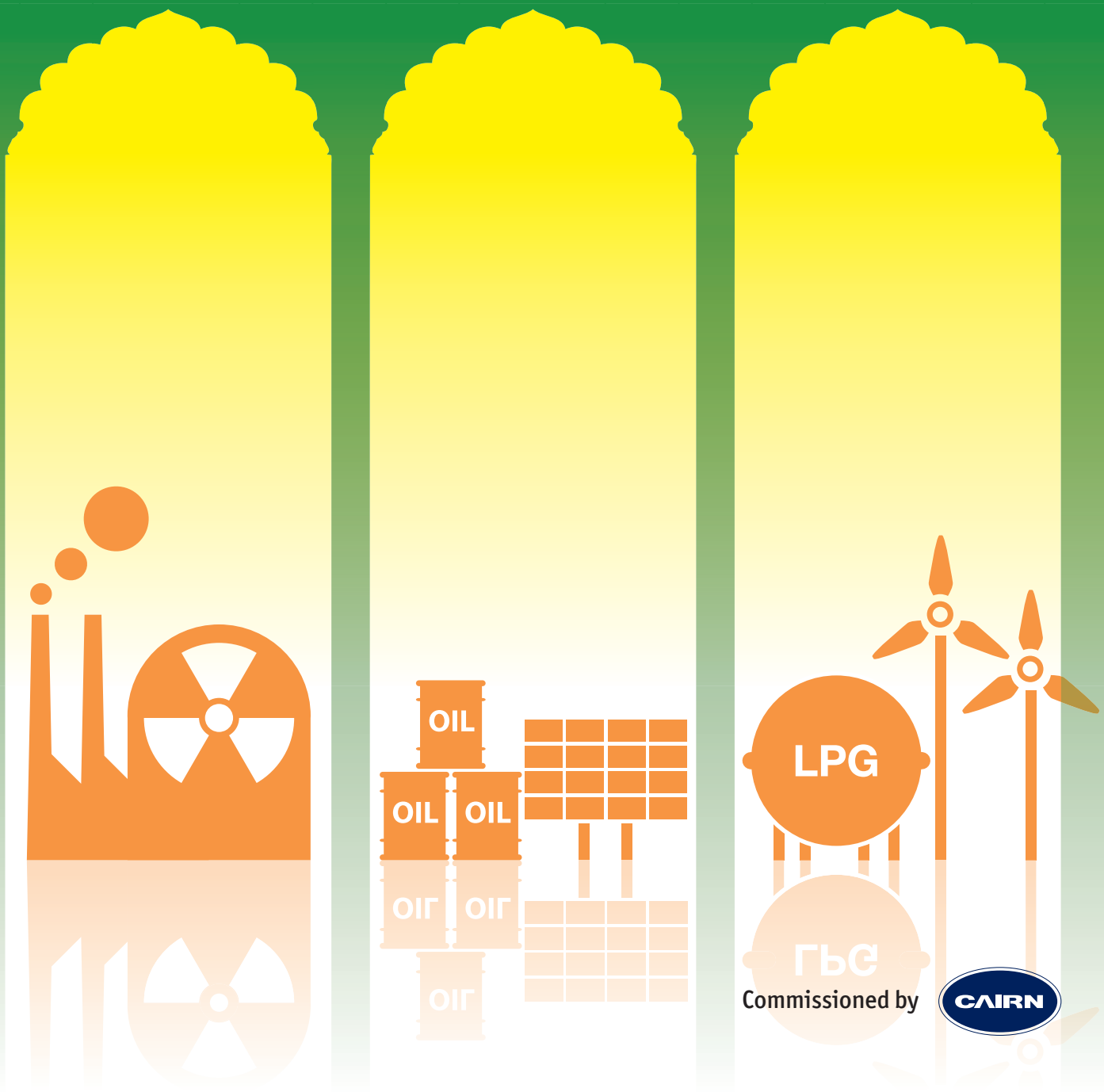
Economist Intelligence Unit

The Economist

Empowering growth

Perspectives on India's energy future

A report from the Economist Intelligence Unit



Commissioned by CAIRN

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Preface

Despite India's roaring economic growth over the past decade, and its citizens' growing belief that it is finally ready to join the league of global superpowers, the country remains vulnerable to occasional dysfunction. Nothing typifies this better than the blackout in July 2012 that left some 600m people without electricity. Reforms that began in 1991 have gone some way towards improving the efficiency of India's energy sector, but serious impediments to investment remain. As a result, India's energy supply is constantly playing catch-up to the demands of its burgeoning economy. Can India's energy sector continue to power its economy in the long term?

This question was the starting point for this paper. The Economist Intelligence Unit (EIU) asked prominent figures from research, industry and academia to consider India's long-term energy future. Their contributions, in the form of essays and in-depth interviews, tackle the fundamental issues India must consider when plotting a sustainable and secure energy future. These include: the need to address domestic price distortions and other inefficiencies; prospects for renewable energy; how to encourage greater energy efficiency; how to meet the energy needs of industry and commerce; challenges in distribution and infrastructure; and what India can learn from other countries' energy strategies.

Cairn India commissioned this project but had no editorial input into any of the sections below, which are solely the work of the authors.[1] Their contributions can be summarised as follows:

1. India's energy future: The EIU view

***Martin Adams**, Energy Editor, Economist Intelligence Unit*

The EIU's view is that India's demand for energy will continue to expand rapidly, but domestic supply will be constrained by price distortions and other hindrances. This will increase demand for fossil-fuel imports. By 2020, domestic production will fulfil only half of India's fossil-fuel consumption, down from 60% today. This will add billions to its fuel import bill and deepen its energy security worries.

2. India's "energy trilemma": An international perspective

