

SOUTH ASIA MONITOR

Number 132
August 24, 2009

India's Energy Options: Coal and Beyond

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Over the coming decades, two of India's greatest challenges will be (1) how to grow while concurrently joining a worldwide push toward mitigating climate change and (2) how to secure diversified sources of energy. The discourse on India's energy security has centered on the country's thirst for imported oil. However, India's primary energy source is not oil, but a mostly domestic product: coal. India's rapidly developing economy guarantees a sharp increase in energy demand. However, coal is the most-polluting fossil fuel. But ensuring energy security for India will not take a silver bullet. Moving away from disproportionate coal usage will require incremental steps on a number of different approaches.

Coal—You get what you pay for: Coal has been a mainstay of Indian energy. It accounted for 53 percent of India's energy consumption in 2007, and demand is set to grow dramatically over the coming decades. Coal use for electricity generation is projected to grow 2 percent every year, almost doubling its share of India's generating capacity by 2030. This will increase not only domestic production but also imports: Over the next two decades, coal imports are projected to triple compared with the 2007 level.

This huge spike in demand reflects both natural economic growth and some of the government's pro-poor policies. The programs for the rural poor include providing essentially free electricity in some rural areas and also highly subsidized fuel. Coal is used mainly for generating electricity, and currently 44 percent of rural households (amounting to 400 million people) do not yet have access to electricity. The government and its coal ministry plan to ramp up production by 65 percent in less than a decade to meet the growing demand for rural electrification.

Because coal is both cheap and abundant domestically, it may seem like the perfect solution to India's energy and electricity woes. However, using coal has severe health, environmental, and economic effects. As quality of life improves for most Indians, many will protest against this dirty pollutant. As the world moves closer to a consensus on climate change, using coal at this growing rate may become untenable. To work around these problems, India will need to address market inefficiencies. Developing alternatives to coal will also be essential.

An Environmental Disaster: Indian coal is some of the dirtiest in the world. Its high-ash quality, and the lack of infrastructure to clean it early in the process, creates a huge environmental risk for India, already one of the countries poised to be hit hardest by climate change. Coal is the most polluting fuel in terms of greenhouse gases and already accounts for 65 percent of India's CO₂ emissions. The burning of coal releases respirable particles, noxious gases, toxic trace elements, and radioactive particles into the atmosphere. Additional environmental degradation comes from mining, sometimes done in forests, and coal fires (of which India already has the most concentrated amount of any country). So far, cancer, bone deformation, black lung, sterilization, and kidney diseases have all been attributed to the burning of coal. Already an entire village, Jharia in Jharkand state, had to be relocated because of the deleterious effects of an underground coal fire that has been burning for decades.

In addition to harmful carbon dioxide emissions, burning coal produces one of the most oft-neglected pollutants: black carbon. Black carbon is responsible for one-fifth of observed global warming. Black

carbon stays in the atmosphere for only a matter of weeks, but creates more local warming problems than emissions from most other fuels. Tackling black carbon would be an expedient and effective way to raise the quality of life in India. It would also make for a conciliatory gesture toward the international community.

An Unanticipated Shortage: India's coal reserves are not as large as previously thought. At the current usage rate, India's reserves would be depleted in 80 years. At the projected rate of growth in production, that number becomes 40. Transporting coal is cumbersome and inefficient. Most of the domestic reserves are concentrated in India's eastern and central states, far from the urban centers most in need of increased energy.

Clean Coal—Worthy investment or pie in the sky?: It would be unrealistic to envision a future without India burning coal. Indeed, India's coal consumption is set to rise even if sources of energy are diversified. Clean-coal technologies, such as Carbon Capture and Sequestration (CCS), are appealing to governments and lawmakers because they require less adaptation than other mitigating routes. CCS is a two-step process. First, the carbon dioxide is captured as it enters the atmosphere, and then it is pumped underground for safe storage. While the latter part of the process has been demonstrated, the "capturing" part is underdeveloped and expensive.

Clean-coal technologies will take decades and billions of dollars to develop. There is not nearly enough private investment in CCS technology. At present, it is overpriced (about \$30 per ton of CSS CO₂). R&D costs are high, and investors seem more interested in shorter-term, renewable technologies. The Edison Electric Institute estimates that commercial deployment will require 25 more years of research and cost at least \$20 billion. No large-scale power plant in the world is currently using CCS.

Developing clean-coal technologies therefore should not be seen as an immediate and reliable solution. However, it is a sector worth investment and research. Andhra Pradesh has signed on with state-owned Bharat Heavy Electricals to build a 125-megawatt clean-coal plant. Perhaps once the long-term results are in, clean coal will have been worth the wait.

Alternatives: Nuclear: Because India's coal production at the current level is sustainable for only a few more decades, viable alternatives must be developed and brought to the market. Nuclear power is a low-carbon energy source. That means that the pollution problems stemming from generation are minimal; instead, its environmental costs show up at the back end of the production chain in the storage of nuclear waste, a testy political issue.

