricing and allocation policy to attract energy investment from within India and around the world under contracts that will be inviolate and not altered by the government *ex post facto*. This policy should provide the incentives to exploit fully India's oil and gas resources and develop the infrastructure for their utilization. India needs a reformed New Exploration and Licensing Policy (NELP) and the induction nationwide of aggressiveness on energy infrastructure development.
3. Recognize that by reason of availability, security, and

environmental impact increased reliance on solar, wind and conservation is the ultimate future of Indian energy. Concentrate on increasing the affordability of solar by implementing the Gujarat model for promotion of solar, non-discrimination in sourcing of solar inputs, and encouragement of distributed solar production. In regard to the affordability of wind, reformulate tax incentives to reward production and transmission rather than installed capacity.

4. As a bridge to the future of renewables and backup for solar and wind, increase the proportion of natural gas in Indian energy use forthwith through both domestic production and importation.
5. Increase the efficiency of domestic coal production by establishing the operational security of the industry and by demonopolizing coal production with substantial private participation.
6. While increasing domestic output, recognize that energy security does not require complete energy independence. Provide greater governmental support for Indian participation in international sourcing and markets by making international energy engagement a positive part of a comprehensive energy policy. As a part of this policy, reorient Indian external security policy to include closer cooperation working with the militaries of the United States and other countries to provide security for India's international energy sourcing. India should join the International Energy Agency (IEA) and take a more proactive international role in resolving issues that affect its energy security.
7. Increase Indian civil nuclear output by implementing the U.S.-India civil nuclear deal and other measures to increase the Indian civil nuclear base. Solve the liability issue by working out a risk allocation and insurance policy that includes bilateral government involvement.
8. Recalculate the scope of hydro expansion based on affordability and environmental factors.
9. Formally recognize conservation and energy efficiency as an energy source and treat them on a par with other energy sources.
10. Build on Indian public concern about the harmful health effects of pollution to increase public awareness of the direct link between energy and the environment, including supplies of water and reduction of the reliance on biomass for home energy needs.

From a U.S. perspective, the natural gas issue presents starkly the issue of whether the United States will continue to place restrictions on energy export for domestic economic reasons. These restrictions have been characterized by some foreign commentators as U.S. energy "protectionism."[4] In regard to the environment, natural gas raises the issue of whether climate change is to be attacked strictly through a movement to renewables and conservation immediately or whether improvement through gas and cleaner technology is to have a role. Former vice president and Nobel Prize winner Al Gore makes an argument against "one fossil fuel replacing another" if mankind is to survive climate change.[5] However, given the necessity of a low carbon future, the question is how India and the United States get from here to there. Cost is the key and steps must be taken across the board to make renewables more affordable.

The immediate replacement of fossil fuels with renewable energy and conservation has been rejected by the United States for domestic purposes. Surely, the United States cannot conduct its Indian energy policy by asking India to do something the United States is unable and unwilling to do for itself. The continued geopolitical importance of gas and oil is undeniable, and the United States must take credible measures to deal with this reality.

Thus, if the United States is to play a significant role in partnering with India on energy security, the United States must resolve issues of its own. In regard to working with India on energy security, the United States should do the following:

1. Reform U.S. oil and gas export policies to take advantage of America's position as a leading source of these energy sources. End the discrimination in liquefied natural gas (LNG) export authorization between countries that have U.S. free trade agreements (FTAs) and those that do not. India, as a country that does not have a free trade agreement with the United States, is disadvantaged by this process. Work with India to find domestic and international replacement sources for U.S. sanctioned countries.
2. Take advantage of the Modi infrastructure initiative by working with the Indian government and Indian and U.S. private sector companies to facilitate the financing, design and construction of energy infrastructure. Reauthorize the U.S. Ex-Im Bank and OPIC, and increase the funding for the U.S. Trade and Development Agency and involve them fully along with other relevant departments and agencies in taking advantage of this opportunity.
3. Upon India moving to the Gujarat solar model that does not penalize the United States or other foreign sources of solar equipment, withdraw the U.S. World Trade Organization (WTO) solar complaint against India.
4. Continue the U.S. emphasis on renewables and energy efficiency with the goal of moving to those sources sooner rather than later, but engage with India on energy security generally including its immediate need for non-renewable sources of energy. Assist in the movement from coal, biomass, and oil to natural gas as a bridge to a lower carbon future and as a backup for renewables.
5. Make the security of energy sources for India an integral part of U.S. foreign policy. Engage more fully with India on the security of its energy supplies. Promote military to military contacts focused on the security of energy supplies, including a return to broad scale joint naval exercises.
6. Work with India and the private sector to resolve the civil nuclear liability issue through bilateral risk identification, risk allocation, and insurance in order to fully implement the U.S.-India civil nuclear deal.
7. Broaden U.S.-India cooperation on the environment from an overriding emphasis on climate change to a more prominent inclusion of health issues arising from the burning of fossil fuels.

This study is dedicated to an exploration of India's energy security challenges and opportunities. The major organizational structure for this work is to proceed

energy source by energy source with an analysis of the availability, affordability, security, and environmental consequences for each source.[6]

Since the author is an American with some experience in U.S.-India relations and the nascent U.S. gas liquefaction business, the perspective of this work is admittedly American with a focus on India-U.S. relations and natural gas.[7] However, an understanding and appreciation of the Indian context and viewpoint is fundamental. Thus, the themes that inform the analyses of this work are designed to take into account the Indian perspective. How India views availability, affordability, security, environmental aspects, and policy liberalization is certainly more important to India's energy security than an outside perspective. An attempt to appreciate this perspective will be undertaken by exploring personal episodes that have created the present Indian energy security scenario and prospects for the future.

Domestic Aspects of Indian Energy Security

Energy security is fundamental for India from a domestic policy perspective beyond its immediate impact on the ability to power its homes, government, farms, commerce, industry and transportation. In order to achieve its goal of energy security, India must resolve a range of public policy issues. How India addresses and resolves these policy issues is fundamental to the kind of society that India will be and to the quality of life enjoyed by India's citizens. Security in production, transportation, and freedom from regulatory interruption must be combined with the policy and physical infrastructure needed to sustain a viable energy system. India's present system of subsidies, price controls, and overly-politicized energy decision making is not sustainable. Without greater economic liberalization, use of market mechanisms, and the suppression of economy-distorting corruption in its energy sector, India is unlikely to achieve the energy security necessary to resume growth at rates that will free hundreds of millions of its citizens from poverty. Policy questions are at the heart of India's struggle for energy security and power.

International Aspects of Indian Energy Security

Energy security is fundamental to India's long-term economic future and its place in the world. Of course, the primary responsibility for solving India's energy security problem lies with India. However, India cannot meet its energy security and related environmental goals by itself within any foreseeable time frame. For the foreseeable future, India's energy security will require sourcing a considerable amount of its energy from abroad. Obtaining adequate supplies of energy at affordable prices and making its energy sources secure over a period of decades presents significant challenges to India and the world. How India and other nations deal with India's energy insecurity will be a salient factor in international relations and foreign policy for many years to come.

Because of the United States' unique position as the world's only military superpower, leading producer of natural gas, and leading source of energy technology, it has a unique ability to partner with India in addressing energy security in a way that will further India's political, economic, and environmental goals. If India and the United States are to be strong and effective strategic partners, comprehensive engagement on the issue of energy security can be

an engine for moving the two countries toward this goal. Regardless of whether India and the United States take advantage of this opportunity, the strength of energy security as an element of international strategic relations is manifest.

The year 2014 may be remembered in part as the year Russia taught the world a lesson in the use of energy to further strategic and security goals. In regard to Ukraine and Crimea, Russian President Vladimir Putin showed how to use natural gas to intimidate Ukraine and divide the opposition of Western democracies to Russia's actions in that country. Russia also demonstrated how to use gas to bring Russia and China into closer strategic alignment. During Putin's 2014 visit to China, the two rather authoritarian governments concluded a $400 billion dollar natural gas agreement. This agreement could bring Russian gas into the heart of Asia.

Russia has now proposed a gas pipeline for India. India has expressed interest and is proceeding with an analysis of feasibility and contemplation of signing further agreements. What, if anything, India and the United States will learn from the Russian lesson remains to be seen. However, both must see the security benefits and challenges that arise from choices in the international supply and demand of energy. The Russian lesson of 2014 should be particularly salient in regard to security aspects of the sourcing of natural gas. In regard to India and the rest of Asia, the strategic role of energy security is thus far not so dramatic as that involved in the Ukraine dispute. However, in the longer run it may be more important to world peace and stability as indicated by the competition between India and China for oil in Sudan and South Sudan, Central Asia, and elsewhere.

Democracies throughout the world have a stake in how India addresses its energy issues. India is the test model for whether a large country emerging from economic underdevelopment can meet the challenges of modernization while maintaining the values of democracy and political freedom. In this sense, India, not China, should be of most concern to the United States. Whether it acknowledges its role or not, India is the democratic leader for emerging Asia, Africa, and even Latin America. If India cannot find economic success because of its inability to solve its energy challenge in an environmentally sustainable manner, then the democratic model for national organization will be diminished. The Intergovernmental Panel on Climate Change has reported that the more disastrous results of climate change can still be averted through energy policies that will ameliorate the problem. However, if India is unable to resolve the energy security, economic development, and environmental puzzle, there is little hope that the issue can be resolved within the framework of an economically emerging democratic society. This means that it will be attractive then to turn to more authoritarian models, of which China is the leading example. This certainly will not be in the interest of such nations as the United States that hold democracy and individual liberty as core values.

India's Energy Needs

At present, India simply does not have enough energy to meet its domestic goals, much less those of a nation with aspirations of being a leading world power. Energy resources and their utilization lie at the heart of India's inability to provide enough electric power to sustain a level of growth sufficient to lifting hundreds of millions out of poverty and sustaining the apparatus of international power

projection. As the *New York Times* succinctly put it, "No Power, No Boom."[8] The relationship between energy and development is well-known, and it is simply impossible for India without adequate energy to regain the economic momentum that made it the envy of the democratic world.

It is simply impossible for India without adequate energy to regain the economic momentum that made it the envy of the democratic world.

By mid-century India should be the only major economy continuing to grow rapidly.[9] India will have the largest population and largest working age population of any nation. Indian citizens have talent, ability and entrepreneurial values equal to those of any other. Some reputable commentators have predicted that India will be the largest single economy by midcentury.[10] One fifth of the people on the planet will be Indian.

The energy impact of such a large population shifting from pervasive poverty to modern standards of production and consumption has been foreshadowed by the experience of China. The effect of this Indian economic renaissance on energy issues is likely to be even greater. Not only will India's population be larger but also, if India is to catch up with China, that population will be consuming energy at a rate necessary to overcome energy deficits that have widened between India and China. In 2014, Prime Minister Manmohan Singh said, "India is the world's seventh largest energy producer, accounting for 2.5 percent of the world's total annual energy production. However, it is the fourth largest energy consumer and is slated to become the third largest by 2020. This implies we need to increase the energy supply by three to four times over the next two decades."[11] In projecting a three to four times increase in energy needs over the next two decades, Singh took into account the need for increased energy consumption if India is to restore its growth trajectory to the double digit level required to make an immediate and substantial impact on poverty in the country.

The increase India needs to restore double digit growth constitutes a vast amount of additional energy. This addition for 2022 compared to 2012 is estimated to be greater than the combined energy consumption of Japan, Germany, and Brazil in 2012.[12]

A failure to secure sufficient energy for India may not only be measured by the opportunity cost of an economic boom that is foregone or curtailed. India will be in real danger of losing gains that it made in lifting hundreds of millions of people out of poverty through economic growth. India is justly proud of the numbers of people that have risen to have disposable income that in some ways makes them part of a consuming middle class. However, slowing growth has the potential of pushing hundreds of millions back into abject poverty. A recent analysis has posited that for India this "fragile middle" of those earning between the equivalent of $2.00 to $10.00 per day is particularly large and fundamental to India defining itself as an emerging, much less a modern, economy.[13]

Indian energy needs are firmly linked to an economy highly dependent on electricity. No other big emerging market struggles with insufficient and unreliable

electric power in the way in which India does. Information technology plays a more central role to growth in India than in any other developing economy. No other developing country is likely to match India's importance in bio technologies. These are the technologies of the future that are likely to determine growth even more than manufacturing in the long run. Because of its successes in these fields, the Indian economy can stand at the fulcrum of future world economic activity. Its position will give it even more opportunities for international leadership. But this leadership position will not occur without the fuel to produce the sufficient and reliable electricity necessary to take advantages of these opportunities.

The gap between supply and needs for electric power is perhaps the most salient negative aspect of India's energy scenario. Anyone who has spent even a short time in India knows that electrical power blackouts are a way of life. Any successful Indian business person has backup power systems for his enterprise.

On Tuesday, July 31, 2012, India suffered the world's largest power outage. Over half a billion Indians – 670 million people, or almost one in ten people on the entire planet – went without power for at least several hours. Coming on the heels of another massive outage only the day before, "Blackout Tuesday" focused the world's attention on India's struggle to provide power to its people. Indian embassies around the world sprang to the country's defense, calling the failures of July 30 and 31 "an isolated incident" and spoke of adding 55,000 megawatts of electricity generation capacity during the 11th Five Year Plan, April 1, 2007 – March 31, 2012. But the damage had already been done. In the face of heightened awareness, many questioned whether India would be able to regain and sustain the high growth rates necessary to bring additional millions out of poverty. While there were many technical reasons for the blackout, fuel availability has been perhaps the single greatest constraint on India's ability to provide the power necessary for the basic needs of a modern economy.[14]

This gap in electric power is startling enough if viewed only through the prism of official Indian assessments. According to the Central Electricity Authority, India's peak demand requirement for 2013-2014 was 136 gigawatts, of which it could only meet 130 gigawatts for a deficit of about 4.5 percent.[15] However, the deficit is actually greater than this official assessment.

A more accurate view of the magnitude of India's electrical power deficit can be gained in several ways. If India is to be considered a nation developing as a whole, the areas of low demand should be considered as having a deficit in power supply greater than stated. The Indian states not developing rapidly have a deficit not only at present levels of demand but at a higher level that includes the energy necessary to bring them up to the level of demand of the more developed states. For example, the less developed southern states are projected to have a peak demand deficit of 22 percent for 2014-2015 which does not include the electricity necessary to bring this region up to the level of the more developed western states .

The Indian power supply/demand gap can also be projected by comparing India's per capita electricity consumption with that of the developed countries and with China. India's per capita electricity consumption in 2011 was a paltry 684 watts. For comparison, the per capita 2011 consumption numbers for other prominent

nations were, United States-13,246; Germany-7,081; Japan-7,848; China-3,298; Brazil-2,436; and Russia-6,486.[16] Raising India's per capita consumption to only Chinese levels implies an increase of almost 500 percent. For the 12th Five Year Plan alone, India posited a need for 75 additional gigawatts, or about a 70 percent increase by 2017.

The deficit in electrical power generation is directly related to the availability of energy resources. When then Finance Minister P. Chidambaram addressed Petrotech, the biennial Indian conference on oil and gas, in 2014, a chief component of his presentation concerned the so-called "stranded" power projects. These projects were "stranded" in the sense that they either were not operating at all or were operating at less than capacity because of a lack of fuel. According to Chidambaram, 24,147 megawatts of power generation capacity was not operating because of a lack of natural gas. This figure included 18,000 megawatts of capacity operating at a plant load factor of 20 percent or less.[17] This linkage between lack of fuel and power plants operating below capacity is by no means limited to natural gas. Lack of domestic coal stranded additional power capacity and caused power generators to seek authority to import coal and pass the increases in costs through to customers. About 25,000 megawatts of coal fired capacity was stranded in 2014. According to industry sources, there were some thirty projects attempting to find buyers in 2013 because of inadequate coal fuel supplies.[18] The lack of fuel led to inadequate supplies of electricity and when users attempted to withdraw more than their allocated shares the results were overloads that resulted in technical failures.

After the need for electric power generation, the second most prominent aspect of the need for increased energy is for transportation. India's motorized transportation mobility (as measured by kilometers travelled) increased over eight times faster than Indian population growth from 1980-2000. This increase is continuing and should result in doubling the distance traveled by motorized vehicle by the middle of the 21st century as compared with 2011.[19] In the case of transportation, the most heavily-impacted energy source is oil. In June 2010, India surpassed Japan to become the third leading consumer of oil in the world. This increased consumption was largely fueled by India's growing transportation sector. In 2009, India was consuming approximately 3 million barrels of oil per day, 70 percent of which was imported. By 2014, oil imports were approaching 80 percent of consumption. A projected ten-fold increase by mid-century, increasing consumption to some 30 million barrels per day, would put tremendous strains on world production that was about 84 million barrels of oil per day in 2009. It will be difficult for India to meet all of its energy transportation needs through the oil derivatives diesel and gasoline.

In transportation, natural gas can play a large and constructive role. Natural gas in a compressed state can be used as a substitute for traditional transportation fuels and with a lesser impact on air pollution. Fortunately, India is leading the way with the use of compressed natural gas (CNG) in transportation. In addition, vehicles powered by electricity generated by natural gas offer the prospect of the use of more gas and less petroleum derivatives to fuel India's transportation needs.

Political Factors

All democracies are beset with the struggle between public policy driven by an assessment of the country's economic needs and the demands of party and electoral politics. However, in India this struggle seems particularly acute in regard to policy affecting energy security and the power needs of the country. Repeatedly, India has seen reform initiatives derailed or co-opted by political factors. Perhaps because India is the world's largest democracy with an often fragmented political power system this problem often seems even more prominent than it is in other countries. With the return of a party having an absolute majority in the Lok Sabha, it may be easier to address these conflicts between policy and politics in a positive manner. However, it may be worthwhile to consider at this point an example from the first BJP-led government (1998–2004) that illustrates the difficulty in maintaining a consistent path toward reform in the midst of Indian politics.

Under the leadership of the then Power Minister Suresh Prabhu, India finally reformed the system of literally bankrupt state electricity boards that accounted for much of the energy demand and most of the electric power availability in India. The replacement of the colonial era statute controlling electricity in India was completed in 2002 to become effective in 2003. The new regime was a monumental achievement[20] obtainable in large part by the political impact of Prabhu in going directly to the unions and other sources of opposition to the change.[21]

Prabhu was no stranger to the vagaries and inconsistencies of Indian politics.[22] Having been born and grown up in Mumbai, he became a chartered accountant with a thriving private practice. This practice led to his chairmanship of a cooperative bank. As a successful native of Mumbai and a member of the State of Maharashtra's ancestral ethnic group, the Marathi, he came to the attention of the leader of the Shiv Sena party that advocated the rights of the Marathi against outsiders. Prabhu accepted the Shiv Sena nomination to run for Parliament from the Prabhu family's home district of Rajapur, Maharashtra. Prabhu won from that district four times.

As a capable and personable politician with an appreciation for the realities of business and economics as well as politics, Prabhu had a meteoric political career in the first full-term government led by the BJP. After election, he soon became a favorite of Prime Minister Atal Bihari Vajpayee as the acceptable representative of the Shiv Sena in the cabinet. The Shiv Sena was a key ally of the BJP in forming the coalition National Democratic Alliance (NDA). However, its strong arm tactics in local politics and the mercurial personality of its leader Bal Thackeray, who upon occasion expressed admiration for Adolph Hitler, caused special concern among members of the NDA. Prabhu's abilities and his key political position resulted in his heading of five different ministries. As union minister of power, his crowning achievement was the Electricity Act. This act unbundled the functions of generation, transmission and distribution of electric power into separate entities with significant autonomy and private sector participation. The reforms were particularly successful in bringing private sector investment into the distribution business and adding both public utility and captive power capacity.

However, soon after completion of the Electricity Act, Thackeray demanded that Prabhu resign as power minister and be replaced with another party member. Thackeray made little secret of his concern that Prabhu had not used his position to raise funds for the Shiv Sena. Thackeray derided Prabhu as "an Alice in Wonderland" and argued that Prabhu should not be "clean and efficient" at the "cost" to the party.[23] A quote, supposedly from Thackeray, making the rounds in New Delhi at the time was "Who does he think he is, Rajiv Gandhi?." This was ironic since Prime Minister Rajiv Gandhi had been brought down originally because of his alleged involvement in the Bofors defense acquisition scandal, whereas Prabhu was being asked to resign because he was too honest and too successful in bringing about reforms necessary to provide adequate electric power to India.

Repeatedly, India has seen reform initiatives derailed or co-opted by political factors. Perhaps because India is the world's largest democracy with an often fragmented political power system this problem often seems even more prominent than it is in other countries.

Prime Minister Vajpayee did not want to accept Prabhu's resignation. However, his government, like all national governments in India for the past three decades, was a coalition. Vajpayee's National Democratic Alliance government was dependent on Shiv Sena votes in Parliament to stay in power. Thackeray was adamant and Vajpayee apparently felt he had no political choice but to accept the resignation.

Thus, for raw political reasons India was deprived of leadership to implement reforms vital to India's energy security. The Electricity Act has not accomplished what it might have with Prabhu's leadership. The act was to promote competition so that market prices might be "discovered" rather than set politically and to curtail losses of electricity. Without strong political leadership on the subject, regulators have been unwilling to let competition be a primary factor in setting prices. Instead, the politically expedient system of artificially low prices has continued. Subsidies from the central government to state-owned power producers are necessary to continue even inadequate electric power production. Likewise, the so-called "technical losses" the act was designed to address have continued unabated. Technical losses are all unaccounted for losses including corrupt arrangements and outright theft of electricity. Without people like Prabhu leading the way, there simply has been inadequate political will to take on the problem of technical losses. Instead of declining with regulatory reforms, these losses rose from about 22 percent in 1997 to 27 percent in 2012.[24]

All democracies face the need to balance government regulation and private enterprise. This balancing is necessary to obtain optimum economic prosperity while protecting citizens, particularly the less fortunate. Nowhere is this balancing more important or difficult than in India. While blessed with

a functioning democracy, India has not completed the transition from the Fabian socialism of its independence movement to a regulatory system that values private enterprise and market-driven solutions. In the context of Indian democracy and values, such a transition will be necessary to fulfill India's goals of abundant, affordable, secure, and clean energy. The political barriers to economic liberalization in India are formidable. Throughout the nation, there is still a strong belief that government-driven solutions are sufficient to protect the masses and bring hundreds of millions out of abject poverty. Among many Indians, there is little political belief in the legitimacy of the profit motive or the efficacy of the market. Thus, there is a continuous political competition between governmental and market-driven visions of how India's struggle for energy and the power it produces can best be brought to a successful conclusion.

Natural gas in India is at the juncture between state control and private enterprise, between the government and the market. For example, the role of natural gas in India is inextricably linked to the rise of the private sector company Reliance Industries Limited (RIL) and its struggles with the government in pricing and producing gas. However, natural gas policy in India is not simply an institutional struggle, but one involving human drama and the impact of personalities. Consider the following vignette: in 2001, I was with the group supporting former President Bill Clinton on his first return visit to India after his terms in office. The president and his entourage were invited to lunch with Dhurabai Ambani and his family at their high rise home in Mumbai. Although Mr. Ambani had had a stroke, he was still very much the leader of RIL and the head of his extended family. I recall seeing Dhurabai's older son, Mukesh, at the lunch as a very polite but somewhat retiring member of the family. At the time, of course, I could not have known that little more than a year later Mukesh would take his father's position as the head of RIL.

Literally a rags to riches success story, Dhurahbai had started with nothing, pumping gas in Yemen. He mastered the art of using public financing to fuel the growth of RIL, and wound up integrating his polyester textile business upstream to the petroleum products from which the fibers were made. Dhurabai was convinced that the Reliance process of upstream integration could be extended not just to the purchase and refinement of oil but to exploration and production in India and worldwide. In regard to Indian domestic production, he felt that India's sea beds held more gas and oil than had yet been discovered. He had the vision that Reliance could be an exploiter of this resource to the benefit not just of Reliance but all India.

Dhurabai did not live to see the full fruition of his dream for Reliance to be the major private exploration and production company in India. Dying without a will, Ambani allowed the business to go in equal parts to his two sons Mukesh and Anil. Mukesh, being the older son, had taken on the job of chairman of the Reliance empire. On October 31, 2002, it fell to him as chairman of the company, with his brother Anil at his side, to make an announcement that seemed to seal success in the area of natural gas. Mukesh announced to the annual general meeting of RIL stockholders the world's largest natural gas discovery for that year. Off the coast of the state of Andhra Pradesh in a block known as Krishna Godavari–D6 (KG-D6) drilling in some three thousand feet of water, Reliance had sunk five wells. All were successful and the chairman was able to say that the

discovery indicated reserves of over 5 trillion cubic feet of gas and a 60 percent increase in domestic Indian gas availability.[25]

Obviously, the news was received positively by excited stockholders, the press, the general public, and Indian officials. Congratulations came from all over the world. BP was later to buy a 30 percent stake in the field for $7.2 billion, indicating a value of the property at around $25 billion. Plans were made for the use of the gas from the fueling of cars to so-called "ultra mega" power projects, with uses from home cooking to fertilizer production in between. The government-owned Oil and Natural Gas Corporation Ltd.(ONGC) followed Reliance with exploration and discovery of substantial reserves in adjacent tracts. Thus, it seemed that much of India's gas needs were well on the way to being met from domestic sources.

Yet, a decade later production from KG-D6 was so far below predictions that no gas could be allocated from the Reliance discovery for power production.[26] Goldman Sachs was saying that the market was assigning zero value to Reliance's domestic exploration and production business. Indian gas companies were desperately seeking gas from foreign sources and investing in foreign reserves.

Just as India was gaining confidence about meeting its gas needs from domestic sources, the United States was resigning itself to gas deficiency. Facilities were being built to handle needed imports of gas to meet the scarcity in the United States. However, change was occurring in the American energy scenario just as it was in India. In the United States the new technologies of hydraulic fracturing and horizontal drilling were increasing production. This increase was of such a magnitude that gas prices would plummet, and, instead of importing, U.S. companies would be looking for foreign markets to take their unexpected surplus. In contrast, Indian expectations of domestic production were diminishing. Thus, India would be seeking not only more foreign gas but also the technology and investment necessary to exploit its domestic resources.

What went wrong with India's initial projections of gas from domestic sources? What does it need to do to increase availability from domestic sources? What is the potential role of gas imported from the United States? What do the answers to these questions mean for India in its struggle for power and for the United States as a potential energy partner? This study will explore these and other questions by first presenting background information and a framework for understanding the Indian energy scenario.

SECTION II

THE SOURCES OF INDIAN ENERGY

India's Present Sources of Energy

As can be seen from chart II-1, coal is the largest source of energy for India by a wide margin. Also notable in the Indian energy mix is the outsized role played by solid biomass (chiefly non-commercial wood, dried dung and waste). In quantitative terms this solid biomass is as important to the energy mix as petroleum. Coal and biomass provide India with almost two thirds of its energy. The implications of Indian reliance on these two inefficient and polluting sources of energy are important for the future of India energy. Natural gas constitutes only about 7 percent of India's energy mix, and hydroelectric even smaller at about 3 percent. While expanding rapidly, renewables and nuclear are a very small part of the present Indian energy picture.

As important as the relative amounts of consumption are the trends in the consumption of sources of energy.

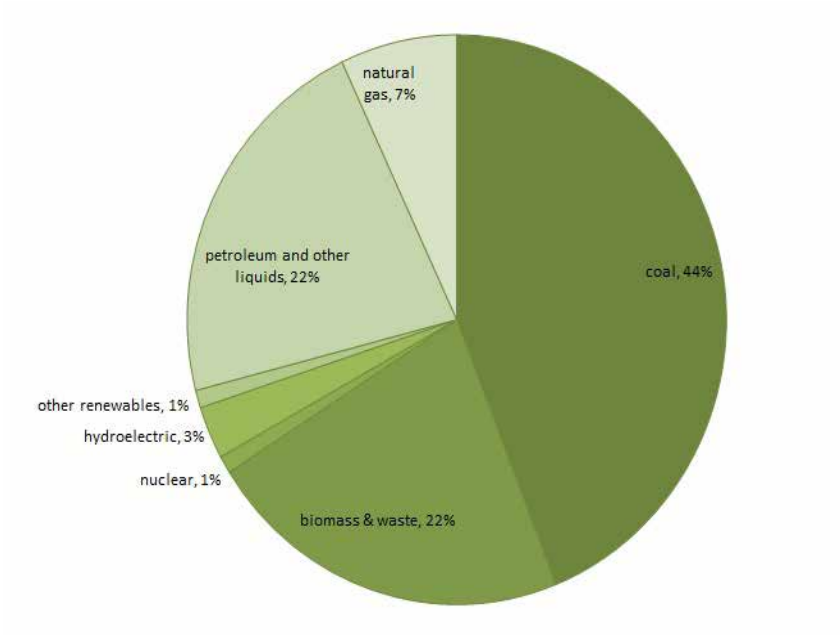
From chart II-2, we can see that natural gas consumption grew rapidly from 2006 to 2011. However, 2012 and 2013 were years of decline. This decline can be attributed to a lack of domestic availability. However, before analyzing natural gas supply and demand, let us examine briefly the most salient attributes of the other fuel sources in the Indian energy mix. Each of these sources will be analyzed in accordance with the four basic themes of this work: (1) availability; (2) affordability; (3) security; and (4) environmental impact.

Coal

India had about 60 billion metric tons of coal reserves in 2012.[27] Consumption was about 600 million metric tons per annum.[28] These numbers place India fifth in the world in reserves and third in consumption. At 2012 rates of consumption, it appears that India would have enough coal for approximately 100 years. However, the IEA predicts that Indian coal consumption will double by 2035 over its 2008 level and India's 2006 Integrated Energy Policy Report estimated that "extractable coal resources will be exhausted in about 45 years."[29] Still this is a large domestic coal resource.

At ground level, the view of coal availability is much different than indicated by data for quantity of reserves. For example, in 2012 a leading group of

Chart II-1 - Total Energy Consumption in India, 2012



Source: Energy Information Administration, U.S. Department of Energy, "India Country Report" (2014) http://www.eia.gov/countries/analysisbriefs/India/india.pdf

Chart II-2 - Trends in Consumption of Conventional Sources of Energy in India

Year	Coal #	Lignite	Crude Oil**	Natural Gas ***	Electricity*
	(Million Tonnes)		(MMT)	(Billion Cubic Metres)	(GWh)
1	2	3	4	5	6
2005-06	407.04	30.23	130.11	26.86	411.887
2006-07	430.83	31.29	146.55	26.77	455.748
2007-08	457.08	33.98	156.10	26.97	510.899
2008-09	492.76	32.42	160.77	27.06	562.888
2009-10	532.04	34.07	192.77	40.83	620.251
2010-11	532.69	37.73	196.99	46.04	684.324
2011-12	535.88	41.88	204.12	41.03	755.847
2012-13(p)	570.23	46.41	219.21	34.30	835.513
Growth rate of 2012-13 over 2011-12(%)	**6.41**	**10.81**	**7.39**	**-16.39**	**10.540**
CAGR 2005-06 to 2012-13 (%)	**4.30**	**5.51**	**6.74**	**3.11**	**9.240**

(p): Provisional
GWh=Giga Watt hour=106x Kilo Watt hour
* Includes thermal, hydro & nuclear electricity from utilities
** Crude oil in terms of refinery crude throughput
*** Gas available for sale, which is derived by deducting internal user of gas by producing companies from Net Availability
# Does not include Lignite and imports

Sources:
1. Office of Coal Controller, Ministry of Coal
2. Ministry of Petroleum & Natural Gas
3. Central Electricity Authority

Source: Ministry of Statistics and Programme Implementation, "Energy Statistics 2014" p.42 http://mospi.nic.in/mospi_new/upload/Energy_stats_2014.pdf

industrialists met with Prime Minister Singh to press their case for more electricity. Chief among their demands was an increase in domestic coal production. The prime minister's principal secretary was assigned the job of increasing coal production. Calling a meeting of senior bureaucrats, a plan was drawn up to increase the production of coal from the state-owned, near-monopoly company Coal India Limited (CIL), provide incentives to other public sector entities that had their own coal supplies, and help private coal miners to produce more from their mines. Yet, two years later, there was no substantial increase in coal production. Coal production increased year on year for the fiscal year ended March 2013 by only 3.3 percent and missed monthly targets thereafter. This was a failure to keep pace with even anemic gross domestic product (GDP) growth.

The lack of domestic actual availability is indicated by coal imports. Imports rose from 64.51 million metric tons for the fiscal year ending March 31, 2010 to 100.82 metric tons for the fiscal year ending March 31, 2011, an increase of 56.29 percent in a single year.

While economic reforms since 1991 have injected large doses of competition into most Indian industries, coal has remained largely untouched. During the period 1971-1973, the government of India took over virtually all the coal mines in the country. Most of these were consolidated as property of the state-owned CIL while those in the far south of the country became the property of the state-owned Singareni Collieries Company Limited (SCCL). CIL produces over 80 percent of India's coal and SCCL another 8 percent. For all practical purposes the state-owned or public sector undertakings have a monopoly on the production of coal. Like most monopolies, the Indian coal monopoly is notoriously inefficient. The sale of about 10 percent of the stock of CIL to the public has basically not changed this picture even though it has increased the transparency and accountability of CIL somewhat.

Theoretically, coal prices can be set by the coal producers. With a monopoly in place, this could mean independent monopoly pricing by CIL. The reality is somewhat different. CIL is not independent of government and politics. Its actions are closely monitored and influenced by the Ministry of Coal and its elected political leadership. Further, since the chief customers of CIL and SCCL are state-owned power producers, each pricing move has an impact on the central and state governments that bankroll the essentially bankrupt electricity producers. CIL regularly issues long lists of differentiated prices that tend to favor certain customers at the expense of others. Thus, political decisions again become paramount.

For example, when CIL sought in 2012 to raise prices in line with wage increases, the Ministry of Coal formulated a Coal Regulatory Authority Bill. The obvious purpose was to ensure that CIL and other producers conducted their business in line with the government's political concerns regardless of the economics of production. Pushback from CIL and private stockholders resulted in the cabinet approving the coal regulatory legislation with a so-called "framework" for pricing. In reality, this left the pricing mechanism about where it had been as a delicate dance among the bureaucrats of the ministry and CIL strongly influenced by their political overseers. The net result on pricing of coal is that coal in India is usually priced 30 percent to 40 percent below what it might be expected to be in a free market and below the cost of coal on the international

market. However, this differential may vary within any particular time period as world prices rise and fall and CIL battles to raise its prices in line with increasing costs.[30]

At the time of the economic reforms in the early 1990s, there were many who advocated reform in regard to coal production. Splitting and privatizing (called "disinvestment" in India for political reasons) the government monopoly was an option advocated by some reformers. This obviously did not occur. However, "captive mining" was instituted for both coal and iron ore as a step in the direction of liberalization. Politically, it was deemed acceptable to allocate the government-owned coal resources to private companies if they would develop those resources for providing needed electric power for the public or for manufacturing. This program languished with very little impact on the overall coal monopoly. Most of the 10 percent or so of India's coal production not directly controlled by the state was from this "captive mines" policy.

During the first term (2004-2009) of Prime Minister Singh's tenure, he saw expansion of the "captive mines" program as a prime tool for injecting market forces into the coal market and expanding desperately needed production. The term "captive" is used to designate mines whose output is tied or "captive" to a particular industrial or power project or company. The theory is that mines so tied will be exploited more efficiently and economically than those worked for general purposes. Accordingly, Prime Minister Singh kept the Ministry of Coal portfolio for himself and added renewed impetus to the expansion of the captive mines program. However, rather than allocate captive mines contracts through competitive bidding, the undeveloped coal blocks were allocated through a series of "screening committees." These committees were constituted periodically and chaired by the secretary of the Ministry of Mines. The committees were composed of chief bureaucrats from the most directly affected ministries, e.g. railroads and power, and representatives of state governments. The operations of the screening committees were not public. In September of 2012 India's Comptroller and Auditor General (CAG) issued a report finding that India had lost some $33 billion by allocating captive mine coal blocks at less than their true values.[31]

The CAG report engendered corruption concerns that went beyond coal block allocation and encompassed the entire government-run coal industry and indeed the Indian political/economic system.[32] The program for allocating coal mining blocks for private development remains in disarray. It remains to be seen whether the Modi government can bring order out of this program. The minutes of the Screening Committee crucial to the criminal prosecution of alleged wrong doers have been lost.[33] Whether the loss has been a matter of convenience to avoid prosecuting powerful persons is suspected but unproven. When action was finally taken, it was against one of the most respected members of the manufacturing community, Kumar Mangalam Birla, the CEO of Aditya Birla Group. There were cries of outrage from among the nation's business elite, several of whom testified that Birla's actions were completely ethical.

From an economic perspective, perhaps the most disconcerting aspect of the focus on the captive mines scandal is the Coal Ministry's reaction. Instead of advocating greater transparency and liberalization, the reaction has been to

clamp down on captive mine owners for failure to lower prices for electricity produced using coal from these mines.

There are other significant barriers to the production and utilization of coal in India's mix of energy sources. One of the chief impediments is the location of the coal. The largest deposits of coal are in the east and southeast parts of the country. The areas of highest growth and most need are in the west and northwest sections of India. The transportation infrastructure for moving coal across the country is inadequate and relatively expensive. Although India has the largest railway system in the world, its lack of speed and efficiency add to the consumer cost in a significant way. According to the IEA, railway transportation costs can double or triple the price of the coal at the mine (pit head price) when that coal is transported across country.

