



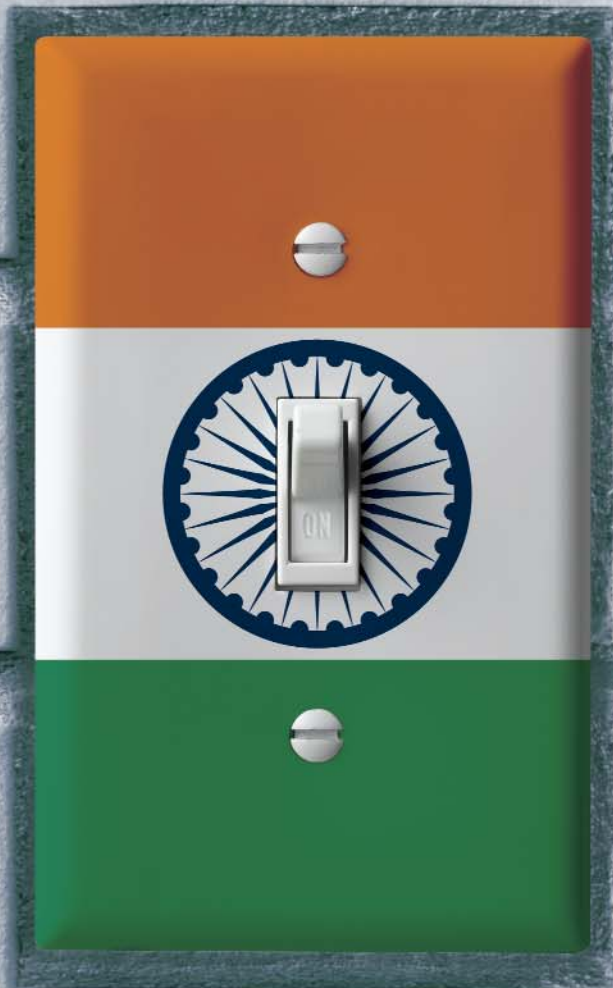
ENERGY AND NATURAL RESOURCES

# Think BRIC!

Key considerations for investors targeting the power sectors of the world's largest emerging economies

INDIA

ADVISORY







# Contents

Contents	3
Foreword	4
Introduction & Methodology	5
Executive Summary	6
1. India: Country in Figures	9
2. Population	10
3. Economy	12
4. Electricity Market	16
4.1. Electricity demand	17
4.2. Electricity supply	23
4.3. Ownership and investments in the Indian power industry	29
4.4. Main determining factors in the development of the electricity industry	32
5. Investment Opportunities	39
Acronyms	40
KPMG's ENR Practice Overview	41
KPMG's <i>"Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies"</i> publication series	45
Other KPMG Thought Leadership	46

# Foreword



**Péter Kiss**

Partner, KPMG Global Head  
of Power and Utilities

Energy is a global industry, vital to economic development and as such has strong political and social implications. The world's largest emerging economies, known in shorthand as the BRIC countries – Brazil, Russia, India and China – are in the top 10 global energy consumers and are home to 40 percent of the world's population.

The strong correlation between economic growth, welfare and energy use means that future demand levels, security of supply, energy mixes, production levels and general market dynamics will increasingly move to the fore as key issues.

Electricity is by nature a unique product. It is indispensable and it has no substitute. It is something we realize the importance of only when we experience a shortage. It is just enough to recall the biggest blackout in U.S. history in 2003 which struck parts of the Northeast, Midwest and even Canada, knocking out power to millions of Americans.

This publication is a part of a series of reports titled *"Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies: Brazil, Russia, India and China"* – aiming to highlight major trends and challenges shaping the evolution of these countries' power sectors over the course of the next decade in light of the global economic crisis.

In this publication we have attempted to turn market data into meaningful information and include top-level executives' perspectives on the evolution of the Indian power sector from political, socio-economical, technical, environmental and legal aspects. They offer scenarios they consider adequate to meet the supply-demand balance challenge in the short-, middle-, and long term.

Major questions raised during this research included how necessary investments in generation, transmission and distribution will be financed in terms of state support, privatization and foreign direct investments, how regulation will support the emerging trends and how global financial turmoil will affect the pace of development.

I trust that the contents of this report will offer you deep insights into these unique, emerging energy industry markets.

A handwritten signature in black ink, appearing to read 'Peter Kiss', written in a cursive style.



# Introduction & Methodology

This publication has been compiled by KPMG's Global Power & Utilities Knowledge & Resource Center, based in Budapest, Hungary as the Indian country report of the "**Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies**" publication series.

KPMG conducted comprehensive research both on- and off-site in India and our in-depth analysis characterizes the development of the electricity industry.

This report is partly based on a survey conducted by Ipsos, an independent international market research company, assigned by KPMG to interview key decision makers of the Indian power sector. Based on these interviews, professional databases, evaluations and KPMG forecasts, KPMG's Global Power & Utilities Knowledge and Resource Center compiled predictions for the development of the Indian power sector up to 2020.

During the survey period of March–May 2009, Ipsos' senior qualitative researchers conducted semi-structured personal interviews (based on a questionnaire prepared by KPMG) with top-level executives considered to be key stakeholders in the country's power sector. The target groups of the interviews comprised:

1. **Major market participants:** key players of the electricity industry bearing a dominant market position (both state-owned and privately held integrated electricity companies, TSOs, electricity traders)
2. **Regulatory authorities:** competent ministries, regulatory bodies
3. **Financial institutions:** domestic and international investment banks with dominant market share
4. **WEC** – World Energy Council
5. **Technological suppliers, equipment manufacturers**

The sample consisted of 17 prominent experts working throughout the power sector, and whom KPMG would like to thank again for the wealth of valuable information they shared for this report.

**In India, the following listed companies and their representatives contributed to our survey:**

Segment	Company
<b>Major Market Participants</b>	1. NTPC
	2. Powerlinks Transmission Limited
	3. Tata Power
	4. AES Corp.
	5. Oil and Natural Gas
<b>Regulatory Authorities</b>	6. Planning Commission
	7. Nuclear Power Corporation of India
<b>World Energy Council</b>	8. WEC
<b>Financial Institutions</b>	9. SBI
	10. IDFC
	11. World Bank
<b>Technology Suppliers</b>	12. ICICI
	13. Axis Bank
	14. ABB Group
	15. ALSTOM
	16. Andritz
	17. EMCO

# Executive Summary

Incredible India! says the slogan of the Indian Tourist Board in its attempt to lure the foreign visitor to sample the country's vast array of sights, smells and sounds; but Incredible India! could apply to the electricity sector as well, for its potential to lure foreign investment, know-how and equipment to south Asia is equally vast.

India's population, now around 1.1 billion, is growing fast, and is expected to surpass that of China soon after 2020 – making it the largest in the world. Its economy is also expanding, growing at around 10 percent annually from 2000 to 2008, and despite a current dip due to the global crisis, the pace is expected to be over 9 percent for most of the next decade.

All of this bodes well for the electricity sector; consumption, currently at some 600TWh annually, is set to double by 2020 – by when it will have surpassed Russian levels. To supply this extra electricity, total generating capacity should jump by 90 GW, to 241GW, with an increased emphasis on nuclear, clean coal and renewables, including solar and small-hydro.

In line with this, per capita electricity consumption, currently at just 520kWh annually, is expected to rise to 840kWh by 2020. Yet, though in relative terms this is an impressive leap of 60 percent, the projected figure, if realized, is still only about one quarter of the global average, meaning these predictions would not appear overly optimistic.

But such relatively low base figures beg the question as to why? Everyone accepts that India, as a developing country, inevitably lags behind the west in key economic indicators, particularly in view of its huge rural population.

But India has boasted of economic reform for almost two decades, turning its back on the socialist model so beloved by the first generation of post-independence leaders, so that market forces might boost progress. In addition, India has the lowest electricity consumption per capita of the four BRIC countries – so why are the electricity development indicators not more optimistic?

As this KPMG study reveals, while the state and federal governments have initiated reforms, social programs and legislation designed to supply electricity to all consumer groups across the country, the many conservative elements, systemic weaknesses and contradictions within India frequently combine to stifle progress.

What then, of the position today, and what progress can be expected realistically in the next decade? The advances made in the recent past can not be denied. A rural electrification program in the 1980s brought electricity to 200,000 villages for the first time. Generation capacity hit 150GW in 2006, a 40 percent increase on the 2000 figure, after reforms in 2003 initiated a much-needed restructuring of the power sector.

In 2005 New Delhi announced an ambitious plan for every village to have a grid connection by the end of 2007 and for every household to be supplied by 2012.

But concerns that these plans were flawed began to circulate almost as soon as they were released. For what is available theoretically is often not so in practice. Just because a village is connected to the network does not mean it is supplied continuously – and despite the progress made, one respondent of KPMG's survey estimated that at least 500 million Indians still have no access to electricity.

What though, of those consumers who are connected? Certainly those households that are connected have seen increasing demand; residential sector consumption rose from 70TWh in 2000 to 100TWh in 2006, almost 20 percent of the total. Some estimates put growth in this sector at between 15–20 percent in the coming decade.

Industry, which accounted for 210TWh of electricity in 2006 – 40 percent of consumed – is likewise expected to expand, with some market observers predicting up to 30 percent growth in the next five years, particularly if the power-dependent steel, coal and cement industries perform well.

Agriculture is a special sector, politically sensitive in the government's eyes, as it provides jobs for the rural and largely impoverished masses, and farmers have the legal right to free electricity.

Yet, in spite of this special treatment, rather awkwardly its share of total consumption decreased from 20.75 percent in 2000 to 17.4 percent in 2006.

Observers say that rural electrification programs should result in increased demand within the sector, but, as so often with subsidized or free power, such support is often plagued by corruption; one respondent noting in this study that *“much of the electricity consumption classified as agricultural is actually not so.”*

The commercial sector, which includes India’s fast-developing IT and off-shore back office service companies, has also seen rising demand, accounting for 7 percent of the total in 2006.

