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Re-thinking Coal's Rule in India

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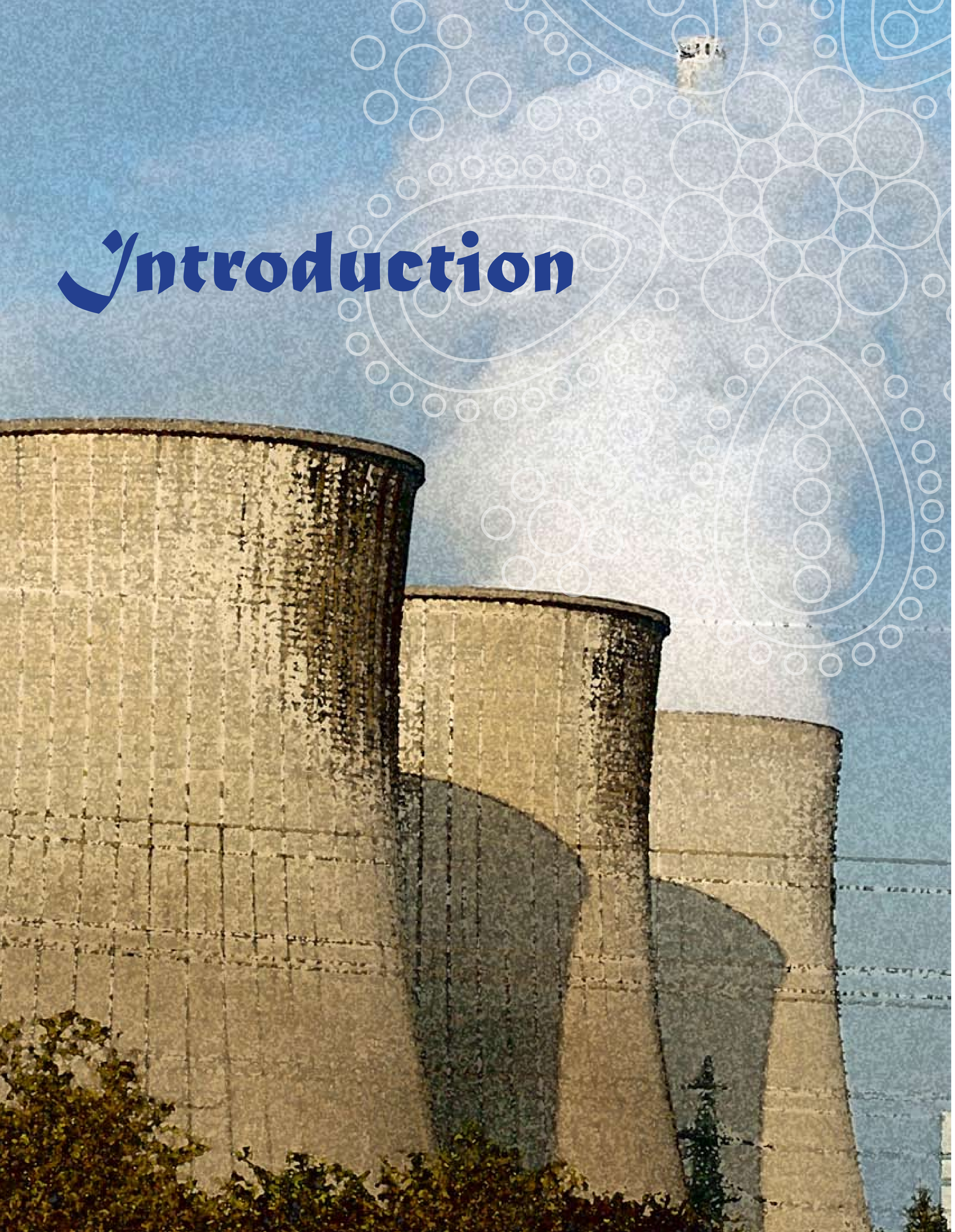


Introduction

As India claims its place in the world economy as one of two emerging giants re-defining the balance of global power, it finds itself on a track that could end its rapid growth.

India faces a potential energy crisis and the blame rests largely with its overdependence on coal. India's coal reserves — which have shaped its energy policies — have been grossly overestimated. This compromises India's argument for depending on indigenous coal for energy security reasons. But worse than the imminent shortage of domestic coal, are the severe social and environmental impacts inherent to India's coal sector — not least of which is the mounting problem of climate change.

Global warming is one of the most urgent and threatening environmental challenges facing mankind — and if unaddressed, the potentially cataclysmic effects will change the world as we know it. The average global temperature is now 0.74°C higher than it was in 1850, the point at which reliable temperature records became available. According to United Nations Intergovernmental Panel on Climate Change (IPCC) data, eleven of the last twelve years (from 1995 to 2006) are among the twelve warmest years on record. Scientists attribute the planet's rising temperatures to excessive amounts of greenhouse gas (GHG)–in particular carbon dioxide (CO_2) – emitted largely by fossil fuels, and which remain trapped in the atmosphere for long periods.

According to the International Energy Agency's (IEA) World Energy Outlook's business-as-usual (BAU) scenario, India and China presently account for 45 percent of world coal use and will be responsible for over three-quarters of the increase by 2030. Coal is trumpeted as the fuel of choice to power booming developing economies and raising millions out of poverty in countries like India. India is projected to need over 400 GW by 2030 – the current installed energy capacity of Japan, South Korea and Australia combined.[1]

As a result, India will become the world's third-largest CO_2 emitter by 2015. Two thirds of India's CO_2 emissions come from coal used in power generation, which will increase slightly to 69 percent by 2030. (It must be noted that India's per-capita emissions in 2030 will still be well below those in OECD today.)[2] Coal-use on this scale, however, is simply not sustainable in India and threatens the very lives that it is seeking to uplift through improved access to energy.

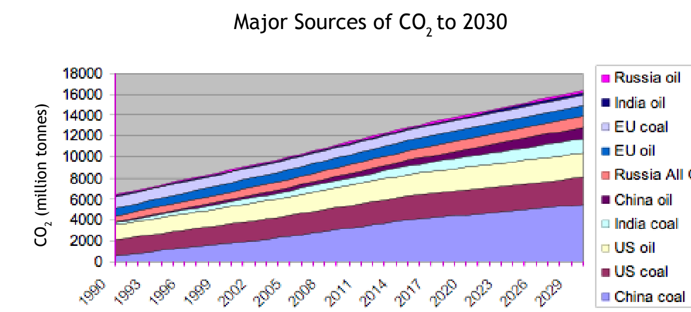
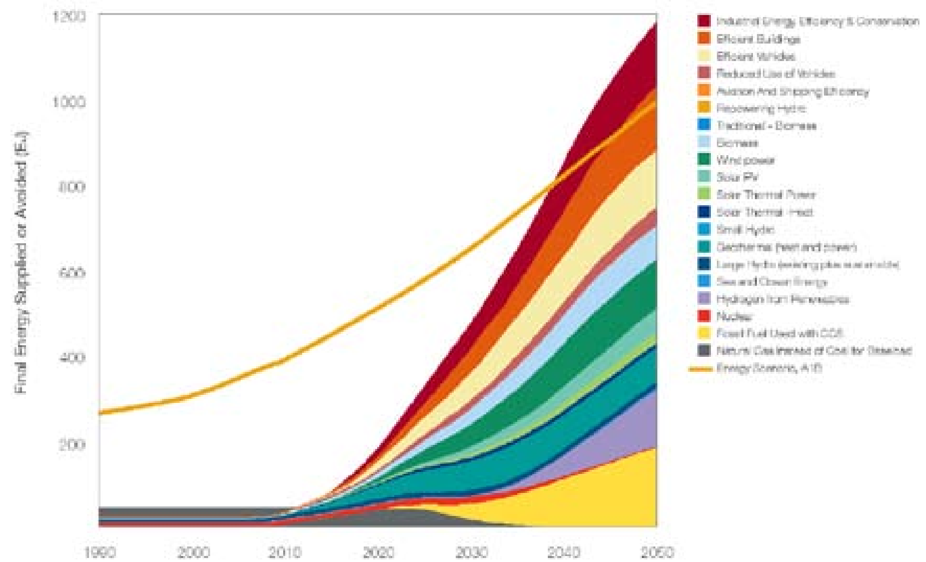


Figure 1: Coal use in China's and India's power sector are No. 1 and No. 4, respectively, of the 10 biggest sources of carbon dioxide globally by 2030, while US Coal and Oil rank no. 2 and 3 respectively. (Note that 'coal' figures are for power sector only and 'oil' figures are for transport sector only. 'Russia All Gas' is all sectors.) Source IEA World Energy Outlook 2006.