Much of India's coal is in eastern forested areas where the opposition to the government of indigenous tribal people and the violent Maoist revolutionaries is strong. Termed "Naxalites" after the area in West Bengal where one of the first outbreaks of communist violence occurred, these revolutionaries have had and are having a major impact on the production of coal. Coal India Limited has estimated its losses from the operations of the Naxalites at over a billion dollars per year. India's largest power generation utility, the National Thermal Power Corporation Ltd., has obtained rights to mine coal from a Pakri-Barwadih field in the state of Jharkhand. However, it has been unable to do so because of Naxalite activity. Indeed Jharkhand, formed out of the state of Orissa (now Odisha), seems the focal point for coal related Naxalite activity, both in interfering with legitimate production and the illicit mining operations used to fuel Naxalite operations in a number of Indian states. Indeed, Naxalites are said to be active in 18 of 28 Indian states.

While the central and state governments own much of the land where coal reserves are located, occupants of the land believe that they have a right to prevent development. Since some 85 percent of Indian coal mines are of the open pit or opencast variety, mining is destructive of the often forested land under which the coal is located. Because so much is at stake for those directly affected and the mechanisms for reimbursement or support so weak, opposition to new or expanded mines is often violent. Thus, local opposition and the inadequacies of Indian land tenure law make it more difficult to exploit coal reserves than it would first appear.

Most Indian imports of coal come from Indonesia (61 percent). India also imports major quantities from Australia (17 percent) and South Africa (14 percent). In 2012, coal imports were about 17 percent of total Indian coal used.[34] With the difficulties in domestic production, imports have risen rapidly. In 2012 they were up almost 50 percent, and in the first half of 2013, imports rose 28 percent year on year. With the drop in value of the rupee, this drove the total rupee value of the imported coal to unprecedented heights.[35] For the fiscal year ended March 31, 2014, imports rose 16 percent compared with the previous fiscal year.[36]

The international security implications involving India's coal imports are important in large part because they involve sea transportation. However, these concerns do not reach the magnitude of security concerns in regard to oil imports. This is chiefly because India's coal imports do not come from the troubled Middle East

region, do not involve sanctioned countries like Iran, and are a relatively small amount compared with total coal availability worldwide. However, both imports of coal and investments in coal source countries do present foreign policy issues for India in its bilateral relations, particularly with Indonesia.

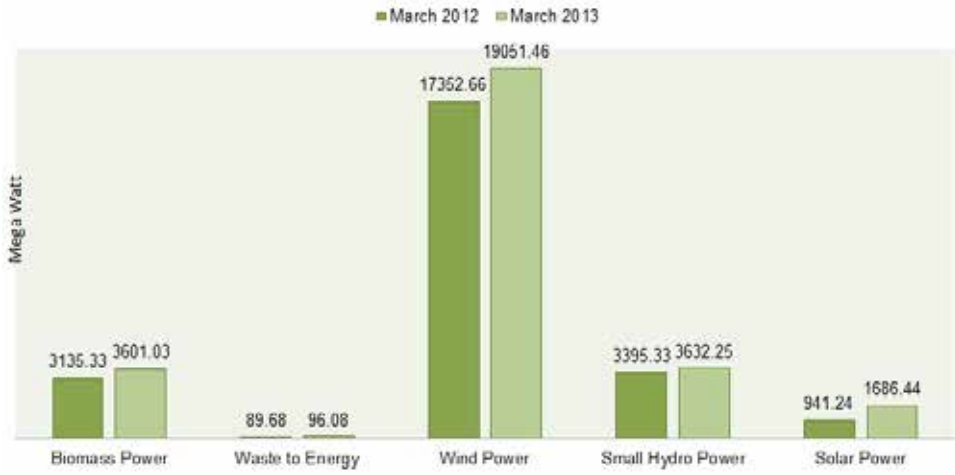
Environmentally, coal is of great concern from the perspective of direct impact on health, climate, and the land. Because of the low quality of India's coal, emissions from the burning of this fuel in India are particularly troublesome. These impacts are discussed in detail below. Suffice it to say at this point that coal is by far the dirtiest of the commercial energy sources available to India. Emissions are not the only concern. The residue from burning coal has an impact on land availability. The author recalls leading a trade mission in the 1990s to coal burning power stations and seeing ashes and cinders piled high for hundreds of acres around Soviet model power plants.

Thus, among the most salient attributes of the coal industry in India are: (1) large amounts, (2) predominant government ownership and production, (3) relatively low prices, (4) significant barriers to exploitation including low quality of the coal, environmental impact, land rights, transportation, and corruption, (5) low domestic productivity, (6) rising imports, and (7) overall inadequate supply.

Biomass

Statistically, non-commercial biomass (chiefly wood, dried dung, grass and agricultural waste) is as important as petroleum in meeting India's energy needs. In human terms it is much more important than oil and its derivatives. Biomass dominates residential energy demand today with 79 percent of all residential energy demand being supplied by biomass. In rural areas the dependence

Chart II-3 - Sourcewise Installed Capacity of Grid Interactive Renewable Power in India as on 31.03.2012 and 31.03.2013



Source: Ministry of Statistics and Programme Implementation, Energy Statistics 2014 p.10 http://mospi.nic.in/mospi_new/upload/Energy_stats_2014.pdf?status=1&menu_id=229

on biomass is even more important, with some 90 percent of rural households depending on biomass for cooking.[37]

There are in India advanced, commercial uses of biomass as well. But this use of the fuel is small and makes up a relatively negligible part of the biomass consumption in India. Nevertheless, recent figures show that it is as large in importance as solar in its grid interactive applications for electricity.

Perhaps because of the primitive nature of the non-commercial use of this fuel, it is given relatively little attention by policy planners. The assumption is that use of this fuel will lessen rapidly as the economy develops.[38] However, as the IEA has pointed out, the use of biomass in rural areas could actually increase as households cook more meals per day and continue to use biomass as a secondary fuel even after shifting to liquefied petroleum gas as a primary fuel.

Of greatest importance to the use of non-commercial biomass is its affordability. The impoverished hundreds of millions in India can obtain biomass when no other form of energy is available to them.

Biomass presents no security concerns in the ordinary sense. It is gathered domestically and burned near the place it is gathered.

The environmental impact from burning non-commercial biomass is worse than coal in terms of its impact on the atmosphere. The outsized environmental importance of biomass is particularly salient because of the harmful health effects biomass has on those who breathe its emissions on a regular basis. Rural women who spend an outsized amount of time in close quarters with poorly ventilated ovens are particularly put at risk by continued use of biomass. One study has put the estimate of pre-mature deaths in India occurring annually because of household emissions from biomass at between 400,000 and 550,000.[39]

The environmental impact of biomass also includes the deforestation and desertification of the Indian landmass. Anyone who has been in Indian vegetated areas proximate to population sees the depredations caused by a constant search for biomass fuels by the poor of India.

Even assuming that increasing levels of prosperity will bring a shift from the use of biomass over time, there is a question of what fuel biomass users will shift to. The prediction is that this shift will be primarily to liquefied petroleum gas (LPG), kerosene, electricity, and natural gas. It seems unlikely that a significant shift to kerosene from biomass will take place because that fuel contaminates the taste of food and is mostly used for lighting in the rural sections. LPG has its limitations in that a continual exchange of tanks must take place. If the shift is to electricity, then the fuel from which the electricity would be produced becomes important when there is presently insufficient fuel for electric power production.

The biomass energy issue for India deserves considerably more attention and analysis from policy makers than it receives. For what approaches a majority of Indians, biomass is the energy source that matters most to them. In terms of producing environmental and adverse health impacts, biomass should be high on the agenda. However, because it does not fit neatly within the scheme of

commercial considerations, relatively little of Indian or international energy policy deals with the questions of moving masses of people on the lower economic rungs of society to cleaner, more efficient, although more expensive, energy sources.

Oil and Its Derivatives

Oil was discovered in what is now the northeastern state of Assam as early as 1867, less than a decade after the seminal 1859 discovery of oil in the United States. The initial discovery was not commercialized immediately, and, at the time of independence, India produced annually a meager 0.25 metric tons of crude oil. At independence, the Ministry of Petroleum and Natural Gas was formed to regulate all phases of the business including exploration and production, refining, distribution and marketing, import and export. However, at first India continued to rely on the multinationals favored by imperial Britain-including Shell, Burmah Oil Company, Anglo-Persian Oil Company that later became BP, Caltex, and Esso–for its petroleum needs.

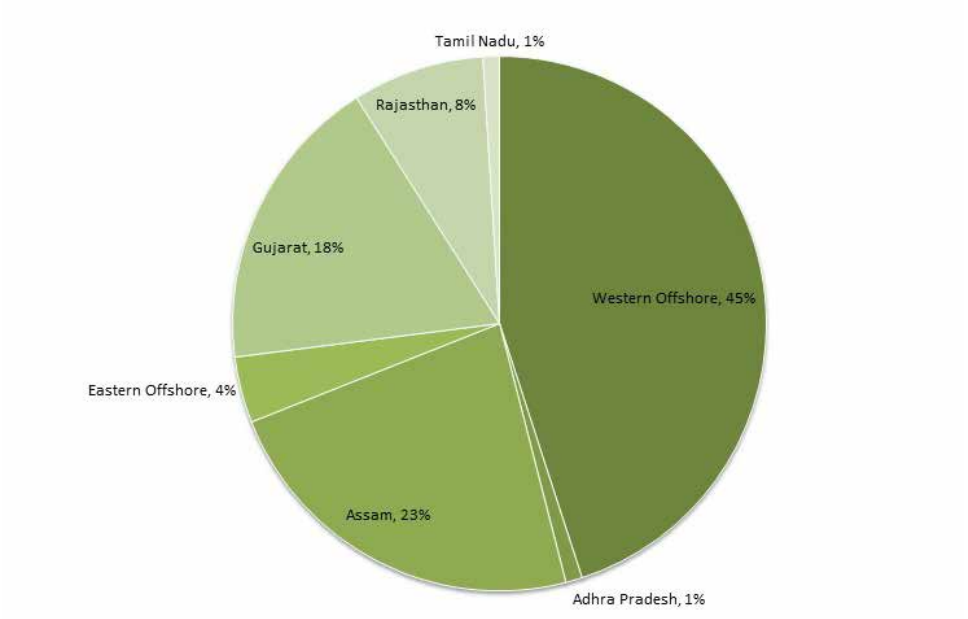
In the '70s, nationalization of oil facilities succeeded in bringing oil importation and distribution largely under state ownership. India still relied almost wholly on imports until 1974. In that year, a significant oil and gas find was made in the waters of the Arabian Sea near the city then called Bombay and now officially Mumbai. This "Bombay High" oil discovery offered hope for lessening India's needs to purchase oil and refined petroleum products on the international market. While the Bombay High production was instrumental in cutting oil imports, there have been limited subsequent discoveries and the field is now declining as imports rise.

Intensive prospecting off the eastern coast and the Andaman Islands met with only modest success. Nationalized Oil India Limited (OIL) continued to produce small amounts chiefly from Assam and the remnants of the old Assam Oil Company continued to pump rather insignificant amounts from those same fields.

The most salient feature of India's oil supply and demand situation is still its overwhelming reliance on imports. The government of India estimates the total crude oil production for the five years of the 12th Plan (2012-2017) at 216 million metric tons whereas the total demand for petroleum products in that same period is estimated at 845 million metric tons. This ratio of 4 to 1 matches closely the almost 80 percent imports presently estimated as India's total reliance on petroleum imports. The physical availability of oil from within India may be very limited. However, the lack of investment in exploration raises the possibility that reserves could be greater than now proven. India has about 5.5 billion barrels of proven reserves. India ranks 19th in world proven reserves, 24th in world production, but 4th in oil consumption and 4th in importation.

The 12th Five Year Plan (2012–2017) estimates that domestic crude oil production has peaked. According to the Plan, production is expected to decline in the years 2015 through 2017. Apparently this predicted decline is predicated on lack of new discoveries. New discoveries have been constrained in part by inadequate funding of exploration and development. Thus, India's physical oil availability is intimately connected with the economics of exploration and production. Pricing is a key component of the profitability of exploration and

Chart II-4 - Estimated Reserves of Crude Oil in India as on 31.03.13



Source: Ministry of Statistics and Programme Implementation, Energy Statistics 2014 p.2 http://mospi.nic.in/mospi_new/upload/Energy_stats_2014.pdf?status=1&menu_id=229

production and therefore the ability to attract the necessary capital. Since the pricing and regulatory mechanisms for oil are quite similar to those for gas, a detailed discussion of this subject is left for the section below on gas. Suffice it to say at this point that in spite of price increases that have sought to cut the losses of state-owned downstream companies, price remains very much a controlled subject for petroleum and petroleum products. While these controls may increase immediate affordability to consumers, in the longer run they act as a restraint on availability.

Much of India's reserves lie offshore where exploration and production are more complicated and difficult than onshore. The requirements for technology and equipment for the exploration and production from offshore indicate the need for greater investment. The greater the preponderance of offshore resources, the more expensive it is for India to exploit its oil reserves.

Chart II-4 shows the extent of India's offshore oil reserves in comparison with those on land.

Given the relatively small reserves of oil in India, it is not surprising that India looks outside the country for oil assets. This "equity oil" strategy is entrusted by the Government to a wholly-owned subsidiary of ONGC, ONGC Videsh Ltd. ("OVL"). Therefore, the person who heads OVL is crucial to India's equity oil strategy and its competition with other international oil companies, both private sector and government-owned. D. F. Sarraf headed OVL before he became chairman of the parent company in 2014. Sarraf is not the usual government

entity bureaucrat, and his career is discussed below under the section dealing with natural gas and ONGC's role in that sector. Suffice it to say at this point that under Sarraf's leadership, OVL projects expanded to 33 projects in 17 countries. Of these, 11 projects are operated by OVL, and 8 projects are jointly operated by OVL and other companies. In 2013, ONGC Videsh had oil and gas production from 11 projects in 9 countries. These projects were in Russia (Sakhalin-1 and Imperial Energy), Syria (Al-Furat Petroleum Co.), Vietnam (Block 06.1), Colombia (MECL), Sudan (Greater Nile Petroleum Operating Company), South Sudan (Greater Pioneer Operating Company and Sudd Petroleum Operating Company), Venezuela (San Cristobal), Brazil (BC-10), and Azerbaijan (ACG).

These projects mainly serve as a physical hedge against rises in the price of oil. The production is sold into whatever market is most convenient at international price levels. Only on rare occasions does the output of a particular property owned by OVL actually travel to India. Nevertheless, output from these OVL projects is planned to increase from 9.144 billion tons of oil equivalent in 2013 to 15.746 billion tons of oil equivalent by 2017.

Of lesser importance than OVL, Bharat PetroResources, the upstream subsidiary of refiner and downstream seller Bharat Petroleum Corp., also has been involved in overseas activities. Although its major involvement has been focused lately on natural gas, Bharat PetroResources owns interests in eight oil exploration blocks in Brazil and one each in Indonesia, Australia and East Timor. [40]

In 1991, a perfect storm of economic disaster struck that would forever change the face of Indian oil exploration and production. India's command and control "license raj" economy failed to produce sufficient growth, and its current account balance faltered as imports increased and exports decreased. As noted in the International Monetary Fund study of the 1991 economic crisis, "India's post-Independence development strategy was both inward-looking and highly interventionist, consisting of import protection, complex industrial licensing requirement, financial repression, and substantial public ownership of heavy industry."[41] At the same time, the crisis caused by Iraq's invasion of Kuwait sent international oil prices rising. In 1990-91 alone the value of India's oil imports increased by about 40 percent. Simultaneously, the easily extractable oil from the Bombay High peaked and began to fall.

Thus, oil was a major factor in the Indian financial crisis of 1991. Prime Minister Nirasimha Rao, assisted by his Finance Minister Manmohan Singh, made oil exploration and production as well as downstream refining and distribution a part of the reforms that the financial crisis forced upon India. India's leading oil exploration and production company, ONGC, was reformed and incorporated as a limited company. Its regulatory functions were placed in a new body denominated by the Directorate General of Hydrocarbons (DGH). ONGC entered into joint ventures with private bodies and a portion of the ONGC stock was sold to the public. Likewise, India's second leading exploration and production company, OIL, sold shares to the public, entered into private sector joint ventures, and began to act more like a private company.

As the government opened up oil production after the 1991 crisis, it also began to allow private sector downstream participation. This trend culminated in 2005 by once again allowing foreign companies to participate in distribution of

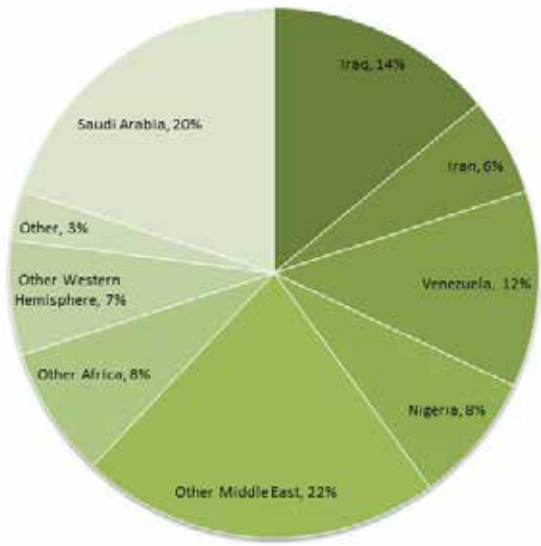
gasoline, diesel and related transportation petroleum products to the consumer. As discussed below, both such domestic companies as Reliance and Essar and such multinationals as Shell moved through this opening to enter the downstream market.

In regard to security of supply of oil, domestic threats cannot be ignored. For example, Assam, the leading state in terms of onshore reserves of oil and gas is threatened by armed uprising. Two terrorist groups claiming to represent the interests of native Bodo tribal people have risen to slaughter Muslims and imperil infrastructure including oil and gas pipelines. Once again the question arises of whether Prime Minister Modi's government can succeed against this threat.

These existing internal threats to the security of energy supply are important not just for the areas presently affected. India suffers terrorist attacks on an annual basis that it claims are aided and abetted by foreign sources. Indeed in regard to the most infamous terrorist attacks on the Indian parliament on December 13, 2001, and Mumbai on November 26, 2008, the evidence seems clear that forces in Pakistan were fundamental to those episodes. The success of domestic terrorist attacks on energy infrastructure cannot be lost on those outside India who wish to use violent attacks inside India to further their agendas. Indeed after the 2014 national elections, a call went out from an Indian terrorist group asking similar groups outside India to attack India, specifically focusing on economic interests.

The necessity for India's importation of nearly 80 percent of its oil needs brings with it a substantial concern with security of supply. The security of foreign

Chart II-5 - India Petroleum and other liquids imports by source, 2013



supply issue has many facets. However, two of the most prominent are (1) security in terms of assured willingness and ability of countries to sell to India at affordable prices, and (2) the actual physical security of the lines of supply. The dimensions of these oil supply security issues may be discerned from a review of where India gets its imported oil. Chart II-5 indicates the relative importance of India's oil supplying nations.

India's overwhelming reliance on the nations of the Middle East (or Western Asia from the Indian perspective) offers an immediate insight into the dimensions of the security issue. In total, almost two thirds of India's oil imports come from this region. The political issues of security of sourcing are immediately apparent.

These issues revolve around the turmoil in Iraq and Syria and the ongoing dispute with Iran over its support for terrorism and nuclear program. In regard to Iraq, interruptions in supply occasioned first by UN sanctions and then the 2003 U.S. invasion was the initial concern. However, with the fall of Saddam Hussein and then the actions of U.S. troops in improving the security of supply situation, Iraq again became a significant supplier. The political instability created by ongoing Sunni-Shia violence is now of great concern as it interferes with oil production and export.

Of even more concern to India is the Iran nuclear issue and what it means for India. Historically, Iran has been an important source of oil for India. Even before Indian independence, the Anglo-Persian Oil Company, which later became BP, was an important supplier. After independence, the India-Iran oil alliance grew. In 2010, Iran was India's second leading source of crude oil, supplying about 16 percent of its imports.[42] In 2010, the U.S. Congress was determined to put teeth into a sanctions regime that had been unsuccessful in keeping Iran from making progress toward developing a military nuclear capability. The result was the "Comprehensive Iran Sanctions, Accountability and Divestment Act of 2010." This act was amended and supplemented by additional legislation and put into effect by the National Defense Authorization Act for 2012. In 2010, the United States had also obtained a fourth UN sanctions resolution to pressure Iran into changing its nuclear development conduct. Under the authority of the U.S. law and with the support of the UN resolution, the United States declared the purchase of crude oil from Iran a sanctionable activity. However, an exemption for "significantly reducing" oil purchases was available under the statute. A 180-day period for "significantly reducing" was provided with a deadline set for July 1, 2012.

In March 2012, the State Department announced that a number of countries had been given an exemption. India was not among them.[43] At the time, India had already shrunk its purchases to about 11 percent of its crude oil imports, but was still Iran's third leading customer accounting for 13 percent of Iran's approximately 2.3 million barrels of oil exports per day.[44]

India denounced the U.S. sanctions effort as not being in accordance with UN resolutions concerning Iran. Nevertheless, the Indian government privately demanded that state-run refiners reduce their purchases from Iran.[45] In May India announced in parliament that Iranian oil purchases would be cut by 17 percent.[46] The State Department issued India an exemption in June 2012 and renewed the exemption thereafter.[47] By the end of 2012, Indian imports of

Iranian oil had been reduced to 6 percent of total imports. Thus, in two years Indian oil imports from Iran had gone from 16 percent to 6 percent, a decrease of almost 63 percent. Indian imports of Iranian oil continued to fall in 2013. However, in the first quarter of 2014 Indian imports of oil from Iran began rising and India acted to cut back to the 2013 levels.[48] The issue continues to be a contentious issue between the United States, India, and Iran.

Since 2001, India has worked with the United States continuously in regard to the security of the sea lanes in the Indian Ocean. The Indian Navy has escorted over a thousand ships to safety from pirates and has taken on special responsibilities in regard to the straits of Malacca between Singapore and Indonesia. Although the scope of U.S.-India naval exercises has declined in recent years, these exercises are continuing and should be brought back to their former vigor. The necessity of keeping these sea lanes open for oil shipments means that India will need to continue to augment its fleet, which is already the fifth largest in the world.[49]

Oil and its derivatives are, after coal and biomass, the most polluting sources of energy. The reliance on these fuels in the field of transportation is particularly problematic. A study reported in the British medical journal *Lancet* estimates that over 700,000 persons in India and the rest of South Asia die prematurely every year from the effects of air pollution caused chiefly by vehicles. Some 65 percent of all air pollution deaths are now in Asia, which lost 52 million years of healthy life from fine particle air pollution in 2010. The report indicates that air pollution also contributes to higher rates of cognitive decline, strokes and heart attacks. If the figures for deaths from outdoor air pollution are combined with deaths from the indoor pollution of biomass, as discussed above, air pollution ranks as a leading cause of death in India.[50]

India's efforts to curtail the effects from burning petroleum products as fuel for vehicles will be discussed below. These efforts chiefly revolve around court-mandated efforts to substitute CNG for gasoline and diesel in public transportation. The comparative advantages of gas over oil in regard to climate change will also be discussed in the sections dealing directly with natural gas.

Hydro Energy

The rivers that fall rapidly from the Himalayan mountains constitute a huge but not easily exploitable resource for the generation of electricity. There are also existing power plants in the south of India, particularly along the relatively low lying Ghats ranges that are inland from the southwestern and southeastern coasts. The estimated total hydroelectric resource is estimated at 149 gigawatts of which only about 32 percent or 48 gigawatts is presently developed or under development. Although hydro power presently accounts for only about 3 percent of India's total energy needs, it is more important in the generation of electricity. In 2012 about 20 percent of India's generation capacity and 14 percent of actual generation came from hydro.[51]

A major hurdle in the development of hydroelectric power is the enormous up front investments required to build the facilities. Since neither center nor state governments have the ability to finance many significant new additions to the inventory of hydro power plants, India looks to private developers to exploit its

hydro resources. This project finance approach requires a reliable stream of payments from customers to service debt and provide an attractive rate of return on investment. This, in return, requires customer prices high enough to insure an income stream to pay lenders and investors. Hydro power developers therefore are met with the same difficulties that others endure to secure payments sufficient to provide debt service and attractive rates of return.

The opposition to the building of hydroelectric facilities in India is fierce and sometimes violent.

The Modi government has revived the linking rivers project. This project has a long history dating from the days of British rule and was a favorite project of the previous BJP-led government. Although the primary purposes of the project are to transfer water from wet to dry regions and facilitate transportation, the project is also to have a hydro energy component.

The opposition to the building of hydroelectric facilities in India is fierce and sometimes violent. As with coal, much of the exploitable hydropower potential is in areas inhabited by tribal and lower caste citizens who feel aggrieved by the government and institutions of development in any case. The flooding of land resources and displacement of persons has provoked strong opposition.

Perhaps the most famous opposition to hydropower in India has come from award-winning author Arundhati Roy. Roy is best known for her initial novel *The God of Small Things.* This novel won the Booker Prize in 1997 as the best novel of the year written by a citizen of the United Kingdom, the Commonwealth, or the Republic of Ireland, and landed on the *New York Times* best-seller list. Although Roy was born in northeast India, her mother was from Kerala and she grew up in that state, which is the setting for her novel. In 1998 with an essay condemning the Indian nuclear tests, she embarked upon a career as a political activist and non-fiction writer, although she is now returning to fiction.[52] After her initial foray into political activism, Roy focused on the human and environmental costs of large hydroelectric dam projects. Her 1999 book *The Cost of Living* was about just such a project on the Narmada River that originates in the state of Madhya Pradesh and flows into the Bay of Cambay in the state of Gujarat.[53] Although the hydro project was finally built, this occurred only after some two decades of protests and has acted as a damper on projects all over India.[54]

Internationally, tensions created by the damming of rivers that cross international borders serves as a detriment to hydro power development.[55] Perhaps the most notable example of this phenomenon involves a series of dams that India plans on the upper reaches of the rivers that water the Indus basin in Pakistan. Since 1960, India has had a treaty with Pakistan concerning the allocation of the waters of this basin. India claims that its dam development plans are fully within the parameters of that treaty and the treaty itself provides for mechanisms to decide allocation controversies. Nevertheless, in Pakistan it is argued that India is stealing water that belongs to Pakistan.[56]

In regard to China, India has claims that waters from Tibet that flow into the

Ganges and the Brahmaputra rivers are being diverted for use in China. Bangladesh has accused India and China of interrupting its water supplies.

One brighter aspect of cross-border water flows and the development of hydroelectric power is found in the cooperation between India and Bhutan. Under agreements negotiated by Indian diplomats, India helps develop hydro projects in Bhutan. These projects export the surplus power to India.[57] India is attempting to reach a similar agreement with Nepal. However, Nepal presently imports more electricity from India than it exports to India.

In the monsoon season of 2013 thousands of people were killed by flooding in the Indian Himalyan mountain state of Uttarakhand. Bordered on the east by Nepal and the north by Tibet, Uttarakhand is the site of much of India's current hydropower development. When the floods came, many blamed their destructive nature on poorly situated or constructed dams. Critics argued that dams could not fully contain flood waters and actually made matters worse by channeling water in unnatural ways that exacerbated the flooding. With 24 projects approved by the state, the Supreme Court of India took cognizance of a complaint alleging irreparable environmental damage. The Court ordered a study of the projects under construction and that no further permits be granted pending an environmental review.[58] With some 292 major dams planned for the Himalayan region, some maintain that the mountains are too fragile and are unsuited for hydropower development.[59]

Unlike fossil fuels, there is no contribution to climate change when hydroelectric projects generate electricity. However, the damage to forests and habitat, as well as human habitation in many cases, is devastating to large tracts of land both in construction and when impoundment takes place. Obviously, the nature of the entire affected area is fundamentally changed as flora and fauna, wild as well as domesticated, are displaced. The variation in size of the project has an effect on the amount of displacement caused by a single project, although some argue that a number of smaller projects generating power equivalent to a single larger project can have equivalent environmental effects.

Just as flood control may not always be a by-product of hydroelectric development, the effects of damming on water conservation and drought alleviation may not always be positive. Particularly for downstream users, the impounding of upstream waters may deprive them of water and lack of flow may contribute to silting and pollution.

Thus, while India has considerable theoretical hydro energy potential, the costs of development and resistance created by those directly affected limit the efficacy of hydropower in significantly ameliorating India's power problem. These factors probably will keep hydro from making a major impact in satisfying India's struggle for power. Nevertheless, the Modi government's intent to revive the linking of rivers project could change this outlook.

Solar

Since India lies predominantly in the tropics, it receives abundant energy from the sun. Particularly in the desert areas of Rajasthan and Gujarat as well as on the dry interior plains the bombardment of the sun is intense. The Planning

Commission has estimated that India receives solar radiation the equivalent of 50 megawatts per square kilometer, or some 150,000 gigawatts for the entire nation. This is a phenomenal amount of energy. By way of comparison, the installed capacity for India's electricity generation is about 290 gigawatts (including captive as well as grid-connected power capacity). However, what matters is the ability to recover the solar energy within India's economic means to do so. At this point solar is simply not a significant factor in meeting India's power needs. In 2013 solar accounted for less than 1 percent of India's electricity generation capacity.[60] Thus, solar energy's contribution to India's overall energy needs was miniscule.

However, recognizing the potential of solar, India has embarked upon the "Jawaharlal Nehru National Solar Mission" in an attempt to turn the abundant sunshine into a significant source of power. The goal of the National Solar Mission is to have 20 gigawatts (20,000 megawatts) of additional solar generation capacity by 2022. This is to be compared with the roughly 1.8 gigawatts solar generation capacity in 2013. (Thus, 22 gigawatts total grid-connected capacity by 2022 plus off-grid and micro-grid capacity.) At the beginning of the Modi administration, a prominent BJP advisor said that the new government would conduct an expanded solar initiative. The plan to use distributed solar technology to give the 400 million Indians without any access to electricity at least a working light bulb by 2019 received widespread publicity.[61] However, this was not an official announcement from the government, much less a plan with resources to make such a goal a reality.

The basic difficulty with solar power is not energy availability but the cost of turning the energy received into usable power. According to the Indian Planning Commission, solar costs both for facilities construction and production were considerably higher than for any other renewable source. Chart II-6 summarizes these comparative costs as estimated by the Indian Planning Commission in the 12th Five Year Plan.

The good news in regard to solar is that the costs are dropping rapidly. The 12th Five Year Plan points out that between the time of the first and second rounds of contracts under the National Solar Mission (about a year), prices per kilowatt hour dropped from 17.91 Indian rupees (Rs.) to Rs. 8.7 for photo voltaic production while the prices for thermal solar were even lower. The prices of 2013 bids for future projects in Gujarat came close to Rs. 5 per kilowatt hour.

Chart II-6 Cost of Power for Various Renewable Energy Sources [62]

Source	Estimated initial capital cost (₹ in crore/MW)	Estimated cost of electricity generation (Financial) (₹/kWh)
Small Hydro Power	5.50-7.70	3.54-4.88
Wind Power	5.75	3.73-5.96
Biomass Power	4.0-4.45	5.12-5.83
Bagasse Cogeneration	4.20	4.61-5.73
Solar Power	10.00-13.00	10.39-12.46

The price for photovoltaic technology (chiefly solar panels) had fallen so fast that solar reportedly was close to competing on price with wind power and coal.[63] Environmentalists have argued for years that if the costs to public health and welfare and the environment generally were priced into the costs of carbon-based energy sources, the prices for solar are already competitive with coal, oil, and gas.

A major barrier to the continued lowering of the price of solar energy in India is the central government's local sourcing requirements. Local procurement may not only add to the cost of solar, but jeopardize the availability of apparatus in the quantities needed to full take advantage of India's solar resource. According to rules published by the Ministry of New and Renewable Energy, about half of solar energy cells and panels must be of domestic manufacture. In a request for bids to build 750 megawatts of solar plants in 2013, 350 megawatts had to be built with photovoltaic equipment manufactured in India. Indian manufacturers Moser Baer India Ltd, LancoInfratech Ltd., Indosolar Ltd., and Websol Energy System Ltd., among others, constituted a significant lobby for the local manufacture rule.[64]

The United States has challenged the local sourcing rule as being inconsistent with India's obligations under the WTO.[65] At the end of the United Progressive Alliance (UPA) government's tenure, there was a move to replace the local sourcing rule with anti-dumping duties. This protection by anti-dumping duties was to give much the same protection to Indian manufacturers as that provided by the local sourcing stricture while arguably being in accordance with India's obligations under the WTO.

One advantage used by states such as Gujarat in attracting foreign investment in solar was that the state of Gujarat did not require manufacture in India for solar contractors in that state.[66] Other Indian states take a similar view and are rapidly implementing plans to follow the Gujarat lead.[67]

In addition to the 20 gigawatts of additional solar generation capacity contemplated by the National Solar Mission by 2022, there are also plans for 2 gigawatts of off-grid distributed solar generation capacity. The Modi plan to use off-grid solar to power at least light for the 400 million Indians without any electric power would presumably be an increase in this goal. Indeed in rural areas, household solar generators are already starting to displace kerosene lanterns as a source of light. Solar powered home water heaters are widely advertised and are becoming more affordable and common. Proponents for off-grid or micro-grid solar claim that the adoption of this strategy could allow large segments of the Indian population to receive the benefits of electricity by "skipping" the enlargement of the grid system. The argument is that this distributed off-grid solar would be to electricity much as cellular telephones skipped hard wired land lines in much of India. Of course, such a strategy would seem not to solve the electricity program for industries and other users who need large amounts of reliable power that would require solar plants too large and expensive for most manufacturing operations.

A chief advantage of solar is that the energy is highly secure. While facilities must be secured against domestic threats, no international transportation security or sourcing security factors are involved. To the extent that renewables

lessen the need for imported hydrocarbons, international security and geopolitical concerns associated with oil, gas and coal are lessened. However, since oil is the mainstay of the transportation sector, the development of electric transportation technology is necessary for renewables such as solar to offer an alternative to oil.

Solar has almost no significant adverse effects on the environment. There is some concern about the taking of large acreages of undeveloped land for industrial size solar power plants. Regardless of the technology involved, these projects require large numbers of solar collectors that cover the land upon which they are arrayed. These arrays render the land upon which they are located largely unfit for native flora and fauna. Nevertheless, human health is not jeopardized by exploitation of the resource, and the environmental threat is insignificant in comparison with the use of hydrocarbons, and even hydro and nuclear. This marked advantage over most other sources of power is its major attraction as a power resource.

Thus, solar theoretically could provide a virtually inexhaustible supply of energy adequate to meet Indian energy needs while doing minimal damage to the environment. In reality, solar energy is presently so expensive to capture, store and use as to make it difficult to rely on for a significant portion of India's energy needs in the immediate future. The affordability and reliability of solar power is improving rapidly, and the use of solar could in the future eliminate many of the security and environmental concerns arising from most other energy sources.

Wind

For planning purposes, India uses estimates of its wind energy resources at between at between 50 and 300 gigawatts. However, wind resources are not sufficient for their exploitation throughout India. The Planning Commission identifies only seven of India's twenty-eight states as suitable for wind power development.[68]

Availability of power from wind is further constrained by the remoteness and difficulty of terrain for many of the best locations for siting wind generation equipment. This not only inhibits development by virtue of siting the generation machinery, but also makes difficult the laying of transmission links to collection sites.

India's installed capacity for wind generation is approximately 20 gigawatts, which places India fifth in the world for installed capacity. Wind accounts for less than 7 percent of electricity installed capacity. However, much of this installed capacity does not generate up to capacity and less than 2 percent of electricity is actually generated from wind, while wind accounts for about 1 percent of energy consumed.

The Indian wind energy industry rose to a position of third in the world on the backs of subsidies and tax incentives in the form of accelerated depreciation. Without these subsidies and incentives (and without hydrocarbon fuel having to bear the costs of pollution), wind energy has had difficulty being affordable within the Indian energy context. These incentives and subsidies were in place from 2003 to 2012. During this period,17 gigawatts of wind generation electrical capacity were added. Before the worldwide economic crisis of 2008 and the

later withdrawal of subsidies and tax incentives, India had obtained international prominence not only for the installation of wind capacity but as a manufacturer of wind generation equipment.

The face of India's rise and decline in wind energy is Tulsi Tanti. In 1995, Tanti was an average Gujarati 37-year-old businessman trying to run a small textile manufacturer with a couple dozen employees. In an attempt to cut costs and his dependence on then uncertain power, he founded Suzlon to purchase a small 3-kilowatt wind farm. The initial use of this captive power source was a success and he saw how his experience might, with the help of tax incentives, create a market for the manufacture and installation of wind generation equipment. Tanti's ambitions went beyond India and soon he was both exporting from India and acquiring companies abroad. The Suzlon approach was to provide a complete suite of equipment and services to wind energy customers. Suzlon developed large sales to the United States and Europe, while remaining the market leader in India, and became the third largest wind energy company in the world. Awards for environmental leadership poured in. Tanti commissioned an expensive office campus near Pune in Maharashtra State from which to run his business.