In general, increasing economic activity, wealth and population, leading to an improved standard of living and such

developments as shopping malls, are all expected to underpin a continuous increase in demand for power into the next decade.

Can the power stations supply this new demand? In short, the answer is no. Indeed, the current generating capacity has failed to keep up with user needs in this decade, with the shortfall being made up by imports, which almost doubled from 1.6TWh in 2005 to 3.0TWh in 2006. While the latter figure is still only 0.4 percent of total production, it is a trend which India can ill-afford to ignore. The country’s peak power capacity deficit is expected to widen in 2010 to 12.6 percent of total capacity, up from 11.9 percent last year, according to one report this summer.

India is rich in coal (albeit often of low quality), so it is no surprise that coal currently accounts for roughly 70 percent

of generation, with oil and gas making up another 12 percent. Hydro is another important component, with 15 percent.

For the future, thermal plants are likely to be the first choice for expansion, regardless of environmental concerns. As one respondent put it: *“It’s the fastest means to add power, and at this stage you cannot wait for the development of other resources.”*

Although official policy supports a low carbon economy on paper, most observers admit that in the rush for additional generation capacity environmental concerns will take a back seat.

This means the total thermal share of the production cake in 2020 will still be nudging the 80 percent line, particularly if the commercial conditions for retrofitting old, inefficient plants are introduced.



But market players expect – given the right conditions – a strong surge of investment into nuclear, with the current 3,900MW of installed capacity potentially rising to anything between 10,000 – 20,000MW. This could cause the nuclear share of production, currently less than 3 percent, to double or grow even more in a time period extending to 2030.

Observers also predict strong interest in renewables, particularly mini-hydro plants, wind, biomass and – if the price of hardware could be brought down to competitive levels – solar energy.

India has already made a start with wind farms – Suzlon building the world's largest installation of 1,000MW in Maharashtra. Wind, responsible for 1.1 percent of electricity in 2006, should more than triple its share by 2020. India has identified some 4,000 sites for mini-hydro schemes, and the total potential capacity is reckoned to be 15,000MW. (Large hydro, while offering huge potential, is not in favor at present due to environmental and payback concerns.)

As for solar, India receives a daily solar energy equivalent of between 4–7 kWh per square meter, depending on location, or over 5,000 trkWh per year, which far exceeds the total national consumption. But due to the high capital cost, solar energy is a minimum of five times more expensive than coal-based generation, so for the time being development will be limited.

Regardless, the energy sources are available for expansion, but can the transmission and distribution systems deliver? Or, perhaps more to the point, can they deliver on a commercially viable basis? For, as this study reveals, the aggregate technical and commercial

(AT&C) losses are shocking, reaching almost 50 percent in some states and averaging out at 25 percent across the nation – compared to a global average of some 8 percent.

For a start, technical losses across the system are higher than average, mostly due to inadequate investment by the publicly-owned utilities over the years, including ad hoc extensions overloading the system. There is also a lack of motivated technical staff, well-versed in modern technology and *“meaningful” – as opposed to formal – systems analysis.*

But theft and unauthorized connections are at the heart of these atrocious figures. Solving this problem will require not only investment in modern metering and monitoring systems, but an investment into human resources as well. As this report states, summing up the view of respondents; *“This business is the most complex among the three [power] segments. Apart from [hardware] investment, it requires significant managerial competencies. There is ..... an under-emphasis on managerial issues.”*

Respondents also point out that privatization is one effective means of combating electricity theft, citing distribution in Delhi as being *“efficiently managed”* by private players (although no data is given).

But privatization efforts, begun in 1991, have made little headway in the transmission and distribution segments, and only limited progress in generation. Participants point to the legal and regulatory uncertainties, along with incomplete tariff reforms, as the primary causes of this reluctance to enter the market.

As one respondent put it: *“Today, anyone can open a plant; but people do not want to invest as they are unsure when they will get their returns.”*

There is no doubt that pressure to bring genuine improvements to the sector – and to consumers – will increase, and that investment, whatever the sources will have to take place. The IEA estimated India requires a total of USD 960 billion investment in its electricity sector between now and 2030, with almost half of that in generation alone, and more than a third in improved transmission. The domestic Planning Commission estimates are more modest, forecasting the need for between USD 150–200 billion – although that is to cover needs for only the next five years.

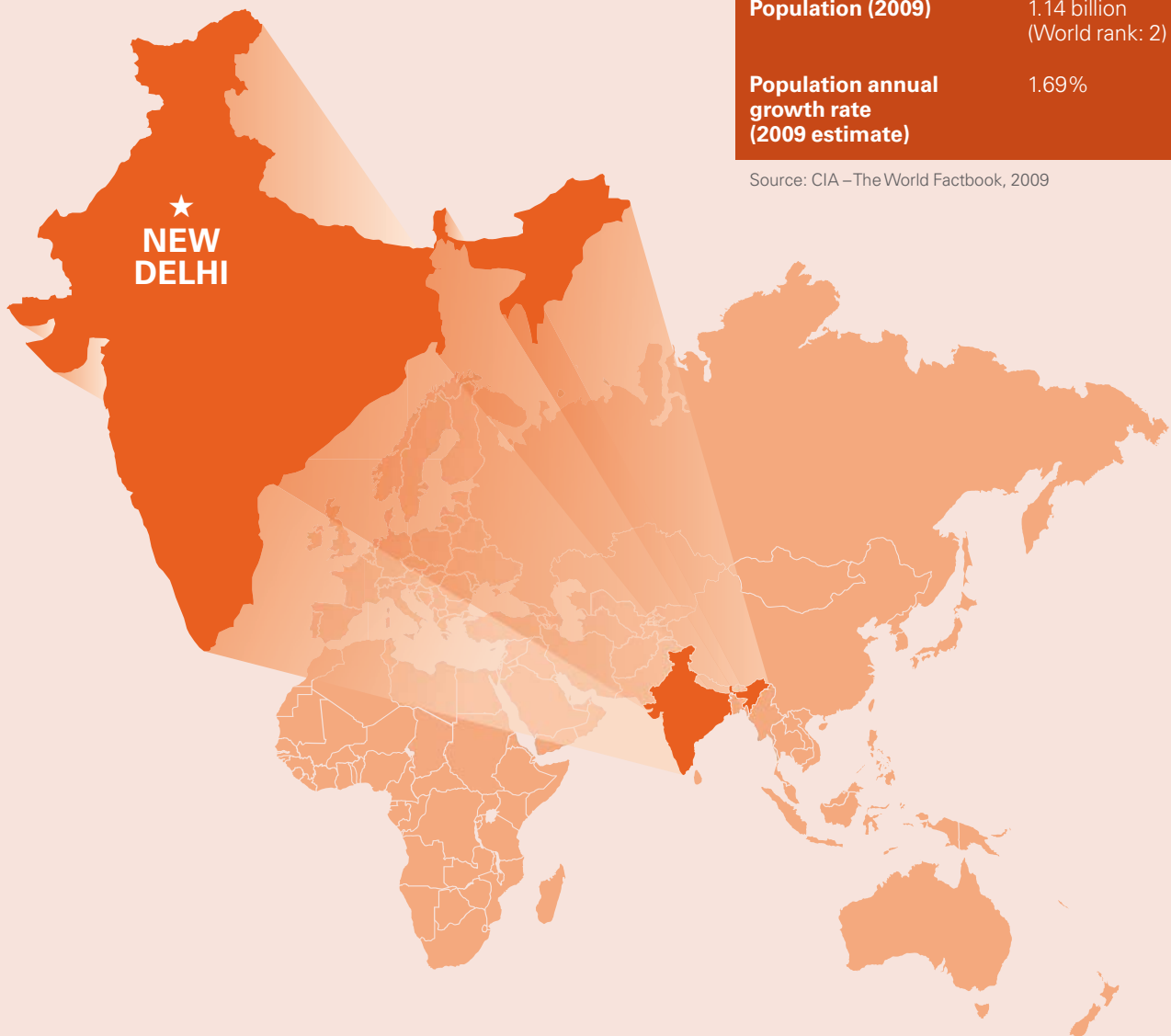
Some respondents to this survey expressed confidence in government assurances that a truly independent regulatory system will be in place as planned in 2010, and that this will support growth in private investment, either in independent merchant projects or, more likely, in public-private partnerships.

They also point to the private investors, notably Reliance, who have already made a start in building independent power plants, with the share of privately generated electricity currently at around 13 percent of the total and rising.

In short, there is no doubt the demand for an improved and expanding electricity sector exists in India, and that primary fuel is available in most cases. And while government finances will find it impossible to manage alone, private finance and skills are largely available if investors feel the regulatory and legal framework is made to work for a fair return. If so, targets such as the need to provide 90GW of new generating capacity by 2020 can almost certainly be achieved.

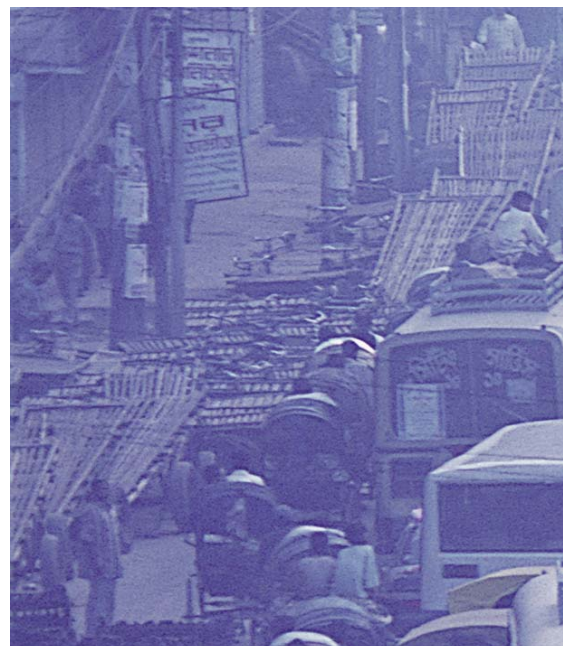


# 1. India: Country in figures



Source: CIA – The World Factbook, 2009

## 2. Population



Population growth is one of the main determining factors of energy use in India. Although the share of the residential sector in electricity consumption is only 19 percent, its share is expected to increase as a result of population growth and electrification allocation programs. In the overall economic growth of India, population is the determining factor in domestic consumption of goods, as well as in fueling the industrial output and domestic gross production. In this first section, India's main demographic trends and trajectories are presented to show the future opportunities in the country's economy and energy consumption.