***Stuart Neil**, Director, and **Philip Thomas**, Scenarios Project Manager, World Energy Council*

Only a robust and coherent energy policy will enable India in the long term to manage the different elements in its "energy trilemma": energy security, equitable energy access and environmental impact mitigation. This is important because the global Energy Sustainability Index by the World Energy Council indicates that India's

[1] David Line and Sudhir Vadaketh of the Economist Intelligence Unit were the editors of the paper. Bina Jang assisted with project management, interviews and additional editorial duties. Gaddi Tam was responsible for layout and design; the cover image is by Wai Lam.

performance has been declining in all three dimensions, particularly energy security. In the medium term, it is vital for India to formulate holistic policies that will encourage investment in energy infrastructure, create a strategic energy mix, and promote coordination between the central and state governments so that the country's energy supply will be able match its economic growth aspirations.

3. India and the other BRICs: Energy and the implications for economic growth

***Charles Ebinger**, Senior Fellow and Director, and **Govinda Avasarala**, Senior Research Assistant, Energy Security Initiative, The Brookings Institution*

India has possibly the most uncertain energy future of any BRIC nation. Demand for energy in Brazil, Russia, India and China is expected to grow in tandem with rapid economic growth. While the first two are rich in energy resources and should cope quite well, India and China face a challenge, as domestic energy resources will fall far short of projected demand. China seems to be handling its energy deficiencies more determinedly than India, whose tentative energy policies suggest no immediate solutions. This is bad news for India's economy, which has already begun to slow. Promoting hard-nosed energy policies, however, could help to bring growth back on track.

4. India's energy strategy: Historical and future perspectives

***M Govinda Rao**, Director, National Institute of Public Finance and Policy*

Electricity supply and demand lie at the heart of India's energy future and its aspirations to maintain an annual GDP growth rate of 8% in the medium term. However, the power sector is hobbled by inefficiencies and bad pricing policies that have left the state utilities virtually bankrupt. This has particular ramifications for coal, the electricity sector's main fuel and a major element in India's energy mix. A growing reliance on imports of coal, as well as oil and gas, will exacerbate energy worries in the coming decade. Renewable energy provides only a little relief, but nuclear could be the energy of the future.