Climate Solutions: WWF's Vision for 2050, a global roadmap for the new low carbon economy, investigates how global economic development can be achieved whilst avoiding dangerous climate change. WWF concludes that the technologies and sustainable energy resources known or available today could be harnessed between now and 2050 to meet a projected doubling of global demand for energy services, while still achieving the necessary GHG reductions, in the order of 80 percent. Dangerous climate change can be avoided — *provided there is a significant shift away from global dependence on fossil fuels*. The report further states that there is still sufficient time to build up and deploy low or zero emissions technology, *but only if comprehensive action is taken in the next five years*.

[1] *International Energy Agency, World Energy Outlook, 2007*
[2] *Ibid.*

Caption: Figure 2 shows the impact of WWF's technology solutions and how they can replace projected fossil fuel use to 2050. The top yellow line refers to the energy demand projection in the IPCC A1B Scenario. Energy efficiency solutions need to be introduced immediately. Use of energy efficiency solutions effectively keeps overall energy demand flat from 2015 to 2020 onwards, even though provision of overall energy services continues to increase. Most energy consumption post-2030 is derived from various sources of renewable energies, notably wind, sustainable biomass, geothermal and various systems for harnessing solar. CCS only starts to penetrate in the period between 2020 to 2030, meanwhile gas without CCS is used heavily in the period between 2010 and 2040 to displace the use of coal.



For a coal-dependent country such as India, the urgency is clear on the need for alternative solutions such as energy efficiency, natural gas, and renewable energy–solar thermal electricity and off-shore wind[3] – to play their role in reducing India's carbon footprint. However, with coal likely to continue playing a role in India's energy mix, low emissions coal technology, such as Carbon Capture and Storage (CCS)[4], may become an option in the long-term. But according to WWF's Climate Solutions, even with CCS, CO_2 emissions remain a problem, and therefore the total worldwide coal use must be constrained to levels that will adequately mitigate climate change. WWF estimates that coal used with CCS can safely account for a maximum of 20 percent of the total global energy production by 2050.

For coal to play a role in India's energy future, the following measures are an absolute imperative to protecting local communities and the environment:

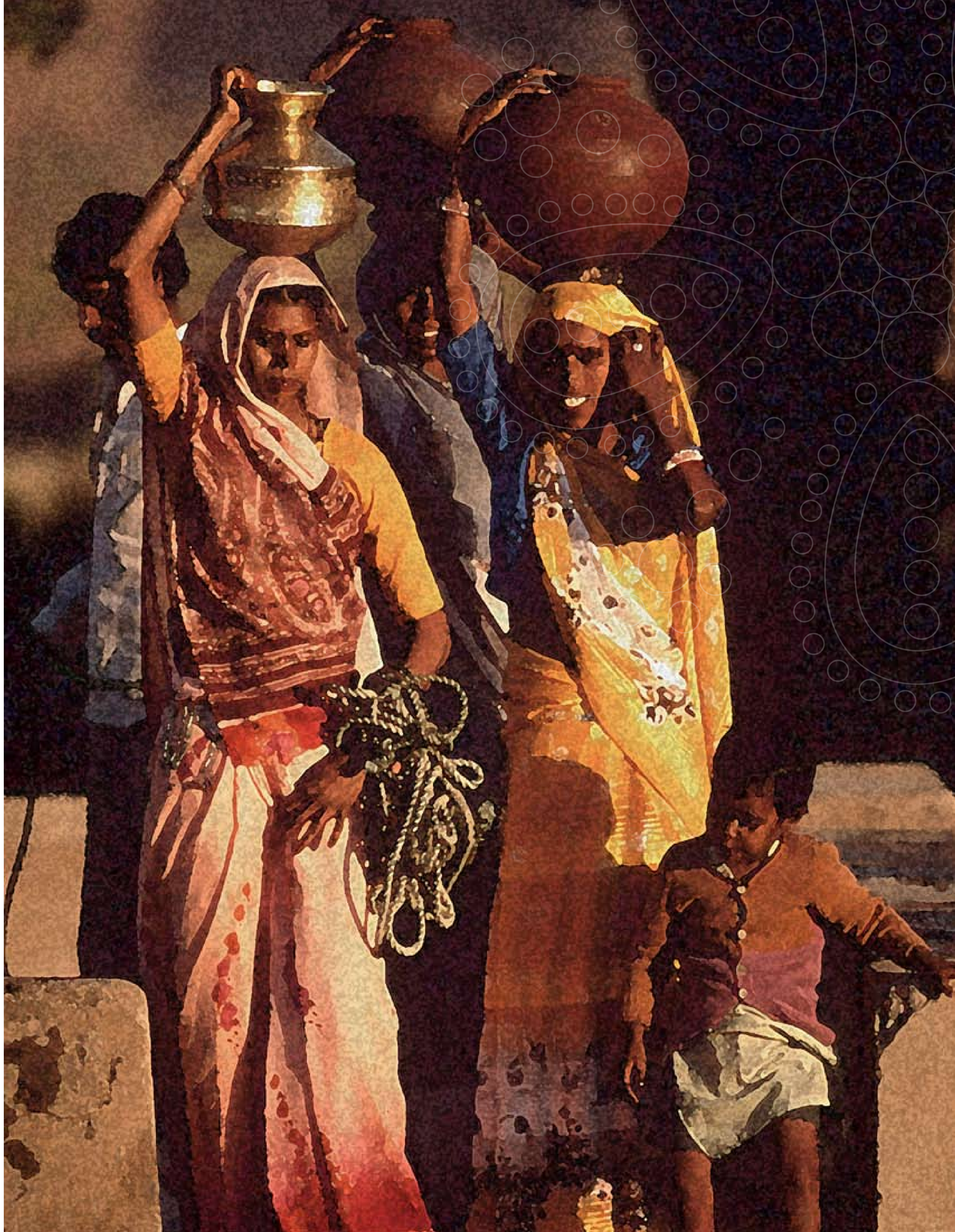
- The true costs of coal in India, arising from its social and environmental impacts, must be internalized so that funds are made readily available for research and development and immediate deployment of zero and low-emissions coal technology.

- Government policies must be strengthened–particularly the Environmental Impact Assessments (EIA), that involve civil society in decision-making processes and protect local communities from coal's negative impacts.

- Low-emissions coal technology – such as Supercritical, Ultra-supercritical, Integrated Gasification Combined Cycle (IGCC)[5], and eventually CCS–needs to be rapidly and widely deployed.