Unfortunately, orders from the United States and Europe diminished radically with the international financial crisis of 2008. Still more unfortunate this 2008 collapse coincided with Suzlon's taking on massive amounts of debt for foreign acquisitions including for the offshore wind specialist in Germany, Repower. Customer complaints in the form of allegations of cracked blades and one which actually fell from a turbine in North Dakota also occurred in 2008. In 2009, the company retrenched by selling some properties, refinancing its debt, and refocused the company on India and emerging markets.

These measures kept Suzlon from immediate bankruptcy. However, the company continued to incur losses, with its auditors warning of "material uncertainty about the company's ability to continue as a going concern."[69] The auditors' greatest concern was defaulting on payments to foreign currency convertible bond holders. With the withdrawal of Indian subsidies and tax breaks in 2012, the pace of wind generation capacity installation in India dropped by about half. Suzlon was unable to pay its obligations and had to be re-organized.

In the summer of 2013 modest wind subsidies were restored but the accelerated depreciation tax break was not.[70] Tanti argued that restoration of accelerated depreciation was necessary to restore growth in the industry, but this tax benefit languished.[71] Whether the modest Rs. 5 subsidy per kilowatt hour alone would be able to revive the industry was problematic. Tanti said he expected the accelerated depreciation to be restored and growth to resume in 2014. Suzlon has been active in getting the Modi government to restore accelerated depreciation, and it appears that effort may be successful. A difficulty with the previous accelerated depreciation provision was that it encouraged installed capacity rather than actual generation and transmission to users. Hopefully, these problems will be resolved if full incentives are restored.

Thus, by 2014 Tanti had gone from praise as the face of Indian success in wind power to being an image of its difficulties. A proxy advisory advised shareholders to vote against his reappointment as chairman and managing director.[72] But Tanti held on. Through a German subsidiary, he negotiated a further loan of 850 million

euros with a coalition of banks,[73] retained Suzlon's position as the world's number five wind company, and managed to get the Suzlon board to raise his salary from 20 million to Rs. 30 million (or about $600,000) per annum. As opposed to Tanti's salary increase, the possibilities for increases in wind capacity to resume a steep upward path seemed dim.

Like solar, wind energy theoretically would solve the issues of both domestic and international security of energy supply. The likelihood of interruption of wind power by sabotage or military action seems remote. However, like the Indian solar equipment industry, the wind equipment manufacturers seem to have quality control and supply issues, which, in turn, make the reliability of the supply suspect. Further, since the wind does not blow continuously, the supply of wind power is inherently insecure. When the wind does not blow or blows with insufficient intensity, wind power must be supplemented with a carbon-based fuel.

Environmental concerns around wind power center around damage done to forests during siting and installation of generators as well as harm to birds from revolving blades. In India there have been calls for greater regulation to minimize environmental damage.[74] In regard to pollution and climate change, wind energy has negligible environmental and health adverse effects.

Through the rise of Suzlon to international status, India has proven itself to be capable of being a global player in this energy sector. However, the viability of wind power to meet Indian needs for energy is problematic. The Indian and world experiences seem to show that subsidies and tax incentives are necessary to make electricity generated from wind competitive. With only seven of India's 28 states seen as suitable for wind power, wind may be important only regionally. The gap between installed wind generation capacity and actual production of electricity is probably indicative of a poorly designed incentive system that brought about installation of generators but did not provide adequate infrastructure to make much of the electricity generated useful to consumers.

Nuclear Power

Within the framework of present technology, the chief natural resource for nuclear power is uranium. India is often said to have only limited supplies of uranium and that this operates as a constraint on the development of nuclear power in the country. Indeed, opponents of the U.S.-India civil nuclear deal argued that the size of India's indigenous uranium resources were so small that the United States providing nuclear fuel would enable India to produce nuclear weapons that it would otherwise be unable to produce. A leading expert, Dr. Ashley Tellis, showed this argument to be invalid. According to Tellis, for India to produce at the rate of several dozen weapons per year (up from the 6 to 10 per year India was believed to be producing in 2006) only some 57 metric tons of uranium would be required per year against estimates of Indian uranium holdings of some 79,000 metric tons in 2006.[75] These reserves have now been doubled to some 150,000 tons of uranium through additional discoveries.[76]

The validity of the claim that India's nuclear power production is constrained by a lack of uranium depends very much on the size of the civil nuclear industry projected for India. As matters stood in 2006 at the time of the U.S.-India civil

nuclear deal, India had an annual fuel requirement for all its existing reactors of only 478 metric tons of uranium per year. Against reserves of 150,000 metric tons of uranium, uranium resources would be available for some 300 years. However, Indian processing restraints as well as price considerations cause India to import about 40 percent of its uranium needs.[77] In 2014, India signed an agreement to import uranium from Australia.

India's installed capacity of nuclear power would have to increase many times for nuclear to be a significant part of India's energy mix or come close to being constrained by a lack of uranium as fuel. As of September 2013, India's installed capacity of power stations was a mere 4.780 gigawatts, or only about 2 percent of total installed capacity and about 1 percent of total energy production.[78]

India has ambitious plans to increase its nuclear capacity. In 2013, seven additional power plants with a capacity of 5.3 gigawatts were under construction and due to come on line by 2016. Thus, 2013 capacity could be more than doubled by 2016. Further, India's stated goal for nuclear is to have a total capacity of 63 gigawatts by 2032, a more than thirteen-fold increase from 2013.[79] India's goal for 2050 is for 25 percent of its electricity to be generated from nuclear power plants, when 1094 gigawatts of base-load capacity is expected to be required.[80] Because nuclear power generation at this level could strain uranium reserves, India is endeavoring to develop the capability for the use of thorium in nuclear projects. India's reserves of thorium are among the largest in the world and significantly greater than its reserves of uranium.

India is endeavoring to develop the capability for the use of thorium in nuclear projects. India's reserves of thorium are among the largest in the world and significantly greater than its reserves of uranium.

Obviously, the costs of construction for nuclear energy vary from country to country. In the United States and most of the developed world, the rising costs of nuclear plants and some well-publicized cost overrun disasters have acted as a major break on civil nuclear power development. However, according to Chinese data, China is building nuclear plants based in large part on Westinghouse technology at prices considerably below those seen in Japan, Korea, or the West. China is trying to expand its civil nuclear industry internationally using the cost efficiency of its plants as an attraction. With French help, there was announcement in 2013 of a plant of Chinese design to be built in the United Kingdom.[81] However, it is unlikely that India will allow Chinese involvement in its civil nuclear program because of security concerns.

In 2011, India announced plans for the construction of two 700 megawatt nuclear plants in Rajasthan at a cost of $2.9 billion.[82] This would put the per kilowatt price in the same range as for similar plants in China. However, the rupee

depreciation since the announcements makes it likely that the cost to India is to be significantly greater than estimated.

With the costs of capital being such a significant part of overall costs, it seems likely that high costs of nuclear power plant construction in India will be a significant drag on India's civil nuclear program, as it is in most nations. According to an IEA study, the nuclear option for India energy is considerably more expensive per kilowatt hour than coal, gas, or wind energy.[83] An Indian commentator has estimated the price per kilowatt hour from a Russian designed nuclear power plant to be about Rs. 6 and from a U.S. plant using Westinghouse equipment about twice that. Either price is more than Indian consumers are used to paying.[84] One U.S. analyst has compiled estimates from various sources indicating that the cost per kilowatt hour of nuclear electricity to be more than twice that of solar and wind and even more expensive when compared with any carbon alternative.[85]

In the United States, rising costs put an end to the so-called "nuclear renaissance" of a decade ago. According to Massachusetts Institute of Technology estimates of plant costs per kilowatt, costs of nuclear power doubled over less than five years in the mid 2000s. The present U.S. Secretary of Energy Ernest Moniz has attributed the freeze in U.S. nuclear construction to the advent of much cheaper shale gas-fueled alternatives. But experiences such as the Georgia nuclear power plant originally priced at $660 million in 1971 coming in at $8.87 billion sixteen years later along with many cancellations on account of costs is a major factor in limiting nuclear power development. [86]

Nevertheless, some analysts see signs of a resumption of the nuclear renaissance recently. They offer as evidence for this position the three nuclear projects commenced in the United States in 2013-14 and the so-called "fourth generation" technology being pushed in China with the assistance of the Bill Gates Terrapower project. All of these projects are heavily dependent on government financing, and it remains the case that the need for this financing is a major constraint on the development of nuclear power.

Because of production and price constraints (rather than resource availability), it seems unlikely that there will be a significant diminution of India's 40 percent imported uranium rate in the short run. Most of these imports come from Russia and Kazakhstan.[87] India is searching elsewhere for inexpensive sources of uranium. Uzbekistan and Namibia are two of the more promising nations of focus for additional supplies.

With so much of its uranium fuel supply being imported, the same types of security questions apply as with other imported energy sources. However, these concerns are less acute in their possible economic impact simply because India generates so much less of its energy from nuclear sources than it does from other fuel sources. Conversely, since uranium is fundamental to making nuclear weapons and subject to intense political interest, keeping supplies of nuclear fully secure is intensified. The movement of material fundamental to weapons of mass destruction requires outsized military security. Intense international political interest makes exports always vulnerable to political interference from both foreign and indigenous political actors.

However, perhaps the greater threat to security of supply is from domestic political forces. Violent mass protests have been held at two of India's six nuclear plants, and it appears that protests will follow many of the additional plants on the drawing boards.

Planned with help from the erstwhile Soviet Union in 1988 and finished with reactors and engineering from Russia, the Kudankulam nuclear power plant has been under construction for a decade and the subject of ever increasing local protests over that time. With Japan's Fukushima Daiichi nuclear disaster in September 2011, protests became violent as residents spurred on by a variety of non-governmental organizations became more fearful of what a similar disaster would mean for them. Kundankulam is on the coast of Tamil Nadu where many people make their living from the sea and are wary of fish being poisoned by radiation as well as direct harm to their health and well-being.[88]

French plants at Jaitapur, Maharashtra have similarly been protested. As of this writing, protests of that project had been going on for eight years. Even though the government had agreed to compensate some leaders of the protests, other protestors said the demonstrations would continue.[89]

Fundamental to the argument for nuclear power is that its production creates no greenhouse gases or other forms of pollution likely to contribute to climate change. However, radiation emissions are central to nuclear power production and must be controlled to prevent major health and environmental damage. Proponents of nuclear power take the position that safety features of nuclear power plants make the danger from nuclear power extremely small. Nevertheless, in India as elsewhere, the nuclear accidents at Three Mile Island, Chernobyl, and Fukushima Daiichi have raised concerns about safety and environmental degradation from nuclear power production. The related problem of the disposal of radioactive spent fuel has yet to be satisfactorily solved, at least from a political perspective.

In addition to the prospects of major nuclear accidents, other health risks have been cited. In response to a freedom of information act request, the Indian Department of Atomic Energy provided information concerning the deaths of several employees at the Kalpakkam nuclear site. This information indicated these deaths were caused by multiple myeloma, a rare form of bone marrow cancer linked to nuclear radiation.[90]

As an unwritten part of the U.S.-India civil nuclear deal, U.S. based nuclear companies were to be instrumental in the development of two new nuclear power plants in India. Sites for these plants have been identified and negotiations held with the U.S. based companies GE and Westinghouse. However, the law India passed to govern liability in the case of nuclear accident did not meet what the U.S. considers to be the international standard. According to the U.S. and the Convention on Supplemental Compensation, liability should be on the power plant operator rather than suppliers. As a consequence of the dispute over liability, actual implementation of the U.S.-India civil nuclear deal in regard to the export of U.S. civil nuclear goods and services has not occurred. Protracted discussions are ongoing concerning ways around this liability impasse.

It is beyond the scope of this work to present an analysis of the health, safety and environmental risks of nuclear power. Suffice it to say those risks exist. When those risks mature into actual harm, they seem to be of a far more dramatic nature than those associated with carbon-based energy. Whether they are potentially more or less harmful in the long run than carbon-based energy is a matter of contention. In comparison with renewable energy sources, the effects of civil nuclear seem more hazardous to the environment and human health, safety and welfare.

India's commitments to nuclear energy are clear and ambitious. Starting from an extremely small base, the growth required to meet those commitments is very large. The major difficulties are cost, lack of indigenous uranium milling capacity, the vulnerability of supply to international and domestic security concerns, and potential effects on the environment and health.

Energy Efficiency

Before moving to an analysis and discussion of natural gas, it is appropriate to examine the role of energy efficiency as a part of India's policy to meet its energy needs. The dean of energy writers, Daniel Yergin, has referred to efficiency as the "fifth fuel."[91] Presumably, the other four fuels are petroleum, coal, nuclear, and renewables or "alternative" sources of energy. While not usually thought of as a fuel, efficiency has the characteristics of a type of fuel. It can be subjected to the same sort of analysis as other fuels in terms of its availability, affordability, security, and environmental impact. On each aspect efficiency compares favorably with all other fuels.

Chart II-7 Energy Intensity

Country	Energy Intensity (Kgoe/US$)
United Kingdom	0.102
Germany	0.121
Japan	0.125
Brazil	0.134
USA	0.173
South Korea	0.189
India	0.191
China	0.283

Source: World Energy Outlook 2011 and Planning Commission, *12th Five Year Plan* p.131

With renewed emphasis on “sustainability,” energy efficiency whether referred to as “conservation,” “energy productivity,” or “energy ingenuity” can be as important to solving India’s energy conundrum as any other type of fuel. India, the United States and others of India’s international energy engagement partners have recognized the role of energy efficiency and taken steps to disseminate the technology and best practices necessary to utilize the efficiency tool. India has rightly taken pride in its increasing energy efficiency as evidenced by a declining energy intensity factor. This energy intensity factor is a measure of efficiency since it describes the unit value of energy that it takes to create an additional unit of economic output. Chart II-7 from India’s 12th Five Year Plan of selected countries indicates that India’s energy intensity approaches that of several developed nations and is better than that of China.

In 2001, India passed an energy conservation act that set up a Bureau of Energy Efficiency within the Ministry of Power. This Act was strengthened by amendment in 2010. Studies commissioned by this Bureau estimate the potential for saving energy at around 25 percent for the nation as a whole. As India’s stock of buildings is renewed and augmented, energy efficiency is being incorporated The Indian strategy for energy efficiency includes a standards and labeling program as well as demand side management and a conservation building code. There is a program to increase energy efficiency in the states and to set up a system of certified energy auditors.[92]

Energy efficiency measures have the virtue of reducing cost in a secure and environmentally sound manner. The slogan that “pollution is the footprint of inefficiency” captures the benefit to the environment as well as the cost-saving nature of energy efficiency. As efficiency increases, environmental damage in the form of pollution decreases.

We have now examined each of India’s major sources of energy except natural gas. Because natural gas potentially could play such a constructive role in bridging the Indian energy gap, let us now take a closer and more detailed look. First, we will examine generally the role of natural gas and then analyze this energy source using the availability, affordability, security, and environmental impact framework already employed for India’s other energy sources.

SECTION III

Understanding the Need for Natural Gas

Against the background of India's unfilled energy needs, Indian leaders have viewed favorably the increased use of natural gas to meet energy goals.[93] However, in regard to the attractiveness of gas as opposed to coal, India's planning does not reflect that view. This is a serious shortcoming in understanding the need for gas.

During the period of the 12th Five Year Plan, 2012-2017, India plans for a continued reliance on coal for the preponderance of its fuel to supply electrical power and a decrease in the role of natural gas. According to the Plan, over 80 percent of the electrical capacity addition for the Plan period would depend on coal. While India evidently intends to lessen its dependence on coal in favor of nuclear and renewables after 2030, for the near-term coal is the fuel to be relied upon. Natural gas is posited as playing a diminishing role. Chart III-1, taken from the 12th Five Year Plan indicates this reliance on coal.

Chart III-2, also taken from the 12th Five Year Plan, shows that during the five-year plan period through 2017, India plans to add 28 times more coal fired capacity than that for gas.

Chart III-1 Changing Structure of Fuel for Electricity

	2012	2017	2030	2012	2017	2030
1. Coal	56	57	42	70	69	58
2. Oil	1	1	0	0	0	0
3. Gas	9	6	3	7	5	3
4. Hydro	20	15	13	14	12	11
5. Renewables	12	17	33	6	9	16
6. Nuclear	2	4	9	3	5	12
Total Clean Energy (4+5+6)				23	26	39

Source: Government of India, 12th Five Year Plan.

Chart III-2 Sector-wise and Mode-wise Capacity Addition (Provisional) during the Twelfth Plan (MW)

		Thermal	Coal	Lignite	Gas/LNG*		
Central	6,004	14,878	13,800	250	827.6	5,300	26,181.6
State	1,608	13,922	12,210	0	1,712.0	0	15,530.0
Private	3,285	43,540	43,270	270	0.0	0	46,825.0
Total (Excluding RES)	10,897	72,340	69,280	520	2,539.6	5,300	88,536.6
Renewables	-	-	-	-	-	-	30,000.0
Total (Including RES)	10,897	72,340	69,280	520	2,539.6	5,300	118,536.6

*Addition of gas capacity is provisional and will depend upon the availability of gas. This will be reviewed during the MTA
RES=Renewables; MTA=Mid Term Assessment

Source: Government of India, 12th Five Year Plan

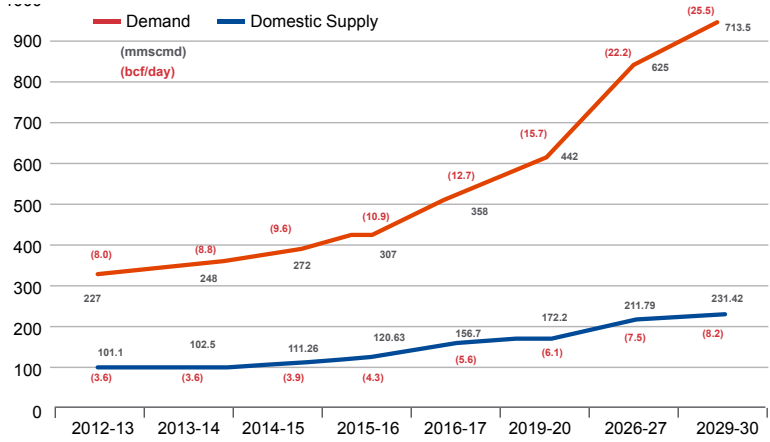
Chart III-3 Fuel Requirement during 2016-17

Fuel	Requirement	Availability
Coal	730 Million Tonnes	550 Million Tonnes
Lignite	46 Million Tonnes	46 Million Tonnes
Gas/LNG	207 MMSCMD*	102 MMSCMD*

*In addition about 17,500 NW gas-based capacity is under various stages of construction for which additional gas requirement is about 84 MMSCMD.

Source: Government of India Planning Commission

Chart III-4



Source: Vision 2030, Natural Gas Infrastructure in India

The footnote to this chart indicating a review of even the modest natural gas capacity increase during the MTA (mid-term assessment) indicates the concern about the adequacy of domestic gas supply.

India does recognize a gap between the existing need for gas for electric power production and domestic availability. The Planning Commission by the following chart concedes a 50 percent (or 105 million metric standard cubic meters per day (MMSCMD) deficit between the requirement from existing consumers of gas and availability from domestic sources for power generation.

Note that the Commission states that the projected deficit does not include a requirement for 84 MMSCMD to fuel an additional 17,500 megawatts of gas powered electrical generation presently under construction. The requirement of an additional 84 MMSCMD means that India's natural gas domestic supply deficit for power generation in 2016-2017 is likely to be 291 MMSCMD and the deficit between requirement and availability approximately 65 percent of the requirement.

The 17,500 megawatts of additional gas-fired electricity capacity presently under construction is obviously many times greater than the 2,539.6 megawatts capacity addition contemplated for addition between 2012 and 2017. This apparent acknowledgement that most of the 17,500 megawatts of gas powered electrical generation capacity under construction will not have fuel appears to be a part of the basis for planning a decline in gas as a percentage of the energy sources used for electricity generation in India. The possibility of fueling this additional capacity with imported LNG seems to be ignored. This failure to plan for the fueling of power plants under construction is a gap in the Indian planning process.

India's overall requirement for natural gas is significantly higher than that forecast for electrical power generation alone. Only about 60 percent of gas is used for this purpose. A group of experts commissioned by the Indian government has forecast demand for natural gas in the fiscal year 2016-17 at 358 MMSCMD as indicated by the chart III-4.[94]

According to the Central Electricity Authority gas-based power plants operated at 29 percent capacity in the second quarter of 2013, against 61 percent in 2008 because supplies were unavailable at the $4.20 per million British thermal unit (mmBtu) fixed by the Indian authorities.

Natural gas consumption for residential purposes is dwarfed in importance by the use of biomass. City gas, or use of natural gas for residential heating, cooling and cooking constitutes only about 1 percent of natural gas consumption in India. Since biomass is a less efficient, more polluting fuel for residential energy use, the replacement of biomass by gas constitutes a huge potential growth market for India. Indian planners have given little attention to this source of additional need.

India has received much favorable publicity for use of CNG for transportation vehicles. This use was given a major impetus by a complicated political process running from 1985 through 2002 in which public surface transportation in New Delhi moved from the use of diesel and gasoline to CNG in order to protect citizens of the city from the harmful effects of air pollution. The Supreme Court

of India played a major although far from exclusive role in this transition. The shift has made a discernible difference in air quality in New Delhi.[95] The use of CNG has since spread to approximately 30 other cities, chiefly in the state of Maharashtra. In 2010 there were some 700,000 natural gas vehicles in use in India. India ranked fifth in the world in such vehicles. However, this was only a small portion of total Indian cars and less than 1 percent of Indian natural gas consumption is attributable to vehicles that use CNG. Thus, transportation is another potential source of demand for gas that has not been given adequate attention.

Of vastly more importance in domestic competition for natural gas than household or transportation uses are the non-energy uses of the gas. Chief among these is the manufacture of fertilizer, which outranks all other uses individually except for natural gas consumed by general purpose electrical power plants. Approximately 20 percent of Indian natural gas goes to the production of fertilizer. Another 15 percent or so goes into the manufacture of petrochemicals and plastics.

From a comparison of Indian consumption with consumption in other countries, it appears that India should be using more gas than it is. During India's fiscal year 2012, India consumed only about 57 billion cubic meters (bcm) of gas. By way of comparison, China's consumption for the same year was 147 bcm. These levels of consumption amounted respectively to 54 and 96 cubic meters on a per capita basis. Other members of the BRICS grouping per capita levels of consumption were 126 cubic meters for Brazil, 2,906 for Russia, and 111 for South Africa. U.S. per capita consumption was 2,117 during this same period. Thus, India's use of gas was considerably less than that of similarly situated developing economies, much less more developed countries.[96]

Of course accurate forecasts of demand (as opposed to needs or requirements) must take into account the price at which gas is available. A 2011 study by McKinsey projected 2015 demand for natural gas to vary from 230 MMSCMD to 388 MMSCMD depending on whether the customer gate price was $16-17 mmBtu or $8 -10 mmBtu. Using those same price assumptions, McKinsey forecast gaps between supply and demand from 59 to 77 MMSCMD or from 26 percent to 20 percent of total demand in 2015.

Thus, India's needs for natural gas are great and unmet by almost any measure. In the face of this unmet need, Indian planners seem to be at a loss as to how it may be met. Let us now turn to an examination of how natural gas might be made available to meet India's goals of availability, affordability, security, and environmental impact.

The Availability of Natural Gas for India

Until 2004 all of India's natural gas was produced domestically. The vast majority (about 70 percent) of Indian gas still comes from internal domestic production.[97] However, the stated political goal is to eliminate even the approximately 30 percent that is imported. Energy independence is a salient political slogan, and Prime Minister Singh in 2013 set a goal of slashing India's energy import bill by 50 percent within seven years and eliminating it altogether by 2030. The Modi government also is pursuing the elimination of imports. While political leaders

of many countries (including the United States) have touted the goal of energy independence, the antipathy toward importing is greater and the desire to rely on domestic sources more pronounced in India than in most countries.

A distinct part of the Indian anti-imperial independence movement was a belief in the necessity of economic self-sufficiency if India was to be politically independent. That India was being exploited economically by Britain was an observable fact to those leading the Indian independence movement. Economic independence from international imperial influences thus was a chief aim of the founders of modern India. Economic imperialism was thought to be as inimical to the interest of India and its citizens as was political imperialism. In the area of gas supply as in many other parts of the Indian economy, the solution was for the government to concentrate on the development of domestic resources.

Directly related to India's world view of the need for economic self-sufficiency was a belief in government ownership of the major factors of production and the underlying natural resources. The national state of India is by constitution the owner of all rights to gas beneath the seabed of Indian territorial waters. In regard to gas under land, ownership is more complicated but generally the states and the central government have control of these resources.

Even as faith in direct ownership of the means of production has waned, belief in regulation and price control as the major elements in the system for providing gas remains. Regulation has hampered the ability to supply needs from outside India. Even though gas can be imported at market prices, the complex system of regulation and price controls dampens not only domestic production but also the incentive to import.

Lack of infrastructure to take advantage of gas imports also pushes India toward reliance on domestic supplies. Natural gas can presently be moved economically by only two methods, pipelines or in ships as a liquid. At present India is served by no international pipelines and has only limited infrastructure for receiving and regasifying liquefied natural gas. Regasification terminals that India is now constructing are hampered by insufficient pipeline connectivity. In some instances this affects the very viability of the project. For example a regasification facility in the southern Indian state of Kerala had its opening delayed because there were insufficient pipelines to get the gas to customers who need it.[98]

Thus, because of an international worldview, political belief in the desirability of government control, and the lack of infrastructure necessary to receive gas from abroad, India has relied primarily on domestic sources.

Domestic Availability

The first onshore fields to be exploited, those in the northeastern states of Assam and Nagaland, are still the most important of the onshore sources. But these account for only about 6 percent of total production. Gujarat produces about the same, but altogether onshore production is only about 9 bcm or 24 percent of total production. In terms of reserves, the estimates of proved and indicated offshore gas are approximately twice as high as for onshore gas. Even so, these estimates are rather low. The latest estimate available indicates just 448 bcm

Gas recoverable in India through fracking is not likely to be on the scale of the United States or China.

of onshore proved and 883 bcm of offshore reserves for a total of 1330 bcm of reserves.

In regard to offshore production, the Mumbai High is still important with approximately 18 bcm produced per year. However, it was overtaken in 2009 by the offshore production from the Krishna Godavari basin of the Bay of Bengal with production of some 20 bcm per year. While the Mumbai High continues to produce gas at a relatively stable rate, the Krishna Godavari production has decreased after reaching a high in 2010. This decrease, rather than predicted continued increases in production from the KG basin, is a cause of deep concern for the strategy of self-sufficiency in natural gas. Unless the KG basin can live up to its planned output, the prospect for significant amelioration of the Indian gas shortage from domestic sources is dim.

Seeing the success of fracking in the United States and Canada, some have suggested that the spread of this technology to India may significantly expand the availability of gas from Indian domestic sources. In 2012, a draft policy on fracking in India was circulated to a group of ministers. Although there have been pronouncements that make it seem that widespread fracking is imminent,[99] the policy had yet to issue.

In view of recent evaluations of present data, it does not seem likely that the recovery of gas through fracking is likely to contribute greatly to filling the gap between gas supply and demand in India. The U.S. Energy Information Agency estimated that India has 44 trillion cubic feet (TCF) of proved natural gas reserves and 96 TCF of unproved shale gas technically recoverable reserves.[100] Greater economic incentives to exploration would doubtlessly increase estimates of reserves because data is so inadequate for making estimates in many areas. Even so, the size of these initial estimates for India seem small in comparison with those for China (124 TCF proved; 1,115 unproved) and the United States (318 TCF proved; 567 TCF unproved with some estimates significantly higher).

The U.S. Geological Survey conducted an in-depth study of 3 of the 26 basins in India thought to have reserves recoverable through unconventional means. The study could substantiate only about 6.1 TCF of this resource, which further indicates that gas recoverable in India through fracking is not likely to be on the scale of the United States or China.

In addition, technical difficulties for fracking in India seem to limit the utility of the technique for India. Fracking requires vast amounts of water that are often difficult to obtain in India.[101] The correct mix of chemicals and other materials used in the United States is viewed as proprietary by U.S. companies and may not be readily obtainable in India. However, India is the leading producer of guar beans from which the thickening agent used in the fracking liquid is extracted.[102]

Further, given the per capita scarcity of arable land in India and the little economic benefit to be derived by land owners and occupiers, resistance to exploitation of such land is likely to be great. The political influence of farmers seeking to protect the lands they farm has been serious with other development schemes. It is likely to be an equally serious impediment to fracking.

Commercial Availability

In order to understand the commercial availability of natural gas in India, it is important to have an understanding of the corporate gas players in India. The organizational foundation for Indian companies participating in the natural gas industry is built upon the history of India as a planned economy and its past nationalization of private entities in the oil and gas sector. Many of the policy tensions in regard to gas arise from the tensions between predominantly government-owned entities and those privately-owned.

Rather than allowing the continued exploitation of the nation's resources by private entities, the new national government of independent India moved to create government-owned entities (designated "Public Sector Undertakings" or "PSUs") for the complete control of the petroleum value chain. During the early years of independence, natural gas was only a largely unwanted adjunct to the production of oil. Hence, the government of India got into the gas business by virtue of its oil centered policies. Initially, the same entities empowered for oil were to handle natural gas. The entity that was to become the Oil and Natural Gas Corporation was created for oil and gas exploration and production. The private sector companies exploring and producing oil and gas in the northeast of India were nationalized piece by piece and rolled into Oil India Limited, which had been established by the government in 1959.

To complement the socialized exploration and production companies, additional government-owned entities were created for refining and marketing oil and gas. These entities were merged in 1964 as Indian Oil Corporation Ltd (IOC). This state-owned entity remains the dominant downstream natural gas company. Other downstream companies were formed largely to take over private sector assets as they were nationalized. Established in 1974, Hindustan Petroleum Corporation Ltd. took over the Indian assets of Esso Standard, Caltex Oil, and Kosan Gas in a series of nationalizations and mergers from 1974 through 1979. The Bharat Petroleum Corporation was started in 1976 to take over the refining and distribution assets of Burmah Shell.

In 1984, the government created the Gas Authority of India (GAIL) for the acquisition, transportation, distribution and marketing of natural gas in its own right and not just as an adjunct to oil. As we shall discuss below, up until 2004 the gas handled by GAIL was only the domestic gas produced by the upstream companies ONGC and OIL.

While all of these entities were independent corporations in form, ultimate power lay with the central government and especially the Ministry of Petroleum and Natural Gas. In the first instance this power was with the civil servants who staffed the Ministry and ultimately with the politicians who headed the Ministry and ran the Cabinet.

This socialistic natural gas system was modified by the economic reforms that swept the nation in response to the crisis of 1991. The central government began to allow private sector involvement back into the oil and gas sector in 1993. A greater opening came in the form of the NELP announced in 1997 and implemented in 1999. Under this policy, auctions were held not just for "discovered fields" but also for unexplored blocks.

Private sector response, particularly international private sector response, to the opening of natural gas upstream exploration and production was not as great as anticipated . However, the policy produced a major new private player in upstream gas, Reliance Industries Ltd. The Reliance entry brought back to India British Petroleum when BP purchased a portion of the Reliance gas operation. Reliance was also to become a major player in transportation and overseas acquisition of gas. Smaller private players, notably Cairn Energy, also became a part of the upstream gas system.

One Indian state took advantage of the central government's liberalization policies to become a corporate player in oil and gas. Beginning in 1993, the state of Gujarat formed the Gujarat State Petroleum Corporation (GSPC) that has expanded into a group of companies denominated the "GSPC Group." The GSPC Group has companies involved in virtually all aspects of the natural gas business. Prime Minister Modi's experience in supervising GSPC and dealing with private energy companies while chief minister of Gujarat is doubtlessly a factor in his thinking about India energy.

Along with the exploration and production reforms, other measures added new downstream private natural gas sector players such as Essar and Adani. Also added to the essentially government-owned and controlled system were two private sector entities concentrating on the importation, regasification and sale of LNG. These latter two entities were Shell India and Petronet, although the characterization of Petronet as "private" is somewhat misleading.

Shell India teamed with the French company Total to introduce spot purchasing of LNG, regasification, and private sales of natural gas into the Indian market. The government established Petronet to secure LNG that would be regasified and sold chiefly to government-owned companies. ONGC, Indian Oil, GAIL, and Bharat Petroleum were each allotted 12.5 percent shares, thus limiting indirect government ownership to 50 percent and allowing Petronet to qualify as a "private" entity under Indian law.

Thus, the basic character of the Indian gas system is that it has some of the characteristics of market-driven enterprise while still lying predominantly in a governmental orbit. The system has been opened to private enterprise with the likes of Reliance Industries Ltd., Shell, Total, BP, Adani and Cairn India playing significant roles. Even the dominant public service undertakings-ONGC, GAIL, Indian Oil, Oil India, Bharat Petroleum, and GSPC-have the trappings of independent competitive corporations and some private stockholders. In reality the system is controlled by government and the political masters who have garnered power within the Indian system. This government control is quite direct for companies with government ownership and oversight through the Ministry, the regulatory boards, the officer selection board, and ultimately the Cabinet. While private players present an outward appearance that is different from the PSUs

and Petronet, the private players are largely subject to the same governmentally controlled system through the myriad regulatory and political pressures brought to bear on them.

The tension between nominally independent players and the reality of political control presents the chief challenge to making the Indian gas system capable of meeting a more substantial portion of India's energy needs. Resolving this tension is basically a political problem that will take strong political leadership to resolve.

Foreign Sources of Natural Gas for India

It seems unlikely that India can meet its needs for natural gas solely from domestic sources. While there are several proposals to bring gas from other nations by pipeline, each of these proposals faces significant barriers to implementation. None are in a posture to provide even mid-term relief for India's increasingly critical need for fuel that can be turned into power. Thus, importation of LNG appears to be the only feasible method for India's obtaining sufficient gas to meet the existing mis-match between domestic requirements and supply.

For the production of LNG, methane (C1H4) gas is cooled to –161.5° C (–260° F), converting its gaseous phase into a liquid. This liquid has a volume approximately 600 times less than the equivalent volume of methane gas. Thus 600 cubic meters of methane gas will shrink to a volume of around one cubic meter of clear and odorless LNG. [103] While liquefaction and regasification are complicated and expensive, the liquid itself is relatively easy to transport in double-hulled cryogenic ships that keep the gas in its liquid state. Given the likely prominence of LNG in bridging the natural gas gap for India, let us examine the possible sources for India's LNG.

In 2012, the world's leading producers of LNG were as follows:

Qatar	31 percent
Malaysia	10 percent
Indonesia	9 percent
Australia	8 percent
Nigeria	8 percent
Trinidad	6 percent
Algeria	5 percent
Russia	4 percent
Oman	3 percent
Brunei	3 percent
Yemen	3 percent
Egypt	3 percent
UAE	2 percent
Equatorial Guinea	2 percent
Peru	2 percent
Norway	1 percent
US	0.1 percent
Libya	0.03 percent

From among these LNG exporting countries, the most likely immediate sources are those countries from which India is presently obtaining LNG. Let us look at these sources.

Qatar

In 2012, India purchased approximately 10 metric tons per annum or 13 percent of Qatar's output and was Qatar's second-leading customer. Qatar reached its planned nominal liquefaction capacity of 77 metric tons per annum in 2011, ensuring that country's place as the world's largest LNG exporter.

Qatar and Iran split the world's largest conventional production gas field. Called the North Field in Qatar and South Pars in Iran, the field lies in the Persian Gulf and extends in approximately equal areas on either side of the international boundary of control between the two countries. Qatar first developed its capacity to liquefy and export natural in the mid-1990s. About 84 percent of exports from Qatar are under medium to long-term contracts. The rest of its gas is sold in the spot market.

Procuring additional gas from Qatar is not easy given that the sale prices are set by Qatar in a very controlled manner that reflects Qatar's traditional view that the demand for gas is very strong . Even though the prospect of additional competition from Russia and the United States has evidently had some impact on the Qataris' thinking, the following episode is illustrative of the difficulties facing India when it seeks additional gas from Qatar.

When the Amir of Qatar came to India in 2012, a chief request from the government of India was to act on India's proposal for increased supplies from Qatar. In addition to the 7.5 million metric tons that was purchased through Petronet, GAIL sought 3 million metric tons–one ton per annum each for the Dahej, Dhabol and Kochi terminals. The reply was that of course Qatar would like to export more gas to India. The reality was that Qatar was already exporting its entire liquefaction capacity. Diverting more of its LNG production to India would have to be justified by India's willingness to pay higher prices for the gas than existing customers. As a result when Indian buyers requested Qatar to supply three million additional tons of LPG, the Qataris asked for a price that was 15 to 16 percent of the Japanese Crude Cocktail (the average price of customs-cleared crude oil imports to Japan), or about $14.00 per million British thermal units. Indian buyers were unwilling to pay this higher price and thus initially got no more gas. Negotiations continued with each side seeking leverage in such diverse fields as Qatar Airways landing rights.[104]

Australia

India's efforts to diversify its sources of supply by securing supplies from Australia seemed more promising. In 2012 Australia overtook Indonesia to become the world's third leading LNG exporter, after Qatar and Malaysia. Some have predicted that Australia will overtake Qatar as the world's top exporter of LNG by 2020.[105] Although the Australians export the vast majority of their LNG to Japan and China, India sought to diversify its sources of supply by signing long-term contracts for Australian LNG. Initial efforts in this regard were not successful. Petronet, in a contract for Australian gas, agreed in August 2009 to buy 1.44

million tons per year at a price equivalent to 14.5 percent of the international price of oil. This gas was to be resold primarily to GAIL, IOC, and Bharat Petroleum for distribution. With the price of oil at more than $100 per barrel and taking into account transportation and tariffs, the price to GAIL and the other off takers would be about $17 mmBtu when landed at the Petronet regasification terminal at Kochi. GAIL called on Petronet to renegotiate the contract with ExxonMobil for LNG from its Gurgon Australian facility.[106] In its letter GAIL noted a number of renegotiations that had taken place around the world and particularly referenced $4.00 mmBtu price for U.S. gas at the Henry Hub in Louisiana.