At present, nuclear power accounts for only 2.3 percent of electricity generation in India. The Indian government plans to raise nuclear energy's contribution to about 5 percent by 2020 and hopes to derive 25 percent of total energy from nuclear power by 2050. These goals are ambitious, especially in an industry that has generally run behind the government's planning targets. The U.S.-India agreement on civil nuclear cooperation makes reaching these goals more likely. Realistically, however, a significant increase in nuclear power is a long-term, not a short-term, option.

Following the completion of the U.S.-India civil nuclear agreement, France and Russia have been the first to sign nuclear power deals with India. The Indian government has made clear that it wants U.S. businesses to participate and has publicly pledged to designate two areas where U.S. bidders will have priority. Nonetheless, moving from designation to production will be slow. The U.S. suppliers are reluctant to jump in until India has put in place liability legislation.

Sun and Wind: A resource with greater potential in the short term is solar energy. India is endowed with abundant sunlight and solar radiation. Solar radiation is most concentrated in the north and west, in Rajasthan and Gujarat. The potential amount of energy to be reaped is staggering—an estimated 13,000 MW based on existing infrastructure alone.

The Indian regime has publicly committed itself to expanding its solar energy capabilities. Prime Minister Manmohan Singh announced last year an ambitious “National Solar Mission” over the next decade. The first three years would see a push to scale up research to drive down costs, spur domestic manufacturing, and fund solar lighting with micro-finance. The second phase would require the installation of solar water heaters in office buildings and large residences. In the third phase, which India hopes will begin by 2017, solar energy is to achieve tariff parity with conventional power. Even if the plan does not fully adhere to this timetable, increased solar energy should be an important addition to India’s total energy output. The Clinton Foundation is in talks with the government to set up an “Integrated Solar City,” to be the largest solar power project to date, in Gujarat. Although a relatively diluted energy source, solar energy should be a component in helping India to quench its energy thirst in a way that is environmentally responsible.

India also has a sizable homegrown wind industry, with a total installed capacity of 5,340 MW and seven manufacturers of wind turbines. India recently overtook Denmark to become the fourth-largest wind energy market in the world. Wind energy is strongest on the coasts, particularly in Tamil Nadu, Karnataka, and Maharashtra, as well as in landlocked Rajasthan. The low cost and readiness of the wind industry in India make it an attractive source for short-term growth.

Expanding Natural Gas: Natural gas produces less carbon dioxide and pollutants than other fossil fuels. India’s use of natural gas is growing faster than its use of other fossil fuels, at an average of almost 10 percent per year over the past six years. India imports small amounts of natural gas, which make up 8 percent of its commercial energy usage. To meet its natural gas demand, India primarily uses its own domestic supply off its western coast.

India recently found a gas field deep in the Krishna-Godavari basin, with reserves of between 10 and 20 tcf (trillion cubic feet). These reserves would be 40 times larger than those in the Bombay High field and double the entire annual gas production of India’s Oil and Natural Gas Corporation (ONGC). Plans for the field’s development are still in their initial stages while companies wait for the government’s approval. In the medium term, expanding the use of natural gas is a good solution to coal usage .

Investing in Efficiency: Energy analysts agree that the most effective way to expand India’s usable energy resources is to increase efficiency. Indian government spokespersons have estimated that as much as 30 to 50 percent of the electricity generated in India may be lost along the delivery chain. Better maintenance and modernizing of cooling systems could significantly reduce the amount of energy needed to generate power.

During her recent visit to India, Secretary of State Hillary Clinton visited the country’s first LEED-certified building, another example of efficiency investments that can conserve the energy India needs to fuel its growing economy. This kind of investment will have less short-term impact, however, because replacing existing buildings will take several years.

Implementing Market Mechanisms: India’s energy sector is dominated by government-owned enterprises. India created a central energy ministry in 1992 and then divided it into the ministries of coal, petroleum, and natural gas; nonconventional energy sources; and power. This fragmentation has been a challenge for users and for investors, making it difficult for the Government of India to implement an integrated energy strategy.

Among the state-owned energy companies, some, such as ONGC, are regarded as the jewels in the Indian government’s corporate crown. Others have a weaker reputation. The government-owned Coal India Ltd., the largest coal company in the world, controls 90 percent of India’s coal mines. Thanks to its monopoly and inefficiencies, its production costs are on average 50 percent higher than those in other countries. It has a bloated staff (it is the second-largest employer in the world), controls the allocation of exploration blocks, and has low productivity.

Conclusions for the United States: India’s economy grew at more than 9 percent a year for the three years before the financial crisis struck. Its growth rate has slowed to an estimated 6 percent this year but is expected to start picking up again in 2010. Even at these reduced rates, India’s energy consumption is

guaranteed to rise. If India's rural poor share in the prosperity, as the government wants them to, this growth will include increased use of energy, such as an expanding electricity market.

Making this expansion in energy use compatible with mitigating global warming will require additional tools. India will seek energy alternatives because of its shrinking coal supply and its lack of indigenous oil reserves. However, seeking alternative energy sources is not enough. India must work to develop new technologies. The recently created U.S.-India Science and Technology Endowment fund could be a useful vehicle for accelerating the necessary technological development. Sharing technologies will help India to meet its objective of improving its energy security while working to slow global warming.

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