Because of the longevity of coal plants — some of which operate for upwards of fifty years — the decisions that India makes today will have long-term and in some cases irreversible ramifications for communities and the environment. The time to implement environmentally and socially responsible energy policies therefore is today.

[3] While these alternatives have enjoyed sustained government support, key initiatives are required to remove existing policy, regulatory, economic and institutional barriers.
[4] Carbon Capture and Storage (CCS), currently untested, is touted as the low-emissions coal technology most capable of dramatically reducing carbon dioxide output.
[5] Integrated Gasification Combined Cycle (IGCC) plants can reduce nitrogen oxides, remove 90-95 percent mercury, and reduce sulfur dioxide by 99 percent.



India and its huge appetite for energy

India's economic growth rate has averaged approximately eight percent over the past three years, and the Indian government predicts a growth rate of over nine percent in the next few years.

India's Eleventh Year Plan outlines the country's economic goals from 2007-2012, with a key focus on poverty reduction, providing affordable access to clean energy to all sections of society, and improving the standard of living. India's government recognizes that an adequate and uninterrupted supply of electric power is instrumental to the country's economic development, and therefore plans to make electricity available to all by 2011-2012. Given these trends and visions, it is abundantly clear that a rapid increase in India's energy requirements is inevitable.

King Coal in India

Coal remains India's most important fuel and predominantly used to generate electricity. Coal's share in power generation is predicted to increase from today's 69 percent to 71 percent by 2030.[6]

This dependence on coal, as well as the lack of infrastructure to support alternative forms of energy, is the historical fall-out of a shortsighted energy vision based upon the following:

- Availability and affordability of mature coal technology to meet energy needs during India's nation-building phase post-Independence
- India's ostensible abundance of coal as a natural resource
- The flawed yet long-standing belief that India has vast indigenous coal reserves
- Nationalization of India's coal sector between 1971 and 1973 that created a virtual monopoly, dominated by Coal India Limited (CIL) – a public sector behemoth with over 458,000 employees and significant political sway.[7]

Sectoral use of coal in India (2005-2006)

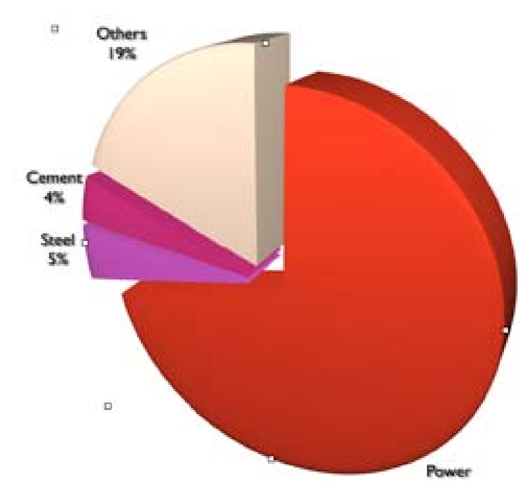


Figure 3 shows coal used predominantly in the power sector with 72 percent share in the year 2005-2006
Source: Coal Directory of India. 2005/06

Changes in India's Electricity Generation Mix in the Reference Scenario

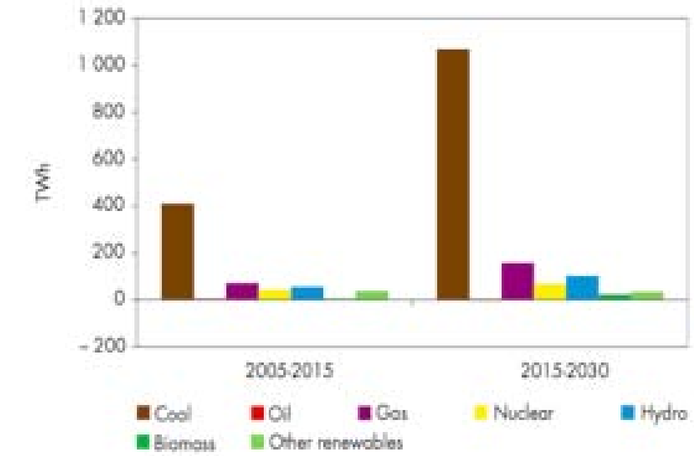


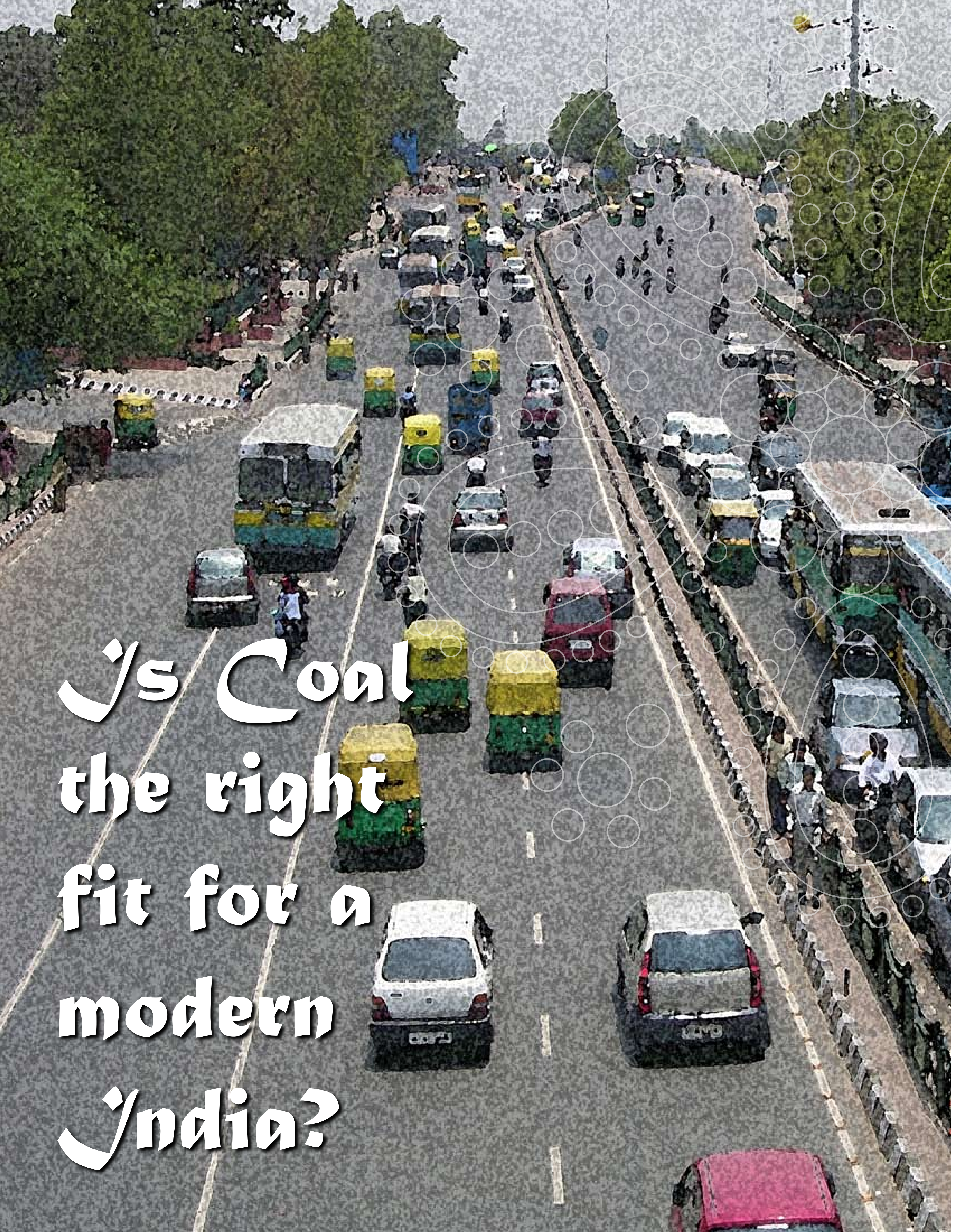
Figure 4 shows that coal's dominance in India's power sector will continue to 2030
Source: IEA, World Energy Outlook 2007

[6] *International Energy Agency, World Energy Outlook, 2007*
[7] *This has been addressed with a recent government decision to allow private sector bidding of coal reserve blocks.*

Natural Gas: An Alternative to Coal?