Indeed, cost appears to be the Achilles heel for Australia in seeking to help meet India's unfulfilled gas demand. Liquefaction facilities cost approximately 30 percent more to build in Australia than in the United States. Australian gas workers earn an average of $163,600 a year, almost double the global average.[107]

Russia

Russia holds the largest natural gas reserves in the world, and is the second largest producer (after the United States) and leading exporter of natural gas. However, most of this gas is either consumed domestically or exported by pipeline to Western Europe and, increasingly, China. Russia presently has but a single liquefaction plant located in far Eastern Russia on Sakhalin Island. The Sakhalin facility has a nominal capacity of 9.6 million tons per annum. Although it produced at 114 percent of capacity in 2012, almost all of this production went to Japan and South Korea.[108]

However, India sees an opportunity with Russia somewhat similar to that in the United States. GAIL signed an agreement in 2011 to take gas from a new liquefaction plant at Shtokman in the far northern Barent's Sea. The deal called for a 20-year contract with Russian gas major Gazprom for the supply of 2.5 MPTA. The supplies were expected to start in 2018-19. However, they are to be indexed against oil prices, and it is unclear as to how price competitive the gas, if delivered, will be.[109]

The events in Ukraine including the Russian annexation of Crimea could provide a sea change in the availability to India of gas from Russia. For decades Russia has been secure in its markets for pipeline gas to Europe. Now Russia is faced with the prospect of lessening demand for its gas in Europe.[110] Especially in view of the Ukrainian experience, Europe is moving toward obtaining more of its gas from non-Russian sources. Algeria and Norway are providing more gas. Qatar, the United States, and Australia are looking to expand LNG exports to Europe, while Azerbaijan, Turkmenistan, and other Central Asian countries continue to plot for a southern route for gas to Europe.[111] Europe is becoming increasingly energy efficient and is still in the midst of an economic slowdown. Thus, Russian sourcing of natural gas is an increasingly viable option for India as Russia seeks to hedge its reliance on pipeline sales to Europe.

Mozambique

Extensive exploration off the coast of Mozambique has found a massive gas field in the Rovuma Basin in the western Indian Ocean. Two of the basin's operators,

Italian-based Eni Group and U.S.-based Anadarko have agreed to jointly develop on-shore facilities to provide 20 million tons per annum of liquefaction capacity. Operational startup is targeted for 2018.[112]

Because of its location in proximity to India and planned liquefaction facilities, Mozambique is considered a prime prospective source for importations of LNG to India. Consequently, ONGC through its foreign property acquisition subsidiary ONGC Videsh teamed with Oil India Limited to buy for $2.48 billion a 10 percent share in the Rovuma-1 gas field.[113] Subsequently, OVL bought another 10 percent on its own for $2.64 billion.[114] However, before this investment can result in additional gas to India, gas will actually have to be produced and a liquefaction tolling agreement reached with Eni and Anadarko, or whoever winds up owning the liquefaction facility.

In January 2014 at its biennial trade show and conference, ONGC highlighted Mozambique as a major future source of gas for India. The Mozambique Minister of Petroleum came to India and attempted to substantiate these claims. However, Mozambique has a long history of civil war and instability. An AK-47 automatic weapon is a prominent part of the Mozambique flag. There presently is very little modern infrastructure of any kind. Extensive construction of pipelines, liquefaction, and loading facilities will be required. Thus, in spite of a favorable geographic location in regard to India, it is unclear when and how much Mozambique can be counted on to contribute to Indian gas needs. At the end of the Petrotech conference, the Indian Minister of Petroleum and Natural Gas could not remember the name Mozambique.

Short Term and Spot Cargoes – Qatar, Nigeria, Egypt, Algeria, Yemen, Norway, Malaysia

In addition to short term and spot cargoes from Qatar, India purchases such cargoes from the indicated nations and others. However, the purchase of short term and spot cargoes is not a viable alternative for meeting India's long term needs simply because the prices are too high and uncertain.

Pipelines - Iran, Turkmenistan, Oman, Myanmar, Bangladesh, and Russia

Pipeline projects have long been proposed as ways to meet the gas demands for India. The following are the major proposals.

Iran

An Iranian economist and former deputy foreign minister, Ali Sharms Ardekani, teamed with an Indian academic and now chairman of The Energy Research Institute, R.K. Pauchari, to make the proposal for an Iran-Pakistan-India pipeline at an international conference in 1989. The pipeline was dubbed "The Peace Pipeline" from the very start. The peace supposedly to be promoted was that between India and Pakistan, not with Iran. Iran quickly embraced the Iran-Pakistan-India pipeline to promote a relatively close market for its gas. Although Pakistan and Iran continue to negotiate for the pipeline, India has distanced itself from the project as a result of financial, security, and broader foreign policy

considerations. Prime Minister Manmohan Singh himself indicated that it would be difficult to find investors and lenders for the project. Indian policy makers have been unwilling to entrust a significant part of Indian energy security to a pipeline that could be shut off by Pakistan. From a broader foreign policy perspective, Western nations led by the United States have adamantly opposed international dealings that might support a Government of Iran which allegedly seeks nuclear weapons, supports abolition of Israel, and opposes Sunni controlled Arab nations through violent means.[115]

Presently, Iran has no liquefaction capabilities and international sanctions make it highly unlikely that the capital, materiel, and expertise for such development could be secured for such a project at this time. So the prospects of LNG as an alternative to a pipeline are not good.

Turkmenistan

Turkmenistan has large proved reserves of natural gas. In 2013, these reserves were estimated at 17.5 trillion cubic meters or 9.3 percent of world reserves, ranking Turkmenistan fourth in the world.[116] However, production is slight with only 64.4 bcm being produced in 2012. With no access to the world's oceans, one possibility for getting such gas to India would be overland through a pipeline. Western gas promoters have proposed a Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline. Largely to counter the proposal for a pipeline to India from Iran, the United States has endorsed the TAPI pipeline. Since 2008, India has been a participant in discussions about such a pipeline. However, the same difficulties in financing and security as face the Iran pipeline apply with equal or enhanced force to TAPI. Crossing Afghanistan creates additional political and security concerns. Further, the technical problems of crossing the Hindu Kush mountains are daunting. Nevertheless, the managing director and chief executive officer of Petronet has included the TAPI pipeline in his supply calculations for commissioning in 2017-2018 at a supply level of 30 million cubic meters per day. Whether the TAPI pipeline is realistic in that time frame is highly problematic.

Oman

To avoid India's security concerns about pipelines transiting Pakistan, Indian entities have been promoting a deep water, undersea pipeline from Oman. Oman is the nearest point on the Arabian Peninsula to India. Since Oman has little gas of its own, the gas for such a pipeline would need to come from elsewhere. Iran and even Turkmenistan by way of Iran are possibilities. Whether Iran would want to allow such transit for Turkmenistan to compete with its own gas is problematic. Gas could also come from Qatar or Saudi Arabia. However, those countries are already involved in exports by other means and their interests in an Oman pipeline are unclear. Thus, the Oman-India pipeline faces Iranian foreign policy difficulties as well as the technical difficulties of such a deep water transit facility. The pipeline is presently being promoted by a private group with whom both GAIL and IOC have cooperation memoranda. The Oman-India pipeline is speculative at best.

Bangladesh, Myanmar

For years there has been conjecture that a pipeline from Bangladesh to India could be extended to Myanmar and become a significant source of energy for India. Such a pipeline could serve Indian foreign policy goals in bringing the governments of both these nations into closer alignment with Indian interests. A U.S.-based energy company spent considerable effort on a Bangladesh to India pipeline. This effort came to nothing largely because of Bangladeshi fears that its gas reserves were too small to share and animosity toward India. Since that effort, Bangladesh has become considerably less stable politically. The ability of the Bangladesh government to make positive decisions in regard to production and shipping of gas to India is doubtful.

The concept of including Myanmar gas in the effort to pipe gas to India from the east was at first opposed by the U.S. government seeking to bring economic pressure to bear on an oppressive Myanmar government. Now that Myanmar is beginning a policy of more openness, this obstacle is apparently removed. However, the main difficulty in pursuing a Myanmar-Bangladesh-India pipeline would seem to be that neither Bangladesh nor Myanmar have sufficient proven reserves to make such a project worthwhile. Each country has only about 0.2 trillion cubic meters of gas.[117] Nevertheless, India and particularly Myanmar are discussing a Myanmar-India pipeline, perhaps bypassing Bangladesh by means of a difficult overland route to India's far northeast.[118]

Russia

Attempting to build on its initiative for more pipeline sales to China, Russia proposed to the new Modi government a pipeline to India. President Putin discussed such a pipeline in his interaction with Modi at the BRICS 2014 summit in Brazil, and the pipeline proposal was to be a major focus point of Modi's visit to Moscow in December of that year. Since a pipeline over the Himalayas would be so difficult, the Russians have also suggested that a tie-in to the TAPI line would be feasible. It seems doubtful that Turkmenistan would want to facilitate the transmission of competing Russian gas.

Indian Infrastructure Constraints on the Availability of Natural Gas

India's ability to use gas is severely constrained by a lack of domestic pipelines to transport gas to customers. Even where there are off-loading and regasification facilities, the inability to transport the gas to end users has caused some ONGC officials to argue that India is not a position to accept additional gas supplies. The support for this proposition is the experience of the new terminal for regasification at Kochi in the state of Kerala.

Sponsored by Petronet, the Kochi terminal was commissioned in August 2013. The terminal had been constructed at a cost of around $9 billion, one of the biggest investments in the State of Kerala in recent times. The Kochi LNG Terminal could process 5 million tons of LNG (about 20 million standard cubic meters) per day. It was expected to spur industrial activities throughout the southern region of India including the states of Kerala, Tamil Nadu, and

Karnataka. By December 2013 it was operational but only at 8 percent of its capacity. The project was dedicated by the prime minister with great fanfare on January 4, 2014.[119]

The reason given for the low utilization rate was inadequate pipeline connections to the markets envisaged in planning for the facility. Upon opening, the Kochi terminal was connected to only about 43 kilometers of pipeline serving only a few customers. The major pipelines from Kochi to Mangalore and Kochi to Bangalore via Tamil Nadu were not operating. The CEO and Managing Director of Petronet, A. Balyan said, "We have no timeline set for these two pipelines." According to Balyan, the responsibility for the pipelines lay with GAIL, and a pending public interest lawsuit in the courts of the neighboring state of Tamil Nadu was a chief reason for delay in pipeline construction.[120]

India's ability to use gas is severely constrained by a lack of domestic pipelines to transport gas to customers...the inability to transport the gas to end users has caused some ONGC officials to argue that India is not in a position to accept additional gas supplies.

The underutilization of the Kochi facility was in sharp contrast with Petronet's regasification terminal at Dahej in the state of Gujarat. This terminal with adequate pipeline connections was operating at full capacity with plans to increase its 10 million ton capacity by about 50 percent. Pipeline connections allowed Petronet to book 2.5 million tons per year for GAIL for 20 years and the GSPC for an additional 1.25 tons for the same 20 years. The Asian Development Bank offered to provide Petronet around $150 million as a loan for planning the expansion. The total cost for the expansion would be approximately $6 billion, including an expanded marine jetty, regasification facilities and storage tanks.[121] The presence of adequate pipeline infrastructure made the expansion financeable.

The lesson to be drawn from the varying Petronet experiences with its regasification facilities is not that the securing of gas supplies must await the construction of adequate Indian infrastructure. Rather sourcing and construction must go together. A source of affordable gas makes possible the financing of infrastructure. An illustration of this proposition comes from RIL's experience in building a pipeline across India from the Krishna Godavari Basin off the state of Andhra Pradesh in the east to the RIL petrochemical complex in Gujarat and the rapidly growing consumers in the state of Maharashtra in the west of India.

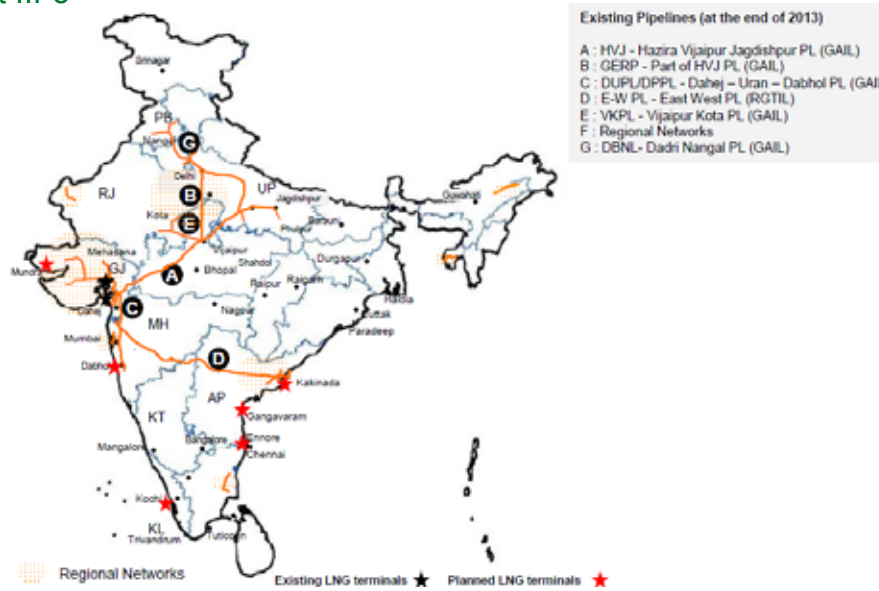
After the 2002 announcement by Mukesh Ambani of the gas discoveries in the Bay of Bengal, his next challenge was to get RIL's newfound gas to market. Among his first steps was to contract with Gulf Interstate Engineering, based in Houston, Texas, for engineering, design, procurement and project management services. The company started the project in 2003. However, the conflict between the Ambani brothers held up progress for nearly three years.[122]

The 48 inch pipeline consisted of a trunk line of 1375 kilometers with spurs built off it to serve customers along its entire length. Finished and commissioned in 2008, the East West Pipeline (EWPL) crosses 18 national highways, 66 state highways, 708 roads, 17 railway lines, and 372 rivers and canals.[123] Engineering challenges were many, especially the crossing of the Gautami Godavari River that took a special technique.[124] The pipeline has made a significant difference in use of natural gas. However, quantities available from Reliance cannot at present utilize the entire capacity of the pipeline and Reliance plans to lease a quarter of the EWPL capacity to others.[125]

Reliance is not the only private sector company to make its mark on Indian gas infrastructure. In addition to its downstream activities in gasoline, lubricant, marine and other petroleum products, Royal Dutch Shell built one of the first LNG port and regasification complexes. This complex at Hazira in Gujarat is owned in a 74 percent/26 percent partnership with Total Gas of France. It was completed in 2005 at a cost of about $46 billion. Although its capacity (3.5 million tons per annum) is only about a third of the original capacity of the neighboring Dahej facility, it is well-connected to pipelines that allow it to serve a variety of industrial customers. Perhaps most importantly, Hazira was built on a merchant model that introduced the possibility of spot cargoes being used to serve Indian gas needs. Although these cargoes are the most expensive way for India to obtain gas, the flexibility of the merchant approach has allowed Shell and Total to benefit from growing commercial demand in a manner that the Indian government-controlled corporations have been unable to match.[126]

Government-owned corporations tend to lack flexibility and agility because they operate like government bureaucracies. Rather than decisions flowing down from a corporate head, each decision must be vetted through committees and

Chart III-5



Source: Vision 2030

working groups always mindful of the political implications of their decisions. Expenditures are considered not just against the needs of the corporation but in comparison with other government needs. The extraordinary time for bringing the Dhabol LNG facility into operation may serve as an illustration.

The U.S. gas developer Enron had commenced an LNG importation and associated power plant at Dhabol in Maharashtra state in the mid 1990s. By 2001 the facility was partially operational. However, with the refusal of the Maharashtra State Electricity board to honor its contracts for purchase of power and the spectacular demise of Enron because of fraudulent transactions in the United States, the Dhabol facility passed into the hands of government controlled entities. It wound up controlled by the National Thermal Power Corporation and GAIL. However, it was not until 12 years later that the regasification facility was made operable. The 5 million metric ton facility still operates on a somewhat sporadic basis. At the end of 2013 gaps of up to six months were being reported in the receipt of LNG shipments.[127]

India has plans to triple its LNG import capacity by doubling the number of import facilities by 2017.[128] India also plans to significantly expand its pipeline infrastructure. The total length of trunk pipelines in 2012 was about 13,000 kilometers. By the end of the 12th Five Year Plan (2017), this network is to be more than doubled with the commissioning of approximately 16,000 kilometers of new pipeline.[129] However, these plans seem more a statement of need than an actual forecast of achievement. Based on the amount of time it has taken India to bring gas projects like those at Kochi and Dhabol into being, this increase in infrastructure within the time frame indicated seems unlikely without further reform of the natural gas system.

Chart III-5 shows the extent of existing Indian natural gas infrastructure and existing and proposed LNG import terminals. As noted above, the Dabhol and Kochi terminals are now operational, although not operating at full capacity.

Thus, the natural gas system in India is dominated by government with a few private companies playing increasingly important roles. Because of government dominance, the factor impelling the system has been the assessment of what is politically feasible and helpful to the government in power. So long as politics is the impelling factor and the terms of exploration, production, and pricing are hostage to this factor, there is little chance that domestic sourcing of gas is likely to meet India's needs. The investment, both foreign and domestic, necessary to fuel an entrepreneurial approach necessary to even determining the status of domestic resources, much less exploitation of such reserves on a scale necessary to meet India's gas needs, is not likely to occur without a significant change in official thinking and practices.

The most feasible alternative at this time for meeting India's natural gas needs in the near to medium term is the importation of LNG. Investment in foreign upstream natural gas assets can provide a hedge against price increases. However, long term contracts with diverse sources of lower cost LNG together with the construction of needed regasification and transportation infrastructure in India provide the most feasible method for meeting India's gas needs over at least the next two decades.

Affordability

The chief factors affecting the affordability of natural gas in India are not supply and demand but government regulation and pricing.

No person in India personifies the tension between government control and private enterprise in the Indian oil and gas sector more fully than Vikram Singh Mehta, the former head of Shell India and now head of Brookings India. Mehta has a long and distinguished Indian heritage as well as deep experience with multinational petroleum companies. Thus, he also personifies the difficulties India has experienced as it tries to obtain foreign direct investment for its energy sector but maintain a domestic political posture of independence from foreign influences. Mehta sees the continuing tension between government regulation of a nominally decontrolled sector as the single most important theme in analyzing India's energy situation. According to Mehta, the contradictions created because of nominal decontrol and actual governmental administration are the fundamental problems of the India energy scenario and the key to affordable energy for the country.[130]

Born in Rajasthan in 1952, Mehta comes from a long line of public officials. His forebears were leaders first in the Udaipur councils of British India and later in the Republic of India. His grandfather was a High Commissioner to Pakistan and his father a foreign secretary. His mother was the first woman to join the Indian Foreign Service, the place where she met Vikram's father.[131] Educated at the elite St. Stephens College, Delhi University; Magdalen College, Oxford University; and the Fletcher School of Law and Diplomacy, Tufts University, Mehta was prepared by family background and education to be a leading member of India's civil service. That indeed is where he started his career in 1978 as a member of the elite Indian Administrative Service (IAS).

However, it did not take the restless Mehta long to realize that the government bureaucracy was not the forum for someone who wanted to see rapid progress. Much to the surprise, if not consternation, of family and outside observers, he resigned from the IAS in 1980, but he did not abandon the concept of serving the public. Rather, it seemed to him that public service might be pursued most effectively for India by a career in the private sector.[132]

Pursuing an interest in the field of oil and natural gas, Mehta joined the U.S. company Philips Petroleum and worked there for four years, first in London and then in Oklahoma. But the call of being able to serve his native land was strong, and in 1984 he returned to India as an economic advisor to Oil India Limited. Again he found the hand of a politicized bureaucracy on the largely state-owned company to be stultifying. In 1988, he accepted an offer from Shell in London. Mehta rose rapidly at Shell, becoming the head of markets and chemicals for Egypt in 1991.

With the start of Indian economic liberalization in 1991, Mehta argued that, in spite of the bad feelings that remained from the expropriation of Shell's India assets in the 1970s, there was great opportunity for the company in India. With the spurt in economic growth spurred by the reforms, Shell decided to try again in India. In 1994, Mehta was appointed chairman of Shell India and returned to re-establish and further the business of Shell in India.

Re-establishment first took the form of re-entering the downstream lubricant and gasoline retailing businesses. However, the greatest achievement of Mehta's tenure as chairman was the construction and commissioning of the Hazira port, LNG off-loading and regasification facilities. Along with this, Mehta established a significant research capability for Shell in India.

However, Mehta had much bigger plans for Shell in India, which were never realized. In large part this was because of the difficulties created by differences between law and reality in regard to the relationship between government and private enterprise in India. As Mehta put it, "Private energy companies have not found it easy to operate in an environment that is de jure deregulated but de facto administered."[133]

In regard to natural gas, price is at the heart of government administration. Mehta had to deal with the results of illogical producer prices throughout his Shell career. He has noted, "Investor confidence is completely shaken in terms of stability and predictability of the laws. …. You cannot have domestic gas at one-third the international prices and expect investors to be enthused."[134] This lack of enthusiasm produced concrete disappointments for Mehta as Shell sold out its interests in the Rajasthan fields to Cairn and refused to take the risks of investing in an Indian refinery.[135]

The difficulties created by politically advantageous but economically illogical pricing apply to majority government-owned and controlled companies as much as they do to private entities. Mehta commented in 2012, "Indian oil companies are standing at the edge of an abyss, PSU under-recoveries went up to Rs. 140,000 crore [about $300 billion] last year. They have no cash to pay for their borrowings, for research, to reward employees or for strategic investments. We have an industry that lives from hand to mouth. Everyone who matters knows this is wrong. If policy makers insist on subsidizing oil, the finance ministry should be doing it directly. Not through the balance sheets of these companies. No one else in the world screws their own companies."[136]

The pricing of gas fundamentally affects every part of gas policy-making, beginning with the planning for India's gas needs. The Indian demand for natural gas is a function of not only how much gas can be usefully consumed, but also the price of that gas. That is to say, Indian economic demand for natural gas is determined by how much gas can be usefully consumed in India and the price of gas. If gas is available at a low price, the amount of gas demanded in India will be greater than if it is available only at a high price. The amount of demand depends on the price of the gas and not just the desire or ability to use gas. Therefore, demand should always be projected in conjunction with price.

If the government of India sets or influences the price for gas at nearly all stages, this affects demand at each stage. For domestically produced gas, price controls have traditionally been in effect from the producer in India to the gas distributor and all the way to the ultimate consumer. Because of ultimate direct control of state-owned entities, imported gas is similarly price controlled when that gas is imported by state-owned entities, which most of it is. Privately imported gas is theoretically salable at whatever price a willing seller and willing buyer agree to pay and can be sold free of governmental restraints. The reality

can be different as both regulation and the presence of competing public sector marketing companies enable the government to influence consumer prices even in instances where the gas is imported by private sector importers and sold to private entities.

Before examining a case of government changes in the price of gas, let us take a further look at the mechanisms for government regulation and control in India.

The Mechanisms of Governmental Regulation and Control

The Prime Minister and the Council of Ministers

Regulation and pricing of natural gas in India is very much a top-down process with the prime minister and his fellow ministers in the Council of Ministers, or Union Cabinet, (hereinafter referred to as the "Cabinet") in control. Under the UPA political power was very much dispersed within the Cabinet and affected from outside by the leadership of the largest party in the coalition government, the Indian National Congress. This fragmentation of power is considerably less under the Cabinet headed by Prime Minister Modi.

Unlike in the United States, the Cabinet of the government of India is specified in the Indian Constitution. The Constitution specifies that the president appoints the prime minister and the prime minister provides the binding "advice" to the president for appointment of the other ministers and the exercise of the president's functions.

Constitutionally, the Cabinet could be composed of up to 82 members. In the configuration extant at the time the gas price increases were considered under the UPA, there were 29 members of the Cabinet. Each Minister holds one or more "portfolios" that place them as the political heads of the various ministries. Under Prime Minister Modi, this number of union ministers has been reduced to 23.[137]

In addition to the ministers who are members of the constitutionally designated Cabinet, there are ministers of state. Ministers of state are also politically appointed upon the advice of the prime minister. Ministers of state are of two varieties. Those with the designation "Independent Charge" head a ministry but are not considered sufficiently powerful or senior to warrant inclusion in the Council of Ministers. Where there is no designation of "Independent Charge" they are junior ministers placed to assist a union minister with the discharge of a particular portfolio. In regard to a subject as important as gas pricing or regulation a plain minister of state, acting as a subordinate in a ministry, is unlikely to have much influence in the final analysis. But a minister of state (independent charge) can have significant influence. Prime Minister Modi has put a minister of state (independent charge) to head three key energy ministries – Power, Coal, and New and Renewable Energy. The fourth key energy ministry, Petroleum and Natural Gas, is also headed by a minister of state (independent charge).

In the United Kingdom or "Westminster" form of parliamentary government that India adopted, in essence, the executive and legislative functions are melded together. The Indian constitution provides that Parliament for the Union consists not only of the two legislative houses but the President as well.[138]

The Council of Ministers must have the backing of a majority of the members of the Lok Sabha. Thus, elective politics is a chief determinate of the orientation of these Council members. For some three decades up until the Lok Sabha elections of 2014, majorities in the Lok Sabha could only be maintained by coalitions of parties. No single party could obtain a majority and the ability to put together a majority coalition was, of course, a highly political endeavor. The BJP under the leadership of Modi changed this pattern by securing an absolute majority of 283 seats. Although Modi elected to honor his commitments to his New Democratic Alliance partners by appointing several cabinet members from among their ranks, his absolute majority in the Lok Sabha considerably altered the political dynamic of the cabinet as did having an elected member of the Lok Sabha heading the government.

Even though the minutes of Cabinet level discussions are made available, the rationale for setting prices is not readily known. As Mehta has noted, "unfortunately not much of detail comes out in cabinet discussions, where pricing is decided. All the detail is distilled out of the 15-20 minute discussions."[139]

With some two dozen members, the union cabinet is an unwieldy body to act as a whole on intricate policy matters. This difficulty is addressed in the Indian system in two ways. First, the Cabinet relies on committees to prepare policy matters. Second, the Cabinet is assisted in its work highly informed by a secretariat of bureaucrats.

The number and designation of cabinet committees has varied depending on the administration and issues before the nation. Under the UPA government, there were eleven such committees. The Modi government reduced this number to seven.

In regard to energy regulation and pricing, the leading standing committee is the Cabinet Committee on Economic Affairs (CCEA). Chaired by the prime minister, the CCEA is usually the decision-maker in matters likely to affect large numbers of citizens, even though decisions are formally issued in the name of the Cabinet.

In the UPA government, a "Group of Ministers" (GoM) was often used as an inter-agency mechanism to resolve differences among ministries and prepare an issue for decision by the CCEA. In contrast to an ordinary "Group of Ministers" was an "Empowered Group of Ministers" (EGoM). As the name implies, the EGoM had had some decisional authority delegated to it. These GoM's and EGoM's tended to develop as power centers under the UPA government. Upon assuming office in 2014, Prime Minister Modi basically eliminated the GoM/EGoM system. He returned coordination functions to the cabinet secretary and secretaries to the various ministries while strengthening the decisional empowerment of the Council of Ministers and himself.

The bureaucratic support for the Council of Ministers comes from the Cabinet Secretariat. The Cabinet Secretariat has a long history with roots deep in

India's period of colonial rule. It is perhaps the highest expression of an elite bureaucracy known as the "steel frame" of Indian government. The Secretariat has taken pride that its history reaches back to the operations of the colonial Councils Act of 1861. However, it equally emphasizes that upon independence, the Cabinet Secretariat's functions shifted from simply shifting papers to "effecting coordination among the Ministries."[140]

The Secretariat is headed by the cabinet secretary, who, as chairman of the Civil Services Board, is considered the chief civil servant of India. The coordination that is effected by the Secretariat is accomplished through the top civil servants at each of the Ministries. The Secretaries of the various ministries know each other well as leading members of the IAS.

The Indian National Congress Core Group and the National Advisory Council

Under the UPA parliamentary coalition, the government on such matters of political importance as a gas price increase did not act within the formal organizational parameters.

The leading party of the UPA was the dynastic Indian National Congress led at independence by Jawaharlal Nehru, later by his daughter Indira Gandhi, then by her son Rajiv Gandhi, and after his assassination by his widow Sonia Gandhi. Manmohan Singh had never been elected in a popular election and had not even taken an electoral leadership role. He was able to serve as a minister only by virtue of his indirect election to the Rajya Sabha by a state legislature at the behest of the Congress Party which controlled that state. Sonia Gandhi was the person who had stood for popular election in 2004 and 2009 and was leader of the Party for those nationwide parliamentary elections.

Largely because of political resistance to someone of Italian birth becoming prime minister, Sonia Gandhi decided not to approach the President to form a government. Instead, she used her position as leader of the Congress Party and the UPA to have Manmohan Singh designated prime minister and to form the government in 2004. However, Gandhi retained great decisional authority that she exercised on a continual basis.

With this unusual state of affairs, Sonia Gandhi in 2004 established and began to chair the Indian National Congress Core Group. The Core Group was expressly set up to "assist" the UPA government in carrying out is functions. The prime minister sat as a subordinate to Sonia Gandhi on this committee, which met on a weekly basis with the prime minister at his official residence.

Gandhi also set up and began to chair in 2004 a "National Advisory Council." This council was established within the prime minister's office to "oversee the implementation of the National Common Minimum Programme of the Government." Among its powers was "to provide support to the Government in its legislative business." Since in the Westminster parliamentary system the government is dependent on the legislature for its legitimacy, this was an officially powerful juncture in the governmental structure. With its own staff and eminent members, it provided an official forum from which its chair, Ms. Gandhi, could act within the government.[141]

This two-tier style for government of India decision making was swept away by the definitive Modi triumph in the elections of 2014. There was no politician standing over the prime minister for ultimate decisional authority. Although the President of the BJP was brought into the cabinet as home minister, it seemed clear that on a matter like gas price increases the decision of how the price increase should be decided, if not the actual outcome, would be made by the prime minister.

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The Ministry of Petroleum and Natural Gas

While private participation in the natural gas sector is now an important part of that sector, regulation and pricing are firmly under the purview of the Ministry of Petroleum and Natural Gas as instructed by the Cabinet. The jurisdiction of the Ministry of Petroleum and Natural Gas is extremely broad. As the Ministry states: "The Ministry of Petroleum & Natural Gas is entrusted with the responsibility of exploration and production of oil and natural gas, their refining, distribution and marketing, import, export, and conservation of petroleum products and Liquefied Natural Gas."[142] Thus, all phases of the natural gas business are basically controlled by the Ministry of Petroleum and Natural Gas.

Here again the structure is very much centered on the politically chosen minister. In regard to natural gas regulation and pricing, the "steel frame" of the IAS informs the participation of the minister, while the minister is responsible for seeing that the huge apparatus of the ministry follows the decisions handed down by the Cabinet.

While the state controlled and majority state-owned PSU are nominally independent, a basic task of the Ministry is supervision of the PSUs. Within the Ministry there are minders for the various government-owned entities operating in the gas industry. A PSU executive cannot ignore the wishes of the India Administrative Service bureaucrats charged with oversight of his company. This oversight extends to pricing by the public sector oil and gas companies.

The Directorate General of Hydrocarbons

In regard to regulation of the upstream activities of gas companies operating in India, the Directorate General for Hydrocarbons wields considerable power. Officially charged with a degree of autonomy for upstream regulation, the DGH operates within the purview of the Ministry and its elected leadership. The licensing and permitting authorities of the directorate provide ample leverage

for enforcement of government policies on private as well as public sector companies operating upstream in the Indian gas industry.

The DGH was established as a part of the opening of the Indian economy in the early 1990s. The reasoning was that if private enterprise was to be allowed in exploration and production there must be a regulatory body that would both regulate and provide data to encourage private and particularly foreign upstream participation. The chief function of the DGH would be the licensing of blocks of territory for oil, natural gas and coal bed methane. In 1993 DGH was charged with negotiating production sharing agreements and supervising their implementation.[143]

Rather than encouraging participation and competition, the DGH has tended toward confrontation with the industry.[144] When participation under the NELP did not meet expectations and India's energy situation became more perilous, there was hope that the orientation of the DGH might shift in the originally-envisaged direction of facilitation. However, this did not happen, and DGH continues in the regulatory mode with little emphasis on assisting in the increase in production.

The Petroleum and Natural Gas Regulatory Board

Downstream transportation and marketing of natural gas is regulated by the Petroleum and Natural Gas Regulatory Board (PNGRB). The PNGRB is a relatively new body having only been established by act of Parliament in 2006. The need for a regulatory body was felt as a necessary exercise of government power to protect consumers. This protection is to be accomplished "by fostering fair trade and competition."[145] Although the powers of the board are rather broad, a review of board orders shows that the majority of the board's work has dealt with pipelines. As set forth in the act, the board has the authority to approve and regulate all aspects of the LNG and gas transportation business.

The PNGRB is not specifically authorized to set prices. However in addition to the authority to set transportation rates for common carriers of gas, it is to "monitor prices and take corrective measures to prevent restrictive trade practice by the entities" and "secure equitable distribution for petroleum and petroleum products." This has led some to speculate that in the future the PNGRB may play a role in pricing to consumers of gas from LNG facilities.[146]

The foregoing provides a basic introduction to the organizational framework for Indian regulation of natural gas. Let us now look at gas pricing which illustrates how the system works or fails to work in determining the affordability of gas to the Indian consumer.

Gas Pricing

Gas pricing in India has largely been the product of a policy conflict between producing enough natural gas to meet the needs of a growing economy as against the political advantages of keeping gas prices low for fertilizers, electric power, and other consumer needs. This conflict has produced a range of gas prices that depend on the seller, the date when approvals for exploitation were given, the location of the wells, the type of customer, and the location of the customer. The following description of present gas prices indicates the varying

prices set in India for the same commodity.[147] This description is set forth in some detail so that the reader can have a better understanding of how complex and nuanced the gas price setting has become.

Gas produced by the national oil companies ONGC and OIL from blocks that had been assigned, or "nominated," to them by government fiat prior to implementation of the NELP is supplied to customers at Administered Price Mechanism (APM) prices. These customers are predominantly government-owned fertilizer plants, power plants, court-mandated customers and small consumers. In 2010 the APM price for natural gas was set at $4.20 per mmBtu. The EGoM acted upon data developed by the Ministry of Petroleum and Natural Gas. The decision was approved by the Cabinet and issued in the name of the Cabinet. This was the same price set the year before for NELP gas that was supposedly not under the APM.

However, the price for gas from the northeast of India, primarily Assam, was set at 60 percent of the $4.20 with a subsidy being paid directly to ONGC and IOL for the remaining 40 percent.

From time to time, ONGC and OIL sell gas from nominated blocks to customers that are not listed under the APM as entitled to APM gas. As to these customers, the Ministry of Petroleum and Natural Gas notifies a so called "market driven price." In 2010 these prices were set at prices varying from $4.20 to $5.25.

After the NELP went into effect, the national oil companies, ONGC and OIL, were supposed to be able to charge a market-determined price for gas from wells drilled in fields that had not been previously drilled even though those fields were within blocks that had been previously assigned to, or "nominated," to these companies. However, it did not turn out that way. For this non-APM gas the government issued a pricing schedule and guidelines that in effect also controlled the price of this gas. The government divided the country into four geographical areas, namely, the "Western & Northern Zones," the "Southern Zone – KG Basin," the "Southern Zone – Cauvery Basin," and the "North-East." In 2010, prices in these zones were set by the schedule and guidelines at prices from $4.20 to $5.00 mmBtu plus a $.25 mmBtu premium for gas produced from offshore fields. This premium was based on the observation that "higher investment" was required to exploit these offshore fields than to develop and produce from onshore fields.

Between the time of economic liberalization in the early 1990s and the entry into force of the NELP in 1999, there were a group of fields that had been discovered by the national oil companies but were not being exploited properly due to lack of funding or technological resources. In regard to these fields, the government determined to allow private participation. These discovered fields were divided into two groups. The larger fields were auctioned to joint ventures in which the PSUs were participating with production sharing contracts that allowed sale of the gas only to GAIL. The price for this gas was set under a complex formula tied to a basket of international fuel oil prices. Prices ranged from $4.20 to 5.73 per mmBtu. The smaller discovered fields and pre-NELP exploratory blocks were auctioned to private exploration and production companies without the participation of the PSUs. There was no price formula specified under the production sharing contracts for these smaller properties, and the gas could be

sold at arm's length prices in the domestic market. Gas from these fields sold at a wider range of prices varying from $3.63 to $6.79 mmBtu. However, the sales from these smaller properties were largely dependent on GAIL for offtake and it is difficult to characterize these prices as set competitively.