5. Industrial demand and energy supply management: A delicate balance

***Arunabha Ghosh**, Chief Executive Officer, Council on Energy, Environment and Water*

Indian industry, particularly manufacturing, faces a huge challenge to procure enough energy to fuel future expansion. It faces three scenarios: ignore the problem, with the risk that limited energy supplies will cap growth and investment. Or internalise it, by securing captive energy sources—which might skew governance and retard the adoption of cleaner fuels. Or innovate in policy and practice across the energy supply chain and manage demand. Only one of these scenarios can ensure a sustainable energy future.

6. The distribution and infrastructure challenge: Improving India's grid network and rural connectivity

***Rajiv Lall**, Vice-chairman and Managing Director, IDFC*

India's massive grid failure in July 2012 was symptomatic of deep-seated problems with the country's electricity connectivity. The malfunction flows down the entire supply chain, from generation to transmission and distribution. Rural connectivity is especially poor, despite official claims that 90% of villages are electrified. The solutions are easy to identify: better grid management practices, higher electricity tariffs, improved billing/collection and greater private participation in the supply chain. Finding the political will to implement these steps is the difficult part, but the country's continued economic development depends on it.

7. Renewable energy in India: For now or the future?

***Rahul Tongia**, Technical Advisor, Smart Grid Task Force, Government of India, and Adjunct Professor, Carnegie Mellon University*

Are renewable sources the answer to India's energy problems? Their potential is undeniable: in five years they could account for 18% of capacity—if only about 6% of generation. Wind and solar could contribute much of this alone. But scaling up renewables generation means resolving fundamental challenges of supply volatility, grid integration, geographic dispersion and uncompetitiveness. Someone must bear the higher costs of renewable power sources. While the central government has developed several policies to this end, states—and consumers—might be less eager to finance further renewables development.

Economist Intelligence Unit, October 2012

5 Industrial demand and energy supply management: A delicate balance

Indian industry, particularly manufacturing, faces a huge challenge to procure enough energy to fuel future expansion. It faces three scenarios: ignore the problem, with the risk that limited energy supplies will cap growth and investment. Or internalise it, by securing captive energy sources—which might skew governance and retard the adoption of cleaner fuels. Or innovate in policy and practice across the energy supply chain and manage demand. Only one of these scenarios can ensure a sustainable energy future.

Arunabha Ghosh
Chief Executive Officer, Council on Energy, Environment and Water

The average Indian uses less energy than the average Chinese or Brazilian. And certainly much less than the average American or consumer in other developed nations. Consider this: in 2009 the average Indian used 560 kg of oil equivalent (kgoe) of energy. This was half the usage of the average Brazilian (1,243 kgoe), one-third of the average Chinese (1,695 kgoe), and one-twelfth of the average American (7,051 kgoe). Similarly, the average Indian in 2009 consumed just 571 kWh of electricity, compared with 2,631 kWh used by the average Chinese and 12,914 kWh by the average American.

Why does low energy use per person matter for India's industrial development? For a start, energy access is closely associated with human development progress. India's large, youthful population cannot become the foundation of the country's economic growth—fuelling income generation and demand for industrial products—if its schooling and studying are hampered by unreliable (or absent) power supplies, or its health endangered by exposure to polluting traditional fuels at home. Moreover, low levels of energy use usually reflect low levels of energy supply—which means that in India's energy-constrained economy, industry is competing for limited resources with several segments of society, not least an aspirational middle class.

Indeed, final energy consumption is dominated in India by the residential and industrial sectors, with the former taking a slightly larger share of the total energy pie (34% versus 33% for industry).[1] Industry uses a third of all electricity to run machinery, among other purposes. Since electricity generation is heavily dependent on coal, using 222.1m tonnes of oil equivalent (mtoe), it follows that industry is a significant user of

[1] Final energy consumption is defined as the total energy consumed by end-users such as households, industry and agriculture, excluding energy used by the energy sector itself.

coal (although this consumption goes beyond electricity generation). Industry consumes more than 90% of coal used in final energy consumption, a third of natural gas and a fifth of oil products. Coal makes up nearly half of industry's final energy consumption total of 163.3 mtoe (see Chart 1) and oil products account for 19%, while natural gas accounts for just 4%.