Currently, in terms of global population India is second to China. The total population of India is about 1.1 billion, which accounts for 17 percent of the world's population.<sup>1</sup>

Population growth is significant compared to that of the other three BRIC countries or Western Europe. The Compound Annual Growth Rate (CAGR) of the population was 1.69 percent between 2000 and 2008 which is predicted to continue until 2020.<sup>2</sup> As shown in Figure 1, with this trend, the population of India will reach Chinese population levels soon after 2020.

The majority of India's vast population lives in rural areas – over 71 percent – indicating a slight decline due to the significant level of migration from rural areas to cities in the last two decades. Forecasts show that the urban population is going to double by 2030, while in the meantime the population growth of many major cities has slowed.<sup>3</sup> The proportion of the country's rural population is still higher than in most Asian countries, including China.

<sup>1</sup> Source: IEA World Energy Outlook 2007

<sup>2</sup> Source: EIU

<sup>3</sup> Source: IEA World Energy Outlook 2007

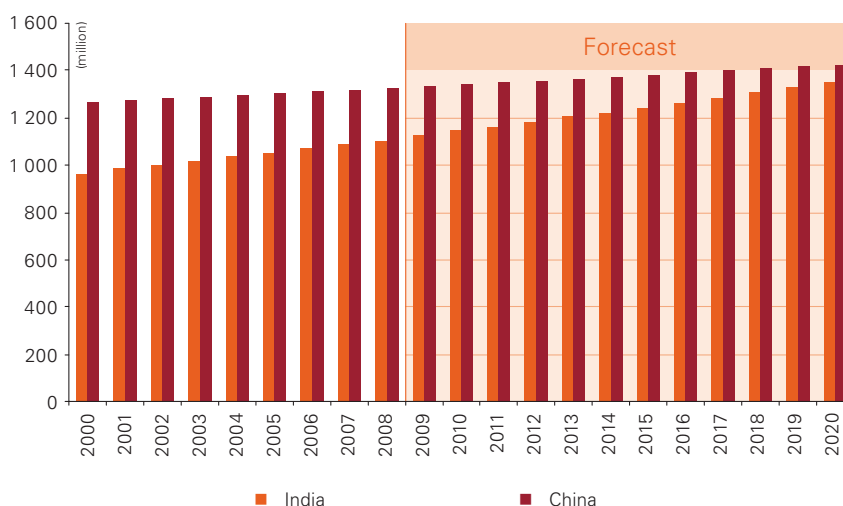


The fertility rate has fallen sharply in recent decades, while mortality rates have fallen even faster resulting in a rise in life expectancy from 54 years to 64 in the period 1980–2005.

Currently, the percentage of the population which is economically active is around 40 percent. If India’s demographic trends continue at this pace, the country is expected to gain an additional 270 million economically active individuals by the end of 2025.<sup>4</sup>

In the long run, the growing population will present fundamental social, economic, and environmental challenges for India. Due to the growth of labor participants, and a significant level of migration from agriculture to industry and services, there will be no low or medium skilled workforce shortages.

**Figure 1:** Population of India (2000–2020)



Source: KPMG, Economist Intelligence Unit

<sup>4</sup> Source: IEA World Energy Outlook 2007



# 3. Economy

*“India’s growth story is irreversible. In the next 10–20 years, despite the global economic crisis, India’s growth story will remain intact and the outlook will probably become even better...”*

*- Major market participant -*

An important relationship exists between a country’s economy and its electricity use. Interest in studying this relationship between electricity consumption and economic growth arises from the need to understand the complex links between the two. Electricity use depends on technical and economic factors, while it also supports advances in technology and stimulates economic growth. Gross domestic product, as one of the most important economic indicators, correlates with electricity use and presumably will do so in the future. Ferguson et al. (2000) found a correlation between electricity use and welfare<sup>5</sup> and numerous studies imply a relationship between the two. Our survey looks at the main factors affecting economic growth to consider the implications and shed light on future prospects for the electricity industry in India.

India’s economy is the world’s fourth largest with a GDP (at PPP) of USD 3,356.9 billion, and the country is the fifth largest energy consumer in the world.

India’s growth has been continuous over the last three decades, mostly due to the boom in private investments and in manufacturing.

Services, which used to make up the largest share of India’s economy, are expected to remain its main driver in addition to manufacturing. The future growth of India’s economy lies with structural and business reforms, fiscal discipline and removing barriers to trade and investment. One of the largest and most critical challenges for India is poverty.<sup>6</sup>

## Nominal GDP

India is one of the largest developing countries, capitalizing on its considerable number of educated people. India’s GDP rallied in recent years, resulting in 13.2 percent growth in 2006 and 12 percent in 2007. In 2008, 8.3 percent GDP growth was boosted by a manufacturing sector that expanded significantly. This strong GDP growth also brought inflation concerns to the fore.



**Figure 2:** Main economic indicators

<b>GDP (PPP)</b>	USD 3,356.9 billion (2008)
<b>GDP real growth rate</b>	6.6% (2008 est.)
<b>GDP/capita (PPP)</b>	USD 2,924.1 (2008 est.)
<b>GDP composition by sector</b>	agriculture: 17.2% industry: 29.1% services: 53.7% (2008 est.)
<b>Labor force</b>	523.5 million (2008 est.)
<b>Labor force by occupation</b>	agriculture: 60% industry: 12% services: 28% (2003)
<b>Unemployment rate</b>	6.8% (2008 est.)
<b>Level of electricity provision to households:</b>	Total 67.9% (2006)
<b>Industrial production growth rate</b>	4.8% (2008 est.)

Source: CIA – The World Factbook, 2009

<sup>5</sup> Source: Ferguson, R., Wilkinson, W., Hill, R., 2000. Electricity use and economic development. Energy Policy. 28, 923–934.

<sup>6</sup> Source: EA World Energy Outlook 2007



India's economy exhibited growth of about 10 percent annually, between 2000 and 2008. Nominal GDP was USD 3,356.9 billion at PPP in 2008<sup>7</sup> which represented approximately 5 percent of the total world GDP (at PPP) in 2008. This outstanding performance has slowed down, partly due to the financial crisis. Despite this, the country's nominal GDP is predicted to grow by 5.6 percent until 2010. After 2011 that growth is expected

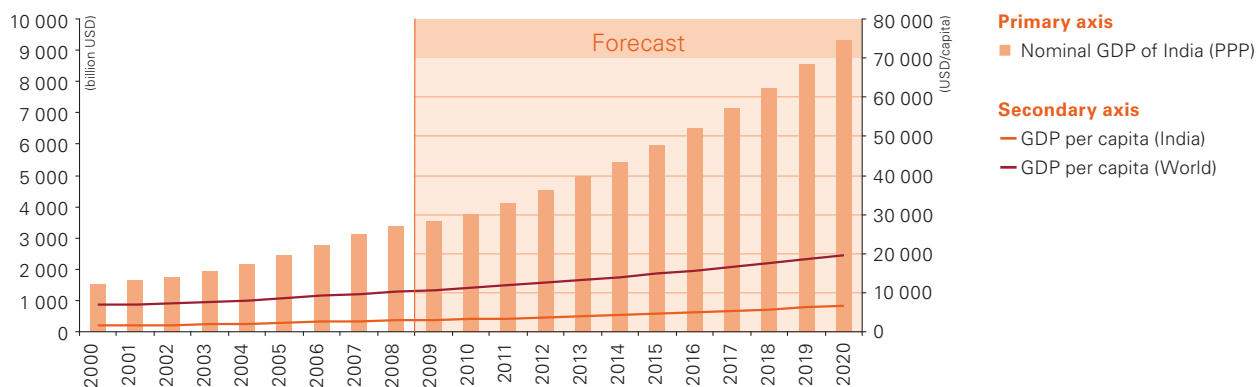
to show a 9–9.5 percent increase through 2020. If the trends continue, according to forecasts the nominal GDP of India is expected to represent 6.4 percent of the total global GDP (at PPP) by 2020.

### GDP per capita

GDP per capita was estimated at USD 2,924.1 in 2008, which is less

than one-tenth of the Western-European level (USD 34,420) and 32.8 percent of the world average for 2008.<sup>8</sup> In spite of having a high population growth rate, India's GDP per capita growth is still higher than the global average. This is due to the fact that the country's economic growth is proportionally larger than the population growth.

**Figure 3:** India: Nominal GDP (PPP), GDP per capita



Source: KPMG, EIU

<sup>7</sup> Source: CIA – The World Factbook, 2009

<sup>8</sup> Source: CIA – The World Factbook, 2009

The CAGR of GDP per capita in India is forecasted at 7–8 percent in the period 2000–2020. Overall, India’s GDP is set to reach USD 6,655 in 2020, which would be 34 percent of the world average (up from the current level of 32.8 percent).

## Foreign investments

The development of the Indian economy is also supported by the increasing potential of foreign direct investment. The government has reduced controls on foreign trade and investment activities resulting in higher FDI in certain sectors such as telecommunications. Conversely, present tariff systems and the lack of economic reforms are blocking the expansion of foreign investment. Privatization of government-owned industries is not moving forward, remaining a political quandary.

### **How do you see the attractiveness of India for foreign capital investment during the course of the next five years?**

According to recently published rankings, China and India sit in the top two positions for most positive investor outlook and most preferred offshore investment locations for business processing functions and information technology services.

*“Though China has been more attractive in the past, India is showing positive growth now. Investors take their time entering the country but once they have entered they stay....”*

- Major market participant -

India’s strong performance is mainly driven by the desire of manufacturing, telecom and utility enterprises to make productivity-enhancing investments in IT, BPO and R&D.



Survey respondents also confirm that India is seen as an attractive candidate for FDI. The fact that India’s growth rate is 5 percent and is expected to grow at the same pace reflects an overall magnetism, which is likely to increase in the future.