The pricing of imports also falls chiefly into two groups. The first of these consists of the companies in which there is a direct or indirect government interest. These companies are GAIL, GSPC, and the nominally private but actually state-controlled Petronet. These companies bought LNG chiefly on term contracts with those of Petronet being the overwhelming bulk of such purchases (9.35 million metric tons for Petronet as compared to 0.9 million metric tons for GAIL and 0.561 million metric tons for GSPC). These companies sell their degasified LNG at near cost with the price for Petronet gas purchased under contract from Qatar being $10.44 mmBtu for June 2012.

The second category of LNG imports prior to the price increase of 2013-2014 is comprised of those of Hazira LNG Private Limited, the company majority owned and controlled by Shell. Shell's imports of LNG were much smaller than those of Petronet (9.350 to 2.532 million metric tons) but priced considerably higher because they were purchased under spot contracts. The costs for this spot contract gas varied from $12.52 to $17.44 mmBtu exclusive of regasification charges.

This jumble of varying prices for the same commodity has little or no economic rationale. The political justification for these government administered prices has been that the prices are consistently lower than the market would have set them. These lower prices are in turn justified politically as a benefit to the economically disadvantaged, particularly poor farmers and the urban poor. The political concept is that farmers are economically disadvantaged and therefore need cheap urea fertilizer manufactured from natural gas and cheap or free electricity primarily to run pumps needed for irrigation. One political argument is that cheap inputs to farmers result in cheaper food to the poor. As a matter of economics, there is no proof of this since prices for food are largely determined by factors other than the cost of inputs. However, it is plain that farmers constitute a majority among voters in India since about two thirds of Indians make their living from the land. Pleasing them with low prices for fertilizer and electricity is a political plus. Similarly, subsidizing electricity with cheap fuel supposedly to benefit the poor is an immediate benefit to all who use electricity and a potent political force.

Gas prices kept lower than market prices operate as subsidies. These subsidies benefit not just the poor but the rich and middle class as well. Consequently, the artificially low subsidized prices benefit a wide segment of voters and political interests. There is little political impetus for eliminating or reducing them. However, the low prices discourage the attraction of new resources to gas exploration and production. This lack of resources is a primary reason for the limitation of supply. The limitation of supply requires further controls to allocate the supply and artificially inhibits economic growth by channeling resources for political not economic ends. The need to change the pricing system is widely accepted among economic advisors to the Indian government, but the political will to do so has not yet been forthcoming.

However, the Indian politics of setting gas prices goes far beyond the justification of keeping prices low to benefit the poor. A closer look at the Indian gas pricing saga is instructive concerning the need for reform.

The Politics of Gas Pricing

In practical terms, the question of pricing and allocation of NELP gas was of little importance until Reliance found major amounts of gas at KG-D6. After that find, human factors entered the picture to complicate the Indian gas pricing puzzle even more.

By 2004, disputes between the Mukesh brothers over the running of Reliance had become public and increasingly acrimonious. In 2005, their mother intervened to arrange a division of the Reliance properties. Under the division agreement, or "demerger," Mukesh got the upstream RIL gas exploration and production properties. Anil took the downstream gas properties under a corporation eventually named Reliance Natural Resources Ltd.(RNRL).The gas properties included all the Reliance electric power producing businesses powered by gas. However, this split in the gas business between upstream and downstream was conditioned upon RIL selling gas to RNRL at a low price. This price was eventually fixed by the parties at $2.34 mmBtu, the same price at which RIL had agreed to sell to the government-owned National Thermal Power Corporation.

By 2004, disputes between the Mukesh brothers over the running of Reliance had become public and increasingly acrimonious.

In 2006, RIL submitted this price to the Ministry of Petroleum and Natural Gas for approval, although it was not clear that the price itself needed approval. By the terms of the Production Sharing Contracts, it appeared that NELP contractors had a right to sell gas at negotiated prices. Nevertheless, the $2.34 mmBtu price contracted between Mukesh's RIL and Anil's RNRL was submitted to the Ministry of Petroleum and Natural Gas. The Ministry rejected the price by letter dated July 26, 2006. The rationale provided by the government for rejection of the low contract price was that the low price would deprive the government of revenues that were to be based on sale price.

Anil alleged that the rejection was based on secret dealings between the then Minister for Petroleum and Natural Gas Murli Deora and RIL. Indeed the rejection of the low contract price did seem anomalous since the usual reason for price control is to keep prices low for the political reasons indicated above, e.g. cheaper electricity which the low contract would presumably allow Anil's Reliance power company to produce.

The government then set up a committee to advise on a methodology for discovering both the price and the value of the gas. The "value" could be different from the price. If the methodology yielded a "value" higher than the actual sale price, then the value was to be used to determine the amount the government received from the sale of the gas. When the price was higher than the

determined value, then the price was to be used to determine the government's take.

In response to the rejection of the contract and the comments of the government committee, in May 2007 RIL submitted a price formula that was tied to the international price of crude oil but provided a floor and ceiling price for the crude, a factor to account for swings in the dollar value of the rupee, and a factor for competitive bidding. This proposal was sent to two advisory bodies: the Economic Advisory Council to the Prime Minister under the chairmanship of Dr. C. Rangarajan and to a Committee of Secretaries (Indian Administrative Service Secretaries to relevant ministries) under the direction of the cabinet secretary. These advisory bodies recommended accepting the RIL formula with two basic changes. The sales price would be calculated and denominated in dollars (eliminating the need for adjustments because of changes in the value of the rupee) and the factor for competitive bidding eliminated.

The modified RIL formula would result in an increase in the price of gas from NELP wells to $4.20 mmBtu. When news of the recommendation became public there was considerable protest, not the least of which came from Anil Ambani's RNRL. RNRL pressed a suit that it had filed in November 2006 in the Bombay High Court to require selling of gas to RNRL at the $2.34 mmBtu price that had been agreed by RIL and RNRL. In the face of the opposition to an increase in the price of gas, the government of India, acting through the Cabinet, commissioned in August 2007 an Empowered Group of Ministers, chaired by the then Finance Minister Pranab Mukherjee, for decision. Pranab Mukherjee, a veteran politician who later became the president of India, was able to calibrate the political impact of governmental decisions with considerable skill. A month later, on September 12, 2007, the EGoM accepted the modified RIL formula and later went on to declare allocation priorities for the KG–D6 gas.

After the EGoM 2007 decision on prices, Anil Ambani continued to lead opposition to the price increase. Actual first commercial production and supply commenced in March 2009, and the price of $4.20 became effective April 1, 2009 to run for a period of five years. On June 15, 2009, Anil Ambani was handed a major victory in his effort to obtain the gas at the $2.34 mmBtu price when a final judgment of the Bombay High Court went in favor of RNRG. The judgment required that RIL provide RNRG 28 MMSCMD for a period of 17 years from the KG–D6 field. The judgment went on to make it clear that the agreement between RNGL and RIL prevailed over the 2007/2009 pricing decision setting the price at $4.20 mmBtu. According to the Court, the ability of the government to set a price other than that agreed to by the parties was limited to the 10 percent of the gas which was the "government's take" under the production sharing agreements.

The government immediately notified its intent to appeal the High Court decision to the Supreme Court. Until the judgment of the Bombay High Court, the government had played very little role in the litigation, taking the stance that it was a dispute between private parties. The government owned National Thermal Power Corporation had actually sued RIL for delivery of gas at the $2.34 mmBtu price. The Empowered Group of Ministers, in its September 12, 2007 ruling, had specifically said that its decisions were without prejudice to both the NPTC vs. RIL and RNRL vs. RIL court cases. However, after the High Court decision, the Ministry of Petroleum and Natural Gas took an active role in the case. Anil

Ambani took umbrage at what he called “an unnecessary legal intervention by the petroleum ministry in the hon’ble Supreme Court.” He went on to attack the Ministry of Petroleum by name and Minister Murli Deora by implication in a speech to shareholders and a series of advertisements.

The RNRL advertisements did not have the effect of arousing public opinion as Anil Ambani had hoped. But the allegations of “gold plating” of reimbursable contractor expenses would later result in a government Comptroller and Auditor General (CAG) investigation and changes from a production sharing to revenue sharing model for contractors.

On May 7, 2010, the Supreme Court of India rendered its decision and judgment in the case of RIL vs. RNRL. The decision was a complete victory for the power of the Indian government to deal with all of the offshore gas of India in any way it saw fit so long as those actions were in accordance with certain social welfare provisions of the Indian Constitution. The agreement between RIL and RNRL as to price, quantity, and duration of delivery was of no force and effect. The disposition of all supplies of natural gas could only be in accordance with the policies of the government. The Court placed all rights to the gas in the people of India in accordance with what it saw as the mandate of Articles 297, 39, 19 and 14 of the Indian Constitution. The government held these rights as a public trust. The court said:

> “RNRL has repeatedly argued that in as much as NELP promised the freedom to market to the contractors and that is what is provided in Article 21.3 of the PSC, and no other utilization policy was put in place, RIL had the right to commit to sell natural gas at its sole discretion. They argue that in this case RIL chose to commit to RNRL, via the MoU and the Scheme. Therefore, according to RNRL’s counsel, the GoI should not have any right to interfere in this contractual commitment. We disagree. The sale at the Delivery Point takes place when the people of India are still the owners of the natural gas and consequently they have the responsibility of ensuring that they exercise their permanent sovereignty, through their elected government, in order to achieve a broad set of goals that constitute national development. While revenue generation is one part of those objectives, that cannot be the only objective of India. Timely utilization, by users spread across many sectors and across regions as the network of pipelines spreads and conservation are all necessary objectives to be kept in mind. The fundamental rationale of the PSC is “the overall interests of India”; and the obligation of the Contractor is to always be mindful of the rights and interests of India.”[148]

With the government of India confirmed in its powers over all the gas off the shores of India, Mukesh Ambani and RIL redoubled their efforts to further increase their compensation for the gas RIL was producing from the KG–D6 fields. The government controlled and majority-owned ONGC also sought a change in pricing for natural gas. ONGC had long been saddled by the low prices enforced by the APM. Besides, ONGC, which actually produces more gas than RIL, had its own NELP properties that it wished to exploit but was finding impossible to do because of low gas prices.

In January 2011, Minister of Petroleum and Natural Gas Deora was replaced with Jaipal Reddy. Reddy took a decidedly different approach to RIL than Deora. Reddy took seriously the allegations that RIL was holding back on KG-D6 gas production in violation of its agreements with the government. Moreover, a group of secretly recorded telephone conversations between Mukesh Ambani and a governmental and public relations lobbyist surfaced about that time. These conversations in part were about natural gas pricing. In one of the tapes, Mukesh Ambani can be heard referring to the leadership committee of the Congress Party led government as "our shop," in Hindi. The implication in press reports was that RIL was making contributions that allowed it to influence if not control congressional policy decisions affecting RIL.

Further the Anil Ambani allegations about the accounting for RIL's production sharing contract were gaining traction. Since the gas production sharing contractors allowed the contractor to recover capital and operating expenses from revenue prior to sharing with the government, the allegations that these expenses were being inflated, or "gold-plated," were particularly salient. The Comptroller and Auditor General (CAG) audit report on this subject was issued on August 24, 2011. The audit report was critical of the production sharing contract and management of oil and gas exploration and production management.

Perhaps to show that RIL was not being favored by the government, in May 2012, Minister Reddy approved the levy of a $1.5 billion penalty against RIL for disallowed cost recovery. RIL immediately sued for arbitration under the terms of its PSC. This penalty is still in litigation.

The CAG audit report added to public concern about the production sharing contracts and their administration. Thus, Minister Reddy wrote to the prime minister in March 2012 asking for a review of the profit sharing mechanism and PSC's in hydrocarbon exploration. Prime Minister Singh again turned to the Chairman of his Economic Advisory Council, Dr. C. Rangarajan, to run a committee to conduct a study and make recommendations.

In its December 2012 report the Rangarajan Committee had two major recommendations. The first was to replace the existing cost-recovery PSC mechanism with a royalty, revenue sharing mechanism. Under this recommendation, the government would receive payments right from the onset of production. Second, as to prices the Committee rejected "gas-on-gas competition" as infeasible and instead recommended the government setting of prices in accordance with a formula "ensuring that producers in India get at least the average price of what producers elsewhere are getting." According to the committee, this could be accomplished by calculating the netback price at the wellhead for Indian LNG imports and averaging these prices. Next, there would be a calculation of the average of prices prevailing at (1) the Henry Hub in the United States; (2) the National Balancing Point of the U.K.; and (3) the netback price at the sources of supply for Japan. Finally, the prices for these two methods would be averaged. Prices would be calculated monthly (later changed to quarterly) based on the previous 12 months data. The proposed pricing formula would apply to all sectors uniformly, while allocation of gas would continue to be under the prevailing Gas Utilization Policy of the government.

The Rangarajan Committee recommendations went to the CCEA rather than the Empowered Group of Ministers on Gas Pricing and Commercial Utilization of Gas. Perhaps the most practical reason for taking action through the CCEA rather than the EGoM was that the Ministers of Chemicals and Fertilizers and Power, who were known to be against any price increase, were members of the EGOM and not the CCEA. If adopted, application of the new formula was bound to increase the price of gas significantly. This, of course, was the whole point from the perspective of both public and private gas producers. In the circulation for comment of a "Cabinet Note" prepared by the Ministry of Petroleum and Natural Gas, the Planning Commission had suggested a price of $11.18 mmBtu and the Ministry of Finance $6.99 to $8.93. RIL indicated the necessity of higher prices to cover the costs of deep water extraction.

After considerable discussion, the Cabinet Committee on Economic Affairs approved the Rangarajan Committee recommendations on June 28, 2013.

In the face of considerable public opposition to an increase in the price of gas, the government put out a press brief trying to justify the CCEA decision. The government pointed out that only six out of 110 discoveries under NELP were under production, that even the state-owned ONGC and OIL were saying that production would not be viable at any price less than $7 mmBtu, and that India was in dire need of more gas.

While the process is opaque, it is probable that between the time the Rangarajan Committee recommendations were made to the Cabinet and the time they were acted upon these recommendations were considered by the Indian National Congress Core Group, chaired by Sonia Gandhi. This was the usual political vetting process that was practiced for any price increase in a basic fuel. For example, in regard to a decision on raising diesel prices by Rs. 3-5 per litre, kerosene by Rs. 2 and LPG by up to Rs. 50 per cylinder such a decision could only be taken after Sonia Gandhi returned to India from a medical examination in the United States. According to an Indian official speaking about these price increases:

> "It is a political decision. The Congress Core Group will have to first decide on it before it can be considered by the Cabinet Committee on Political Affairs…." [149]

Since the raising of natural gas prices had obvious political implications and the more popular position was to keep prices low, there is a question of why the political system of the Congress Party and the UPA would have acted to authorize such a steep price increase. The explanation offered by the government was that the decision was sound economic policy necessary to increase output and induce increased investment. However, there was one leading reformer politician, who had a more sinister explanation, an explanation that he would attempt to ride to national power.

In 2012, a prominent anti-corruption campaigner, Arvind Kejriwal, entered elective politics. Kejriwal was a former civil servant in the Indian Revenue Service who had for more than a decade campaigned against corruption in the Indian tax, electric power, water, and food distribution systems. His chief technique had been to act as an advocate for economically disadvantaged citizens who

had been victimized by corruption within the bureaucracies of these systems. He then adroitly used the advocacy to excite the media into coverage of the story. With others, Kejriwal founded "Parivartan," an organization that combined advocacy with an astute use of public demonstrations, media publicity, and, later, legal action to compel correction of corrupt bureaucratic actions. In 2006, he was recognized by the prestigious Ramon Magsaysay Award Foundation for "… greatness of spirit in selfless service to the people of Asia." In a biographical interview connected with the award, Kejriwal said he had been inspired to be an anti-corruption campaigner when early in his Indian Revenue Service Career his superior advised him, "In the first few years of your service, you should make sufficient money for yourself so that you can appear to be honest the rest of your life."

Kejriwal had split with another prominent anti-corruption leader, Anna Hazare, to form a party to contest state-level elections in 2013. Kejriwal's organization was the Aam Aadmi Party (AAP). "Aam aadmi" is loosely translated from Hindi as "common man." Kejriwal's thesis was that the common man was being treated unfairly by a governing political-business elite that was colluding to cheat "aam aadmi." Through demands for bribes and collusive high prices, for electricity and water particularly, the aama admi was suffering at the hands of a corrupt combination of government officials and business officials who bribed them for decisions favoring their businesses.

The Aam Aadmi's initial foray into electoral politics came in the National Capital Territory of Delhi. In its debut December 2013 effort, the AAP shocked both national parties and the Indian political establishment by winning 28 out of 70 legislative assembly seats. Although Aam Aadmi obviously did not obtain a majority, the Congress Party (which had held power in the Territory for the previous 15 years) dropped to 8 seats and agreed to support the AAP in forming a government.

As Chief Minister of Delhi, Kejriwal's most salient anti-corruption action was to start criminal investigation proceedings against the incumbent Minister of Petroleum and Natural Gas and a former minister, the former head of the DGH, Mukesh Ambani, and RIL. The criminal allegations were that the gas price increase was awarded to RIL by virtue of the UPA government wanting "to favor RIL for corrupt considerations, which would then help for the expenditure with the upcoming national elections." No mention was made of the benefit a gas price increase would bestow on the country's largest gas producer, ONGC, or its oldest, Oil India Ltd.

Just three days after filing papers in the criminal case, Kejriwal and his government resigned over the refusal of both the BJP and Congress members of the legislature to allow the introduction of a bill that would have established an anti-corruption ombudsman for the Delhi Union territory. Kejriwal and his party established the gas price increase as the cornerstone of their election campaign against corruption in both Congress and the BJP. On March 20, 2014, Kejriwal wrote to the Elections Commission asking it to delay the gas price increase until after the national elections. His argument was that the increase would violate the Election Commission's Model Code of Conduct by conferring an economic benefit on Mukesh Ambani and Reliance. Implicitly, this economic benefit would impact the elections by inducing Ambani and RIL to provide funding to the UPA.

The Elections Commission then wrote the Secretary of the Ministry of Petroleum and Natural Gas on March 24 stating that for the quarter April 1–June 30, 2014, the gas price increase in natural gas "may be deferred." The Ministry complied with the deferment. The only reason specifically cited was that the matter was before the courts. Indeed the Communist Party of India had brought such a suit. However, Kejriwal and the Aam Aadmi took credit for the deferral and pressed both the BJP and the Congress on the issue.

However, the gas issue did not work for Kejriwal and the AAP. Kejriwal's abrupt resignation as Chief Minister of Delhi enabled both the BJP and Congress to portray Kejriwal and the AAP as not serious about government. In regard to the gas price itself, the BJP said it opposed the formula, while many Congress politicians were happy to see the issue deferred. After Modi's victory, the issue was still too toxic to handle in a manner that accorded with economic reality. The Cabinet Committee on Economic Affairs deferred the matter for three months.[150] When the decision was finally announced in October 2014, it was once again a compromise driven by political considerations. The eight-year history of political and governmental turmoil centered on the price of gas shows the present Indian system for handling this crucial economic matter is untenable. The affordability of gas cannot be determined in an economically sound manner by the present complex and often opaque process of price control and supply allocation. Neither the history nor result of this gas pricing process can inspire the confidence needed to increase investment in energy. Without this investment, India's struggle for power will not be successful.

Security Considerations

India's drive to reduce imports of natural gas is premised in part on the assumption that if India's needs could be met solely from within the country, then its natural gas security would be complete. The equation of "energy independence" with "energy security" or "natural gas independence" with "natural gas security" is, of course, incomplete. This equation fails to take into account domestic challenges to security.

No energy source can be deemed secure in an absolute sense. Rather, the security of any particular energy source must be evaluated in comparison with other sources. In this regard, Indian natural gas has greater domestic security in comparison with its major competitor in the Indian energy mix–coal, which is a focus of the Maoist Naxalite insurgency. Indeed, the location of most of India's natural gas offshore makes its production more secure than other domestic sources of energy. Being offshore, natural gas production does not involve the taking of land. Thus, the land rights issues that have sparked many Indian resource confrontations simply are not applicable to the production of gas offshore. Further, it is much more difficult for Naxalites or other insurgents to mount a destructive attack from boats than on foot.

Still, gas produced from offshore wells must come ashore at some point and the pipeline facilities are theoretically subject to disruption. However, gas transportation security compares favorably with domestic transportation of other fuels. All major natural gas pipelines have sophisticated monitoring systems for the detection of difficulties along the lines. Further, the strength of the pipelines and the fact that most are buried underground lessen the chances for security

breaches caused by hostile forces. Nevertheless, the security difficulties for such a major pipeline as the Reliance East-West Gas Pipeline do exist. [151]

The security risks of Indian domestic pipelines pale in comparison with those of international pipelines. The security risks of the TAPI pipeline Indian planners are projecting to go into during the present five year (2012-2017) plan begin at the source. While Turkmenistan has the fourth largest proved reserves in the world, its government is authoritarian.[152] Such governments are notoriously subject to upheavals that threaten the ability to supply. The security risks to a pipeline across Afghanistan with its ongoing war and Pakistan, an avowed enemy of India, not to mention one of the world's most rugged mountain ranges are obvious. The proposed pipelines from Iran, Russia, and, to a lesser extent, Myanmar have similar security problems.

LNG for India from such established sources as Qatar and other Middle Eastern producers do not entail the security risks of pipelines that run through unstable territory. However, such LNG does run the risk of interruption by virtue of the region's volatility. The disruptions at the source of supply and difficulties in protecting the sea routes for transportation by sea are major concerns. When war breaks out, as it has repeatedly in this region, the impact on gas from the region can be devastating. India's struggles with the price and availability of oil each of the times the United States went to war with Iraq is an indication of what could happen to Indian gas supplies from the region in the event of major hostilities. Since Qatar is India's major LNG supplier and shares its major gas field with Iran, United States or Israeli hostilities with Iran over the nuclear issue would be particularly problematic for India. LNG from the east, namely Australia, Indonesia, and Malaysia offers fewer security challenges since the area to the southeast of India is more stable than further west.

For non-established but prospective sources of LNG, such as Mozambique, concerns about the physical security of source infrastructure should be a key factor in assessing security of LNG supply. OVL has already had difficulties with its oil investments in unstable Sudan and South Sudan because of source security factors.[153] Similar security factors apply to Mozambique and other relatively unstable emerging sources of LNG.

Regardless of the country involved as a source, the purchase of significant amounts of gas from that country inevitably involves India in security and diplomatic considerations. These considerations pertain both to the supplier country and other international actors who have interests involving that supplier. The outstanding example of this is India's energy relations with Iran and consequent impact on relations with the United States, Israel, and Europe. However, the phenomenon is by no means limited to the Iran situation. For example, India's relations with Qatar would be vastly different if it were not the chief foreign supplier of natural gas to India. The involvement of Prime Minister Singh's National Security Adviser in recent LNG contract negotiations with Qatar is an indication of how closely related gas supply and national security concerns can become.

The threats posed by pirates and other non-state actors present additional security concerns when gas is sourced from abroad. Thus far no LNG tanker has been hijacked. However, the devastating consequences of such an action

cannot be completely discounted. As hijacking has increased in the Indian Ocean and around the Malacca Straits between Singapore and Indonesia, more and more shippers of LNG are placing armed guards aboard LNG vessels.[154] Mutual concerns about piracy become a factor in naval cooperation for India with other nations who share these concerns. The impact of the need to protect vessels is not always positive, as shown by the recent controversy between India and Italy over armed ship guards killing Indian fisherman whom the Italians mistook for pirates off the southwest coast of India.

Environmental Considerations

Viewed from an environmental perspective, natural gas can be seen for India as a bridge to a future of sustainable growth and less damage to the environment. India depends upon domestic deposits of poor quality coal for the bulk of its commercialized energy. Since this coal produces significantly more air pollution and unusable residue when burned than natural gas, the replacement of coal with natural gas seems a logical way to progress to a lower carbon future. Gas is far cleaner to burn than coal. Much the same observation can be made for replacement of oil as the energy source for uses outside of transportation. For gasoline and diesel refined from oil, the bridge argument is more difficult. Although CNG as replacement for transportation fuels has made headway in India, the replacement or retrofitting of large numbers of vehicles presents problems more difficult than switching from coal to natural gas in power plants.

Often overlooked in environmental assessments is the role that even a very small conversion from biomass to gas might play. Since biomass is the source for meeting approximately 22 percent of India's energy needs and 80 percent of its household energy consumption and is a huge source of environmental pollution in India, conversion of even a portion of this usage to natural gas could produce huge environmental benefits.

The significant environmental advantages of burning natural gas as opposed to other fossil fuels can be seen from chart III-6.

Emissions from burning biomass are even worse than for coal. For example 213,000 lbs. of CO2 per billion Btu is generally cited for dry wood.[155] Dung cake has even higher levels of CO2 and particulate emissions than wood.[156]

Chart III-6 Fossil Fuel Emission Levels Pounds per Billion Btu of Energy Input

Pollutant	Natural Gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0.000	0.007	0.016

Source: EIA - Natural Gas Issues and Trends 1998

Recently, attention has been given to the deleterious greenhouse gas effects of leakages of natural gas into the atmosphere in the processes of production and transportation. The principal component of natural gas, methane, is considerably more potent than carbon dioxide in producing a greenhouse effect. Thus, to the extent there are leakages into the atmosphere of methane associated with the use of natural gas, these leakages may offset the environmental advantages of natural gas over coal. However, improved techniques are cutting rapidly methane leakages in the production and transportation of natural gas. Further, natural gas retains its environmental advantages over other fossil fuels in regard to each of the other major pollutants indicated in the chart. The much lower levels of sulfur dioxide and nitrogen dioxides can be of fundamental importance in combatting acid rain and the acidification of lakes and the ocean. Much of U.S. progress in lessening acid rain can be attributed to switching from burning coal to burning natural gas. In addition, the absence of mercury in emissions from burning natural gas is important to addressing mercury pollution in seafood.

Strictly from an environmental perspective, the best way to meet Indian energy needs is through the use of non-polluting renewable sources of energy, namely wind and solar. These renewables avoid the harmful emissions associated with burning fossil fuels as well as the environmental dislocations involved in hydro power and the health and safety concerns associated with nuclear power. While the costs of wind and solar are diminishing over time, making them more attractive as primary sources of energy, the reliability issue will remain. This is simply because the sun does not shine at night and only with insufficient power on cloudy days. Likewise the wind does not blow on a steady and consistent basis in most places. Thus, solar and wind energy will need a backup for those times when solar and wind are not producing sufficient electricity. For these periods, gas is more environmentally responsible than either coal or gas.

Advancing electricity storage technology could change this picture by the storage of electricity during the periods when backups for wind and solar are needed. Most of the focus has been on batteries as the means for solving the reliability problem created by the intermittent nature of solar and wind energy. There is at least one company that claims to have solved the storage problem in regard to industrial magnitude solar power. A U.S.-based company is seeking to commercialize a molten salt power tower design that is said to allow seven hours to 24 hours of full power energy storage. While requiring significant amounts of land and having yet to solve its cost problems, this is a promising technology.[157]

While battery storage or molten salt technologies may eventually solve the reliability issue of solar and wind power, this technology will come at a price. For a relatively poor country like India, where affordability is already such an important barrier to adoption of renewables as a primary energy source, it seems unlikely that electricity storage technology will become sufficiently efficient and inexpensive in the near to medium term to solve the problem of lapses in solar and wind electricity production. Since gas availability is unaffected by lack of sun or wind, it is an attractive backup to solar and wind energy in the near to medium term.

SECTION IV

THE POTENTIAL ROLE OF U.S. LNG

In view of recent developments and present realities, the United States can play a special role in cooperating with India on natural gas to meet its goals for available, affordable, secure, and environmentally helpful energy. Further, engagement between the United States and India on natural gas can support mutual economic, national security, and environmental interests. On all these points, the synergistic relationship in regard to LNG offers an opportunity for positive engagement to support closer U.S.-India ties.

Availability of U.S. Natural Gas

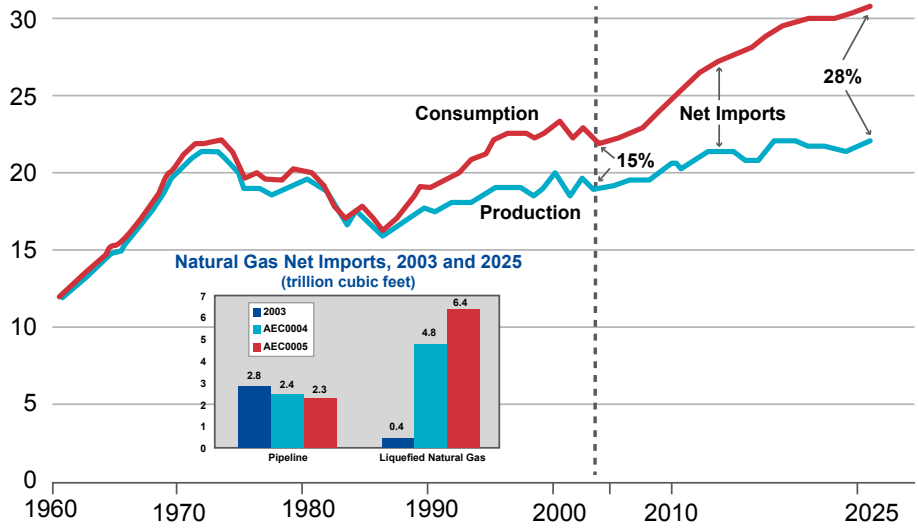
There are at least three aspects concerning the availability of U.S. natural gas for India: (1) physical availability, (2) logistical availability, and (3) legal availability. Physical availability encompasses production and proved reserves. Logistical availability takes into account the infrastructure necessary to capture, transport, refine, liquefy, and ship the gas from the United States to India. Legal availability means gas that is available under existing U.S. regulatory regimes for shipment to India. Let us examine U.S. natural gas in terms of each of these aspects, or types, of availability.

Physical Availability

There is now wide familiarity with the revolution that has occurred in regard to the physical availability of natural gas in the United States. The word “revolution” is not too strong a term to use because the United States has revolved in less than a decade from a position of relative scarcity to one of natural gas abundance. Most importantly, the factors and trends that have produced this abundance do not appear to be lessening but rather increasing in the direction of greater physical availability. The revolutionary nature of these trends may be seen in the comparison of what the U.S. Energy Information Administration (EIA) was predicting for U.S. natural gas production, consumption, and imports a decade ago and the situation as it now exists and is predicted to become.

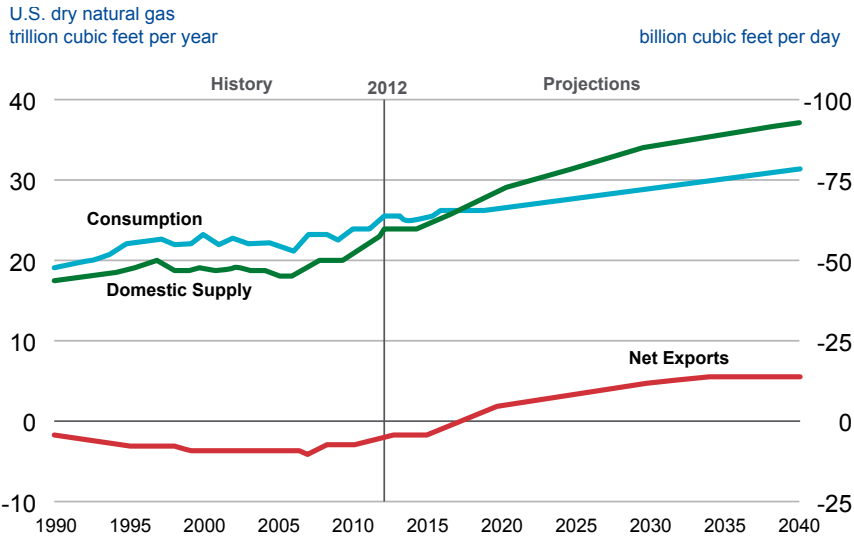
In 2003, the gap between production and consumption filled by imports was 15 percent and projected to increase by 2025 to 28 percent as shown by chart IV-1.

Chart IV-1 Natural Gas Production, Consumption, and Imports, 1970-2025 (trillion cubic feet)



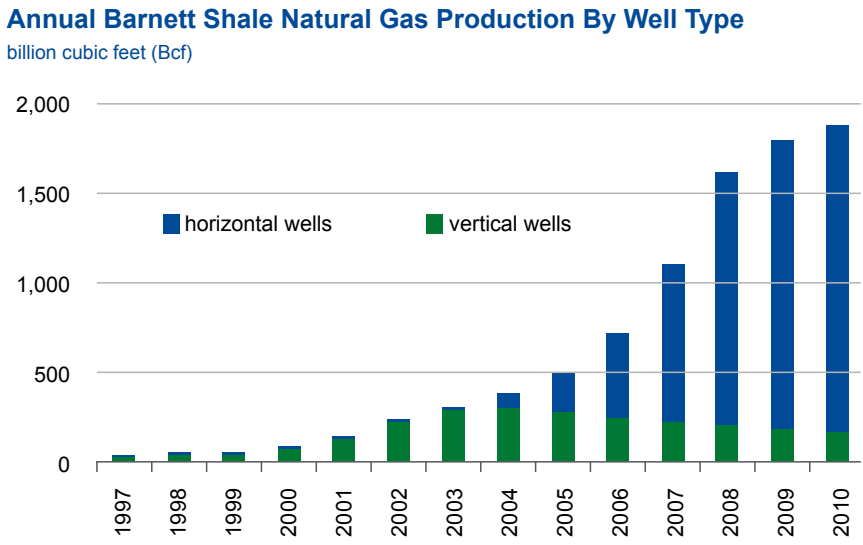
Source: 2005 Energy Information Administration Annual Energy Outlook

Chart IV-2 U.S. Becomes a Net Exporter of Natural Gas in the Near Future[158]



Source: EIA, Annual Energy Outlook 2014 Reference Case

Chart IV-3 Annual Barnett Shale Natural Gas Production by Well Type[159]



Source: U.S. Energy Information Administration based on HPDI, LLC

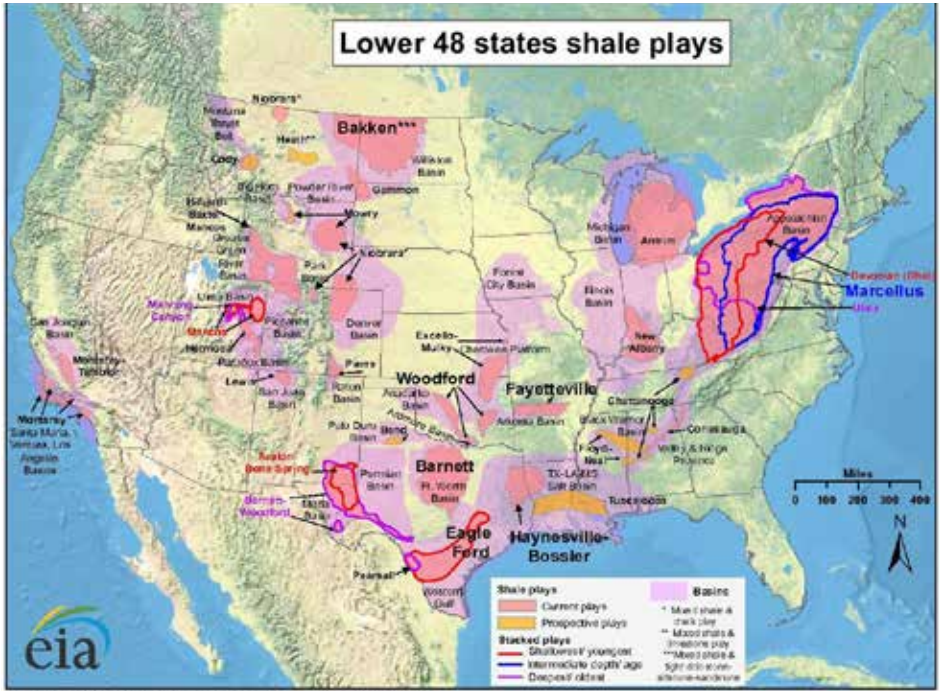
Instead of ever-increasing U.S. import needs, those needs have diminished rapidly. The United States is now officially projected to be a net exporter by 2017. Chart IV-2 shows the official projection for U.S. natural gas as it stood in 2014. When contrasted with the projections from less than a decade previously in chart IV-1, a startlingly different picture is presented. The prospects for even greater change toward exports and away from imports are real.

The obvious reason for this changed picture is the advent and employment of sophisticated technologies for extracting natural gas from shale and other gas-bearing geological formations. The most important of these technologies are hydraulic fracturing and horizontal drilling. These technologies were developed in the United States and U.S. companies are presently the repositories for the most advanced forms of the technologies. India can benefit by involvement in the market that is home to these technologies.