Under pressure: industry jostles for energy

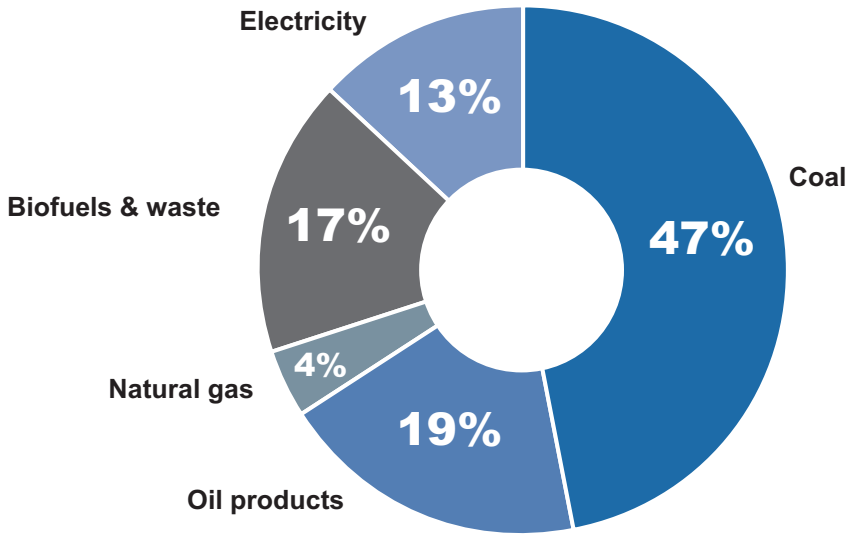
With demand expected to spike over the next few decades, competition for energy supplies is set to intensify. According to the International Energy Agency (IEA), energy demand in India from 2009 to 2035 will show the highest growth rate in the world. A dominant user of almost all energy sources, the industrial sector will feel the most pressure, although so too will the other two sectors, agriculture and services. Indeed, the services sector, which includes hotels, transport, communication, finance, real estate and business-related facilities, has a huge appetite for energy that is likely to grow. (Transportation is expected to show the sharpest rise in energy demand until 2020.) In agriculture, greater mechanisation and use of irrigation pumps on India's farms will mean greater demand for energy.

Government planning is expected to sharpen demand in the energy-hungry industrial sector. Manufacturing, which accounts for a little over half of industrial output, has been slated for a big push. The National Manufacturing Policy sets the lofty ambition of increasing manufacturing's share of national income from about 15% currently to 25% by 2025, creating 100m jobs along the way. But the policy does not spell out the energy resources needed to realise this vision. Although energy intensity has eased in manufacturing, falling by about 55% during 1992-2007, some studies indicate that this has been largely due to substituting alternative fuels for coal and changes in relative shares of different industries compared to actual increases in energy efficiency.[2]

Industrial sub-sectors that clamour for energy include iron and steel, which accounts for 16%

Chart 1: Final energy consumption by industry

(%, fiscal 2010, ended March 31st 2011)



Source: *Energy Statistics 2012*, Central Statistics Office, Government of India

[2] Because manufacturing straddles several industrial sub-sectors, it is difficult to determine from available data what proportion of final energy consumption by industry it accounts for.

of final energy consumption, and transport equipment, which accounts for about 7% (see Chart 2). But a large chunk (65%) of final energy consumption is classified as "non-specified". (This means it has not been attributed to sub-sectors despite being categorised under industry—a challenge for energy data collection and analysis.)