*“India is an attractive destination for foreign capital investment. People are witnessing the country’s growth. They also want to sell their products and are expecting good returns. They have realized that there is a market here and a huge demand.”*

- Major regulatory agency -

*“In a growing economy like India’s where there is an inherent demand, you have a lot of potential to grow.”*

- Major technology supplier -

Respondents listed the following reasons underlining India’s attractiveness for FDI:

- There is a total change underway in the country’s economic structure. India is becoming a developing country in contrast to an underdeveloped one.

*“India bore the tag of “underdeveloped country” but now it is turning into a “developing nation”, which highlights the need for better infrastructure.”*

- Survey participant -

- Developing nations entail changing lifestyles and growing consumption levels which offer a broad scope of opportunities for investors.
- India’s GDP growth is vastly higher than most countries’ across the globe.
- Government and private utilities are endeavoring to set up an infrastructure framework to facilitate investments in the country. Some positive examples cited by the respondents include the DMRC<sup>9</sup> project, which has changed the face of Delhi and the Andhra Pradesh Irrigation Projects.

9 Delhi Metro Rail Corporation (DMRC)



India is in an advantageous position for future investment in production and manufacturing facilities as production costs should remain comparatively cheap in India.

*“Unlike developed countries like the USA, those in Europe and others which have less scope for further investment, India offers a favorable place for future investment in production and manufacturing facilities.”*

- Major technology supplier -

Some factors however are negatively affecting how India is perceived in terms of the country's level of attractiveness.

The following obstacles were mentioned by respondents:

- A high dependency on foreign capital makes the country's economy weak.

*“We need to keep a close watch; foreign investments are leaving our country, making it a weak economy.”*

- Major financial institution -

- Regulatory and political decision making processes face bureaucracies instilled with corruption, resulting in delays in approvals, business disputes and an increased overall country risk profile in terms of FDI.
- Structural issues, primarily the lack of physical infrastructure (roads, airports, harbors, power etc.), are prevalent.
- Specifically in relation to the power sector, some felt that Enron's debacle at Dabhol raised some doubts in the minds of the investors, resulting in a need for the government to restore some faith for investors.

**Figure 4: Fossil resources of India (2008)**

	Proved Reserves	Production	Consumption
Oil	5.8 billion barrels	0.76 million barrels per day	2.88 million barrels per day
Natural gas	1,009 billion cubic meters	30.6 billion cubic meters	41.4 billion cubic meters
Coal	58.6 billion tons	512.3 million tons	608.3 million tons

Source: BP Statistical Review of World Energy, 2009

## Energy economy

Though India is abundant in natural resources, the country's rapidly increasing appetite for energy substantially exceeds its current production. More than 50 percent of the country's total primary energy supply is covered by coal, of which India is a major importer, since the growing power sector consumes 72 percent of the coal supply.

**Figure 5: Main energy indicators of India, 2006 (million TOE)**

<b>Production</b>	435.64
<b>Import-Export</b>	134.83
<b>Dependency (Net Import/TPES)</b>	24%
<b>Total Primary Energy Supply (TPES)</b>	565.82
<b>Total Final Consumption (TFC)</b>	378.48
<b>Conversion Rate (TFC/TPES)</b>	67%
<b>CO<sub>2</sub> emission (million tons)</b>	1249.74

Source: OECD/IEA Energy Balances of Non-OECD Countries, EIA, CENEF, UNESCAP

Oil represents one-third of India's primary supply mix, while natural gas adds a further 8 percent. India's oil refinery capacity of about 3 million barrels per day exceeds the needs of the domestic market; however, the country buys big amount of crude on global markets. India has also imported 10 billion cubic meters of natural gas in recent years, through LNG terminals. Natural gas fuelled power plants burn 35 percent of the total gas supply. Growing nuclear power and hydroelectricity contribute 8–9 percent to the total primary energy supply (TPES). Though the renewable energy sector is growing fast, in terms of TPES it is still not significant.

Households are the main consumers of end production, since residential consumption accounts for 42 percent of the total final consumption (TFC). Industrial share of TFC comprises nearly 30 percent, while transportation represents a bit more than 10 percent.

# 4. Electricity Market



The accelerated growth of the Indian electricity sector started when the country gained its independence. Since then, one of the main goals of the Indian government has been to provide the nation with a reliable supply of electricity and to maintain its economic growth.

In the 1980s, rural electrification in India made great progress, providing electricity for more than 200,000 villages for the first time. In 1990, around 84 percent of India's villages had access to electricity; however, it was only available for certain periods of the day. Cities also experienced frequent blackouts.<sup>10</sup>

In 2003, India initiated a much-needed restructuring of its power sector. However, the action failed to completely eliminate subsidies on energy supplies which are still present on the Indian market.<sup>11</sup>

In spite of these achievements, India faced numerous challenges:

- A significant proportion of villages had not yet received access
- Lack of quality electricity supply without interruptions and with constant frequency
- State Electricity Boards were running at huge losses
- Heavy, double digit transmission losses and thefts.

In 2005, the Indian Government outlined an ambitious plan for reaching a 100 percent level of village electrification by the end of 2007 and total household electrification by 2012. However, newly connected rural households may be restricted unless the ambitious grid expansion plans are accompanied by similarly ambitious distribution reforms.

Concerns have been expressed about the long term financial and technical sustainability of the program.<sup>12</sup>

In 2006, the Indian government approved an Integrated Energy Policy to achieve coordinated actions among energy ministries.

Most of the electricity generating capacities remain state-owned, regulated and operated by the State Electricity Boards, including transmission and distribution. Private generation is undertaken mainly by IPPs and by industrial companies fulfilling their own consumption. Nevertheless, recent reforms have brought more private participation to India's oil and gas sectors.

Infrastructure development of power generation will require the mobilization of public and private funds within a transparent and predictable investment framework.

<sup>10</sup> [http://www.indianchild.com/electric\\_power\\_india.htm](http://www.indianchild.com/electric_power_india.htm)

<sup>12</sup> World Bank 2004

<sup>11</sup> IEA World Energy Outlook 2007



### 4.1. Electricity demand

The electricity demand of India was the eighth largest in the world in 2006, at 517.2 TWh which represented 3.18 percent of the total global electricity consumption.<sup>13</sup>

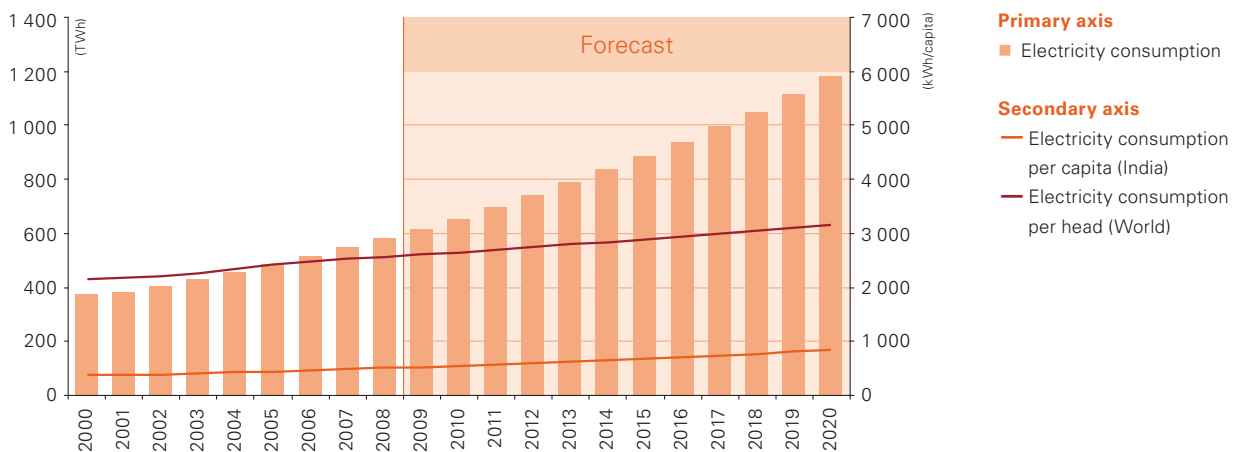
### Electricity consumption

The Indian economy is growing at one of the fastest rates in the world. With per capita GDP rising by about 8 percent per year in 2000–2008, it is expected to grow by 7.59 percent in 2000–2020. The potential for growth in energy demand is enormous,

in particular regarding electricity.<sup>14</sup> However, in order to fulfill this demand, India will face challenges until 2020.

Figure 6 shows the increasing trend of India’s electricity consumption and per capita consumption compared to the world average.

**Figure 6:** Electricity consumption, electricity consumption per capita



Source: KPMG, EIU

13 IEA  
14 EIU



Compared to the other BRIC countries, India had the second highest growth rate between 2000 and 2008 with an electricity consumption of 5.7 percent CAGR.<sup>15</sup> Additionally, if the current trend lasts, India’s electricity consumption will exceed that of Russia by 2020.

In spite of India’s significant growth rate for total electricity consumption, the country has the lowest electricity consumption per capita out of the BRIC countries. In 2008,<sup>16</sup> it was 509.4 kWh annually, though India’s per capita consumption had the second highest growth rate between 2000 and 2008 at nearly 4 percent. Despite the continuing growth trend, the country’s electricity consumption per capita is expected to be roughly 841 kWh in 2020, representing only about one quarter of the global average.

### Electricity consumption by sectors

The country’s total electricity consumption is divided into six major sectors accompanied by other miscellaneous areas of consumption. Figure 7 illustrates the share of each sector of the total consumption. The major drivers of consumption growth are expected to be the industrial, residential and agricultural sectors; others are set to remain mostly constant up to 2020.

Electricity consumption of the energy sector comprised 9.4 percent of India’s total consumption in 2006. Although the total consumption of the sector increased from 36.5 TWh to 48.6 TWh between 2000 and 2006, the share of the sector did not change significantly in that period.