Given India's domestic fuel mix, natural gas is the principal alternative to coal. If natural gas proves to be more abundant than current assumptions—which is a distinct possibility given the potentially large projected yields from India's Krishna-Godavari basin, among other areas—then India's coal use could be considerably displaced. It should be pointed out however, that aside from being more expensive than coal, there are alternate, and potentially more lucrative uses for natural gas—in which case its marginal value could very well be higher than its value if used solely as a fuel. Therefore, competing uses for natural gas may reduce its role for use in power generation.

Is Coal the right fit for a modern India?



The economic, environmental, social and political realities of 21st century India are obviously much changed from the period following post-independence, when coal was considered an ideal energy resource. But coal is no longer a suitable fuel of choice for India, and is now seriously compromising the country's energy security and the health of its communities and natural environments. There are two reasons for this: India's questionable coal reserves coupled with limited production capabilities, and the social and environmental impacts of a coal-dependent energy structure.

Questionable Coal Reserves

There is a tremendous gap between India's reported coal reserves and the actual amount of indigenous coal available for use—this confusion can be traced to the method used in India to calculate its coal reserves. Instead of the well-known method developed by the United Nations Framework Classification (UNFC), which considers feasibility, economic viability and geological estimates when accounting for coal reserves, the Indian government has relied on a traditional Indian resources base statistics method that dates back to 1956. This assumes that all proven reserves are extractable. The unchallenged view is that India has enough coal to last over 200 years.

However, in 2006, India's Integrated Energy Policy Report estimated that if coal domestic production continues to grow at 5 percent per year, the total extractable coal reserves would run out in 40 years.[8]

It has become clear that previous reserve estimates were based on flawed data on availability and extractability. These misleading figures have fueled a skewed energy policy that has seriously handicapped the development of alternate forms of energy India. At business-as-usual (BAU) levels, India's current coal demands will lead to constrained domestic production and consequently the need for ever-increasing imports.

[8] *Planning Commission, Government of India, Integrated Energy Policy, 2006*

Limited Domestic Production

Just as India looked to coal as the quick fix to quell the energy demands of a fast-growing population, it also turned to surface mining techniques to address those same needs. Underground mining has been neglected in India primarily due to government policies aimed at increasing coal production in a very short span of time. Opencast mines are favored over underground mines because of their comparative short-term benefits, such as low costs and short gestation periods. Consequently, investments in new underground mining projects, in capacity building or in mechanizing existing underground mines, have been far below those of opencast mines.

In 2005, open pit mines accounted for 85 percent of India's total coal production, while underground mines yielded the remaining 15 percent. The dominance of opencast mining techniques in India means that coal resources below 300 metres remain inaccessible—at least without significant investments, technology transfer and adaptation, and research and development. It a distinct possibility that future coal explorations in India will lead primarily to deep deposits—and if that proves to be the case India may already have reached the point of diminishing returns with regard to coal.

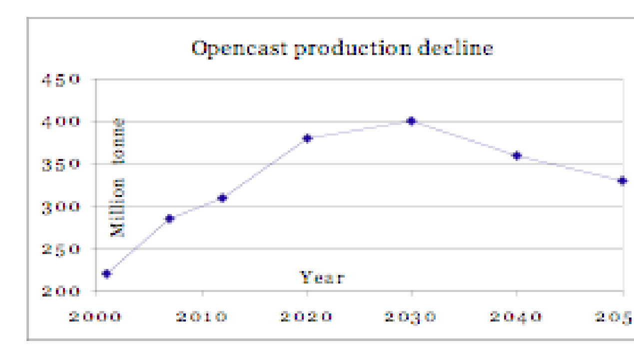


Figure 5 shows a projected decline in production from India's opencast mines from 2030 onwards
Source: Central Mine Planning and Designing Institute, 2001

Coal Imports: A Risky Business

India currently imports 12 percent of its coal supply due to inefficiencies in coal transport from mining regions to coal plants located in the coastal regions, low quality domestic coal, and slow reforms within the coal industry. By 2030, total coal imports in India will exceed coal imports into the entire European Union by ten percent.[9] Such a dramatic increase will give rise to a host of new energy security concerns, including economic consequences resulting from likely trends in world coal prices, changing trade patterns, investments in coal mines outside India, and potential geopolitical concerns.

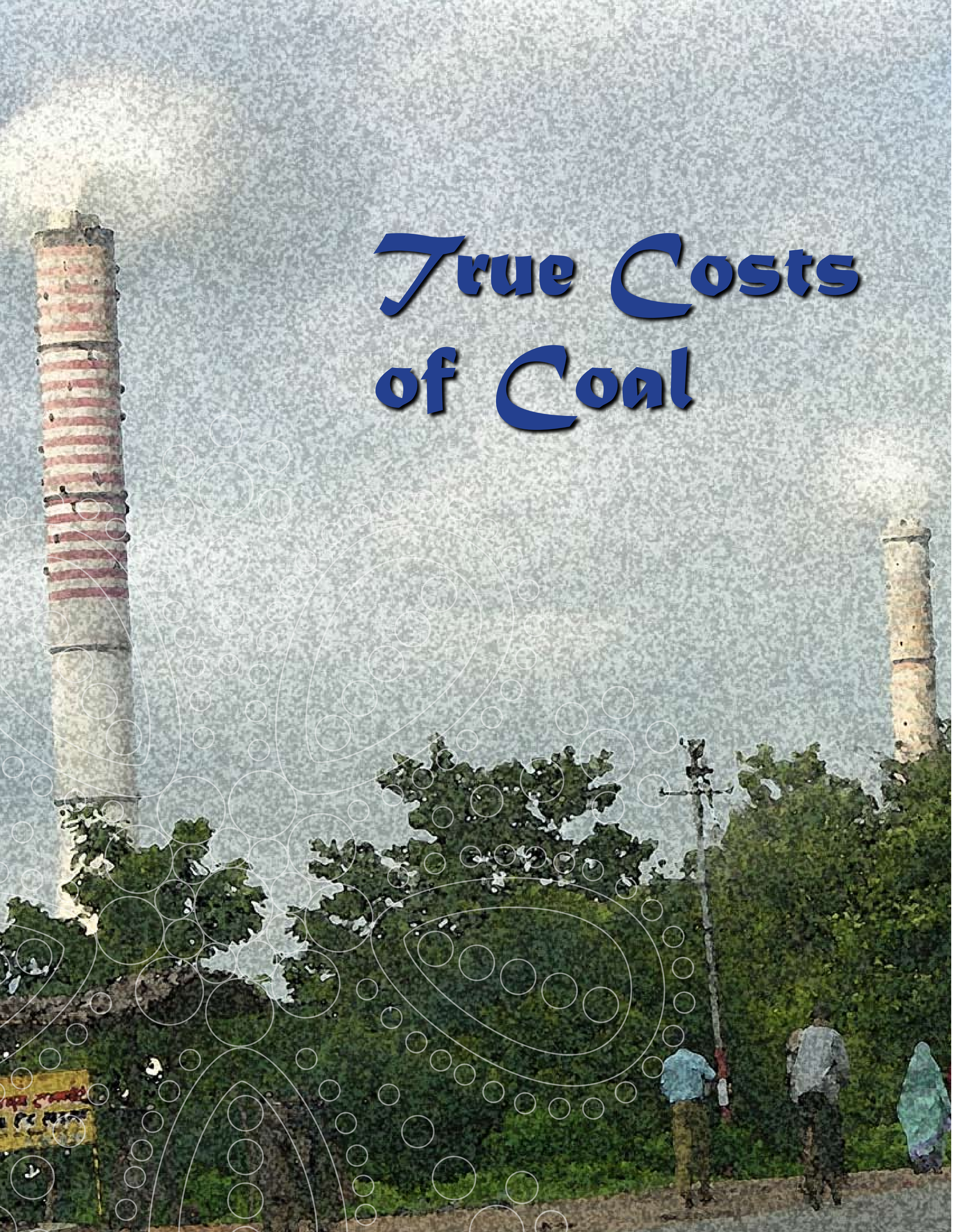
Coal is believed to contribute to enhanced energy security (given its advantages in terms of geopolitics, safety, economics, and the existence of a well developed market) but price volatility since 2003 and tight international and domestic coal markets, along with rising global demand pose concerns for developing countries importing coal.