The main energy sources for industry vary by sub-sector. To the extent that final energy use is measured across different sub-sectors, coal provides 88% of energy use for iron and steel production, and 100% of energy use in non-metallic minerals, pulp and paper, and construction. By contrast, oil products are dominant in the chemicals and petrochemicals sub-sector, providing 94% of its energy requirement. Transport equipment, machinery, and mining and quarrying also rely entirely on oil products. There are other energy sources available for industry (see Chart 3) but government statistics do not break down their shares across the various sub-sectors. Clearly, there is a need to improve energy data collection and analysis, in order to understand and prepare for changing patterns of energy demand and usage in industry.

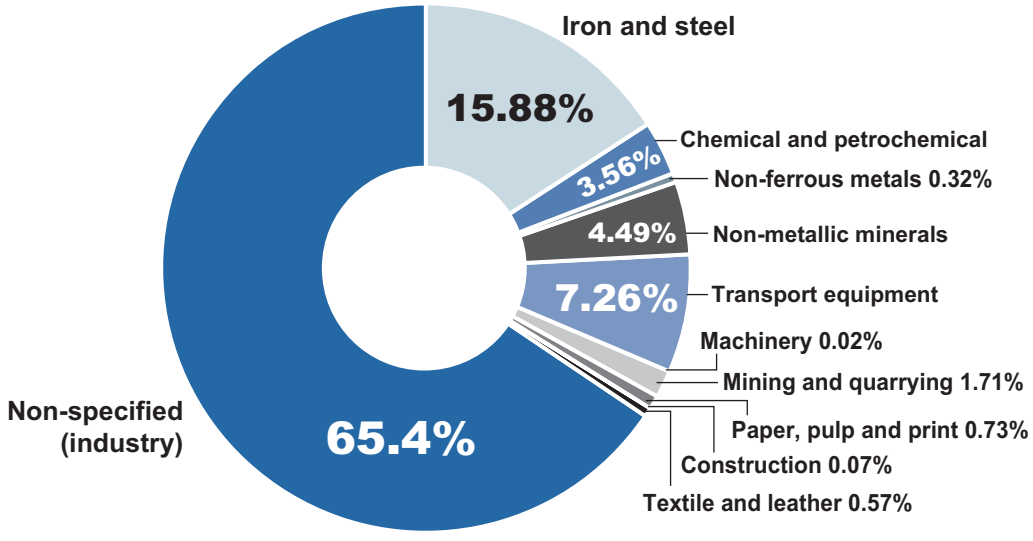
Higher economic growth = higher industrial growth = higher energy demand

To add to industry's energy pressures, the government aims to rev up economic growth overall. But if the Indian economy grows by an average of 9% a year until 2030, the International Energy Agency estimates that industrial energy demand will swell by three times, to more than 520 mtoe. The greatest increases in energy demand are expected in the energy-intensive sub-sectors: pulp and paper (which will see a seven-fold increase), aluminium, and iron and steel (which will both see more than five-fold increases). For all three sub-sectors the main energy source is coal, for which they will have to compete with electricity generators.

Further energy anxiety will come from a burst of developmental activity from states like Bihar, Chhattisgarh, Jharkhand and Odisha. After decades of being dismissed as the country's

Chart 2: Shares of industrial sub-sectors in final energy consumption

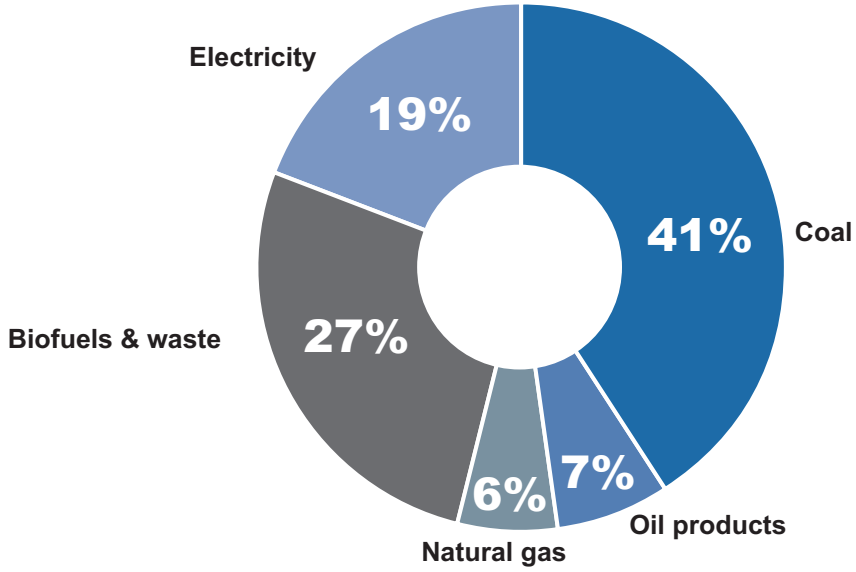
(%, fiscal 2010, ended March 31st 2011)