The transportation sector accounted for 1.86 percent of the country’s total electricity consumption at 9.6TWh in 2006. The consumption of the transportation sector is set to increase as economic growth puts a strain on India’s infrastructure. There are also serious investments needed in all infrastructure areas.

The total annual consumption of the residential sector increased from 69.5 TWh in 2000 to about 100 TW in 2006.<sup>17</sup> The electricity share of households also increased in that period from 18.52 percent to 19.3 percent. The share of households is set to increase as rural electrification programs move ahead with connecting the remaining third of the population to the grid.

### How do you see the dynamics of electricity consumption of households during the course of the next five years?

Despite an ambitious rural electrification program, some 500 million Indians still have no access to electricity. The dynamics of residential electricity consumption are directly linked to the country’s potential economic growth.

A mapping out of electricity consumption reveals an expected compounded growth rate of 15–20 percent in both rural and urban India due to the following:

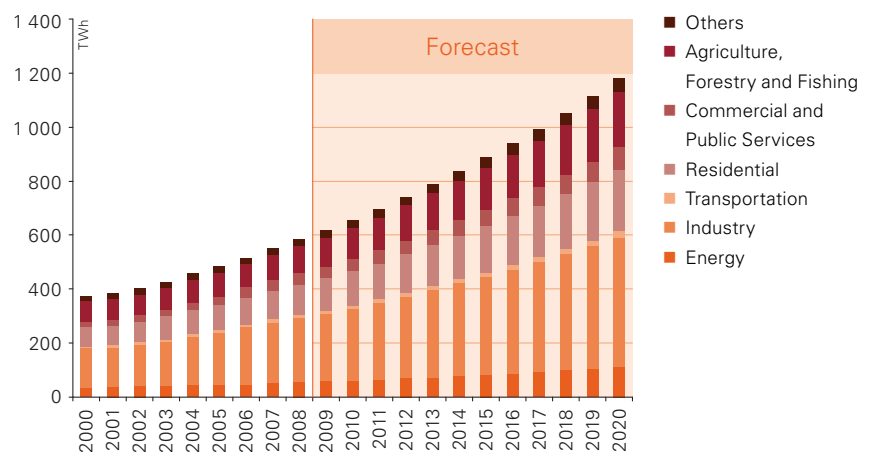
- Increasing living standards in both rural and urban India
- Increasing purchasing power equates with buying more and more electric devices
- Development of the real estate sector is also contributing to the steady increase in power demand.

*“The standard of living for both urban and rural populations will definitely improve, resulting in an increase in electricity consumption.”*

- Major financial institution -

According to statistics, currently only 44 percent of rural households are connected to the electricity grid and approximately 56 percent still need to be identified and connected, in comparison to the 80 percent connectivity level of India’s urban population.

Figure 7: Electricity consumption by sectors



Source: KPMG, IEA

15 Economist Intelligence Unit

16 Economist Intelligence Unit

17 IEA

*"The increase depends on two things: First, the basic necessities of those living in rural areas that did not have electricity until now must be satisfied and, second, the increased load in urban areas must be provided for."*

*- Major market participant -*

Urban household demand accounts for about 20 percent of total consumption, and urban consumers expect improved living standards. Rural households are also increasing their usage of domestic appliances and electronic agricultural equipment, resulting in a continuous increase in their power demand.

Today the market is supply driven, where "demand chases supply." To fill the gap, mega capacity addition projects are underway to curtail the deficit, which is currently above 8 percent. Stability can be observed in the government's policies and programs like the Rajiv Gandhi Gramin Vidyutikaran Utkal Yojna (RGGVY),<sup>18</sup> APDP<sup>19</sup> and R-APDRP<sup>20</sup> (Restructured Accelerated Power Development & Reforms Program), or the UMPP programs which are designed to bring development and show remarkable results over the course of the next five years.

### **How do you evaluate the progress of the rural electrification program from political/institutional/financial perspectives?**

Respondents cited the Rajiv Gandhi Gramin Vidyutikaran Utkal Yojna rural electrification scheme, which was established in 2005 with the aim of electrifying villages. The program still has a long way to go and requires further improvements before being able to accomplish its mission to provide power for all by 2012.

*The biggest challenge in India is the huge power shortage, especially in states without their own generation capabilities.*

*"We will have the wires/infrastructure but it will still be very challenging to provide electricity for consumption in rural areas because India has such a huge shortage. Even if they have the physical infrastructure to supply the villages, they will not have enough power."*

*- Major market participant -*

*In line with the Rajiv Gandhi Gramin Vidyutikaran Utkal Yojna rural electrification scheme all of the states have agreed to deploy franchisees for distribution management. The government needs to introduce various models to manage the franchisee system which is expected to grow from 1,000 to 100,000, requiring a proper management information system to be in place in order to ensure the smooth running of the concept. In addition to this capacity, the building of franchises is also being pursued by the Ministry of Power.*

*Considerable support is coming from the NGOs, the World Energy Council, and other public and private utilities to assist the government on the rural electrification programs running in India.*

It is assumed that the industry sector followed by the residential sector will be the main electricity consumers by the year 2020.

### **Industrial sector**

Industrial activities are providing an increasing share of the GDP, reaching more than half of the commercial sector's contribution. India's industrial sector mainly focuses on textiles, chemicals, food processing, steel, transportation equipment, cement, mining, petroleum, machinery, and software production. The sector is exhibiting an increasing level of development as a result of India's richness in natural resources.

Energy efficiency in the industrial sector has been significantly improved resulting in a lower intensity level of energy consumption.



18 A program of rural electricity infrastructure and household electrification for the attainment of the National Common Minimum Program goal of providing access to electricity to households in five years. Source: [www.rggvy.gov.in](http://www.rggvy.gov.in)

19 Accelerated Power Development Program (APDP) of the Ministry of Power, Government of India had been undertaken from the year 2000–2001 as a last means for restoring the commercial viability of the distribution sector. Source: [http://203.193.148.117/apdrp/projects/about\\_apdrp.htm](http://203.193.148.117/apdrp/projects/about_apdrp.htm)

20 The focus of the R-APDRP program shall be on actual, demonstrable performance in terms of sustained loss reduction. Source: [www.apdrp.gov.in](http://www.apdrp.gov.in)

*“Often – especially in the aluminum, steel and cement industries – it is expected that the capacity will be doubled.”*

*- Major market participant -*

However, this sector is still the most significant consumer of electricity in India at 211.5 TWh annual consumption, accounting for about 41 percent of total consumption in 2006. In addition, the industrial sector showed significant growth of 6.4 percent annually between 2000 and 2006, from 145.6 TWh annual consumption to the 2006 level.<sup>21</sup>

**How do you see the development of power-intensive industrial activities and its expected effect on electricity consumption over the next five years?**

*Electricity consumption of power intensive industrial activities is expected to grow due to increasing demand for industrial goods. Respondents envisage a growth of 25–30 percent within five years.*

*The present program for the installation of additional generation in the next five years is perceived as facilitating investments in the power intensive industries due to the following characteristics:*

- *India’s economy bears huge potential for growth.*
- *India has significant natural resources for the aluminum, copper and steel industries within the same region (e.g. Chatisgarh, Bihar, Orissa, West Bengal and Jharkhand) where abundant coal reserves exist.*
- *With the growth of the core industries – aluminum, coal and cement – and an increase in the demand for their products, more and more capacity additions are likely.*

*This in turn will increase their electricity consumption. For example, in the steel and aluminum industries, 60 percent of the cost base is composed of the cost of the power. Industrial companies are looking for a reliable, uninterrupted power supply and may opt for their very own captive power generating units.*

- *Additionally, the Power Grid Corporation of India Limited plans to install many substations to meet increasing demand.*

*However, the following disadvantages linked to risks and returns in the sector must be noted:*

- *Indian industries are currently at a disadvantage because they pay much higher tariffs compared to their counterparts in other countries. This is a global disadvantage as far as the power intensive industries are concerned. So, the increase in power consumption in power intensive industries will be dependent on how much tariffs are reduced to achieve global competitiveness.*
- *The unpredictability quotient is significant: the electricity sector is volatile and requires a high level of investment, with returns showing only after 7–8 years.*

*“Investors want quick bucks so no one would want to venture into this sector where one needs to wait for 7–8 years for results to show and profits to be earned.”*

*- Survey participant -*

## Agriculture

One of the major sectors of India’s economy, agriculture comprises traditional village farming, modern agriculture, handicrafts, a wide range of modern industries and a multitude of services.

Agriculture is the most dominant sector in terms of occupation, whereas it only provides approximately 17 percent of the country’s GDP. A continuously increasing number of people are engaged in agriculture, which is also supported by government programs targeting the creation of basic infrastructure and aiming for improvement of living standards.

The share of the agriculture, forestry and fishing sector decreased from 20.75 percent in 2000 to 17.4 percent in 2006.<sup>22</sup> As the application of technology and automation spreads in this sector, the level of consumption is forecasted to grow. On the other hand, the sector’s inefficiencies and collateral activities must be monitored and separated from actual agricultural activities, as these should not fall under support programs.

**How do you see the development of agricultural electricity consumption in the country (India) over the next five years?**

*The rural electrification programs and various other programs executed by the government to provide free electricity for agriculture will boost the growth of agricultural and agricultural power consumption. An increase in population will add to current agro product demand and in turn will impact electricity consumption.*

21 IEA World Energy Outlook 2007

22 IEA



It is a big challenge for India to satisfy the increasing demand of this sector, but with proper execution of programs like the Andhra Pradesh Irrigation Project,<sup>23</sup> which is supported by The World Bank, and strong political will behind the initiative, the various rural electrification programs should be able to meet the challenge.

*“There are many challenges such as that of population, and managing schemes to provide free electricity in the sector.”*

*- Major technology supplier -*

According to respondents there is a huge potential for development in this area as, despite the rural electrification

programs, most villages are still not electrified and experience severe power shortages.

*“Today we have villages with connections but no power to supply them, and also villages that are not even electrified. So, there is a lot of unexplored potential.”*

*- Major market participant -*

Government should properly guide the sector's consumption. Much of the electricity consumption classified as agriculture is actually not agricultural, demonstrating a need to segregate core agricultural electricity consumption from that of its associated activities, thus reducing the potential for power theft.