The spike in coal prices from 2002 to the middle of 2004 was driven by a number of factors such as high domestic demand in China, a shortage of ocean going bulk carriers, weather related disasters, and problems related to mining, which affected output from Australia and Indonesia. These factors have eased off to some extent and for the time being, coal prices are expected to remain moderate. But unless coal exporters rapidly expand production capacity, the long-term effects of rising demands for coal in China, India and the United States, along with high mining and fuel costs, could drive a steep increase in costs for large importers of coal. If that were to occur, hedging and futures markets in coal, equity investments in other countries[10] and entry of new players to the coal market will very likely become extremely important aspects of the international coal trade, making coal security issues increasingly complex.

Indian planners and policy makers must consider the economic ramifications of increased imports as they make energy policy decisions today. Large investments in infrastructure will be necessary to support future imports — this includes port facilities on east and west coasts as well as dedicated rail freight corridors to transport coal from the port of import to power plants and other bulk consumers. Coastal plants can reduce this need to some extent but in the long run both kinds of infrastructure additions will be needed.

[9] *International Energy Agency, World Energy Outlook, 2007*
[10] *In 2004, Gujarat NRE Coke Ltd. acquired a coal mine in Australia. CIL has created an international wing to scout for equity investment opportunities in countries such as Australia, South Africa, Mozambique and Indonesia.*

True Costs of Coal



There are huge environmental and social costs attached to coal use in India but the current market price of coal does not reflect the value of ecological and social resources implicit to the exploitation and use of coal. Tragically, such costs often wind up being "paid" by those communities subject to coal-generated pollution, in the form of degraded natural resources, loss of livelihood, displacement, and a myriad of health problems.

Coal Mining

Coal is extracted either through underground mining or surface mining, also known as opencast mining. Key problems that arise during coal mining include particulate and dust emissions (which can exacerbate respiratory problems), methane release, changes in land-use pattern, damage to forests, land, biodiversity, and aquatic ecosystems, as well as contamination of water supplies. Such impacts have both immediate and long-term adverse effects on communities in a mining locality.

Dependent upon the scale of operation and technology adopted, mining can generate massive piles of wastes. Coal waste is susceptible to spontaneous combustion, which causes the release of toxic air pollutants and greenhouse gases. And waste disposal sites are prone to erosion, which leads to highly acidic runoff and seepage that is extremely hazardous to both terrestrial and aquatic ecosystems.

In India, mining land is frequently left in an abused state, in unclosed or abandoned mines. Considering the severe consequences of mining for communities and local environments, it is essential that steps be taken to reduce degradation of land. However, land reclamation is presently not a priority in India.

The outlook for coal miners in India is also often grim. In a report on labour conditions in an underground mine in Katras, India, the Asian Monitor Resource Center detailed a litany of safety offences, including: lack of proper safety equipment; inadequate lighting, rendering areas of the mine pitch-black; gas and heat saturated mines, causing miners to strip down to their underwear to cope with the temperatures; no proper toilets, creating an intolerable stench from makeshift bathrooms; and most pervasive of all, severe water shortages, often resulting in life-threatening dehydration, or consumption of polluted water.[11]

> In northern India, 50 miners died in a methane gas explosion last year in the hilly coal country around Dhanbad. According to inspectors and miners, operators cut corners, putting profits ahead of safety. "We are often trapped in the coal mines during monsoon," said Jeetan Ram, who recalled a mine flood that drowned 29 fellow miners in 2001. "We are at the mercy of the rain god."[12]

Coal Burning

Coal burning releases toxic air pollutants such as particulate matter, nitrogen oxides (NOx), sulfur dioxide (SO_2), and mercury, which cause respiratory ailments, cardiovascular illnesses, brain damage, coronary heart disease, and can lead to premature death.

Total SO_2 emissions in India reached 7 million tonnes in 2005 up from 3 million tonnes in 1990. Today, nearly two thirds of total SO_2 emissions come from the power sector, which reflects its heavy reliance on coal.[13] Experts predict that with weak government regulations on pollution, SO_2 emissions are expected to rise to 16.5 Mt in BAU scenarios.[14]

The global environment also suffers from toxic

[11] *Asian Labour Update, http://www.amrc.org.hk/4508.htm, 2002.*
[12] *International Herald Tribune, World's growing use of coal carries a cost in human lives, November 10, 2007*
[13] *International Energy Agency, World Energy Outlook, 2007*
[14] *Ibid.*

air pollutants — as seen by the formation, over time, of vast clouds containing particulates, sulfates, sulfuric acid and other toxic substances — which can cover a large region or move from the original source of pollution to other areas. The 'Asian Brown Cloud' is a startling example of such a region-wide phenomenon.

In addition to the pollutants that form toxic clouds, massive CO_2 emissions attributed to coal burning exacerbate climate change. If average global temperatures exceed 2°C higher than pre-Industrial Revolution levels, which they are on course to do, we could be looking at worldwide more than three billion people at risk due to water shortages; increased droughts in Africa and elsewhere which lead to lower crop yields; and three hundred million people will be at greater risk of malaria and other vector and water-borne diseases.[15] These drastic environmental changes are expected to radically disrupt ecosystems and result in significant biodiversity loss. The first comprehensive assessment of the extinction risk from global warming found that more than one million species could become extinct by 2050 if global warming pollution is not curtailed.[16]

Developing countries are the regions most vulnerable to climate change impacts. If for no other reason than self-preservation, it is imperative that India helps to steer global efforts towards low carbon lifestyles and technologies — lest the country finds itself wrangling with much bigger problems than the race to keep up with energy demands. According to IEA projections, aggressive economic growth in India will result in doubling of its coal consumption by 2030. If left unchecked, India's and the rest of the developing world's increasing dependence on coal will lead to global coal related emissions increasing by 63 percent by 2030[17], compared to required greenhouse gas reductions in the order of 80 percent by 2050 to keep climate change to manageable levels.