Source: *Energy Statistics 2012*, Central Statistics Office, Government of India

Chart 3: Shares of energy sources used by "non-specified" industry

(%, fiscal 2010, ended March 31st 2011)



Source: *Energy Statistics 2012*, Central Statistics Office, Government of India

basket cases, these states have begun in recent years to post some of the fastest economic growth rates in India. This is good news for the states, and for the country as a whole, but it means a sharp rise in energy demand in these states in all sectors.

Indeed, rapid growth in industry during the past decade has already led to soaring electricity consumption in that sector (see Chart 4, overleaf). Industry is not alone, however. Electricity consumption by the domestic sector outstripped that of agriculture for the first time during the same period.[3] But as agriculture grows from its current near-stagnant annual growth rate of less than 2%, its electricity consumption will also increase. Then either demand-side energy efficiency must be ramped up across all sectors or supply must increase.

Bottlenecks in supply

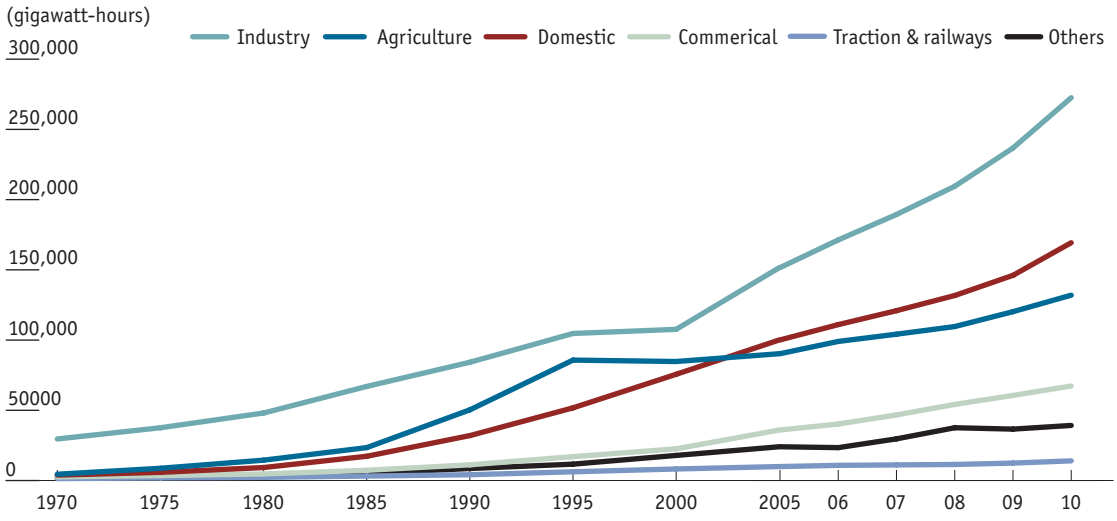
Therein lies the rub. India's primary energy supply was 659.7 mtoe in fiscal 2010 (ended March 31st 2011). When the Planning Commission of India drew up the Integrated Energy Policy in 2006, it estimated that an average annual GDP growth rate of 9%, combined with improving energy efficiency, would imply a primary energy demand in 2032 of 2,043 mtoe, a threefold increase over current supply. Future energy supply is unlikely to meet that demand.