Fracturing as a way to stimulate production goes back to the very dawn of oil production in the United States. First technologies involved explosives that were detonated in well shafts. In the mid-twentieth century techniques for the use of liquids under pressure were developed to produce hydraulic fracturing. However, it was the combination of hydraulic fracturing with horizontal drilling in the early twenty first century that set off the revolutionary increase in gas availability in the United States. The first major employment of these technologies on a large scale occurred in Texas in the Barnett Shale outside the city of Fort Worth. Chart IV-3 shows the significant difference made when the two technologies were combined.

Much of the United States has gas-bearing shale deposits that have yet to be exploited by hydraulic fracturing and horizontal drilling. The same results as were obtained in the Barnett shale are likely to be obtained throughout the United States. The map in chart IV-4 shows how extensive the shale areas, or “plays” are in the United States.

Chart IV-4 Lower 48 States Shale Plays



Source: Energy Information Administration based on data from various published studies. Updated: May 9, 2011

Chart IV-5 Top 10 Natural Gas Producers by Country

Rank	Country	Natural Gas - Production (cubic meters)
1	United States	611,000,000,000
2	Russia	588,900,000,000
3	Canada	152,300,000,000
4	Iran	138,500,000,000
5	Qatar	116,700,000,000
6	Normay	106,300,000,000
7	China	102,500,000,000
8	Netherlands	85,170,000,000
9	Algeria	85,140,000,000
10	Saudi Arabia	83,940,000,000

Source: http://www.indexmundi.com/g/r.aspx?t=10&v=136 from data in CIA World Factbook

The United States is now the largest producer of natural gas in the world.[161] U.S. production is slightly higher than that of Russia and significantly higher than that of India's other major traditional suppliers, Qatar and Saudi Arabia.

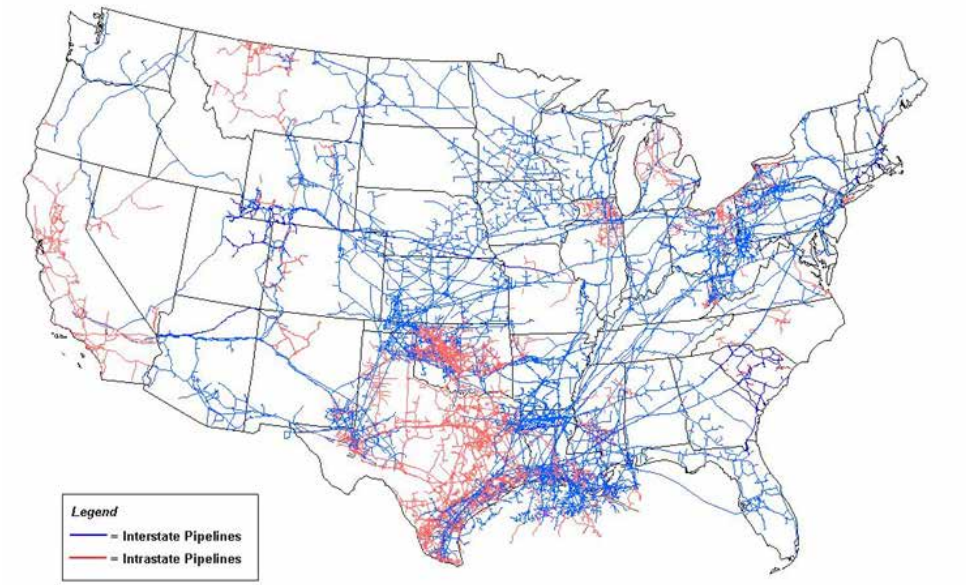
Although the United States ranks fourth in proved reserves (behind Russia, Iran and Qatar), the United States proved reserves continue to increase at a rapid rate. This increase is driven by the application of hydraulic fracturing and horizontal drilling.[162]

Logistical Availability

Physical availability means nothing if the logistical means to get the gas in a useable form to customers do not exist. The United States has by far the most developed infrastructure for production, transporting and processing natural gas. Thus, the domestic logistical availability of United States gas is greater than in countries with higher proved reserves.

The U.S. gas transportation system alone encompasses more than 210 natural gas pipeline systems; 305,000 miles of interstate and intrastate transmission pipelines; more than 1,400 compressor stations that maintain pressure on the natural gas pipeline network and assure continuous forward movement of supplies; more than 11,000 delivery points: 5,000 receipt points: 1,400 interconnection points that provide for the transfer of natural gas throughout the United States; 24 hubs or market centers that provide additional interconnections; 400 underground natural gas storage facilities; and 49 locations where natural gas can be imported/exported via pipelines.[163]

Chart IV-6 U.S. Natural Gas Pipeline Network, 2009



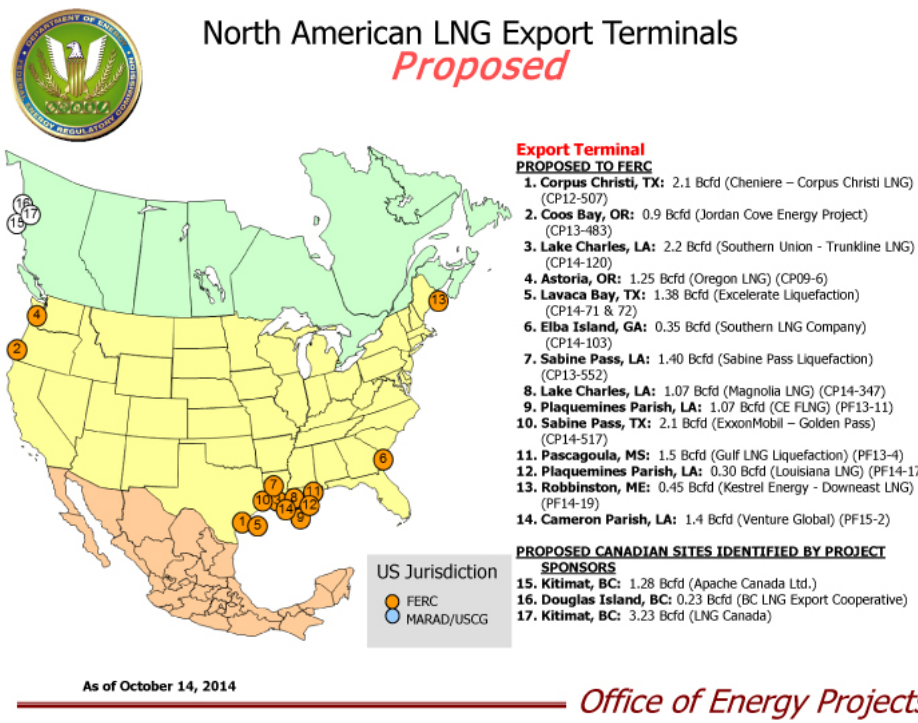
Source: U.S. Energy Information Administration, "About U.S. Natural Gas Pipelines" (2009) http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/ngpipelines_map.html

However, internal U.S. gas transportation facilities do not solve the logistical problem of getting gas to India. Pipelines can get the gas to port sites. However, there must be dockside liquefaction and loading facilities to place the gas onto ships for there to be meaningful logistical availability of U.S. gas.

Before the revolution in natural gas production, the United States had eleven LNG facilities capable of receiving imports of LNG. With abundant gas these facilities are obsolete. Nevertheless, these import facilities have docks, off-loading equipment, transmission pipelines, and storage tanks that can be converted to liquefaction and export facilities. Most have applied for DOE approval to export to non-FTA countries, like India. In addition, other projects are presently proposed for construction in order to export to non-FTA countries. Eight of these export projects have been approved for export and 14 have been proposed or identified to the Federal Energy Regulatory Commission (FERC) for construction. Most of these projects are along the coasts of Texas and Louisiana. Chart IV-7 shows this clustering along the Gulf Coast of proposed export facilities.

The last infrastructure link necessary to get U.S. LNG to Indian offloading and regasification facilities is the ocean transportation to carry and maintain the gas at the -162 degrees centigrade temperature necessary for liquefaction. At the end of 2012 the LNG fleet consisted of some 380 vessels. The “standard” size

Chart IV-7 North American LNG Export Terminals - Proposed



for these vessels was 155,000 cubic meters. For such a ship, regasification of its cargo by the standard increase of 600 times the volume of the gas in its liquefied state means that each ship could carry LNG equivalent to 9 million cubic meters of natural gas. In 2012, 3982 loaded voyages were completed, including 205 to India.[164]

A U.S. private analyst predicts that the United States will become the world's third largest exporter of LNG by 2020,[165] and the head of a large Japanese shipbuilder projects a need for 700 LNG vessels by 2030, almost twice the number in the present fleet.[166] However, it appears that these ships are being built and over the medium to longer run, the availability of ships should not be a major factor in getting U.S. gas to India.

Regulatory Availability

The concern in regard to U.S. LNG availability is whether U.S. regulatory mechanisms will allow this gas to flow to countries with which the United States does not have a free trade agreement. All exports of natural gas from the United States require approval of the national, or federal, government. Section 3 of the Natural Gas Act (15 United States Code Section717b) requires an order from the Department of Energy (DOE) to export gas from the United States. Such an order is to be granted unless the DOE finds that the export will not be consistent with the public interest.

For countries that have free trade agreements with the United States, additional language in Section 3 makes the finding that the proposed exportation is consistent with the public interest automatic.

Thus, it is only exportation to countries with which the United States does not have a free trade agreement (such as India) that can be refused upon evidence that the exportation will not be consistent with the public interest. The criteria for determining the "public interest" have been created by decisions of the DOE. These criteria include domestic need for the natural gas proposed for export; adequacy of domestic natural gas supply; U.S. energy security; the impact on the U.S. economy, consumers, and industry including the impact on the prices consumers and industry pay for natural gas; job creation; the U.S. balance of trade; international geopolitical considerations; environmental considerations; consistency with DOE policy of promoting competition through freely arrived at trade contracts; and other issues raised by the commentators and interveners in the proceedings.[167]

The United States has 14 Free Trade Agreements (FTAs) in force with 20 countries. These countries are Australia; Bahrain; Chile; Colombia; Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua; Israel; Jordan; South Korea; Morocco; Canada, Mexico; Oman; Panama; Peru; and Singapore. The United States is also in the process of negotiating a regional FTA, the Trans-Pacific Partnership, with Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam.[168] In 2010, U.S. FTA partners had only 9 percent of world GDP. [169] This percentage will increase with the recent entry into force of FTA's with South Korea and Colombia. However, it remains the case that countries not having free trade

agreements with the U.S. control far more of world GDP than those with such agreements. This control of the vast majority of world GDP is an added policy reason for approval of LNG exports to non-FTA countries.

As of this writing some three dozen applications for export to non-FTA countries have been received by DOE. These applications encompass exports totaling 36.02 billion cubic feet per day, or approximately 1 billion standard cubic meters per day or 1000 MMSCMD. There are other project promoters preparing to file.

The fears of upward price pressure caused by allowing demand to increase through exports to countries with which the United States does not have free trade agreements seems to have been the driver for a period of hiatus in 2012 after the first approval for non-FTA exports. All further action was frozen for a year from the spring of 2012. This delayed any further decision-making in this area until after the presidential and congressional elections in November 2012. On December 12, 2012, the DOE released a study that found very little upward pressure on pricing would be occasioned by LNG exports. This study confirmed a DOE in-house study and went beyond it to find positive U.S. macro-economic effects.

In addition to eight conversion, or "brownfield," projects there are another 24 totally new, or "greenfield" projects that have asked for authorizations from the DOE to export LNG to non-FTA countries. Several of these new projects seek to take advantage of the technology of placing liquefaction facilities on ships. This "Floating LNG" (FLNG) approach has the advantage of reducing risk by allowing movement of the facility should a particular site prove disadvantageous or unviable. Further, at least two of the FLNG projects seek to operate sufficiently offshore as to be regulated by the Maritime Administration of the Department of Transportation under its Deepwater Port jurisdiction rather than by FERC. These projects still will have to secure DOE approval for export to India and other non-FTA countries.

Among Indian companies, GAIL has taken the lead in seeking advantage from the new abundance of gas in the United States. GAIL moved quickly to secure low prices by negotiating a 20 year contract for LNG at $3.00 mmBtu with Cheniere Energy, promoters of the Sabine Pass project in Louisiana. This was the first project to be approved by the U.S. Department of Energy for export to countries not having free trade agreements with the United States. GAIL also negotiated an agreement with Dominion Resources for use of a liquefaction facility at Cove Point in Maryland on the Chesapeake Bay.

Petronet signed a preliminary agreement with United LNG LP, an affiliate of Freeport McMoRan Energy LLC, for exporting LNG from a proposed export facility off the coast of Louisiana to be called the Main Pass Energy Hub.[170] This is a conversion proposal for an existing import project that lies dormant. Indeed, an order of the FERC authorizing the construction of a pipeline for the purpose of connecting the Main Pass Energy Hub with an existing interstate pipeline was withdrawn by FERC in June of 2013. The pipeline was to have been in service by May 2012 but had never been constructed because of a lack of demand for imports.[171]

In addition, India may receive U.S. LNG from the Freeport, Texas terminal. BP

has an agreement to export LNG with Freeport LNG Expansion, LP. Supplies will start in 2017 from the plant's first unit and a liquefaction tolling agreement with BP will commence upon completion of Freeport LNG's second production unit. The first unit has received export authorization to non-FTA countries from the DOE and the second unit has a partial approval. BP has indicated that it intends to market some of the Freeport gas to India through its Indian Gas Solutions partnership with Reliance Industries Ltd.[172]

Thus, of the applications for export to non-FTA countries that have been granted by the DOE, India stands to participate in three of these. GAIL is participating in two approved projects and Reliance through its joint venture with BP may be marketing gas from another. The Main Pass project of Freeport-McMoRan may also produce gas for India through Petronet, and ONGC has signed a non-binding letter of intent to participate in the South Texas Pangea project. Oil India Corporation, Indian Oil Limited, Hindustan Oil, and the Gujarat State Petroleum Corporation are also trying to find viable ways to enter the U.S. LNG market.

Both the major LNG export studies commissioned by the Department of Energy Office of Fossil Energy have been supportive of exports, finding that the price impacts on consumers and U.S. industries are likely to be minimal. Secretary of Energy Ernest Moniz and the Obama Administration generally have been supportive. However, there is opposition from environmentalists opposed to fracking and several major domestic manufacturers who want to keep the cost of gas low. Several members of the Senate and Congress have expressed their concerns that consumers not be hurt by rising gas prices due to exports.

One drawback in regard to the approvals granted thus far is that they are all conditional. These orders are conditional on completing the review required by the National Environmental Policy Act (NEPA) and can be revoked or modified if there are any unforeseen developments that put the public interest at risk. This is a very vague and broad standard. However, the difficulty created is somewhat alleviated by expressions from the DOE that it does not intend to use this authority as a price maintenance mechanism and it would not modify or withdraw an authorization except in the case of extraordinary circumstances.[173]

Also of concern in determining the availability of U.S. LNG from a regulatory perspective are the many laws and regulations that apply to the construction of a liquefaction facility itself. The Federal Energy Regulatory Commission is a regulatory body independent of any other agency of the government. No LNG facility can be sited, constructed or expanded on land without FERC approval. The Maritime Administration (MARAD) in the Department of Transportation performs a similar function for ports located offshore. FERC is the lead agency for carrying out the NEPA and MARAD for offshore ports. In general FERC or MARAD must identify and consider the environmental impacts of its approval activities and inform the public of those impacts before it makes a final decision. FERC or MARAD will require a detailed engineering design review of all facilities and do an analysis of all LNG hazards.[174]

In May 2014, the DOE announced it was going to act on applications to export to non-FTA countries only after the project had completed the costly FERC or MARAD process. The FERC or MARAD process costs $100,000,000 while the process for non-FTA export approval costs only about $20,000.[175] The DOE now

is requiring the environmental impact statement to take precedence over the non-FTA export approval. This will now slow and limit the number of DOE export approvals to non-FTA countries. DOE argues that the NEPA approval will insure that only projects that are probable of actual construction will be acted upon by DOE, thus conserving administrative resources.[176]

The change in DOE processing procedures may further restrict the probability of new projects coming to fruition. Previously, the DOE export approval was a positive factor in raising funds for a project. Now large sums of money must be committed to a project with no assurance that in the end a DOE export permit will be granted. Consequently, there is considerable interest in changing the law in regard to approval requirements.

Regulatory Availability – U.S. Sanctions

The United States has a long history of attempting to use sanctions to affect the conduct of foreign governments. Among the most prominent of these pertaining to trade and investment in gas and oil are those that are aimed at Iran. These sanctions are designed to change Iran's behavior in regard to nuclear activities, support of terrorism, and abuse of human rights. The United States' first imposition of Iran sanctions took place in 1979 in conjunction with the seizure of American hostages at the time of the Iranian Revolution. These sanctions were lifted with the return of the hostages but re-imposed by Executive Order in 1987 to ban U.S. imports of Iranian goods and services.

The Clinton Administration banned U.S. companies from investing in or trading with Iran by executive order in 1995. When Iran opened its oil and gas industry to foreign participation in that same year, there was immediate U.S. Congressional interest in imposing sanctions on foreign entities that engaged in the Iranian oil and gas sector. Sanctions for such activities commenced with the Iran Sanctions Act of 1996 and were subsequently expanded and tightened by two further rounds of legislation – the Comprehensive Iran Sanctions, Accountability, and Divestment Act of 2010 and the Iran Threat Reduction and Syria Human Rights Act of 2012. In essence, the sanctions can be triggered by selling or providing Iran with refined petroleum products or investing more than $20 million in the development of Iran's petroleum resources. In addition, sanctions can be imposed on countries for purchasing Iranian crude oil contrary to the provisions of Section 1245 of the National Defense Authorization Act for 2012. However, waivers have been given liberally, including to India, where nations had reduced their purchases of Iranian crude.[177] European Union sanctions have broadly mirrored the U.S. approach.

Under the Comprehensive Iran Threat Reduction and Syria Human Rights Act of 2012, an agency of the Congress, the Government Accountability Office (GAO), is required to report to the Department of State on corporations investing in Iran's energy sector including "entities involved in commercial transactions of any kind, including joint ventures anywhere in the world, with Iranian energy companies." This report is formally for informational purposes to the Department of State but has obvious political implications. The Department of State is to make any decisions about whether any particular corporation or person is to be sanctioned.

Thus far, the GAO has issued three rounds of reports.[178] In regard to commercial

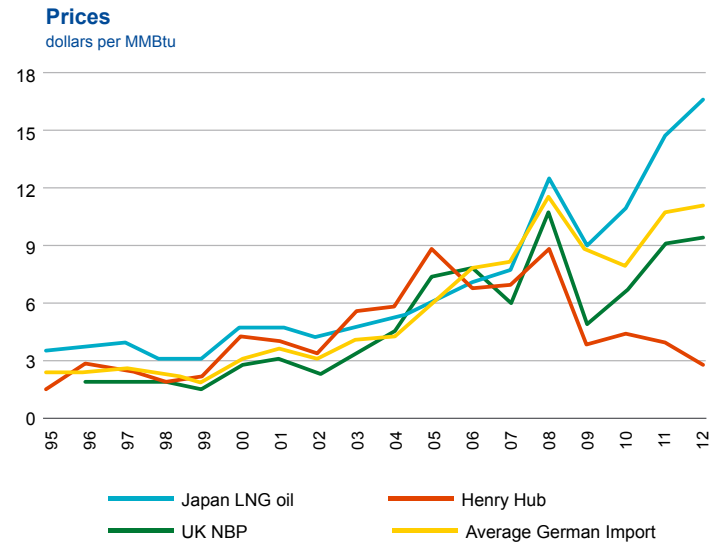
activity, ONGC, OVL, Petronet, OIL, and IOC were listed in the first round of reports. In the second Petronet went to an "insufficient information category" as did ONGC. In the third, issued January 17, 2014,[179] OVL and IOC were removed from the list of those dealing commercially in the Iranian petroleum sector, but OIL remained in an "active" status and ONGC was added back to this "active" status. For ONGC and OIL their listings as "active" were apparently based upon continued ownership interests in Farsi Block gas fields as reflected in their annual statements. Petronet went to a "withdrawn" status based on its statements to the GAO. In this third GAO report, two Chinese companies were also listed as "active," but no others. GAIL has not been listed in any of the GAO reports.

The Indian press has speculated U.S. sanctions will have a harmful effect on Indian companies that wish to invest in Iran's offshore oil and gas resources.[180] It is argued that India should keep its options open in regard to possibly taking advantage of its ownership interests in Iran, where it has already spent considerable funds. Under these circumstances, the U.S. sanctions legislation may have a chilling effect on the willingness of India companies to become involved with the United States. The fear may be that contracts entered into in good faith will be abrogated or that resources placed in the United States will be placed at risk. However, this fear may not be well-founded since it is questionable whether the minimal contacts indicated invoke sanctions. This matter needs to be clarified by the U.S. government.

Affordability

The ability of India to utilize natural gas to meet its energy needs is obviously influenced by the price of that gas. The United States offers two, inter-related advantages in regard to price. First, U.S. gas prices are presently the lowest in the world. Second, they are the most market-based prices in the world. This

Chart IV-8



Source: BP Statistical Review of World Energy June 2013 p. 27.

market-setting of prices is a chief advantage to buyers of United States natural gas when compared with most other producer countries. In the Middle East and Russia prices are set by quasi-government decision, e.g. government influence combined with the interests of monopolistic supplier companies.
Chart IV-8 shows the relationship between U.S. prices and other world prices through 2012.

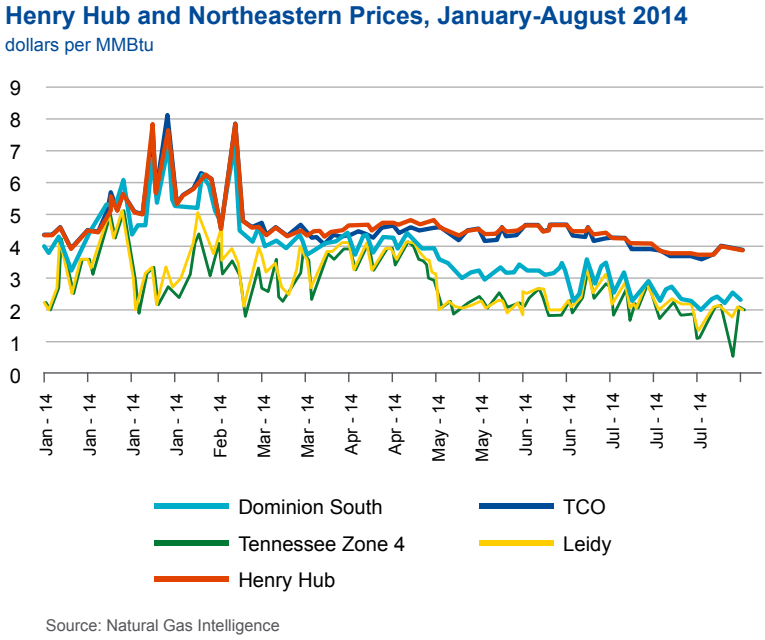
Although U.S. prices for natural gas spiked in the severe winter of early 2014, they since have returned to levels in the $4 per mmBtu for Henry Hub spot trades and even lower levels at hubs for eastern gas fields. Chart IV-9 shows prices into August 2014.[181]

These continued low spot prices auger well for long term contracts to supply India. The reported cost for gas landed in India under the GAIL-Cheniere contract is $10.50 mmBtu, while that received from Qatar RasGas is about $13 mmBtu and Australia Gorgon in excess of $16 mmBtu.[182] Cheniere had projected a landed cost in Asia of $9.90 with gas at a Henry Hub price of $4.00.[183] Chart IV-10 shows the world landed prices as estimated by the FERC.

The contrast between U.S. prices and the rest of the world is apparent. This price differential is likely to remain at least for the immediate future. The chief driver in this projection is a combination of increasing supply and the fact that supply and demand, or the market, is the chief determinant of prices in the United States.

In the United States prices are set at “hubs” where gas pipelines converge and

Chart IV-9 Henry Hub and northeastern prices, January - August 2014



Source: Natural Gas Intelligence

Source: BP Statistical Review of World Energy June 2013 p. 27.

Chart IV-10 World LNG Estimated November 2013 Landed Prices

Source: Federal Energy Regulatory Trade Comission

there are large storage facilities. These hubs enable owners of gas to sell to buyers on the basis of price competition. The most influential of these hubs is the one near the town of Henry in the state of Louisiana. The price set there is used for pricing futures contracts at the New York Mercantile Exchange. These futures are traded by utilities and asset managers across the United States. There are 23 other hubs around the United States. Two of these hubs, Dominion South-Marcellus and Tennessee Gas Pipeline (TGP) Zone 4–Marcellus, draw gas from the massive Marcellus shale formation in the northeastern United States. The Marcellus is so large and productive that gas from this formation has begun to be priced lower than that of Henry Hub. Eventually, gas now being bought and sold at the Dominion South and TGP Zone 4 hubs will influence the Henry Hub price. Thus, the outlook is for U.S. gas prices to go even lower before they start to rise.[184]

Security

The security of the U.S. supplies of LNG is a major factor to be considered by India as it seeks gas from outside its borders. In regard to the physical security of the sources of supply, U.S. LNG has an advantage over most other suppliers. Certainly in comparison to African sources such as those in Nigeria and Mozambique, U.S. sources are more secure. There is virtually no ongoing physical threat from indigenous groups in the United States. Since the September 11, 2001 attacks of Al Qaeda, gas and other energy facilities have been designated for extra protection. In comparison with Qatar and other suppliers in the militarily volatile Middle East, the United States and its production and infrastructure facilities have a security advantage simply because they are not located in an unstable region.

The transportation of LNG by sea from a long distance would seem to entail a security threat greater than that for LNG brought from sources closer to India. However, the greatest threat to physical security lies in the Indian Ocean, whether from pirates off the Somalia coast, from potential hostilities in the Persian Gulf and nearby waters, or from threats in the straits to the east of India.

These threats are common to all LNG shipments that traverse the Indian Ocean to get to India. Should India eventually opt for supply by pipelines, physical threats to the transportation by this means would seem even greater than those to seagoing vessels. These threats, among other factors, have caused experts to argue that India needs to take greater steps to integrate energy into its national security strategy.[185] The protection of U.S. ship cargoes is already a part of the U.S. Navy's mission as it is for the Indian Navy. A common interest in protecting U.S. LNG shipments to India should provide a strong reason for increasingly greater naval cooperation.

In regard to other types of threats to the security of LNG, the United States would also seem to be more secure than supplies from some other nations. Conceivably, U.S. regulatory risks might result in supply interruption. However, such regulatory risks may be small in comparison to those in countries where governments are not constrained by independent judiciaries as in the U.S.

Upstream investment in United States natural gas properties is a security as well as price hedge. Even if LNG shipments should be curtailed by security threat, the ability to participate in the U.S. gas market would produce a hedge. This apparently is a part of the thinking behind the Reliance Industries Ltd. investment of some $6 billion in U.S. gas properties, with stated intentions of investing another $4 billion in the next three years.[186]

A primary security reason for India engaging with the United States on natural gas is that diversification of supply is still the greatest source of security for any nation. It is the principle of the old proverb about not putting all of one's eggs in a single basket, or as Winston Churchill said of oil to fuel the British Navy, "Safety and certainty … lie in variety and variety alone."[187]

The Environment

India has a deep interest in natural gas as a mechanism for ameliorating the effects of pollution from the burning of dirtier fuels including coal, oil, and biomass. Since natural gas is the cleanest of all fossil fuels in regard to harmful emissions from burning, the ability to source large amounts of LNG from the United States at affordable prices will further India's clean air goals. In regard to the leakage of methane into the atmosphere during the process of production, problems with leakage would be in the United States, not India. Other adverse environmental impacts of fracking would take place in the United States and not India. Thus, U.S. gas would be obtained without adverse environmental impact in India from production. In addition to the environmental advantages from burning natural gas as compared to other fossil fuels, this lack of adverse impact from natural gas production is also a plus to India from an environmental perspective.

In regard to technology transfer, much of which concerns environmental goals, there should also be advantages for India in engaging with the United States on natural gas. Many of the technologies for producing and using natural gas in the most efficient and safest manner are from the United States.

Conclusions Regarding Special Role of U.S. LNG

Thus, Liquefied Natural Gas from the United States can and should play a major role in helping India to meet its vast energy needs. Natural gas meets the tests of availability, affordability, security, and environmental improvement in regard to immediate needs as well or better than any other energy source.

Physically, natural gas is readily available in the United States. The challenges are to overcome the infrastructure and regulatory impediments to making the U.S. gas availability a practical reality for India. The option of U.S. LNG provides the most affordable imported energy source, even when the needs for improved infrastructure are considered. The stability of the United States, along with its military and naval strength, makes supplies of gas from the United States among the most secure in the world. Perhaps most importantly, Indian involvement in the U.S. gas market, particularly with investment in upstream properties, provides a hedge against insecurity elsewhere by diversifying its sources of supply. In regard to the environment and technology, LNG will support the Indian shift to cleaner forms of energy. This assistance will occur not only because natural gas is cleaner than other fossil fuels, but also because it provides a cleaner alternative to support and complement the shift to renewable forms of energy. Indian engagement with the U.S. natural gas industry will provide both opportunities and incentives for technology transfer between the natural gas industries of both countries.

In the Indian context, the most important environmental impact of gas may be directly on the quality of air that is breathed in Indian cities and homes. The cleaner burning attributes of natural gas can have an immediate impact on the health of women particularly. Women of India sicken and die in great numbers from the particulate matter and other impurities generated from breathing the smoke of burning biomass.

In addition to the factors of availability, affordability, security, and environmental impact, U.S.-India engagement in natural gas will add a whole new dimension to what the leaders of both countries have recognized as one of the most important international relationships of the twenty-first century. Energy plays an important role in U.S.-India diplomacy, but the role of natural gas has yet to be fully utilized. Let us now turn to a look at how energy and natural gas have been involved in recent high level U.S.-India diplomacy.

Energy in U.S.-India Diplomacy

India-U.S. engagement on energy has often been at the crux of U.S.-India relations. Chief mechanisms for that engagement have been recent visits of the presidents and prime ministers and cabinet level dialogues. The U.S.-India Energy Dialogue features a commitment by both nations to regular meetings at the cabinet level on the U.S.-India energy relationship. This commitment grows out of presidential and prime ministerial visits and is increasingly associated with the Strategic Dialogue. Administrations on both sides have undertaken to follow up on these meetings to increase India-U.S. cooperation on energy. With the election of Prime Minister Modi and renewed opportunity for relations with an Indian government empowered to make decisions, a review of the role of these interactions should be helpful.

In early 2014, U.S.-India relations reached their lowest point since the Indian nuclear tests of 1998. The arrest of the Deputy Consul General of India in New York, Devyani Khobragade, for visa fraud in regard to a household employee brought to a head a steady accumulation of perceived slights on both sides.

Several of these perceived slights had to do with energy. India was concerned about U.S. sanctions policy and the pressure that had been brought on India to stop dealing with Iran for oil and gas. The United States was aggrieved that the Indians had failed to adhere to the liability provisions of the civil nuclear Convention on Supplementary Compensation. India wanted U.S. gas, but as a country with which the United States does not have a free trade agreement, India felt disadvantaged by the approval process. The U.S. solar industry opposed the local content requirements of the Indian National Solar Mission and had caused the United States to commence proceedings against India at the WTO.

In view of the Khobragade affair, the UPA government made it plain that it would not be "business as usual" in government to government matters. After a New York District Court Magistrate refused to postpone a hearing on the deputy consul general's case and following withdrawal of some U.S. diplomatic privileges in New Delhi, the meeting of the U.S.-India Energy Dialogue was postponed "to a mutually convenient time." After the fact, both sides blamed the other.[188] However, the result was clear: U.S. Secretary of Energy Moniz would not be going to India as scheduled for the week of January 13, 2014.

Cancellation of the Energy Dialogue had significance beyond the fact that it was a meeting with cabinet level participants. U.S.-India engagement on energy has a long history, both negative and positive. U.S. private sector involvement with Indian energy stretches back to 1902 with General Electric providing some of India's first water turbines. Much of U.S. assistance to India beginning in the 1950s has been focused on energy. The misunderstandings regarding nuclear energy originate with the U.S. "Atoms for Peace" program begun under President Dwight D. Eisenhower.

Soon after economic reforms in the early 1990s, President William J. Clinton's first secretary of energy, Hazel O'Leary, had initiated engagement on energy through a visit to India in 1994. This had been followed up by Clinton's Secretary of Commerce Ron Brown in January 1995 through a "Presidential" business development mission. Energy engagement encompassed the so-called "fast track" program of electric power development as well as renewable energy and green technology.

This energy engagement had mixed results. It came to a virtual halt when the BJP government conducted the Indian nuclear tests of 1998. After almost two years of fruitlessly trying to roll back India's nuclear activity, President Clinton changed course and went to India in March 2000. There he was welcomed by the Prime Minister Atal Bihari Vajpayee, Modi's BJP predecessor as prime minister.

During the Clinton visit, Indo-U.S. power agreements were signed as well as a memorandum of understanding(MoU) on renewable energy. However, beyond the effective symbolism and public diplomacy conducted by President Clinton, perhaps the most important accomplishment of the trip was to put into place the architecture for cabinet-level bilateral "dialogues." The array of dialogues

was significant and remains the essential mechanism for promoting U.S.-India engagement. The array included an Annual Foreign Policy Dialogue (later denominated the "Strategic Dialogue"), a Dialogue on Security and Non-Proliferation, a Dialogue on Asian Security, the Financial and Economic Forum (later simply called the "Economic Dialogue"), and the Commercial Dialogue. In addition, there were endorsements of a Joint Working Group on Counterterrorism (which after the 9/11 terrorist attack assumed crucial importance), a Working Group on Trade, and a Science and Technology Forum.

In regard to energy, the bilateral mechanism put into place was the Joint Consultative Group on Clean Energy and Environment. This group was not quite a cabinet-level dialogue. It was to "hold periodic ministerial/high level meets as desirable and appropriate." The co-conveners of the Group would be the Ministry of External Affairs and the Department of State. Since the organizations and not the minister and secretary themselves were named, it can be inferred that clean energy and the environment initiative would not take place at a cabinet level. This, in turn, implied a lower bilateral priority for energy engagement. Perhaps more significantly, neither the U.S. Department of Energy nor any of the Indian energy or power ministries were named.[189] Thus, those parts of the two governments most directly concerned with energy would not be leading the effort, and foreign policy aspects of the issue would be paramount.

The Indians had made it clear during the Clinton visit that they wanted U.S. involvement in the gas sector. A statement put out by the Indian side at the time of the visit said:

> "There is a large demand for natural gas in the country, which cannot be met from the available domestic supplies. The import of natural gas through pipelines and as LNG has been placed on the Open General List (OGL).[1] Foreign Direct Investment (FDI) up to 100 per cent is permitted in LNG/Natural Gas infrastructure, distribution and marketing."[191]

Perhaps ironic in view of the lack of progress on continued liberalization in the Indian energy system since 2000, but at the same time a hopeful sign for the new Modi government, is this passage from the same statement:

> "… the government of India has taken a conscious decision to gradually reduce the size of the public sector by withdrawing from/divesting its share-holdings in many areas, thereby throwing open these hitherto protected sectors to privatization. Opening up the economy by progressive dismantling of the licensing and regulator regimes, liberalization of procedures and policies, drive towards market determination of prices by the working of demand-supply forces are characteristics of the new era."[192]

As in other areas of U.S.-India relations, it was left to the George W. Bush administration to push forward the possibilities of a bilateral energy cooperation agenda. On May 31, 2005, the U.S. Secretary of Energy Dr. Samuel W. Bodman and Indian Deputy Chairman of the Planning Commission Dr. Montek Singh Ahluwalia agreed on the formation of the U.S.-India Energy Dialogue. In addition to including the DOE at the secretary's level, the most salient feature of the

Dialogue was the inclusion by source of the full spectrum of energy. There were to be working groups on oil and gas, coal, renewables, electric power, and, most significant of all as it turned out, nuclear energy. Throughout the documents having to do with the establishment of the Energy Dialogue is an emphasis on the need to produce results in time for the visit to Washington of the new Indian Prime Minister Manmohan Singh.[193] This July 2005 visit turned out to be a landmark in U.S.-India relations because of an energy-related subject that had broad international security implications. In the Joint Statement of July 18, 2005, the two sides announced their intention to enter into a U.S.-India civil nuclear agreement.

U.S.-India engagement on energy has a long history, both negative and positive. Much of U.S. assistance to India beginning in the 1950s has been focused on energy.

Throughout the remainder of the George W. Bush Administration, the Energy Dialogue moved forward in a very business-like manner to advance U.S.-India interests in energy. In the Oil and Gas Working Group the emphasis was on investment under the NELP initiative and the sharing of data relevant to the industry in the United States and India. The Coal Working Group was perhaps the most ambitious in the scope of its activities. Its work plan went far beyond clean coal and the possibilities for applying environmental technologies to the use of coal. It focused on business activities in the industry as well as technical matters of production. Clearly, the Energy Dialogue under the Bush Administration was not dominated by environmental much less climate change issues.