Increase in India's CO_2 Emmision by Sector

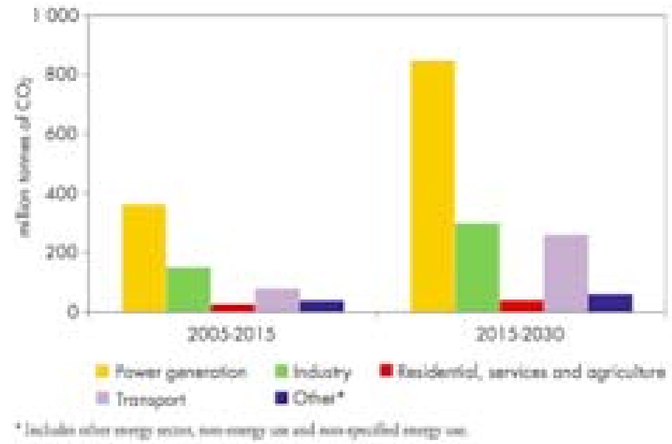


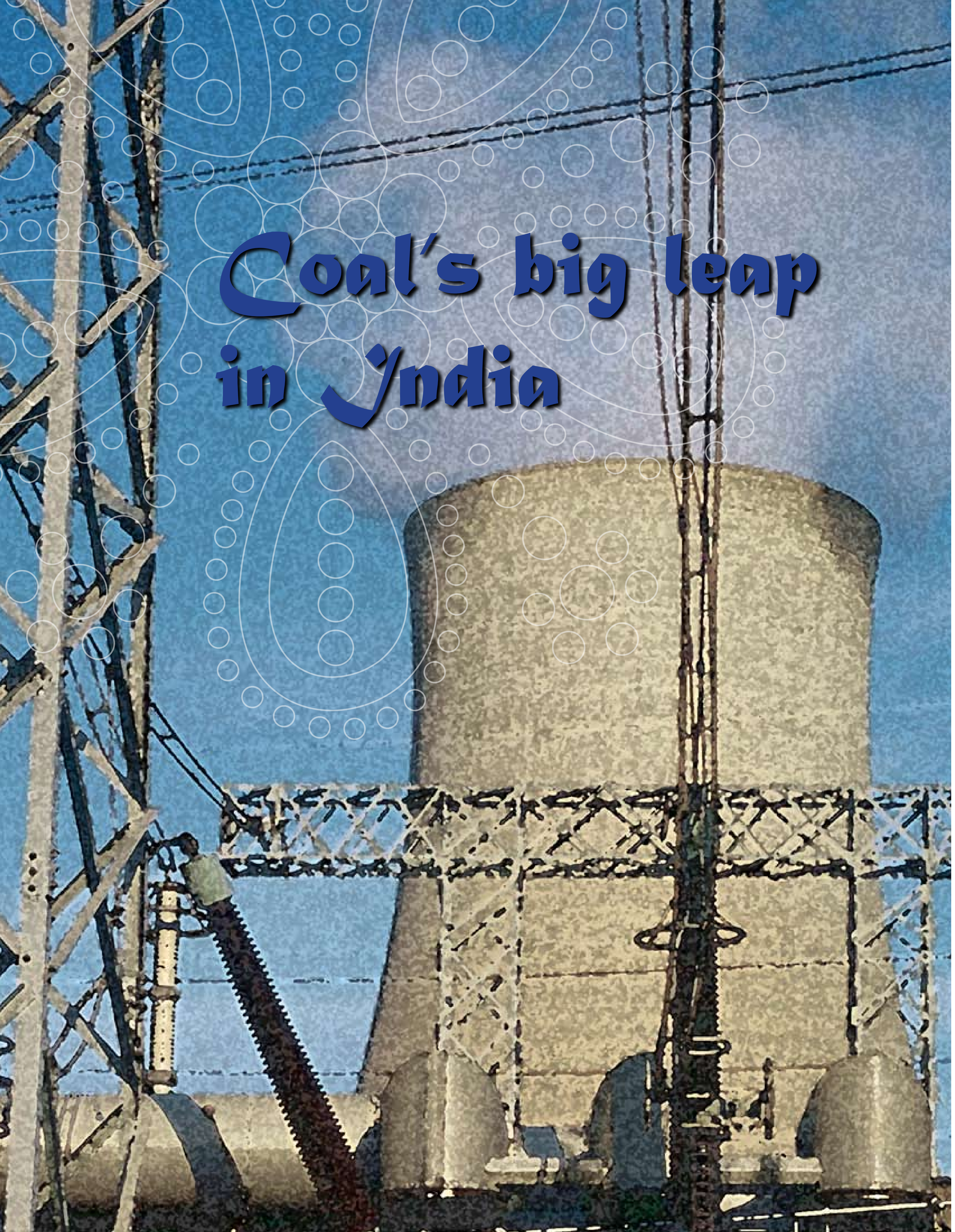
Figure 7 shows that CO_2 emissions from power generation, which are largely fueled by coal, will continue to be responsible for a large share of India's total CO_2 emissions. Source: IEA, World Energy Outlook 2007

Impacts on Communities

Communities living either with, or in close proximity to coal mines and coal plants receive the brunt of the industry's negative impacts — and in India, as in other developing nations, the bulk of coal mining's environmental costs are imposed upon impoverished and marginalised communities. Locals living in these coal-burdened communities endure degraded health, damaged natural resources, and increasingly, loss of their homeland. The Coal Vision 2025 of India's Ministry of Coal reveals that about 170,000 families involving about 850,000 people will be affected by coal projects by the year 2025. Large-scale population displacement raises serious questions about the ability to bear the costs of such rehabilitation, or to find adequate replacement land of similar ecological value. But institutional responses to such woes have been dampened by weak environmental laws and regulations, which effectively deny poor communities a voice.

[15] *WWF International, "Climate Solutions: The WWF Vision for 2050," 2007.*
[16] *Natural Resources Defense Council: http://www.nrdc.org/globalWarming/fcons.asp*
[17] *International Energy Agency, World Energy Outlook, 2006.*

Coal's big leap in India



Low emissions coal technology is more costly than a traditional pulverized coal plant, and this along with other barriers prevent widespread implementation of such installations in India. But low emissions coal technology has enormous potential to alleviate many of the environmental and social problems stemming from coal. And it is important to note that low emissions coal technologies are viewed as a viable solution for India given their dependence on the resource. However commercial low emissions coal technology alone does not solve the problem of global warming, and if coal is to continue to play a role in India's energy sector immediate solutions must be implemented to curb India's steep projected increase in CO_2 emissions.

Supercritical and Ultra-supercritical Plants

Supercritical and Ultra-supercritical power plants are older, more mature examples of low emissions coal technology in developed countries. These plants operate at temperatures and pressures above the critical point when steam begins to decrease in density. They are 45 percent and 50 percent, respectively, more efficient than traditional plants and produce significantly lower emissions. Efficiency levels of most coal-fired thermal plants in India are extremely low by world standards,[18] with the average efficiency in the region of 27 - 30 percent compared to the 37 percent in the OECD. Supercritical plants are a mature and commercially available technology in industrialised countries, with minimal increases in capital costs to that of sub-critical units. It is essential that India's new power plants implement supercritical technology, and that older sub-critical units are eventually phased out.

Ultra-supercritical plants operate at higher temperatures and pressures than supercritical units and consequently require the use of special steel alloys. These plants have already been set up in Japan, the European Union and the United States. As costs come down and alloy properties improve, such plants might become fully commercial within the next decade.

Experts predict that while power plants in India are expected to increase in efficiency from today's 27 percent to 38 percent by 2030, it will remain below the 42 percent average efficiency in OECD expected in 2030. According to IEA's Reference Scenario, no IGCC plants nor plants with CO_2 capture are expected to be built before 2030.