First, domestic production of critical primary energy products has slowed in recent years (see Chart 5, overleaf). Crude oil production has remained flat for the past decade, and natural gas output has fallen short of growth expectations by increasing barely 1% annually since 2005. Even coal, of which there are abundant reserves, suffers from low growth rates primarily because of difficulties in extraction in forested areas. As a result, India's net imports of key energy sources are climbing—crude oil imports have jumped by 10.5% annually since 2005, coal imports by 12% annually.

Secondly, the infrastructure to handle the rising energy demand and subsequent imports is inadequate. While coal imports are expected to rise sharply to 343m tonnes in 2016 (a 432% increase over 2010), only four major ports handle coal imports (for a capacity of 63m tonnes), so minor ports pick up the slack. The major coal

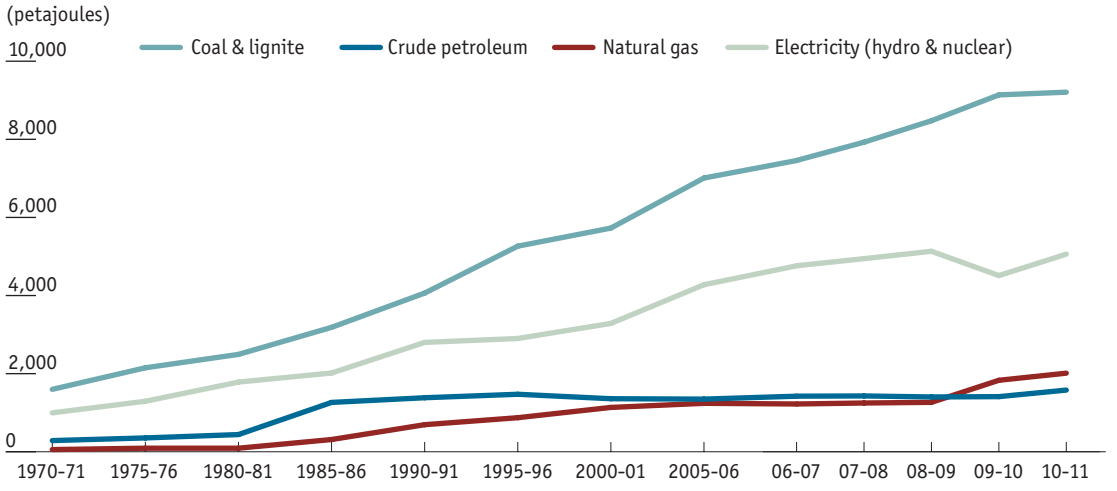
[3] The share of domestic intake might in fact be higher because unaccounted-for losses are often attributed to agriculture rather than to inefficiencies elsewhere in transmission and distribution.

Chart 4: Electricity consumption



Sources: *Energy Statistics 2012*, Central Statistics Office, Government of India; Central Electricity Authority

Chart 5: Production of primary sources of energy in India



Note: Thermal electricity is not treated as a primary source of energy

* 1 petajoule = 277.7 gigawatt-hours

Sources: *Energy Statistics 2012*, Central Statistics Office, Government of India; Ministry of Coal; Ministry of Petroleum & Natural Gas; Central Electricity Authority

ports are located along the eastern coast, which made sense historically because most power plants were located in the east (closer to the coal fields). But now some of the ultra-mega power plants are being constructed in the western states, where an industrial corridor between Delhi and Mumbai is also being planned. Either new railway freight lines will have to be built or more port facilities will have to be opened along the western coast, or both.

Likewise, the largest terminals for importing oil and liquefied natural gas (LNG) are along the west coast (closer to West Asian sources). But new sources of oil and gas from South-east Asia and further afield will require infrastructure development in the east as well. Finally, investments in grid infrastructure have long lagged a supply- side focus on electricity generation, not only in terms of transmission and distribution networks, but also of the staffing, training,

modelling and scenario planning crucial to the management and efficiency of a national grid.

Energy management for industry: ignore, internalise or innovate?