This changed with the inauguration of the Barack Obama administration in 2009. The first state visit of the new administration was from Prime Minister Singh. The visit was a one-day affair that took place on November 24, 2009. A few weeks earlier, the new Secretary of Energy Dr. Stephen Chu had led a delegation of U.S. bureaucrats for the first Energy Dialogue of the Obama administration. This meeting was, in part, to set up energy "deliverables" for the forthcoming visit of the Prime Minister. The Dialogue session resulted in the launches of a "Green Partnership" and an Indo-U.S. Clean Energy Research and Deployment Initiative when the president and prime minister met in Washington**.** The latter initiative was perhaps more significant than the former since it established "a Joint Research Center operating in both the United States and India to foster innovation and joint efforts to accelerate deployment of clean energy technologies."[194] However, the 2009 visit will probably best be remembered for the lavish state dinner that was both the most expensive of the Obama presidency[195] and crashed by uninvited guests who somehow got past the security authorities.

The energy announcements at the 2009 Washington visit became consolidated under the title "Partnership to Advance Clean Energy (PACE)." This umbrella concept was introduced into the bureaucratic lexicon through a memorandum of understanding signed during the visit. It served to bring the energy issue forward

for President Obama's 2010 visit to India, reciprocating the 2009 Singh visit to the United States.

President Obama's November 2010 visit to India emphasized shared U.S.-India values. It was most noted by the Indians for presidential statements condemning terror originating in Pakistan, supporting India to be a permanent member of the UN Security Council, and lifting restraints on export of certain high tech items to India. However, in his speech to Parliament, Obama mentioned joint U.S.-India research and development to "create green jobs" and giving "Indians more access to cleaner, affordable energy."[196] More importantly, the Joint Statement issued by Obama and Singh at the end of the visit used PACE as a vehicle for two new agreements. One was an agreement to establish a Joint Clean Energy Research Center in India, into which both sides would contribute some funding. The other was an MoU on assessment and exploration of shale gas. Both agreements were hailed as "important milestones" in U.S.-India clean energy cooperation.[197] This was the first indication that shale gas was an official part of U.S.-India energy engagement. Significantly, the White House cast this development as one of environmental importance.

As a follow up to the Obama visit to India, the Secretary of Energy announced on May 16, 2011, the establishment of a "PACE Joint Clean Energy Research and Development Center." This "center" was a mechanism to provide money to institutions developing solutions to issues in the areas of efficiency, solar energy, and advanced biofuels. Some $125 million in such grants was to be supplied over a five year period to organizations doing research and development in these areas. On the deployment side, the Ex-Im Bank and OPIC pledged loan guarantees chiefly in the solar energy field that enabled the Department of Energy to say that more than $1.7 billion had been "mobilized for clean energy finance" by June 2012.[198]

Secretary of State Hillary Clinton listed energy as one of the "Five Pillars" of U.S.-India relations for the Strategic Dialogue she led in New Delhi in June 2012.[199] At the Energy Dialogue of September 28, 2012, in Washington, attention to the positive role of shale gas and LNG occurred at Indian insistence. The joint statement for the meeting "noted the enormous trade and investment opportunities, which have been opened up with discovery of U.S. shale gas" and discussion of "the impact of relatively less expensive LNG imports from United States to India, on the Indian power sector and prospects of growth in India."[200]

Coinciding with the run up to the Strategic Dialogue meeting of June 24, 2013 was the release by the Department of Energy of a comprehensive report on the U.S.-India Partnership to Advance Clean Energy (PACE). This document summarized all of the U.S.-India engagement on energy including shale gas and cleaner coal.[201] Also noted in the June 2013 report was the establishment of a PACE working group on Sustainable Growth to measure the impact of the U.S.-India initiatives on the subject of most concern to the Indian side–economic growth.

In spite of the Obama administration policy "pivot" or "re-balance" to Asia, the June 24, 2013, Strategic Dialogue did not fully reflect the importance of India in any such re-balancing. Engagement on energy was summarized in the joint statement issued at the end of the meeting. The emphasis was on expanding

engagement on clean energy and energy efficiency through PACE and under the multilateral Clean Energy Ministerial. There was mention of mobilizing approximately $2 billion in clean energy financing to India since 2009 and the $125 million for the Joint Clean Energy Research and Development Center. They noted the decision taken to create a new Sustainable Growth Working Group under the U.S.-India Energy Dialogue, and the growth of U.S. investment in India's energy sector. The United States and India welcomed additional efforts aimed at financing clean energy investments, promoting the development of smart grid technologies, energy efficient buildings, solar power, smart and efficient air conditioning and space cooling, and expanding off-grid access to clean energy, but did not specify what those efforts might be.[202] There was no mention of shale gas, the export of LNG from the United States to India, or any other measures by which India's energy shortage might be met in the foreseeable future.

Prime Minister Singh visited the White House on September 27, 2013 for a third and final time as prime minister. The event was a farewell visit apparently not designed to make significant policy progress. This was certainly the case in regard to energy. However, the White House did issue a "fact sheet" recognizing unconventional gas as a "lower-carbon bridge fuel to a clean energy future" and referencing United States partnering with India "to improve its understanding of the country's unconventional natural gas resource potential under the auspices of the Global Shale Gas Initiative (GSGI) and PACE."[203]

After the Khobragade affair had been calmed down sufficiently, the Energy Dialogue was held on March 10-11, 2014, in New Delhi, with Secretary Moniz then going on to Mumbai for talks on civil nuclear. After the intense publicity on the postponement of the Dialogue in January, the actual meeting was something of an anti-climax. Perhaps reflecting the priorities of the Energy Secretary, the U.S. side wanted progress on the civil nuclear liability issue. Even after the side trip to Mumbai, no progress was shown. The Civil Nuclear Working Group was the one Dialogue working group that did not meet. The Indians wanted assurances on substantial exports of LNG. They got little beyond explanations of how the DOE non-FTA approval process was working. The Indians asked for comments on their newly-released "India Energy Security Scenarios, 2047." The Americans said they would take it under advisement and get back to their Indian colleagues. An off-grid electricity access demonstration and study project under the auspices of a "Promoting Energy Access through Clean Energy (PEACE)" initiative started the previous September was noted, but little actually happened.

Thus, the United States and India have a long history of government-to-government engagement on energy. That engagement broadened significantly under the George W. Bush administration and became focused on clean energy under the Obama administration. Whether energy engagement will play an increased role between the two democracies with Prime Minister Modi remains a major question. Let us now turn to a consideration of possible answers to this question as we attempt to draw conclusions about India energy situation and its struggle for power.

SECTION V

WHERE DO INDIA AND THE UNITED STATES GO FROM HERE IN REGARD TO INDIA ENERGY?

Prime Minister Modi in his first Independence Day speech made an impassioned plea for economic growth, particularly emphasizing manufacturing as the way to prosperity for a large segment of the Indian population. He called for hard work and sacrifice for national goals. All of these were inspiring thoughts. However, his plans and inspiration may come to naught without a solution to India's energy challenge. The United States can play a helpful although subordinate role in meeting this challenge. How India and the United States engage on energy can be a driving force in the relationship between these two great democracies for decades to come. However, the challenge can be met only with strong political leadership and private sector partnership for feasible strategies and implementation actions that proceed source by source in regard to availability, affordability, security, and environmental impact.

In Regard to Availability

The amount of energy necessary for India to regain double digit growth and catch up with China is large and daunting. The best estimates seem to be that India needs from three to five times its present annual consumption of commercial energy and somewhere in the range of 1600 to 2600 million tons of oil equivalency per year. These estimates can be reduced by perhaps as much as a quarter through energy efficiency, but still are very large amounts. This per annum increase in commercial energy alone necessary to regain double digit growth would be greater than the present consumption of Germany, Japan, and Brazil combined. If one adds to the requirements for commercial fuels the need to move hundreds of millions of people from reliance on pre-historic fuels used to keep home fires burning, the Indian energy deficit is even larger.

Energy security for India requires both reforms for maximizing domestic production and a realistic energy import policy.

Doubtlessly, greater production from Indian domestic sources is fundamental to the goal of energy security. The United States and others can contribute to increased domestic production through initiatives to create and transfer technology to India and through a strong public-private partnership that makes foreign direct investment in Indian energy economically viable. The key to maximizing energy availability as well as affordability from domestic sources is reform in the pricing and allocation of fuels. Top down, governmental command

and control simply has not worked to provide India with a maximization of its own energy resources. The Modi government has made a start in regard to natural gas, and natural gas price liberalization can be the harbinger of reform for other fuel sources.

However, if India continues in its stated policy of obtaining energy security strictly by relying on its domestic resources, i.e. "energy independence," the problem of physical availability presently seems to present an insurmountable barrier to Indian energy security. In regard to oil and gas there are presently no indications of the presence of reserves in sufficient quantities that would indicate India's needs can be met entirely from domestic sources. Much the same can be said of coal and even nuclear energy although India has large reserves of coal and uranium. Even in regard to renewables, there are physical availability limitations. Wind resources are limited to certain geographical areas in India. Hydro power is limited by the physical ability to harness waters in remote, environmentally fragile areas of the Himalayas. Solar power, while theoretically unlimited in its physical availability, requires technology, financing, and equipment not available in sufficient quantities from strictly Indian sources.

Internationally, the problem of physical availability is much less acute, if not non-existent. On a worldwide basis, the concept of "peak oil," much less "peak gas" or "peak coal," seems thoroughly discredited. With the advent of new and improved technologies such as fracking and horizontal drilling, supplies of oil and gas are increasing worldwide at a great rate. There are abundant coal reserves throughout the world. India already imports significant amounts of hydro power from Bhutan and Nepal, and the ability to source additional hydro power from its neighbors is plausible.

A greater problem of availability of energy, especially hydrocarbon-based fuels, on an international basis is one of regulatory availability. This difficulty is illustrated by the U.S. example. The largest producer of natural gas with some of the world's largest reserves can be a source of energy for India in large enough volumes to make a difference. Regulatory approval of projects seeking to export to India, and other countries with which the United States does not have a free trade agreement, acts as a significant stumbling block to making the physically available gas available in reality to India.

The United States needs to change the process of approvals of applications for export to the countries with which the United States does not have a free trade agreement. Japan, the United Kingdom, Spain, and Taiwan are all economies who are leading LNG importers. Legislation for this purpose evidently has strong support in the House of Representatives, but less than sufficient support in the Senate. Some Senate opposition is apparently based on environmental concerns, particularly that exports will encourage fracking, the continued use of climate change implicated hydrocarbons, and the development of environmentally fragile coastal areas for liquefaction facilities. Those representing residential consumers in the northeast have concerns about increased gas prices for home heating and cooking, while a coalition of companies in gas intensive manufacturing have wanted to keep gas cheap for their own use. Additionally, the White House is said to favor the present process as an incentive for its trading partners, particularly the European Union and potential participants in the Trans

Pacific Partnership, to complete free trade agreements with the United States.

These concerns do not outweigh the need for the United States to engage with India and other non-FTA countries across the board on energy security. A protectionist U.S. policy on U.S. energy export will not further either United States or Indian goals in regard to the availability, affordability, security, and environmental impact of energy.

India needs to take a more proactive energy role in working with like-minded nations and organizations to reach its energy goals. For example, the Organization of the Petroleum Exporting Countries (OPEC) has been the most spectacularly successful commodity cartel in history because of its ability to restrict availability. Since its inception in 1960, the mechanism by which it has restricted availability is the setting of production allocations. The OPEC premise of availability restriction could spread to natural gas. In May 2001, ministers from Russia, Iran and Algeria gathered in Tehran to form the Gas Exporting Countries Forum (GECF), and some of its members advocate that it operate like OPEC.

The IEA was formed in 1974 by oil importing nations expressly to serve as a counterweight to the OPEC supply restriction policies. Initially, the main tool for offsetting these policies was the release of emergency oil stocks to the markets. However, its activities have gone far beyond this initial emergency activity. They now include a wide variety of activities to make markets more competitive and enhancing the knowledge base upon which nations make energy decisions.[204]

India should be willing to align itself with the IEA and in other international fora to advocate for amelioration of the kind of constraints on availability practiced by OPEC and advocated by leading members of the GECF. India's interests in regard to availability of energy sources align with those of the IEA and those who wish to promote rather than constrain international energy availability. The days of the Non-Aligned Movement (NAM) are gone and the policy perspectives of the NAM are no longer useful to India in energy policy. In other words, fear of being too closely aligned with Western or developed economies is not a useful guidepost for Indian energy policy. The question in energy should be what is good for India in meeting its energy crisis and in accordance with its values. India is a strong and completely independent nation with the self-confidence to act as such.

Combatting foreign restrictions on the availability of energy also means that on a bilateral basis India should put renewed emphasis on engaging to help remove regulatory constraints that limit energy availability, such as the U.S. system for limiting exports of LNG to countries like India with which the United States does not have a free trade agreement.

India also should take a more active role with the United States and other interested countries in bringing about conditions that will allow normalization of trade relations with energy producers such as Iran. This means that India should cease being a diplomatic bystander and work to resolve the nuclear impasse and other issues that affect its energy security interests in a manner consistent with its national values.

This principle of active international leadership applies to the technology

necessary to the growth of renewable and nuclear energy as well as trade in hydrocarbons. Solar energy, which India has in virtually unlimited quantities, could eventually be used to achieve energy security. However, in view of the costs of development and the quantitatively insignificant present solar base, this is not likely to happen within any useful time frame unless India works with other nations to remove, not impose, barriers to lowering costs. A step in the right direction will be for India to remove local content and restrictive tariffs that impede this cooperation.

For its part, the United States should welcome greater participation by India in removing constraints to the availability of energy sources. The United States and India should work together with the private sector to put in place the systemic infrastructure that will make energy cooperation a reality rather than just a slogan. The United States and India will be better served by putting limited human and financial resources into facilitating end-to-end infrastructure systems that actually connect the United States and India as opposed to putting those resources into energy policy studies. The U.S.-India Energy Dialogue can be a chief instrument in this effort if it more fully turns its attention to actual projects and partnership with the private sector.

In summary, India should amend its policies of looking primarily inward for solutions to its energy availability problems. Certainly domestic development of availability is important. However, energy independence in the sense of relying solely on domestic resources is a slogan at odds with reality. As importantly, physical and regulatory availability of energy is only a part of the energy puzzle.

In Regard to Affordability

India's struggles with natural gas pricing are indicative of its broader problem of coming to grips with the problem of affordability. India has struggled with the tension between sustaining the hundreds of millions of Indians who are among the poorest on earth with the vision of a modern society among the most powerful in the world. Basic theories of supply and demand pricing have been distorted by the political need to emphasize affordability only as a safety net for the poor.

Elective political needs, bureaucracy and corruption have combined to produce a policy paralysis that has distorted the meaning of and thinking about the very concept of "affordability." This paralysis was relieved somewhat during the period between abolition of the license raj in 1991 through approximately the first half decade of the 21st century as India moved toward freer markets and other liberal economic reforms. The discussion herein concerning gas pricing is indicative of the retrogression that has occurred in the last few years. This pricing dilemma is by no means limited to natural gas but extends throughout India's energy and power sector and beyond. Addressing this issue is key to the economic success of the nation under the government led by Prime Minister Modi.

Where there is a need in society to provide subsidies to those in a disadvantaged economic situation, this should be acknowledged. Subsidies should be provided in a transparent, honest, and direct manner to those in need, commensurate with society's ability to provide such subsidies. Politically influenced price controls are not the way forward to increased affordability of energy. Such controls serve as

disincentives both for needed investment and energy efficiency.

Former Prime Minister Singh recognized the need to move to market-based prices as the key for determining affordability of energy.[205] However, the political power behind his government frustrated the implementation of this economist's insight. It is now up to Prime Minister Modi and his government to use the political power at their disposal to resolve the core problem of energy pricing.

The failure to address this core problem leads directly to India's difficulties in dealing with energy affordability on an international basis. Instead of seeking out international market-based solutions to energy affordability, India continues to pay the highest prices for its oil, gas and coal while neglecting procurement and joint development of alternative sources of energy. For example, so long as India's international procurement of oil can be accomplished with subsidies that are hidden from the public through price controls, there is little political incentive for change.

International market-based solutions to the India energy issue include diversifying supply toward sources whose pricing tends to be more market-based. This argues in favor of the U.S. gas market where competitive pricing at hubs determines price and is a major factor favoring LNG importation from the United States. Other providers in Southeast Asia as well as Australia seem to offer more hope of lower market-driven prices for gas. Much the same can be said of coal sourcing.

India should negotiate for gas prices that are not linked by formula to the price of oil. Pricing by linking to oil is antithetical to market-based pricing for gas since it has nothing to do with supply and demand for gas. Historically, oil-based pricing has been a mechanism whereby Qatar and other Middle East producers have been able to extract a high price for LNG. With other sources such as those in Australia and the United States not using the oil-based pricing mechanism, there are new opportunities to move away from the traditional mechanism to achieve prices more favorable to importers such as India.

India's struggles with natural gas pricing are indicative of its broader problem of coming to grips with the problem of affordability.

Changing the energy mix away from over-reliance on oil where Indian imports are now approaching 80 percent of consumption will also allow for greater competition. For example, India should pursue with renewed vigor its policy of using CNG for larger portions of its transportation fleet. According to the Asian Development Bank, the shares of oil and gas as transportation fuels are expected to remain constant at 93 percent to 94 percent throughout its outlook period through 2035.[206] Even a relatively small change in this mix could provide significant competitive options. The introduction of more CNG and electric vehicles in India could bring further diversification in Indian transportation energy sources, allowing India further pricing options.

Affordability in India is usually thought to favor coal and biomass. However, if the health and environmental costs of hydrocarbon-based energy is included in their prices, the cost equation begins to look quite different. Thus, India, like other countries, needs to find ways to "discover" these health and environmental costs and ways to have them accounted for in determining affordability. The most obvious way to do this is through a politically difficult carbon tax or a cap and trade mechanism, but there may be other ways to accomplish this goal of allowing pricing to be market-driven but including the external costs of pollution.

If an energy source is readily available and unhindered in its availability by law or regulation, it is in effect unavailable if it is unaffordable for India. However, affordability is a relative term that varies depending on the quantity needed or desired as well as the resources of a buyer to purchase the energy source and the utility of the fuel.

Most fundamentally affordability depends on price. Unless India moves to market-based pricing in energy, it will be impossible to arrive at prices based on supply and demand. Without such pricing, affordability cannot be determined as a base for policy decisions. If prices are set above market, energy consumers will be denied value that they would otherwise receive. If prices are set below market, energy producers will be deprived of legitimate value. Investment will not be attracted and hidden subsidies eventually will be necessary to cover costs. Market-based pricing will enable India to cut its subsidy bill and encourage efficiency and conservation. It is difficult to see how maximum, long-term affordability can be achieved without more reliance on market pricing.

Internationally, India should move toward seeking supplies that are priced by market mechanisms. The United States offers market-based pricing for gas, and other countries are moving in that direction. India should move to diversifying its international sources of supply by moving toward suppliers that offer market-based solutions. The United States and other market economies should work with India to move international sourcing in the direction of prices that are market driven.

In Regard to Security

Like charity, security of energy sourcing begins at home. The Naxalite insurgency directly threatens the source of energy upon which India is most dependent–coal. India cannot have a rational energy policy when some 80 percent of its coal production is carried out in areas deeply affected by a combination of Naxalite activity and the outlaw coal mafia. Prime Minister Modi will not be the first prime minister to recognize this problem. The question is whether his government will be able to take effective action.

The Naxalite insurgency is by no means the only domestic security problem in regard to energy.

Added to the security challenges to Indian energy infrastructure must be the challenge of attacks within India that are originated or aided by groups and even governmental entities outside India. Thus, there is a continuing need to take increased countermeasures to safeguard domestic infrastructure from attacks taking place in India but originating outside India. In regard to energy assets

outside of India, India faces security threats similar to those posed by domestic groups.

Presently the greatest international security threat to Indian energy concerns one energy source–oil–and one region–the Middle East. Security of foreign gas is also of concern, but presently it pales in comparison to security of oil because it is so much less important in the Indian energy mix. Often in discussing security threats to Indian energy, the discussion is not really about energy generally but about oil specifically. Similarly, when scenarios are posited concerning international competition for energy resources (such as that between India and China), the competition is not really about energy generally but about oil primarily and, to a much lesser extent, gas. Geographically, the competition and security concerns about oil and gas are focused on the nations of the Middle East. Given the tensions between Iran and Saudi Arabia and other predominantly Sunni nations, civil unrest if not civil war, and the continuing conflicts between Israel and its Muslim neighbors, this region has to be considered militarily volatile and the outbreak of conflict a constant threat to oil.

Since these security of energy concerns are largely focused on oil from the Middle East, obvious approaches to lessening the energy security challenges to India are to move away from dependence on oil for transportation purposes and to lessen sourcing from the Middle East. India should take measures to have a greater transportation mix of non-oil fuels from non-Middle Eastern sources of supply. In regard to a greater proportion of non-oil fuels in the transportation mix, this argues for greater uses of natural gas from non-Middle East sources such as the United States and Australia.

On both counts, greater non-Middle Eastern energy sources and greater use of natural gas, Russia offers itself as a perfect energy partner. Russia has kept up a constant effort to portray itself as the obvious choice for India in regard to oil.[207] The signing of the Russia-China gas pipeline deal has given further impetus to the Russian push to become a supplier of gas to India as well.[208] The security difficulty with this line of reasoning is the example that Russia has set in regard to Ukraine. The Russian use of gas diplomacy in the annexation of Crimea and the attempted dismemberment of eastern Ukraine should give pause to those considering reliance on Russia. This is especially so since Russia is growing ever closer to a China that claims all of one Indian state and portions of several others. China's moves to secure territorial claims to oil and gas in the South China Sea against the interests of the Philippines and especially Vietnam should raise further concerns among Indian policy makers about the security of gas from Russia, especially if that gas comes through China.

Russia's push to become a secure energy supplier for India is not limited to oil and gas. Russia also is attempting to position itself as the most secure supplier of uranium and civil nuclear technology. Russia took advantage of the opening of India to legitimate participation in international civil nuclear trade and investment that was created by the 2008 U.S.-India civil nuclear deal. In 2009 Russia signed an agreement with India for increased cooperation in the field. While the United States has yet to build a single reactor, Russia has moved forward with two reactors and is planning more. Again government-sponsored Russian sources cite this as a part of the growing energy security relationship between India and Russia.[209]

Russia has forthrightly indicated its intentions of bringing India into a closer energy relationship with Russia and China. Some of this is being done trilaterally. The Russia-China agreement on natural gas offers substantial impetus to this effort. The BRICS forum of Brazil, Russia, India, China, and South Africa and the Shanghai Cooperation Organization, where India is an observer, are also being used to try to bring India closer to Russia and China.

The United States along with the other leading democracies of the Asia-Pacific region, Japan and Australia, should counterbalance these efforts of Russia and China by engaging collectively with India on the subject of energy. The United States should respond vigorously, affirmatively, and cooperatively to Indian energy security issues across the board. How effectively the United States engages with India on energy issues may well determine the closeness of the relationship between the United States and India for decades to come.

On the issue of the security of the domestic Indian energy supply from terrorist attack, the United States and India are already sharing intelligence that should be helpful in opposing threats whether either of domestic origin or inspired and supported from outside India. Likewise, U.S. technology and equipment can be helpful in this effort. After the Mumbai attack of November 26, 2008, India procured U.S. technology and equipment modeled on that of the Joint Terror Task Force Center in New York.[210] This U.S.-India engagement can be augmented and focused more specifically on threats to the security of Indian energy. The sharing of intelligence, technology and equipment can also be enlarged in regard to security threats to energy sources outside India.

Military-to-military cooperation has been a high point in security cooperation between the United States and India. In recent years, India has conducted more military exercises with the United States than with any other country. As might be expected, naval cooperation has been particularly strong with the “Malabar” series of exercises pointed at protection of the sea lanes in the Indian Ocean.[211] However, comments by the U.S. Chief of Naval Operations indicate that recent exercises have not been of the intensity or complexity that existed in the mid 2000s.[212] Resuming these exercises at their previous levels leading to joint operations in protection of oil, gas, and coal transiting by sea is in the interests of both nations.

India should give the security of its supplies of energy a higher and more explicit priority than it has to date. Energy security should be an integral part of Indian strategic planning and implementation. The inability of India to lessen domestic threats such as the Naxalite movement is particularly troubling. Unless addressed successfully, these threats are likely both to grow over time and serve as models and incentives to those operating from outside India.

In regard to international security, India needs closer, stronger international partners. The ethos of the non-aligned movement is inadequate to the present needs for energy security. India needs energy partners. India should seek diversity of supply. However, there are benefits and consequences for the choices that are made. India needs to focus fully on where its strategic interests lie. Of course, India may conduct energy trade and investment, either presently or in the future, with Russia, China, and Iran. Hopefully, India will decide that its

strategic interests lie with free market democracies and will adjust its policies to reflect those interests.

U.S.-India cooperation in regard to security aspects of energy holds great promise for both countries. However, if this cooperation is to be taken to a higher level, the United States must, in cooperation with other democracies, seek to become a more reliable partner that works proactively with India on practical end-to-end solutions for its energy security problems. The history of interruptions to supplies occasioned by disputes over nuclear matters, disagreements about Pakistan and threats regarding Iran as well as constraints on high tech transfers still cast a shadow on U.S. reliability.

To accomplish end-to-end energy solutions, the United States government will have to develop a stronger public-private partnership with its own energy industry. Effective U.S. energy cooperation with India will not take place either by just governmental action or by the private sector alone. The same is true for the ability of India to cooperate effectively with the United States.

Examples of what increased public/private partnership might look like from a security perspective may be helpful. U.S.-India nuclear energy cooperation has thus far failed to produce any civil nuclear power in India. Security issues were a chief impetus for moving the U.S.-India civil nuclear deal to a successful conclusion in 2008. Without the U.S.-India civil nuclear deal moving to a full fruition, the effectiveness of the United States and India cooperating on nuclear security issues is damaged. The issue upon which the fruition of the U.S.-India civil nuclear issue has foundered is liability of suppliers. The solution to liability is basically a matter of risk limitation and/or insurance. With the active participation of the governments on both sides in regard to risk limitation and insurance, this problem should not be insurmountable and would allow U.S. companies to compete effectively with Russian and French entities. Thus far, the approach to the civil nuclear liability issue has been mainly a matter of the United States listening to the demands of the U.S. private sector providers and acting as an advocate for these providers in making demands upon the Indian government. A better approach might be for the U.S. government either to use its own sovereign immunity as a shield to the private contractors (as is the case with French and Russian contractors) or to work out a sensible insurance plan for the contractors. Likewise, if the government of India wishes to bring the U.S.-India civil nuclear deal to full fruition, it can do more than simply act for those who demand unlimited liability for the foreign powers and work out a liability arrangement similar to that which obtains for the state-owned nuclear facilities. The point is that with governments that are willing to become partners with their own private sectors, a solution to this important security of energy issue should be doable.

In regard to United States sanctions for Iranian oil and gas involvement, it simply is not enough for the United States to demand that India (whose dependence on oil imports approaches 80 percent of consumption) have no dealings with Iran. If the United States finds that both the Iran sanctions regime and the U.S.-India security relationship are crucial, then the United States should make common cause with private and public sector oil industry participants to find energy sources for India that can substantially lessen the economic effects of sanctions. Similarly, if India values its U.S. relationship for energy security purposes, India should team with its oil importers both to bring pressure on Iran to find a solution

to the nuclear impasse and to obtain alternative sources if Iran does not.

In Regard to the Environment

From an environmental perspective, India needs to decrease reliance on coal as the dominant source of primary energy and lower reliance on biomass for home use. Instead of moving in that direction, India is presently heading in precisely the opposite direction. As the Planning Commission has noted in regard to the period through 2017, "The most important point to note is that coal remains the dominant source of primary energy."[213] As a share of total commercial energy supply, coal is expected to increase from 53.45 percent to 55.41 percent by the end of the Plan period and nearly 60 percent by 2022.[214] Coal and non-commercial biomass are by far the worst polluting fuels. Oil and its derivatives are not far behind.

The Modi government has given indications that it will seek to counter the trend toward coal through a greater reliance on solar energy.[215] An initial positive sign is the prime minister combining the power, coal, and renewable energy ministries under a single minister, Piyush Goyal. National adoption of the Gujarat solar model of explicit and binding compensation agreements at levels high enough to encourage investment, non-discrimination against foreign suppliers of equipment, and distributed solar generation is in order. Soon after the election, Minister Goyal indicated he would be going to Gujarat to determine the Modi mechanisms for assuring energy and power.[216]

India is already a world leader in wind energy. A reorienting of tax incentives toward grid-interactive productivity and away from installed capacity will increase the contribution of wind energy to the Indian energy mix. Civil nuclear can make a greater contribution and the U.S.-India civil nuclear deal should be fully implemented. However, the cost of nuclear along with the potential for environmentally disastrous accidents calls for a recalibration of the ambitious plans for the long-range role of nuclear. The same may be said for hydro-power with its high costs for infrastructure and effects on mountain ecology.

In order for solar and wind to play a significant role in lessening the harmful effects of energy production, the emphasis must be on cost reduction. The United States has started in the right direction with financing support for Indian solar and research grants. However, Ex-Im Bank financing for solar and the grants through the Joint Clean Energy Research and Development Center are now years old. These programs need to be continuous and increasing with substantial private sector involvement and focus on cost reduction.

In regard to natural gas, the United States has policy work to do that will require strong political leadership. The present system of discrimination against countries such as India that do not have free trade agreements with the United States yet collectively control about 90 percent of world GDP is not in the interest either of the United States or India in promoting cleaner energy. The United States should end this protectionist discrimination.

The environmental impact of producing and consuming energy has had little political saliency and relatively little electoral impact in India. In the atmosphere of wide economic need, it has fallen to the Indian courts to be basic protectors

> On all accounts–availability, affordability, security, and environmental impact–an Indian-U.S. strategic energy partnership has much to offer.

of the environment. For a large portion of Indian voters, health concerns are so immediate and acute that the incremental climate change effects from the production and consumption of energy have received relatively little recognition. Climate change alone is unlikely by itself to be a sufficiently powerful concern in India to motivate voters and elected politicians to induct policies to move away from coal, biomass, and oil. However, there is widespread concern about the immediate health impacts of pollution, and when the argument is broadened to include these health aspects, the need to move to renewables and natural gas should become politically viable. Thus, India and the United States should cooperate on programs to provide both the Indian and American publics with a greater understanding of the human health issues involved in energy production. The leaders of both countries can cooperate to reposition the air pollution problem as one entailing immediate harm to public health as well as the longer term effects of climate change.

Similarly, the movement to renewables such as solar and wind can be positioned by the leaders of both countries as a movement to cheaper and more abundant energy in the medium to long run. Placing the movement to solar and wind in the context of an overall strategy to enhance development rather than environmental preservation will be important to the public support for such environmentally friendly strategies. In this regard, Prime Minister Modi has made a significant start by positing distributed solar energy not as an environmental measure but as a way to bring development to the 400 million Indians presently without electricity.

Conclusion

India's needs for energy and the power that comes from energy are at the heart of its ability to regain the relative domestic prosperity and international prominence that it experienced hundreds of years ago. The key to meeting these needs is a renaissance in energy policy that places India once again on the path to achieving its goals. With change comes the opportunity for putting into place energy policies combined with the political will for their implementation that will enhance the Indian quality of life and world stature. India and the United States are uniquely situated to cooperate on achieving energy security that will benefit both nations.

Over the past several years Indian energy policy has regressed as its struggle for adequate power has become more acute. The Indian economic success story without adequate attention to securing the energy to sustain that success has fueled fears concerning availability when physical availability was not the most important problem. Some initial successes in gas discoveries had the perverse effect of turning India inward. Now the available evidence indicates India needs more, not less, international engagement to meet its energy needs. The

acquiring of equity oil and gas while helpful is by no means a complete answer to India's needs for a comprehensive international energy strategy.
While politically painful, pricing and distribution reform using market mechanisms is the single greatest measure necessary to assure adequate supplies of energy at affordable prices. For the many millions of Indians in need of an energy safety net, that goal should be pursued through direct, transparent and accountable energy subsidies rather than the indirect, opaque, and unaccountable system that now exists.

India cannot afford to disregard the environmental impacts of its energy policy. Hundreds of thousands, if not millions, of Indians are sickened each year by pollution caused by the creation of energy. The environmental impact of energy creation is an immediate and pressing health issue. In addition, it is a longer term climate change issue that will affect India in the form of extreme weather and eventually in the loss of island and coastal territory. Solar and wind energy backed by natural gas seem at this time to be the energy sources of choice for coordinating adequate energy production with environmental preservation in the long run. There is an argument for adding nuclear to this long run view. However, the safety concerns of Fukishima, Chernobyl, and Three Mile Island coupled with the question of radioactive waste make this an open question. In the shorter run shifting away from oil and coal, and toward cleaner technologies for that coal which must be used, is an imperative.

Security of energy is a matter of diversity of supply combined with sensible policing and military policies to eliminate disruptions where India has the power to do so, and to minimize them where it lies beyond India's power to eliminate them. In this endeavor, India needs strategic partners and a security strategy that takes energy fully into consideration as a bedrock of that strategy. India and the United States apparently value their relationship as strategic partners. If this relationship is to grow and become stronger, India and the United States should become more proactive in working together and with their private sectors for the solution of such problems as full implementation of the civil nuclear deal, the Iran sanctions issue, and the solar local content or antidumping dispute.

On all accounts–availability, affordability, security, and environmental impact – an India-U.S. strategic energy partnership has much to offer. India and the United States should redouble their efforts to make trade and investment in gas a reality at levels necessary to be of significance to both nations. This will require attention not only to regulatory matters, but to creation of a system of physical and legal infrastructure that makes such trade a reality.

Energy engagement between the United States and India should go far beyond trade and investment in gas. The technology, goods, services and financing necessary to build the Indian solar and wind industries and to make more effective Indian oil and gas exploration and production all are available from the United States and U.S. based private sector companies. Already the United States Agency for International Development, U.S. Ex-Im Bank, and private sector energy companies are making progress in these areas, along with their Indian counterparts. However, the promise of India-U.S. cooperation, and by extension Indian engagement with the international community, will never be fully realized unless U.S. and Indian energy policies keep up with the energy needs of their economies and their citizens.

NOTES

1 See Sanjaya Baru, “India’s Best Student,” *Careers 360* (2013) http://www.careers360.com/news/3952-India-s-best-students-Dr-Manmohan-singh; See also Sanjaya Baru, *The Accidental Prime Minister* (New Delhi: Viking, 2014).

2 Author’s interview with Secretary D.J. Pandian,February 28, 2012.

3 See Vikram Singh Mehta, “Energy Policy: Redesign the Decision Making Architecture,” King’s India Institute, King’s College London (2013); Nick Butler, “Indian Power: Narendra Modi Must Centralize It,” *Financial Times.* (June 2, 2014) http://blogs.ft.com/nick-butler/2014/06/01/indian-power-mr-modi-must-centralise-it/

4 See “US Should End Energy Protectionism,” *Financial Times.* (August 4, 2014).

5 See Al Gore, “The Turning Point,” *Rolling Stone*, (July 3-17, 2014).

6 See Daniel Yergin, *The Quest* (New York: Penguin, 2011) pp. 3 – 5.

7 In the interests of full disclosure, the author is involved professionally in advising clients in the US gas business on exports to India. However, the views expressed herein are his own and not necessarily those of any other person or entity.

8 Vikas Bajaj, “No Power, No Boom: India Struggles to Dig Up Enough Fuel to Continue a Growth Spurt,” *New York Times* (April 19, 2012) p.1.

9 See Goldman Sachs, *Global Economics Paper No: 99 Dreaming with BRICs: The Path to 2050* (2003) and Jim O’Neil, *The Growth Map: Economic Opportunity in the BRICs and Beyond* (Penguin, 2011).

10 See Tushar Dhara, “India to Top China as fastest Growing Economy by 2015, Morgan Stanley says,” *Bloomberg*, (August 2010). John Hawksworth and Gordon Cookson, *The World in 2050* (2008); See also “India Likely To Be World’s Largest Economy by 2050: Citi,” *The Times of India* (February 23, 2011).