Pollution Control Technologies

Newer power plants in India come equipped with ESP (electrostatic precipitators) to reduce particulate emissions, but comprehensive retrofitting of older plants has not been carried out. At present, India has no mandatory controls for SO_2 and NOx. Sulfur levels in Indian coal are naturally low and therefore, SO_2 emissions from domestic coal are generally low but such controls are a necessity for large power projects and for plants using imported coals with higher sulfur content. As ultra mega-power projects emerge and volumes of imported coal increase, installation of flue gas desulfurization (FGD) systems to control SO_2 will become essential. This technology is mature and has been in international use for many years. The control of NOx emissions can also be done both at the point of combustion (through low NOx burners), as well as through the selective catalytic reduction technique. Unfortunately India lacks experience with NOx reduction systems and this is another area where there is a need to upgrade expertise and technology.

[18] Because of low efficiency, India's power sector is one of the most CO_2 intensive in the world. Power stations emitted on average 50 percent more than the average for the world. (World Energy Outlook, 2007)

[19] International Energy Agency, World Energy Outlook, 2007

State of Pollution Control in Coal-fired Power Plants in India

Particulate emissions:	Electro-static precipitators and fabric filters control particulate emissions with removal efficiency of over 99.5 percent	Technology developed and widely accepted both in developed and developing countries. However, not all old plants in India are retrofitted with ESPs
NOx emissions:	Low NOx burners are the key technological solution. Advanced combustion technologies can reduce emissions by 90 percent	Technologies developed and widely applied in developed countries. In India, low NOx burners are widely accepted but there is little experience with advanced reduction systems
SO2 emissions:	Flue gas desulphurisation and advanced combustion technologies can reduce emissions by 90 to 95 percent	Wide application in developed countries. In India there are no emission standards for NOx and SO_2. SO_2 emissions are currently dispersed through stack heights rather than controlled. Flue gas desulfurisation (FGD) is still not widely used.

Coal Gasification

Coal can be transformed into a gaseous state that makes it a convenient fuel, potentially to be used in a variety of applications. Coal gasification is challenging in India because indigenous coal has high ash content, which makes conversion to gas difficult and expensive. India has gained some experience in coal gasification using a moving bed process (commercially proven in Germany and South Africa) that can be used with high ash coals. Another technique, Fluidised Bed Combustion (FBC) is supposedly superior to the moving bed process for high ash coals but is currently at a research stage worldwide.

Combined-cycle-systems use both gas and steam turbines. The gas turbine requires coal to either be converted to a gaseous fuel or requires clean flue gas following the combustion of the coal. There are thus two alternative routes to a combined-cycle power plant – the PFBC (pressurised fluidised bed combustion) option, and the IGCC system. Efficiency levels in an IGCC plant are slightly higher than in Ultra-supercritical plants. IGCCs can be outfitted for carbon capture much more easily and cheaply than conventional and pulverized coal plants because the carbon can be removed in the gasifier, before the fuel is combusted. Even without carbon capture, the high thermal efficiency of IGCC plants means that IGCC plants release less carbon while producing the same amount of energy.

Carbon Capture and Storage (CCS)

CCS aims to permanently prevent CO_2 from entering the atmosphere through "carbon capture." Once the carbon is "captured" it must be stored, usually by injecting it deep into geological layers. CCS is touted as the low emissions coal technology most capable of dramatically reducing carbon dioxide output—which is important for countries like India, which are predicted to have steep increase in coal use, and therefore sharp rises in CO_2 emissions. Low emissions coal technology is a critical component of seamless introduction of CCS, as retrofitting traditional inefficient pulverized coal plants is more expensive and complicated compared to using coal gasification or ultra-supercritical coal plants.[20] However, the technology to accommodate such geological storage is still being refined, and CCS has yet to be proven commercially on a large-scale.

For India, the main barriers to large-scale implementation of CCS presently include the immaturity of technology and associated loss of overall generating capacity, installation and operating costs, virtual absence of data on location and capacity of carbon dioxide storage sites and weak environmental regulations. CCS requires a robust regulatory framework to ensure that it is implemented in a manner that is environmentally sound.

[20] *According to IEA's World Energy Outlook, 2007, the cost of retrofitting a coal-fired pulverized plant with CCS is estimated between US $66 and $122/tonne of CO_2. Using cost-effective technologies and favorable citing, the lowest costs achievable for CCS are currently estimated at US $50/tonne.*

Barriers and Constraints to Low-Emissions Coal Technology

Low emissions coal technology is virtually nonexistent in India at present. Even technology on the mature end – such as supercritical and ultra-supercritical power plants – and already in commercial use internationally, remain unavailable. The following helps to explain why low emissions coal technology has been slow to spread in India:

Intellectual property rights and patents: In some cases, parts of the technology needed to successfully implement low emissions coal solutions are proprietary and protected by strong international patents. Thus, licensing fees can be prohibitively expensive. Patent restrictions also often hamper the ability of host countries to adapt and innovate to imported technology.

Insufficient technology adaptation: It is often the case that solutions cannot be transplanted from one situation to another. Technology needs to be adapted to local conditions, and the research and engineering for this needs to come from the host country. In the absence of such efforts, directly importing and attempting to use technology solutions can lead to failure.

Lack of indigenous capacity: Even if the technology itself is available, there may be a shortage of trained manpower in the country that are needed to operate this new technology and conduct maintenance and repairs. If training services and maintenance require support from suppliers outside the country, costs can often become unmanageable. Insufficiently skilled operating staff can lead to operating faults and reduced efficiencies. Lastly, shortcomings in the in-house ability of companies to regularly carry out technology assessments can also prove to be problematic.

Lack of enabling frameworks: Technology transfer and diffusion require the presence of institutions to share knowledge internationally, and mechanisms for contact between different parties (non governmental organizations, governments, private corporations, universities and research laboratories). Tools such as information clearing-houses, knowledge databases and the growth of industry associations also aid technology transfer. These measures also serve to reduce high transaction costs (in terms of money or time), which are a big barrier when sourcing technology from outside the country.

Government policy and incentives: Low emissions coal technologies (and other environmentally sustainable technologies) would diffuse faster in the presence of the adequate motivating factors, such as financial incentives rewarding efficiency and clean power generation; well implemented regulations at different points in the supply chain; increasing awareness through measures such as labeling of products or green ratings given to companies; fostering national innovation through the establishment of research centers, potentially in partnership with the private sector; and funding of demonstration projects.

Risk appetite: Utilities and power companies (especially those in the public sector) may be very conservative in their willingness to take on the perceived risks in new technology (even if it is in use elsewhere). Insufficient in-house capabilities to assess technology options, along with the lack of this expertise elsewhere only serve to increase risk aversion.

Financing problems: Low emissions coal technologies often require significant capital. It can be difficult for companies to raise sufficient funds, and financing institutions that lack the know-how to assess capital requests for technology up-gradation exacerbates this problem. Thus risk aversion on the part of financial institutions can stall attempts to implement new technologies. Demonstration projects have a role to play in reducing the perceived risk for both utilities and financial institutions.

Way Forward

Under projected rates of coal use in India, pollution from coal can only be expected to increase exponentially. Urgent solutions are needed to allay problems surrounding energy security, and to protect the public and the local and global environment. A responsible approach to coal use that supports economic growth and poverty alleviation is critical, but only so far as it supports the health of communities and the planet. The following measures must be implemented to safeguard India's natural environment and spare humanity from the worsening impacts of coal use, and time is of the essence.