Given the yawning gap between energy demand and supply, it appears that industry, particularly manufacturing, is walking an energy tightrope if plans for rapid expansion go ahead. What are the prospects for balancing industrial energy demand with energy supply?

Under one scenario, the problems are simply ignored; there is no strategic approach to address energy demand or the need for energy efficiency within industry, nor is there a process to secure access to resources at home or abroad. In such a scenario, the best case would be for industry to grow to the extent of available energy. Power plants might have to write down usable capacity based on fuel availability, and iron and steel or other heavy industries might limit their production. A worse outcome would be a reversal of investment trends as Indian and foreign firms hold back on investing capital in new industrial capacity. Manufacturing and job creation, as envisaged, would stumble, and the share of industry (and manufacturing) in the economy could stagnate or even decline.

A second scenario envisages industry internalising, and taking the lead in securing access to captive energy. These could be via allocated coal blocks or captive generation of electricity. Industry also might seek private and exclusive access to other energy sources such as building natural gas terminals and re-gasification facilities. Again, a benign outcome would be an increase in energy efficiency in the form of either lower consumption because of higher energy costs, or better management of resources by the private sector. A less desirable outcome would be heightened corruption and opacity in the awarding of contracts and resource blocks—already a concern. There could be increased demand for (polluting) diesel fuel for captive electricity generation, say, in small and medium-sized plants. This in turn would skew energy governance even further, as both industry and agriculture would continue to expect inefficient subsidies on diesel and certain other fuels.

A third scenario proposes that the energy challenges will spur innovation. At a policy level, initiatives would focus on energy efficiency. For instance, the recently launched Perform, Achieve and Trade scheme for energy efficiency certificates could be expanded to cover more of industry (eight sub-sectors are covered currently). More importantly, the scheme could be deepened by offering incentives not only for overall plant energy efficiency but also for increasing efficiencies along the entire production process. Giving support to energy efficiency in small and medium-sized enterprises, which might not always have the financial and technical resources to undertake large efficiency-promoting investment, would be another approach. That said, energy efficiency would only ease some of the pressure, as the energy saved would be supplied to other firms.

Policy innovation involves appropriate energy-resource mapping for all sectors so as to anticipate and prepare for potential vulnerabilities in physical supply or fluctuating energy prices. This approach might push for rationalising energy supplies, and reducing, removing or narrowing the subsidies that badly distort India's energy market. Innovation could also occur in the energy infrastructure and supply chain. This would not be limited to building more port capacity (to handle imports of coal or oil and gas; two new LNG terminals should get commissioned by the end of 2012), new rail freight corridors (to supply energy to emerging industrial clusters) or transmission lines (for both fossil-fuel and renewable energy sources). Infrastructure innovation would include investing in software for energy management, training of grid operators, and building up a parallel "soft" energy infrastructure.

Energy-management innovation also could be found in technologies. For instance, work is already under way on solar power, second-generation biofuels and energy efficiency at a virtual US$125m Joint Clean Energy Research and Development Center.[4] Promoted by the Indian and US governments, the R&D centre is co-financed by research consortia comprising government, academic and corporate entities from both countries. Other initiatives include the National Mission on Enhanced Energy Efficiency, National Mission on Clean Coal Technologies, and National Solar Mission, all of which are part of the National Action Plan on Climate Change.

Technological innovation need not be restricted to upstream exploration and extraction activities for mineral resources. Technological breakthroughs in smart grids, usage efficiency, reduced land and water requirements, and better energy storage capacities, among other initiatives, could help to reduce demand at one end and improve stability of supply at the other.

Ultimately, energy demand for industry cannot be viewed in isolation, at the expense of critical human development priorities of energy access and overall economic growth across all sectors. The approach that industry takes to address its energy management issues—ignore, internalise or innovate—will determine Indian industry's development at an economic, environmental, social and political level. It has little choice other than to manage its energy supply in a sustainable way.

[4] The Council on Energy, Environment and Water acted as a facilitator for the initiative, but did not seek any funding for itself.

Cover image - Wai Lam

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