## Commercial and Public Services sector

Compared to the agricultural sector, services are the major source of GDP (by contributing more than half to it), while employing only 28 percent of the labor force.

Electricity consumption of the commercial and public services sector showed the most significant growth between 2000 and 2006, from approximately 21 TWh to 36 TWh, which resulted in 10 percent annual growth. The sector accounted for nearly 7 percent of the country's total consumption in 2006, boosted by the development of special economic zones (SEZ), government incentives, and special conditions provided to this sector.<sup>24</sup>

India's business services comprise information technology, information technology enabled services, and business process outsourcing. India provides offshore back office services that are highly attractive for international companies searching for outsourcing alternatives. The outsourcing of services is one of the fastest growing activities in India, which is due to the specialization and availability of low cost, highly skilled and fluent English speaking workers. However, as salaries rise, those services that are easily replaceable are expected to disappear. Therefore India's economic growth is heavily dependent on the presence of international companies.

***How do you see the development of the SME (small and medium-sized enterprise) and the commercial sector and its expected effect on electricity consumption in the next five years?***

*As current global centers of growth, India and China are attracting significant investments. They are possible markets for MNCs, SMEs, and shopping malls. From this aspect, their overall growth profiles are very promising, similarly to all of the BRIC economies.*

23 Source: Andhra Pradesh is the fourth largest state in India with a population of 72.7 million and a geographical area of 27.44 million hectares.

The primary objective of the Andhra Pradesh Irrigation Project is to complete ongoing irrigation development and scheme rehabilitation works and thus realize the potential for increasing agricultural productivity and rural incomes in two economically backward regions of Andhra Pradesh.

24 IEA World Energy Outlook 2007



Two main factors are contributing to the growth of this sector:

- Increasing living standards resulting in more disposable income which favors an increase in the demand for malls
- Tremendous growth in the IT sector has seen the development of many IT cities which also impact electricity consumption.

The effect of the sector's development on electricity consumption will be industry specific:

- SMEs are typically not as energy intensive as the core industries (aluminum, coal and cement). They are concentrated more in the service oriented sector where energy intensity is low, but as the SME sector grows, and the overall rate of economic growth increases, this will act as a catalyst for consumption. However, for small manufacturers and service providers, it may not be viable to set up their own captive power unit, thus their dependence on the main grid would remain and possibly even increase in the following years.
- Conversely, as India becomes more commercialized, organized retail, in the form of huge shopping malls and entertainment complexes, will

appear which consume high levels of power. However, given today's power shortage scenario, these facilities are likely to be heavily dependent on their own internal captive generation.

Almost all survey respondents expressed optimism towards the development of the SME and commercial sectors and their impact on electricity consumption which is expected to double in the next five years.

### Power pricing

India established a cost-plus tariff system more than 60 years ago. Nonetheless, the power sector traditionally has not been able to cover its costs relating to electricity supply. Power companies are owned and operated by the central government, or by individual states (State Electricity Boards) making losses, even if the central and state electricity regulatory commissions heavily cross-subsidize the various consumer groups when setting tariffs. Typically, residential and agricultural consumers (24 percent and 22 percent of the total supply in 2007) enjoy cross-subsidies from industrial (38 percent of total supply) and commercial users.

The latter still generally pay 30–60 percent above the average level. Moreover, tariffs set by the Central Electricity Regulatory Commission and State Electricity Regulatory Commissions greatly vary by regions, municipalities and generator/supply companies.

The table below shows the actual total average revenues collected from end-users vis-à-vis the official cost of supply.

A modernized regulatory framework based on the Electricity Act of 2003, the National Electricity Policy and National Tariff Policy seeks to promote private investment in the sector, notwithstanding the strong inertia of the politically driven, state-owned, monopolistic bodies throughout the supply chain.

Eight to 10 percent of total generation is traded on short-term markets (bilateral, unscheduled interchange, and power exchanges). Recently established power exchanges (IEX, PXIL) still handle minor quantities, but they also contribute to transparency, reflecting prices in the range of 6.50–8.0 INR/kWh<sup>25</sup> in December 2008.

Figure 8: Average electricity prices in India

	2005		2006		2007	
	INR/kWh	USD/kWh	INR/kWh	USD/kWh	INR/kWh	USD/kWh
Cost of Supply	2.54	0.0573	2.58	0.0571	2.76	0.0685
Total average price	2.09	0.0472	2.21	0.0489	2.27	0.0563
Agriculture	0.757	0.0171	0.794	0.0176	0.713	0.0177

Source: CERC India, Deutsche Bank Research, KPMG calculations

25 INR: Indian Rupee, currency of India



## 4.2. Electricity supply

India is rich in coal resources, even if the country's coal is of low quality. As the third largest coal consumer in the world, India's economy relies heavily on coal and 70 percent of its electricity generation is based this resource. Oil and gas reserves are running short, while the increasing consumption of oil and gas is driving up GHG emissions. Overall energy imports are continuously growing, dominated by oil imports. Renewable energy sources bear promise except for traditional biomass and hydropower, which are limited.<sup>26</sup>

As outlined earlier, the Indian economy is growing at fast pace, which is also driving up electricity demand. According to industry experts, power generation capacity must reach double digit growth to maintain the current GDP growth trend.

The envisioned capacity investments until 2020 would generate approximately 90 GW and comprise 75 percent thermal, 21 percent hydropower and 4 percent nuclear power units.

In 1970, India acquired a nuclear weapons capability that led to its exclusion from the Nuclear Non-Proliferation Treaty (NPT) which has hampered its nuclear energy development to date. Due to these trade bans, India has been developing a nuclear fuel cycle to exploit its reserves of thorium, of which India has about one quarter of total world reserves, amounting to 290,000 tons.<sup>28</sup>

According to our survey respondents, India's target is to increase its nuclear capacities to 20 percent by 2020. However India is facing difficulties with reaching this target since development of nuclear generation is time consuming and currently India is barred internationally from trade in nuclear materials and equipment.

According to estimates, the country's share of thermal power should not change significantly; it is likely to account for 79 percent of India's total electricity generation in 2020; only oil is foreseen to lose its share in the power generation mix, while natural gas is set to see a slight increase.

*"Right now the share of nuclear is minimal, but it will go double digit. Twenty percent is our aim in the next 10 years."*

*- Major technology supplier -*

## Generation mix

Currently, thermal generation accounts for roughly 81 percent of India's electricity production, followed by hydropower with approximately 16 percent, while nuclear power had a share of approximately 3 percent in 2006.<sup>27</sup>

In order to meet the growing demand the Government developed the country's 11th 5-year economic plan period (2007–12) defining an additional capacity investment of 78.6 GW.

This significant increase of generating capacities appears optimistic in the current financial and economic state of affairs. Consequently, these investments are expected to be postponed and the Government's plan may be revised.



<sup>26</sup> IEA World Energy Outlook 2007

<sup>27</sup> IEA

<sup>28</sup> Nuclear Power in India, World Nuclear Association, July 2009



By 2020, it is anticipated that the share of wind energy will increase to about 3.7 percent, up from 1.1 percent in 2006.<sup>29</sup> Figure 9 illustrates India's current and projected generation mix.

**How do you foresee the future balance of power plant fuel consumption? What changes do you expect in the generation mix?**

Respondents agreed that in the coming decade coal would remain the country's main source of power, despite being associated with disadvantages like pollution and global warming, and its contribution would be around 60–75 percent.

*"In the next five years an increase in thermal power of 5 percent is expected as this is the fastest means to add power, and at this stage of development one cannot wait for the development of other resources."*

- Survey participant -

*"Coal, gas, and oil will be the staple fuels for India for the next 50 years"*

- Survey participant -

*"Coal leads to pollution and global warming, but there is still a huge dependency on coal."*

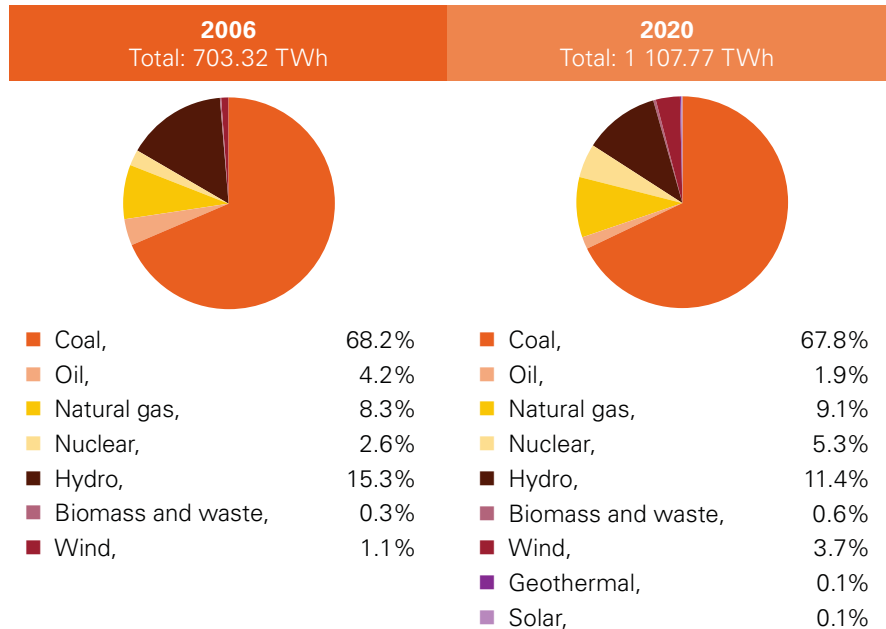
- Survey participant -

*"There is no threat to coal and oil resources for at least the next 20 years; hence, the production of electricity through these means will continue to increase."*

- Major technology supplier -

India must monitor the efficiency of the technology it is using as it moves toward supercritical coal plants achieving a conversion efficiency of some 42–45 percent.

**Figure 9: Generation mix**



Source: KPMG, IEA

With clean coal technology advancements and the refurbishment of existing units, coal's performance is likely to improve and this may eventually help determine the efficiency of the power generation business.