11 “Government unveils 10th round of Nelp,” *Business Standard* (January13, 2014) http://www.business-standard.com/article/economy-policy/government-unveils-10th-round-of-nelp-114011200652_1.html

12 Enerdata, “Total Energy Consumption,” *Global Energy Statistical Yearbook 2013* http://yearbook.enerdata.net/

13 See John Burn-Murdoch and Steve Bernard, “The Fragile Middle: millions face poverty as emerging economies slow,” *Financial Times* (April 13, 2014) http://www.ft.com/intl/cms/s/0/95fb1cca-c181-11e3-83af-00144feabdc0.html#axzz2ys6kpAGN

14 See Jim Yardley and Gardiner Harris, “2nd Day of Power Failures Cripples Wide Swath of India,” *The New York Times* (July31, 2012) http://www.nytimes.com/2012/08/01/world/asia/power-outages

15 Central Electricity Authority, “Load Generation Balance Report 2014-2015,” (May 2014) http://cea.nic.in/reports/yearly/lgbr_report.pdf

16 World Bank, “Electric power consumption (kWh per capita),” http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC (Accessed August 25, 2014)

17 Utpal Bhaskar, “Govt plans lifeline for stranded gas projects,” *Livemint* (January 20, 2014)

18 Mitul Thakar, “Over 30 distressed power projects on block, big companies uninterested,” *Economic Times* (October 4, 2014) http://articles.economictimes.indiatimes.com/2013-10-04/news/42718178_1_power-sector-stranded-projects-power-stations

19 See Sanjay Kumar Singh, “The demand for road-based passenger mobility in India: 1950-2030 and relevance for developing and developed countries,” *European Journal of Transport and Infrastructure Research* (2006) http://www.ejtir.tbm.tudelft.nl/issues/2006_03/pdf/2006_03_03.pdf

20 See Thakur, T.; Kaushik, S. C.; Deshmukh, S. G.; Tripathi, S. C., “Indian Electricity Act 2003: Implications for the generation, transmission and distribution sectors,” *Electric Utility Deregulation, Restructuring and Power Technologies, 2004.* (DRPT 2004). Proceedings of the 2004 IEEE International Conference, vol.1, (April 5-8, 2004) pp.54,58

21 Author’s interview of The Honorable Suresh Prabhu, New Delhi (February 25, 2012)

22 See Savera R. Someshwar, Interview with Suresh Prabhu “Politics is the Toughest Profession,” *Rediff.com* (May 26, 2004)

23 See Sheela Raval, “Shiv Sena chief Bal Thackeray asks Rajapur MP Suresh Prabhu to quit as Union Minister,” *India Today* (September 2, 2002)

24 See Suresh Prabhu, “Strengthening the Regulatory Framework,” *The Hindu* (December 3, 2013)

25 See Mukesh Ambani, Chairman’s Statement at RIL’s AGM on 31st October 2002, http://www.ril.com/html/investor/chairman_communication_agm31oct.html ; Shankkar Aiyar and Shishir Gupta, “Striking it rich: Discovery of gas at Krishna-Godavari basin to enhance India’s energy security, enrich RIL,” *India Toda*y (November 18, 2002) http://indiatoday.intoday.in/story/discovery-of-gas-off-andhra-pradesh-coast-at-krishna-godavari-basin/1/218680.html ;

26 See “Reliance’s gas output at D6 block falls to 14 mmscmd: oil secretary,” *Economic Times* (July 17, 2013) http://articles.economictimes.indiatimes.com/2013-07-17/news/40635298_1_mmscmd-gas-output-urea-manufacturing-fertiliser-plants

27 Energy Information Administration, *India Report* http://www.eia.gov/countries/cab.cfm?fips=IN

28 Ministry of Statistics and Programme Implementation, *Energy Statistics 2013* (2013) p. 43.

29 Charles K. Ebinger, *Energy and Security in South Asi*a (Brookings 2011) pp.34-35.

30 See Debjoy Sangupta, “Now, imported coal more viable for power companies in coastal areas: Experts,” *The Economic Times* (May 21, 2013) http://articles.economictimes.indiatimes.com/2013-05-21/news/39418623_1_coal-india-indonesian-coal-coal-prices

31 See Comptroller & Auditor General of India, “Report No. - 7 of 2012-13 for the period ended March 2012 - Performance Audit of Allocation of Coal Blocks and Augmentation of Coal Production (Ministry of Coal),” (September 2012) http://saiindia.gov.in/english/home/Our_Products/Audit_Report/Government_Wise/union_audit/recent_reports/union_performance/2012_2013/Commercial/Report_No_7/Report_No_7.html

32 See for example Romit Guha, “Scandal Hinders New Delhi,” *The Wall Street Journal* (September 10, 2012).

33 Sripakash Jaiswal, “Missing Coalgate files put govt in a spot,” *The Times of India* (August 20, 2013).

34 Central Statistics Office, *Energy Statistics 2013*, p.36.

35 See Malini Menon, “India’s June thermal coal imports jump 52 pct; rupee fall raises costs,”

Reuters.com (August 21, 2013) http://www.reuters.com/article/2013/08/21/india-coal-imports-idUSL4N0GM0RI20130821

36 See Eric Yep and Saurabh Chaturvedi, "India Runs Short on Coal, Despite Global Price Slump:India's Coal Imports Aren't Rising Enough to Plug Domestic Shortages," *Wall Street Journal* (August 4, 2014) http://online.wsj.com/articles/india-runs-short-on-coal-despite-global-price-slump-1407139782

37 World Bank, "India: Access of the Poor to Clean Household Fuels," (2003) http://siteresources.worldbank.org/EXTESC/Resources/householdenergyIndia.pdf

38 See Planning Commission, 12th Five Year Plan, http://planningcommission.gov.in/plans/planrel/12thplan/welcome.html

39 Kirk R. Smith, "National burden of disease in India from indoor air pollution," *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 97 No. 24 (1997) pp.13286-13293.

40 Press Trust of India, "ONGC directors in race for OVL top job," *The Financial Express* (May 13, 2014) http://www.financialexpress.com/news/ongc-directors-in-race-for-ovl-top-job/1250115

41 Valerie Cerra and Sweta Chaman Saxena, "What Caused the 1991 Currency Crisis in India," (October 2000) http://www.imf.org/external/pubs/ft/wp/2000/wp00157.pdf

42 Energy Information Administration, U.S. Department of Energy, "Independent Statistics and Analysis: India, Oil," (Washington, DC: U.S. Government Printing Office 2010)

43 U.S. Department of State, "Statement on Significant Reductions of Iranian Crude Oil Purchases," (March 20, 2012).

44 See Javier Blas, "Iran's clients for embargoed crude dwindle," *Financial Times* (January 12, 2012) p.3.

45 Reuters, "India pushes refiners to cut Iran imports, despite sanctions scorn," *The Economic Times* (March 21, 2012).

46 Rama Lakshmi, "India plans to reduce Iranian oil imports," *Washington Post* (May 16, 2012) p. 8.

47 See Press Trust of India, "India exempted from Iran oil sanctions," *The Indian Express* (June 6, 2013).

48 See Nidhi Verma, "Exclusive: India to slash Iran oil imports to meet nuclear deal parameters – sources," *Reuters* (March 11, 2014) http://www.reuters.com/article/2014/03/11/us-india-iran-imports-idUSBREA2A0TU20140311

49 See C. Raja Mohan, "India's new role in the Indian Ocean," http://www.india-seminar.com/2011/617/617_c_raja_mohan.htm

50 John Vidal, "Pollution from car emissions killing millions in China and India,," *The Guardian* (December 17, 2012) http://www.theguardian.com/environment/2012/dec/17/pollution-car-emissions-deaths-china-india

51 Planning Commission, 12th Five Year Plan (2012) p. 147.

52 Siddharta Deb, "Arundhati Roy, the Not-So-Reluctant Renegade," *The New York Times Magazine* (March 5, 2014) http://www.nytimes.com/2014/03/09/magazine/arundhati-roy-the-not-so-reluctant-renegade.html?_r=0

53 See Arundhati Roy, *The Cost of Living* (New York: Random House, Inc. 1999)

54 See for example, Anand Bodh,"Tribals oppose hydropower projects," *Times of India* (November 19, 2011)http://articles.timesofindia.indiatimes.com/2011-11-19/india/30418912_1_tribals-hydropower-projects-lahaul-spiti; Mat McDermott, India Cancels Third Hydropower Project on Ganges Tributary on Environmental & Religious Concerns, *Treehugger.com*, (September 13, 2010) http://www.treehugger.com/corporate-responsibility/india-cancels-third-hydropower-project-on-ganges-tributary-on-environmental-religious-concerns.html; Jenny Binstock, "Government Scraps Four Proposed Dams on the Teesta River in India," *International Rivers* (July 3, 2012) http://www.internationalrivers.org/blogs/299/government-scraps-four-proposed-dams-on-the-teesta-river-in-india

55 See Brahma Chellaney, *Water: Asia's New Battleground* (Washington, DC Georgetown University Press 2011)

56 See Lydia Polgreen and Sabrina Tavernise. "Water Dispute Increases India-Pakistan Tension," *New York Times* (July 20, 2010) http://www.nytimes.com/2010/07/21/world/asia/21kashmir.html?pagewanted=all&_r=0

57 Author's interview with Ambassador Meera Shankar, (February 3, 2011)

58 Dhananjay Mahapatra,"Uttarakhand tragedy fallout: SC orders review of 24 hydel projects," *Times of India* (August 14, 2013)http://articles.timesofindia.indiatimes.com/2013-08-14/india/41408798_1_disaster-management-plan-environment-ministry-uttarakhand

59 See Keith Schneider, "Uttarakhand's Furious Himalayan Flood Could Bury India's Hydropower Program," *Circle of Blue* (April 2, 2014) http://www.circleofblue.org/waternews/2014/world/uttarakhands-furious-himalayan-flood-bury-indias-hydropower-program/

60 Central Electricity Authority, http://www.cea.nic.in/reports/monthly/inst_capacity/sep13.pdf

61 See Rakteem Katakey and Debjit Chakraborty, "Modi to Use Solar to Bring Power to Every Home by 2019," *Bloomberg* (May 19, 2014) http://www.bloomberg.com/news/2014-05-19/modi-to-use-solar-to-bring-power-to-every-home-by-2019.html

62 Note that a crore equals 10 million.

63 Victor Mallet, "Solar power industry seeks its day in the subcontinental sun," *Financial Times* (October 8, 2013) p.4.

64 Natalie Obiko Pearson, "India Invites Solar Bids After 2-Year Gap," *Bloomberg* (October 7, 2013)

65 See USTR, "United States Challenges India's Restrictions on U.S. Solar Exports," (February 2013) http://www.ustr.gov/about-us/press-office/press-releases/2013/february/us-challenges-india-restrictions-solar

66 Author's interview with Secretary Pandian (February 18, 2012).

67 See U.N. Sushma "Tamil Nadu takes India's solar power capacity up 30 percent," *The Times of India* (September 17, 2013)

68 Planning Commission, 12th Five Year Plan (2012) p. 184 http://planningcommission.nic.in/plans/planrel/12thplan/pdf/12fyp_vol2.pdf

69 Press Trust of India, "Auditors red flag Suzlon's ability to generate adequate cash," *The Economic Times* (February 16, 2014) http://articles.economictimes.indiatimes.com/2014-02-16/news/47379786_1_fccb-holders-suzlon-energy-auditors

70 Shreya Jai, "Generation-based sops announced for struggling wind power sector," *The*

Economic Times (August 14, 2013) http://articles.economictimes.indiatimes.com/2013-08-14/news/41409871_1_wind-power-wind-farm-wind-industry

71 Press Trust of India, "Restore accelerated depreciation scheme of wind sector: Suzlon," *Business Standard* (February 9, 2014) http://www.business-standard.com/article/companies/restore-accelerated-depreciation-scheme-for-wind-sector-suzlon-114020900114_1.html

72 P.R.Sanjai,"Suzlon gets shareholder nod for Tulsi Tanti's reappointment, pay hike," *Business Standard* (March 26, 2014)

73 Press Trust of India, "Suzlon signs Euro 850 mn loan pact with consortium of banks," *The Economic Times* (April 8, 2014).

74 Centre for Science and Environment, "Wind power needs strict regulations to manage its environmental impacts, says study by Centre for Science and Environment," (July 3, 2013) http://www.cseindia.org/node/5041

75 Ashley J. Tellis, *Atoms for War?* (Carnegie Endowment for World Peace 2006) p.18.

76 Shivom Seth, "New Uranium deposits a boon for India's nuclear ambitions," *Mineweb* (August 9, 2014)

77 Ibid.

78 Central Electricity Authority, "All India Installed Capacity (in MW) of Power Stations Located in tin the regions of Main Land and Islands," (Accessed on September 9, 2013)

79 See K.S. Jayaraman interview with Ratan Kumar Sinha, Chairman AEC Nature (May 29, 2012) http://www.nature.com/news/india-won-t-pull-back-on-nuclear-ambitions-1.10735

80 World Nuclear Association, "Nuclear Power in India," (Updated 13 August 2013) http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/India/

81 See *Financial Times* (October 17, 2013)

82 Eric Yep, "India Starts Building Two New Nuclear Power Plants," *Wall Street Journal* (July 18, 2011) http://online.wsj.com/news/articles/SB10001424052702303795304576453492981882436

83 International Energy Agency, "Projected Costs of Generating Electricity – 2010 Edition," (Paris 2010) p. 17 http://www.iea.org/textbase/npsum/eleccost2010SUm.pdf

84 See Pranab Dhal Samanta, India's n-trade dilemma: U.S. power rate twice that of Russia: The Indian Express (New Delhi, Thu Sep 19 2013), http://www.indianexpress.com/news/indias-ntrade-dilemma-us-power-rate-twice-that-of-russia/1171099/

85 Mark Cooper, "The Economics of Nuclear Reactors: Renaissance or Relapse," (Vermont Law School 2009)

86 Oliver Morton, "The Dream that Failed," *The Economist* (March 10, 2012) p. 15.

87 M. Somasekhar, "Nuclear power, unclear future," *The Hindu Business Line* (July 23, 2013) http://www.thehindubusinessline.com/opinion/nuclear-power-unclear-future/article4945676.ece

88 See Ians, "Anti-Kudankulam activists to raise protest to next level," *The Times of India* (August 17, 2013) http://timesofindia.indiatimes.com/india/Anti-Kudankulam-activists-to-raise-protest-to-next-level/articleshow/21880521.cms; "India to launch nuke power plant despite protests," *RT.com* (June 8, 2013) http://rt.com/news/india-kudankulam-nuclear-plant-416/; Saurabh Chaturvedi and VimanMukheji "India Court Approves Protest-Hit Nuclear Plant," *Wall*

Street Journal Asian Business News (May 6, 2013)

89 "Jaitapur protest will continue, claim villagers," *The Hindu* (September 2, 2013) http://www.thehindu.com/news/national/other-states/jaitapur-protest-will-continue-claim-villagers/article5086085.ece

90 John Daly, "The Darker Reality of India's Nuclear Power Goals," *OilPrice.com* (February 26,2012) http://oilprice.com/Alternative-Energy/Nuclear-Power/The-Darker-Reality-of-Indias-Nuclear-Power-Sector.html

91 See Daniel Yergin, "The Fifth Fuel – Efficiency," *The Quest* (New York: Penguin, 2011) p.621.

92 Ministry of Power, "Energy Conservation," http://powermin.nic.in/acts_notification/energy_conservation_act/introduction.htm

93 See Manmohan Singh, "Address to the 7th Asia Gas Partnership Summit," (New Delhi 2012) http://www.agps.in/press-2012/7.pdf

94 See A.K. Balyan, "Meeting Demand Challenges of an Emerging Market," *LNG 17* (April 15, 2013) http://www.gastechnology.org/Training/Documents/LNG17-proceedings/06_04-Dr-A-K-Balyan-Presentation.pdf

95 See Ruth Greenspan Bell, Kuldeep Mathur, Urvashi Narain, and David Simpson, "Clearing the Air: Why Air Quality Reforms finally Took Hold in Delhi," *Resources for the Future* (2004) http://cleanairinitiative.org/portal/system/files/58048_resource_1.pdf

96 *CIA World FactBook 2013*, https://www.cia.gov/library/publications/the-world-factbook/rankorder/2250rank.html; IndexMundi (2013) http://www.indexmundi.com/g/r.aspx?v=137000; *BP, Statistical Review of World Energy 2013* http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013/review-by-energy-type/natural-gas/natural-gas-consumption.html

97 U.S. Energy Information Administration, "India," (June 26, 2014) http://www.eia.gov/countries/analysisbriefs/India/india.pdf

98 See "India LNG Terminal May Be Hit by Further Delay," *Hindustan Times* (May 6, 2013)

99 See Kakety, op cit.; Kunal Bose, "Will shale gas become a game-changer for India?," *Business Standard* (July 29, 2013)

100 U.S. Energy Information Agency, "Technically Recoverable Shale Oil and Shale Gas Reserves: An Assessment of 137 Shale Formations in 41 Countries Outside the United States," (June 2013)

101 See David Kashi, "As Scarcity Of Water Limits India's Fracking Potential, The Country Looks To The US For LNG Exports," *International Business Times* (August 6, 2013)http://www.ibtimes.com/scarcity-water-limits-indias-fracking-potential-country-looks-us-lng-exports-1373333; R.K. Batra, "Shale Gas in India: Look Before You Leap," *The Energy and Resource Institute Policy Brief* (June 2013)

102 "India to raise 2013 output of fracking ingredient guar gum trade," *Reuters* (May 29, 2013) http://www.reuters.com/article/2013/05/29/india-guar-idUSL3N0D21I120130529

103 http://www.natgas.info/html/liquefiednaturalgaschain.html

104 See "Qatar deal hinges on gas pricing: Petronet," *The Hindu Business Line* (January 31, 2014)

105 KonstantinosTsolakis, "Australia could overtake Qatar as top LNG exporter by 2020 – study," *Platts* (April 9, 2013) http://www.platts.com/latest-news/natural-gas/London/Australia-could-

overtake-Qatar-as-top-LNG-exporter-27850026

106 Press Trust of India, "GAIL wants Australian LNG deal to be renegotiated," *Business Standard* (July 9, 2013)

107 "The next Qatar? The cost of exploiting Australia's new-found gas supplies is soaring," *The Economist* (July 27, 2013) http://www.economist.com/news/business/21582272-cost-exploiting-australias-new-found-gas-supplies-soaring-next-qatar

108 GIIGNL, p.8

109 "Gail inks 20-year gas purchase deal with Russian firm," *The Indian Express* (October 2, 2012) http://www.indianexpress.com/news/gail-inks-20year-gas-purchase-deal-with-russian-firm/1010562/

110 Author's interview with Anand Barve, former Director International Finance Corporation, Oil and Gas Division (July 25,2013)

111 See Matthew Hulbert, "European Gas: How Not To Do Pipeline Politics," *Forbes* (April 9, 2012) http://www.forbes.com/sites/matthewhulbert/2012/04/09/european-gas-how-not-to-do-pipeline-politics/

112 GIIGNL, p. 19

113 Saurabh Chaturvedi, "Oil India, ONGC to Buy Mozambique Gas Stake; Kazakh Deal Looms," *Rizone.com* (June 25, 2013)

114 Press Trust of India, "OVL to invest $3 billion more in Mozambique gas field," *The Economic Times* (March 2, 2014) http://articles.economictimes.indiatimes.com/2014-03-02/news/47823885_1_rovuma-area-golfinho-prosperidade

115 For a discussion of the Iran-Pakistan-India pipeline in U.S.-India relations see the author's "Energy and Defense Security: The Iran Pipeline Example," Chapter 6 in *The Eagle and the Elephant: Strategic Aspects of US-India Economic Engagement* (Woodrow Wilson Press/ Johns Hopkins Press 2011)

116 *BP, Statistical Review of World Energy 2013,* http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf p. 20

117 Op cit

118 Sidhartha,"India may get Myanmar gas bypassing Bangladesh," *Times of India* (June 7, 2013) http://timesofindia.indiatimes.com/business/india-business/India-may-get-Myanmar-gas-bypassing-Bangladesh/articleshow/20470480.cms

119 Petronet, "Dedication To Nation of Kochi LNG Terminal on 4th January, 2014," (January 4, 2014) http://www.petronetlng.com/NewsContent.aspx?newsid=385

120 A. Balyan, "Kochi terminal operating below capacity: CEO & MD," transcript of interview with CNBC-TV18 (December 20, 2013) http://www.petronetlng.com/NewsContent.aspx?newsid=383

121 Ibid.

122 See Business Standard Reporters, "Ambani war: The mother who brought the brothers together, again," *Rediff.com* (May 24, 2010) http://business.rediff.com/slide-show/2010/may/24/slide-show-1-ambani-war-the-mother-who-brought-the-brothers-together-again.htm ; MamtaBadkar, "The Full Story Of The Massive Feud Between The Billionaire Ambani Brothers," *Business Insider* (May 26, 2011) http://www.businessinsider.com/ambani-brothers-feud-reliance-2011-05?op=1#ixzz2tuFa6EA5 http://www.businessinsider.com/ambani-

brothers-feud-reliance-2011-05

123 See Reliance Gas Transportation Infrastructure Ltd. “EWPL Overview,” (Accessed February 20, 2014) http://www.rgtil.com/pipelines_ewpl_overview.html

124 See Hans-Jürgen Nagl, “The Reliance East-West Gas Pipeline Project in India,” *2nd Pipeline Technology Conference 2007,* http://www.pipeline-conference.com/abstracts/reliance-east-west-gas-pipeline-project-india

125 “RGTIL to lease out 25 percent space on East-West line to third parties,” *The Economic Times* (March 26, 2013) http://articles.economictimes.indiatimes.com/2013-03-26/news/38040698_1_kg-d6-mmscmd-east-west-gas-pipeline

126 See “Hazira LNG and Port,” *Shell India* (Accessed February 21, 2014) http://www.shell.com/ind/aboutshell/shell-businesses/india-business-structure/hazira-lng.html

127 Press Trust of India, “Dabhol LNG import terminal gets shipment after six-month gap,” *The Hindu* (November 25, 2013) http://www.thehindu.com/business/Industry/dabhol-lng-import-terminal-gets-shipment-after-sixmonth-gap/article5389753.ece

128 “India to triple LNG Import Terminal capacities by 2017:GSPC and IOC to boost LNG Import Terminal projects,” *2B1st Consulting* (Accessed February 21, 2014) http://www.2b1stconsulting.com/india-to-triple-lng-import-terminal-capacities-by-2017/

129 Petroleum & Natural Gas Regulatory Board, “Vision 2030,” *Natural Gas Infrastructure in India* (2013) pp. 44-49

130 Author’s interview with Vikram Singh Mehta (February 23, 2012)

131 Jyoti Mukul, “Lunch with BS: Vikram Mehta,” *Business Standard* (May 8, 2012)

132 Author’s interview (February 23, 2012)

133 Vikram Mehta, Floreat Magdelena (December 20, 2013) p. 7.

134 Cuckoo Paul, “Vikram Singh Mehta:Shell could have been where Reliance is,” *Forbes India Magazine* (May 11, 2012) http://forbesindia.com/article/exit-interview/vikram-singh-mehta-shell-could-have-been-where-reliance-is/32796/1

135 Ibid.

136 Ibid.

137 Prime Minister of India website, (Accessed June 11,2014) http://pmindia.gov.in/details10.php

138 Constitution of India, Article 79

139 Cuckoo Paul, “Vikram Singh Mehta:Shell could have been where Reliance is,” *Forbes India Magazine* (May 11, 2012) http://forbesindia.com/article/exit-interview/vikram-singh-mehta-shell-could-have-been-where-reliance-is/32796/1

140 Government of India, Cabinet Secretariat Web Site, “Origins,” (Accessed March 3, 2014) http://cabsec.nic.in/about_origin.php

141 See Government of India, Cabinet Secretariat Order No, 631/2/1 /2004 – Cab (May 31, 2004) http://www.nac.nic.in/pdf/nac_constitution.pdf

142 Ministry of Petroleum and Natural Gas website (Accessed September 10, 2014), http://petroleum.nic.in/

143 “Vision and Objectives,” Directorate General of Hydrocarbons web site (Accessed March 3, 2014) http://www.dghindia.org/VisionandObjective.aspx

144 See “OIL director Talukdar selected as Directorate General of Hydrocarbons,” *Times of India* (August 13, 2014) http://timesofindia.indiatimes.com/business/india-business/OIL-director-Talukdar-selected-as-Directorate-General-of-Hydrocarbons/articleshow/21815892.cms

145 “The Petroleum and Natural Gas Regulatory Board Act, 2006,” *The Gazette of India* No. 19 of 2006, Chapter III. Paragraph 11.(a) http://www.pngrb.gov.in/newsite/pdf/Act/gazette_e.pdf

146 Anil Jain and Anupama Sen, “Natural Gas in India: An Analysis of Policy,” Working paper of the Oxford Institute for Energy Services, (April 2011) p.39.

147 See Government of India, “Report of the Committee on the Production Sharing Contract Mechanism in Petroleum Industry,” (December 2012); Charles Ebinger and Govinda Avasarala, “Natural Gas in India: Difficult Decisions,” James A. Baker III Institute for Public Policy, Rice University (October 23, 2013)

148 Reliance Natural Resources vs. Reliance Industries Ltd., Civil Appeal No. 4273 of 2010, Supreme Court of India as reported at *Bloomberg.com* http://www.bloomberg.com/apps/news?pid=newsarchive&sid=abt.517yz7jU

149 Press Trust of India, ‘Call on hiking fuel price after Sonia Gandhi returns from U.S.’, *The Economic Times* (September 5, 2013) http://articles.economictimes.indiatimes.com/2013-09-05/news/41802519_1_record-rs-diesel-price-rs-470

150 “Reliance Industries suffers setback as Narendra Modi govt spikes natural gas price hike, old rate stands,” *Economic Times* (June 25, 2014) http://www.financialexpress.com/news/reliance-industries-suffers-setback-as-narendra-modi-govt-spikes-natural-gas-price-hike-old-rate-stands/1264155

151 See Reliance Gas Transportation Infrastructure, Ltd., “Existing Pipeline,” *RGTIL* http://www.rgtil.com/pipelines_ewpl_overview.html

152 See Central Intelligence Agency, “Central Asia: Turkmenistan,” *The World Factbook*, https://www.cia.gov/library/publications/the-world-factbook/geos/tx.html

153 See Luke Patey, “No oil in troubled waters,” *The Hindu Business Line* (March 25, 2014) http://www.thehindubusinessline.com/opinion/no-oil-in-troubled-waters/article5831115.ece

154 See “LNG shippers confront piracy risk,” *Safety4Sea* (February 29, 2012) http://www.safety4sea.com/lng-shippers-confront-piracy-risk-9871

155 “Carbon Emissions from Burning Biomass for Energy,” *Partnership for Policy Integrity* http://www.pfpi.net/carbon-emissions

156 See C. Venkaratanam, “Emission factors of carbon monoxide and size-resolved aerosols from biofuel combustion,” *Environmental Science Technology* (May 15, 2001)

157 See SolarReserve website, (Accessed May 8,2014) http://www.solarreserve.com/who-we-are/about-us/

158 Adam Sieminski, EIA Administrator “U.S. oil and natural gas outlook,” *IAEE International Conference* (June 16, 2014) http://www.eia.gov/pressroom/presentations/sieminski_06162014.pdf

159 U.S. Energy Information Administration, “Technology drives natural gas production growth from shale gas formations,” *Today in Energy* (July 12, 2011) http://www.eia.gov/todayinenergy/detail.cfm?id=2170#

160 U.S. Energy Information Administration, “Lower 48 states shale plays,” (May 9, 2011) http://www.eia.gov/oil_gas/rpd/shale_gas.pdf

161 U.S. Energy Information Administration, “U.S. expected to be largest producer of petroleum and natural gas hydrocarbons in 2013,” (October 4, 2013) http://www.eia.gov/todayinenergy/detail.cfm?id=13251

162 See U.S. Energy Information Administration, “U.S. Crude Oil and Natural Gas Proved Reserves,” (August 1, 2013) http://www.eia.gov/naturalgas/crudeoilreserves/?src=Natural-f4

163 U.S. Energy Information Administration, “About U.S. Natural Gas Pipelines,” (Based on data through 2007) http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/index.html

164 GIIGNL,”The LNG Industry 2012,” p. 11

165 Isaac Arnsdorf,“Panama Canal’s LNG Surprise to Redefine Trade in Fuel: Freight,” *Bloomberg* (November 4, 2013) http://www.bloomberg.com/news/2013-11-05/panama-canal-s-lng-surprise-to-redefine-trade-in-fuel-freight.html

166 Masumi Suga, “Mitsui Engineering to Team Up With Rivals on LNG Ships,” *Bloomberg* (September 8, 2013 http://www.bloomberg.com/news/2013-09-09/mitsui-engineering-to-team-up-with-rivals-on-lng-ships.html

167 John Anderson, “Exporting LNG: Permitting and Economic Analysis,” (December 6, 2011) http://www.usea.org/sites/default/files/event-file/511/Anderson_DOE_LNG_Exports.pdf

168 Department of Commerce, “Free Trade Agreements,” *Export.Gov* http://export.gov/percent5C/FTA/index.asp

169 Department of Commerce, International Trade Administration, “Free Trade Agreements,” http://www.trade.gov/fta/

170 Reuters, “Petronet in initial agreement to buy LNG from United LNG, Petronet to buy 4mt of LNG a year for 20 years; in talks to buy stake in liquefaction facility in Gulf of Mexico,” *Livemint & the Wall Street Journal* (April 25, 2013) http://www.livemint.com/Companies/FjJCC5OKHbZKmwuzR8TSiI/Petronet-in-initial-agreement-to-buy-LNG-from-United-LNG.html

171 See FERC, ORDER VACATING CERTIFICATE AUTHORIZATIONS Docket No. CP04-68-000 (June 3, 2013)

172 Suchi Srivastava, “Reliance-BP joint venture to source LNG from Freeport Terminal in U.S.,” *Economic Times* (August 12, 2013) http://articles.economictimes.indiatimes.com/2013-08-12/news/41332790_1_lng-terminal-gspc-lng-india-gas-solutions

173 See Sabine Pass, DOE/FE Order 2961. FN 45 and Chris Smith, Deputy Assistant Secretary for Office of Oil & Natural Gas, “Letter to Representative Ed Markey, Committee on Natural Resources, U.S. House of Representatives,” (February 24, 2012)

174 See Ratner, et al Congressional Research Service, “U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes,” (April 8, 2013) pp.14-16.

175 See “U.S. Energy Dept finalizes overhaul of natural gas export reviews,” *Reuters* (August 14, 2014) http://www.reuters.com/article/2014/08/14/usa-lng-exports-idUSL2N0QK1E720140814

176 Department of Energy, “Procedures for Liquefied Natural Gas Export Decisions,” 6450-01-P (August 16, 2014) http://federalregister.gov/a/2014-19364

177 See for example Hillary Rodham Clinton, “Statement on Significant Reductions of Iranian Crude Oil Purchases,” U.S. Department of State (March 2012)

178 General Accountability Office, “Firms Reported to Have Sold Iran Refined Petroleum Products or Engaged in Commercial Activities in Iran’s Energy Sector,” *GAO-13-173R:* (December 7, 2012). http://www.gao.gov/products/GAO-13-173R

179 General Accountability Office, “Foreign Firms Reported to Have Engaged in Certain Activities Involving Iran’s Energy or Communications Sectors,” *GAO-14-218R:* (Jan 7, 2014)

180 Richa Mishra, “Difficult choice: For ONGC, it is US shale or Iran gas,” *The Hindu* (April 13, 2014) http://www.thehindubusinessline.com/companies/difficult-choice-for-ongc-it-is-us-shale-or-iran-gas/article5908671.ece

181 U.S. Energy Information Agency, “Natural Gas Weekly Update,” (August 15, 2014) http://www.eia.gov/naturalgas/weekly/?src=Natural-b6

182 “LNG from U.S. to cost GAIL India $10.5 per mmBtu,” *Zeebiz.com* (July 22, 2013) http://zeenews.india.com/business/news/companies/lng-from-us-to-cost-gail-india-10-5-per-mmbtu_80334.html See also Press Trust of India, “GAIL wants Australian LNG deal to be renegotiated,” *Business Standard* (July 9, 2013) http://www.business–standard.com

183 Cheniere Research, Marketing Presentation (March 2012) p. 11.

184 See Gregory Meyer, “Marcellus production key to US shale price,” *Financial Times* (August 7, 2013) p. 19

185 See for example Michael Kugelman, “Integrating Energy Concerns into India’s National Security Strategy,” (December 14, 2011)

186 See Anupama Airy, “MukeshAmbani to invest Rs. 24,000 cr more in U.S.,” *Hindustan Times New Delhi*, (August 01, 2013) http://www.hindustantimes.com/business-news/mukesh-ambani-to-invest-rs-24-000-cr-more-in-us/article1-1101964.aspx

187 Parliamentary Debates, Commons, July 17,1913, 1474-77 as quoted by Daniel Yergin, “Energy Security and Markets,” in Jan Kalicki and David Goldwyn *Energy Security* (Woodrow Wilson Center Press 2005) p. 72.

188 See Gopi Chandra Kharel, “US-India Row: New Delhi Cancels Energy Dialogue as US Judge Refuses to Extend DevyaniKhobragade’s 13 January Hearing,” *International Business Times* (January 9, 2014) http://www.ibtimes.co.in/articles/533599/20140109/usindia-raw-devyani-khobragade-energy-dialogue-january13hearing.htm and Press Trust of India, “US Energy Secretary cancels India trip,” *The Economic Times* (January 9, 2014) http://articles.economictimes.indiatimes.com/2014-01-09/news/46030138_1_energy-sector-clean-energy-ernest-moniz

189 See Government of India, “President Clinton’s Visit to India: Institutional Dialogue between India and the United States,” (March 2000) http://pib.nic.in/archieve/indous/indouspr2.html

190 The “Open General List” is a category of items eligible to be imported without authorization for each shipment.

191 Government of India, “India: Emerging Opportunities in the Oil Sector,” (March 2000) http://pib.nic.in/archieve/indous/indousfi5.html

192 Ibid.

193 See United States Department of Energy, “India-U.S. Energy Dialogue Joint Statement,” (May 31, 2005)

194 See The White House, “Fact Sheets: U.S.-India Cooperation,” (November 24, 2009) http://www.whitehouse.gov/the-press-office/fact-sheets-us-indian-cooperation

195 See Press Trust of India, “Barack Obama’s State Dinner for Manmohan Singh the most expensive,” *The Indian Express* (February 12, 2014) http://indianexpress.com/article/world/americas/barack-obamas-state-dinner-for-manmohan-singh-the-most-expensive/

196 The White House, “Remarks by the President to the Joint Session of the Indian Parliament in New Delhi, India,” (November 8, 2010) http://www.whitehouse.gov/the-press-office/2010/11/08/remarks-president-joint-session-indian-parliament-new-delhi-india

197 The White House, “Joint Statement by President Obama and Prime Minister Singh of India,” (November 8, 2010) http://www.whitehouse.gov/the-press-office/2010/11/08/joint-statement-president-obama-and-prime-minister-singh-india

198 Department of Energy, *U.S.-India Partnership to Advance Clean Energy (PACE): A Progress Report* (June 2012)

199 See Persis Khambatta, “Update: U.S.-India Strategic Dialogue: Progress, Problems, and Prospects,” (Center for Strategic and International Studies, June 2012) https://csis.org/publication/us-india-strategic-dialogue-progress-problems-and-prospects

200 Embassy of India, Press Release - *U.S.-India Energy Dialogue* (September 28, 2012) https://www.indianembassy.org/archives_details.php?nid=1875

201 See Department of Energy, “US-India Partnership to Advance Clean Energy (PACE): An Initiative of the US-India Energy Dialogue: A Progress Report,” (June 2013) http://www.seriius.org/pdfs/062013_indo_us_pace_report.pdf

202 Department of State, “Joint Statement: Fourth U.S.-India Strategic Dialogue,” (June 24,2013) http://www.state.gov/r/pa/prs/ps/2013/06/211084.htm

203 The White House, “Fact Sheet on U.S.-India Partnership on Clean Energy, Energy Security, and Climate Change,” (September 26, 2013) http://www.whitehouse.gov/sites/default/files/india-factsheets/Fact_Sheet_on_U.S.-India_Partnership_on_Clean_Energy_Energy_Security.pdf

204 See International Energy Agency website, http://www.iea.org/ Accessed May 19, 2014.

205 See Press Trust of India, “India needs market-based energy pricing to meet vast needs, says Manmohan Singh,” *DNA* (December 3, 2013)

206 Asian Development Bank, *Energy Outlook for Asia and the Pacific* (October 2013) p.263 http://www.adb.org/sites/default/files/pub/2013/energy-outlook.pdf

207 See for example the Russian English language website *RT* “When energy starved India meets oil rich Russia,” (May 14, 2014) http://rt.com/op-edge/158880-energy-starved-india-russia-oil/

208 See Jane Perlez, “China and Russia Reach 30-Year Gas Deal,” *New York Times* (May 21, 2014) http://www.nytimes.com/2014/05/22/world/asia/china-russia-gas-deal.html?hpw&rref=business

209 See Alexander Korablinov, “India, Russia to expand nuclear cooperation,” *Russia & India Report, Rossiyaskaya Gazeta* (February 21, 2014) http://in.rbth.com/economics/2014/02/21/india_russia_to_expand_nuclear_cooperation_33239.html

210 See the author’s discussion of such procurement in *The Eagle and the Elephant: Strategic Aspects of U.S.-India Economic Engagement* (Johns Hopkins University Press/Woodrow Wilson Press 2011) pp. 126-127.

211 See S. Amer Latiff, *U.S.-India Military Engagement: Steady as They Go* (Center for Strategic and International Studies, December 2012)

212 See Victor Beattie, “US Navy ‘Shaping Events’ in South China Sea,” *Voice of America* (May 20, 2014) http://www.voanews.com/content/us-navy-shaping-events-in-south-china-sea/1918187.html

213 Planning Commission, 12th Five Year Plan (2012) p. 132

214 Op cit, p. 134.

215 Rakteem Katakey and Debjit Chakraborty, “Narendra Modi Plans To Bring Solar To 400 Million People, Electrify Rural India,” *Bloomberg* (May 19, 2014) http://www.bloomberg.com/news/2014-05-19/modi-to-use-solar-to-bring-power-to-every-home-by-2019.html

216 Press Trust of India, “Will visit Gujarat soon and study their model: Piyush Goyal,” (May 27, 2014) http://economictimes.indiatimes.com/industry/energy/power/will-visit-gujarat-soon-and-study-their-model-piyush-goyal/articleshow/35628073

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