1. Internalising the true costs of coal production and use

Coal's market price reflects various cost elements including: mining, production, transportation and retailing costs, government levied taxes and fees, and profit and the relationship between supply and demand.[19] But this pricing system ignores some of the biggest costs of coal use: the local and global environmental and social impacts accrued by the exploitation, transformation, transportation and utilization of coal. If the price of coal reflected the external costs imposed on society by mining and combustion, investors would be more willing to devote funds to energy efficiency, renewable energy and low emissions coal technology, projects and policies would be developed with more sensitivity to the environment, technology would not be as cost prohibitive, and there would be increased funding for environmental restoration.[20] Coal's external costs could potentially be internalised through economic instruments such as pollution levies, charges and taxes, and trading permits.

2. Strengthening environmental regulations by empowering the public

For coal to play a role in India's sustainable energy future, and a role that instils trust in host communities, then transparent public participation in the decision-making process is an absolute priority. This is particularly critical in a weak regulatory environment. The Environmental Impact Assessment (EIA) is often one way the public can protect itself from unfettered industry development. However India's most recent version of the EIA law, issued in September 2006, was designed to streamline environmental clearance and reduce delays in order to encourage investment. Clearly this EIA law needs to be refined so as to fulfil its original purpose—to protect the environment and public from destructive industry practices.

[21] *Energy Foundation, "The True Social Cost of Coal: The external cost for the exploitation and utilization of coal in China: a preliminary study," 2006.*
[22] *Ibid.*

People's Power in India

In May 2006, the Climate Change and Energy Programme of WWF-India launched its People's Power Campaign, in cooperation with North Delhi Power Limited (NDPL), a TATA power utility. This project was initiated to increase sustainable practices in the Indian power sector, looking at energy efficiency measures in particular. The key strategy was to popularize this concept by engaging consumers.

The campaign has succeeded in helping to develop a network of Residents Welfare Associations (RWA) and Consumer Groups to advocate for increased transparency in energy decision-making processes. The government of Delhi, as the host for this pilot project, will help communicate the outcomes of the project among various stakeholders, with the end goal of replicating this on a national level.

The mission of the Peoples' Power campaign is to catalyze the development of a People-Governed Paradigm in the Indian power sector - which will lead to low cost, reliable and environment-friendly power generation and distribution systems in the country.

For more information:
www.peoplespower.org

3. Implementation of Low Emissions Coal Technology

While it is crucial for India to eventually transition to less carbon intensive fuels, pursue renewable energy, and practice greater energy efficiency, the country's immediate energy needs ensure a continued dependency on coal until accurate pricing and regulations curb its use. Therefore in the interim, low emissions coal technology, such as supercritical and ultra-supercritical power plants, coal gasification and CCS offer significant improvements in plant efficiency and marked reductions in emissions. According to a WWF study, substantive potential for energy efficiency remain untapped in the fossil-fuel based power supply sectors of China and India. Building only the most highly efficient coal power stations in both countries may reduce the needed electricity production by 2030 by 35 percent in India and 27 percent in China, and consequently reduce emissions.[23]

Recent studies, among them a report from the IPCC, show that measures to reduce GHG emissions have the added benefit of tackling the sources of air pollution.[24]

For low emissions coal technology to be viable for India, appropriate economic and regulatory incentives are critical. The following measures would significantly bolster commitment to low emissions coal technology:

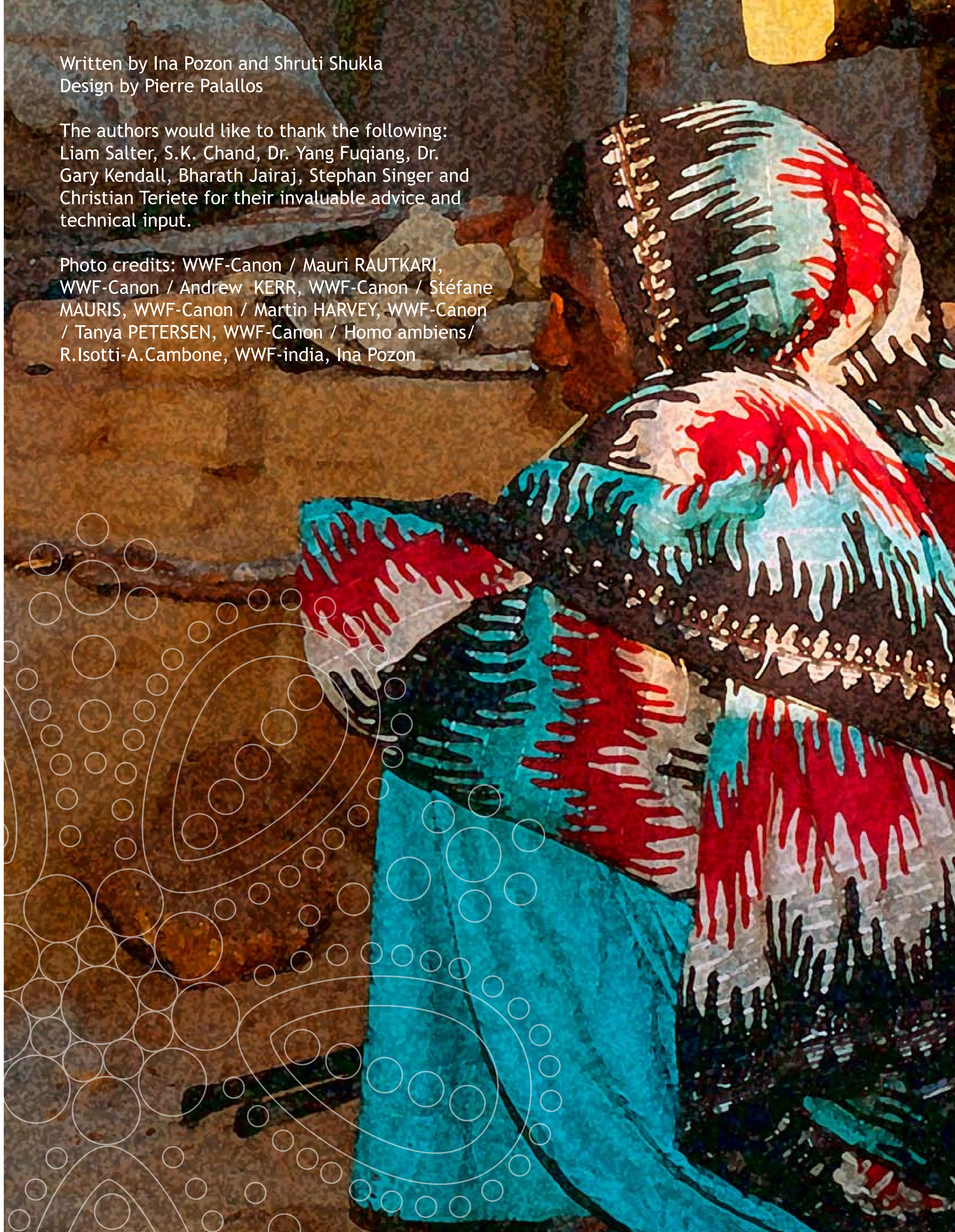
- Stricter, and consistently enforced standards and regulations covering the entire life-cycle of coal

- Mechanisms internalising the true costs of coal use, and ultimately an approach that places an explicit financial value on CO_2 emissions

- Intervention by governments to accelerate technology transfer

- Portfolio standards for low emissions coal technologies

[23] ECOFYS (commissioned by WWF for the G8 summit in Germany) "Making energy efficiency happen - From potential to reality" An assessment in G8 + 5 countries, 2007
[24] International Energy Agency, World Energy Outlook, 2007



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The authors would like to thank the following: Liam Salter, S.K. Chand, Dr. Yang Fuqiang, Dr. Gary Kendall, Bharath Jairaj, Stephan Singer and Christian Teriete for their invaluable advice and technical input.

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WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

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