The rest of the generation mix is likely to be shared among hydro, nuclear, wind and solar (nuclear and hydro accounting for about 20 percent and the remainder comprised of wind and solar) on a 15–20 year time horizon.

**What are the expectations on the development of nuclear power generation during the course of the next decades?**

Survey respondents were enthusiastic optimistic about the role of nuclear power generation in the next decade. Nuclear power's potential in India is characterized by the fact that fossil fuel resources are becoming depleted and are not likely to be available in 50 years' time.

Nuclear power may be the only option left for India to fulfill its increasing power demand.

*"Nuclear power is the major source of energy to come."*  
*"Nuclear energy will likely provide energy security to India in the future."*

- Survey participant -

The US-INDO agreement signed by the Government shows the advent of nuclear technology in the country. The partnership of NTPC with Nuclear Power Corporation of India is also seen as a significant step towards development of the sector.

At present, installed nuclear power capacity is 3,900 MW, accounting for 3.1 percent of the total installed power generation capacity; however, in the future respondents envisage double digit growth in this sector.

29 IEA

**Figure 10: Installed capacity (GW)**

2000	108
2001	112
2002	122
2003	126
2004	131
2005	137
2006	151
2015	204
2020	241
<b>CAGR (2000–2006)</b>	5.71%
<b>CAGR (2000–2020)</b>	3.39%

Source: KPMG, IEA, EIU

*“Right now its share is minimal, but it will go double digit. Twenty percent is our aim in the next 10 years.”*

*- Major technology supplier -*

Respondents believe that liberalization of the sector will hasten its development in India, considering the following:

- Currently the sector is completely in the Government’s hands, but in the future private participation should be allowed.
- The Government should devise policies to promote a proper mix of public and private participation in the sector.
- Participants from countries like France possess the technology and are keen to develop nuclear projects.

Apprehensions over safety comprise the only misgivings in regard to nuclear power. However, rapid technological developments and improved safety measures can assuage those concerns according to respondents.

Nevertheless, nuclear power is still seen as a relatively distant option mainly due to the following:

- Long preparatory phase for nuclear projects which can take 8–10 years
- At present, the government is in favor of allowing private investors to enter into this sector, although its efforts are progressing slowly.

Respondents believe that once the nuclear power sector is open for private participation, with the proper safeguards in place there will be enough players to join. Nuclear power is likely to contribute 10–20,000 MW, but the 80–90,000 MW India needs will mostly be fulfilled by coal, which will retain its leading role within the country’s generation mix.

#### **To what extent do you see further development of the renewable power generation segment (taking into account the related incentive schemes) in the next five years?**

Respondents believe that India has a good capacity for renewable energy.

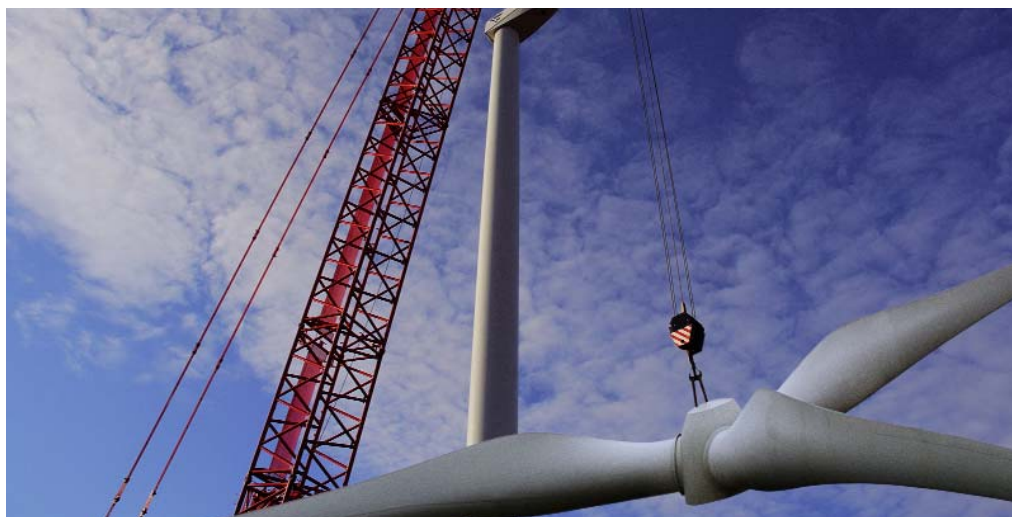
The estimated potential in India for generation of power from wind, small hydro, and biomass is around 80,000 MW. Renewable power capacity is likely to double every five years, reaching approximately 20,000 MW by 2012, accounting for 10 percent of the country’s total installed capacity. Currently its portion ranges from 4,000 to 5,000 megawatts. All renewable energy matters are under the jurisdiction of the Ministry of Non-Conventional Energy. Source (MNES).

The renewable power industry in India can be broadly categorized into wind, solar, small hydro, and biomass.

Sources estimate that about USD 7.5 billion have so far been invested in the renewable power sector in India. About 90 percent of the investment has come from the private sector.<sup>30</sup>

#### **Wind**

India has already made a significant investment in wind mills and is among the top 5 in the wind energy industry. In Maharashtra, Suzlon Energy is building one of the world’s largest wind farms with a capacity of 1,000 MW.



<sup>30</sup> Source: <http://kn.theiet.org/magazine/issues/0807/india-renewable.cfm>

However, according to some experts wind power has been over exploited and not harnessed efficiently.

### Solar

India receives a solar energy equivalent of over 5,000 trKWhr/yr, which is far more than the total energy consumption of the country. The daily average solar energy intake varies from 4–7 KWhr/m<sup>2</sup> depending upon the location.<sup>31</sup> Only a tiny proportion of the aggregate potential in solar energy is being used due to the high cost of generation, which is 5–6 times more expensive than coal based generation. Therefore, solar cannot be considered a major power source for India until a technological breakthrough emerges which makes its cost structure efficient for India.

*“People are considering these distinct options. Solar is a more attractive proposition. We are very fortunate that the country is blessed with an abundance of solar potential.”*

*- Survey participant -*

### Small Hydro Power systems

In India, hydro projects up to 25 MW have been categorized as small hydro power (SHP) projects. Depending on capacities, they are categorized as micro, mini or small hydro projects.

Mini hydro – 10 kW to 99 kW

Micro hydro – 100 kW to 999 kW

Small hydro – 1,000 kW to 25,000 kW

The estimated potential of small hydro power in India is about 15,000 MW. More than 4,000 potential sites have been identified totaling a capacity of 10,000 MW - showing the tremendous potential of small hydro power in India.<sup>32</sup>



### Biomass

Over 70 percent of the Indian population lives in villages without proper electricity or a steady supply of water. Biomass is available in these settlements and should be tapped to provide electricity.

MNES has estimated the biomass power potential in the entire country as 19,500 MW.

Biomass is considered a sustainable option to meet the rural power needs of India, therefore, the government is strongly encouraging the utilization of biomass energy.

Biomass gasification offers immense scope and potential for:

- providing electricity to remote villages for basic services like lighting, pumping drinking water etc.

- providing power for pumping irrigation water and agro-processing (e.g. flour milling)
- improving healthcare, education and the quality of life.

### What are the expectations on the development of large-hydro capacity expected to be during the next decades?

India is considered one of the best places in the world in terms of hydro potential, with 60,000 megawatts of hydro power available for harnessing. The share of hydro capacity within the country's total generating capacity stands at 25 percent. This figure has declined from 34 percent in the past two decades. Respondents expressed an optimistic view on the future development of large hydro capacity in India, but felt that development of such projects will be subject to controversy which could be an obstacle to its growth:

<sup>31</sup> Source: <http://kn.theiet.org/magazine/issues/0807/india-renewable.cfm>

<sup>32</sup> Source: <http://www.greenbusinesscentre.com/Documents/smallhydro.pdf>



- There are human, environmental, zoological and geological risks involved in the process of setting up new large HPPs.
- Issues of land acquisition, resettlement of people and environmental rehabilitation are significant.
- Issues related to climate change are sensitive, as the Himalayan glaciers are the fastest melting glaciers in the world. Therefore, huge reservoir-based hydro energy plants should be constructed in the north and the Gangatic plain, which means a large number of people would be displaced to build reservoirs.
- Licensing is lengthy and difficult.
- There is a high construction risk.
- Despite the private sector's participation, the government must play a major role in financing these projects due to their long preparatory phase and long pay-off period.

*"Large hydro projects need a lot of investment and it takes 8–9 years for*

*"Large hydro projects need a lot of investment and take 8 to 9 years for returns to show up. This must be handled by the government."*

*- Major financial institution -*

*returns to show up. The private sector is looking for profit and cannot wait that long for results. This can only be handled by the government."*

*- Major financial institution -*

*"It is a long term project, say 15–20 years, and people who have invested will have to wait a few decades to start recovering their principal and profits."*

*- Major technology supplier -*

*In order to overcome the obstacles, efforts are now being made to develop a proper framework for the settlement and resettlement of people, and to adhere to all of the environmental restrictions. Additionally, the National Hydroelectrical Power Corporation (NHPC) is interested in developing a project which, with good strategic management and investment, should be able to drive the effort efficiently.*

## Supply – demand mismatch

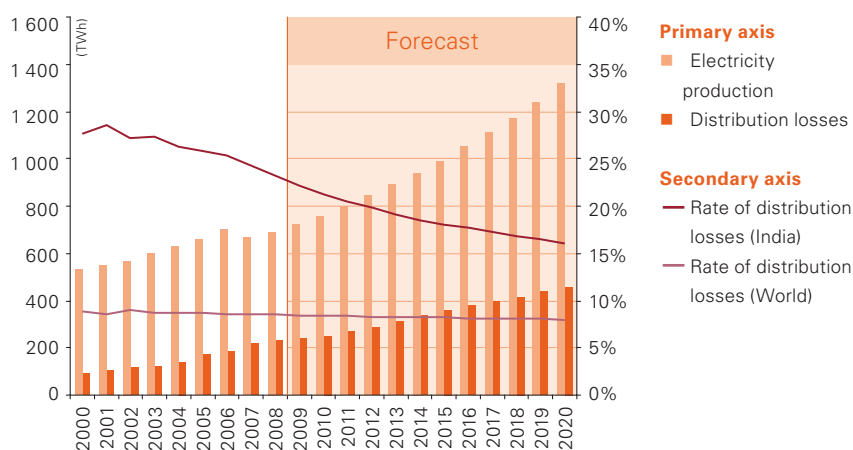
The electricity production of India grew by 3.33 percent annually between 2000 and 2008, which was lower than the consumption growth rate (5.7 percent).<sup>33</sup> It is expected that the peak demand capacity deficit will be more than 12 percent in 2009–2010. Despite this, electricity production is expected to grow further by 5.5 percent annually until 2020. The supply-demand mismatch is one of the most crucial issues to be solved.

The levels of transmission and distribution losses in India are among the highest in the world. There is a wide variation of losses between states, even exceeding 50 percent; the combined rate across India was approximately 25 percent in 2006, deriving from insufficient investments, poor network maintenance, and power theft.

The T&D losses in India are at the same level with those of several countries in Sub-Saharan Africa and in Eastern-Europe, while the world average was significantly lower: 8.5 percent in 2006. India is now making efforts to monitor and reduce losses. High loss levels lead to significant unpaid generated electricity, diverting resources from investments. Reduction of losses and thefts is expected to result in a significant consumption growth rate.

Figure 11 illustrates the growing electricity production of India compared to the significant losses of the electricity network.

**Figure 11:** Electricity production and distribution losses



Source: KPMG, IEA

**What kind of network developments including metering need to be taken over the next five years to reduce power outages and electricity losses during the transmission and distribution?**

Respondents believe that the Indian power sector will not become viable until transmission and distribution losses are brought down significantly.

The Aggregate Technical and Commercial (AT&C) electricity losses in India are almost 40 percent, whereas the international norm is around 15 percent.

These high technical losses are primarily design and engineering related due to inadequate investments over the years for system improvement works, resulting in unplanned extensions of distribution lines, overloading of the system elements like transformers and conductors, and a lack of adequate reactive power support.

Commercial losses are mainly due to low metering efficiency, theft and pilferages. These may be eliminated by improving metering efficiency, proper energy accounting and auditing and improved billing and collection efficiency.

Towards those ends, the following actions are needed:

- Improvement in the quality of equipment
- Improvement in the infrastructure (separate feeders for agriculture)
- Technology upgrading
- Transparency, accountability and penalization of power theft and pilferage
- Political commitment
- Privatization.

The Government has already taken steps to curtail these losses. It has launched the APDRP (Accelerated Power Development and Reforms Program) whose goal is bringing AT&C losses down to less than 15 percent by the end of the Eleventh Five Year Plan in urban and high population density areas.

Additionally, as mentioned previously the distribution of franchises should be spread across all states to reduce outages and help ensure proper and smooth distribution to the end user.

To achieve this, there needs to be transparency and accountability. Overall, the focus should be on energy audits, metering, billing and the entire collection chain. Managerial excellence, i.e. the availability of good middle management in distribution companies, is a key success factor in developing the sector.

*“In India what is really missing is... someone analyzing all the information that is coming in and preparing meaningful management information reports and following up with actions. This pertains to the entire organizational structure. Most state companies have not recruited for the last 15–20 years and the average age of employees is 54–55 years.*

*It is very difficult to motivate them to achieve an organization that is focused on the future. This is the missing link on the distribution side that needs to be addressed.”*

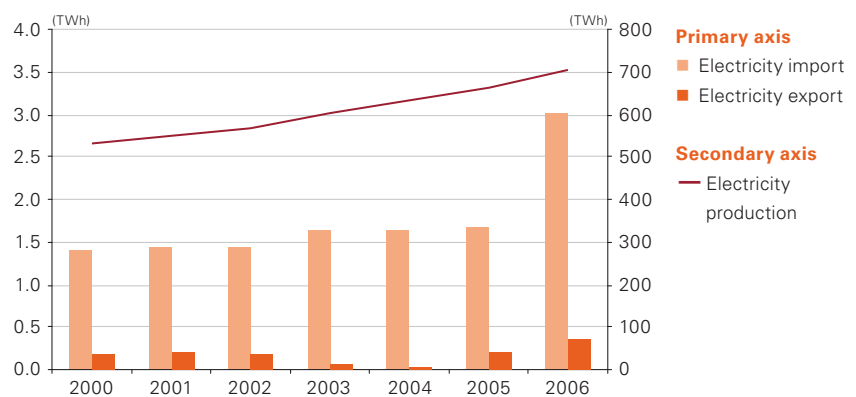
*- Survey participant -*

Thus, by using an appropriate mix of technology and management, and encouraging privatization, India can effectively reduce its technical as well as non technical losses.

**Electricity import, export**

As supply is unable to meet demand, electricity is being imported. As illustrated, electricity imports are increasing in parallel to total electricity production, which is due to the strong economy and population growth. Still, India’s total electricity imports accounted for only 0.4 percent of total domestic production in 2006; the increasing trend and continued power deficit implies that the development of supply is not able to keep up with booming electricity demand. As India does not want to stay dependent on electricity imports, a long term solution would be the strengthening of electricity supply and the reduction of T&D losses.

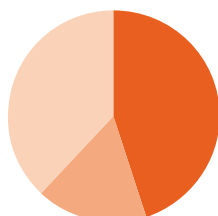
**Figure 12: Electricity import, export and total electricity production**



Source: KPMG, IEA

**Figure 13:** Investment needs of the electricity sector up to 2030

**Total: USD 960 billion**



■ Power generation	45%
■ Transmission	17%
■ Distribution	38%

Source: IEA



## Long-term solutions

In absence of long term investment and improvement activities, India will be increasingly dependent on foreign imports. Long term investment programs for generation, transmission and distribution are expected to be led by government initiatives.

As a result of promised improvements and efforts towards reducing losses and theft, the high distribution losses are likely to be significantly decreased by 2020. Based on current trends and expectations, losses should be lowered to roughly 16 percent by 2020, which would still be double the global average. Approximately half of power theft could be turned into legal consumption, which would result in an increase of consumption by 6 percent per year; lower production growth of 3.7 percent per year would likely be able to cover future consumption to a greater extent.

Overall, the synergies of the extensive generation capacity addition program and the envisaged reduction in distribution losses are expected to lead

to a self sustaining electricity sector in India, thus reducing future import dependency. In order to succeed, considerable effort will be needed to improve the investment climate, to reduce transmission and distribution losses and to modify relevant legislation.

### 4.3. Ownership and investments in the Indian power industry

Worldwide experience and best practices support the concept that decentralization and privatization lead to market liberalization and sustainable development. To facilitate these, a supporting legislative environment is required, which is one of the main constraints on the development of a country's electricity system.

As states are usually unable to maintain their electricity systems sufficiently

through its own investments, especially on the scale India should, the involvement of private capital is a necessary step to keep the technology stream flowing into the country. This also requires controlled support from the state.

Additionally, India is facing significant population growth and economic development, which necessitate continuous significant investments in both the electricity sector and other supporting services and infrastructure.

Based on IEA estimates, the investment needs of the Indian energy sector until 2030 total approximately USD 960 billion. As shown in Figure 13, most investments are needed in the generation sector, amounting to USD 435 billion, followed by USD 360 billion into distribution and USD 165 billion into development of the transmission network.<sup>34</sup>

34 IEA



**What are the top investment priorities in the electricity sector over the next five years?**

According to respondents an equal emphasis should be placed upon each of the three segments – generation, transmission, distribution – to prevent a imbalance. However, as top investment areas, generation and distribution were highlighted as both require significant injections of capital.

*“All three segments – generation, transmission and distribution – are parallel and investment in them should happen simultaneously.”*

- Major technology supplier -

As per the policy of “Power for all by 2012” approximately USD 14.4 billion was set aside by the government for investment in the country’s high voltage transmission sector.

In power generation, India is still in a stage of capacity addition. Currently there is an

installed capacity of 78,000 MW in place, and another 35,000 MW (of private investment) is in the implementation phase, but the desire for more electricity still continues. Those placing generation (capacity addition) in first place believe that mega power projects are the most critical to carry out in order to keep up with increasing power demand and decrease the country’s power deficit of 12.6 percent in FY10.<sup>35</sup>

Significant capacity additions have been planned within the Eleventh Plan and around 30–40 percent of the total investment coming into the power sector will be concentrated in generation.

*“Right now everyone is concentrating on generation. If generation came and we do not have distribution to the end user, that would cause dissonance.”*

- Major market participant -

Distribution has also been mentioned as an area of concern, and is a top priority for most of the respondents.

- T&D losses have been consistently high, and are presently in the range of 18–50 percent in various states.
- Maximum losses are accounted for at the distribution end and need to be curtailed to make this sector profitable.
- This business is the most complex among the three segments. Apart from investment, it requires significant managerial competency. The investment portion of distribution is overemphasized while managerial issues are underemphasized.
- Delhi is managed efficiently on the distribution side by private players.

*“Distribution will be more focused in the days to come and based on that, generation will receive investment in the next five year plan.”*

- Major technology supplier -

*“Investment in one without the other does not make sense.”*

- Major technology supplier -

Currently, in terms of transmission systems India is divided into five regions: northern, north eastern, eastern, southern and western. Efforts are being made to create a national grid, something which would require investment. There is also a need to implement new technologies.

India requires huge equipment manufacturing capabilities and the requisite investment for its capacity addition projects.

As per Planning Commission estimates approximately USD 150 to 200 billion of investment is required for India’s power sector development in the next five years.



35 India’s peak power deficit is expected to deepen in the fiscal year 2010 to 12.6 percent from 11.9 percent in the fiscal year 2009 ended in March, union minister of state for power Bharatsinh Solanki said on 10 July 2009. According to the minister the Central Electricity Authority has projected an energy shortage of 78,429 mega units and peak power shortages of 14.98 GW in 2009–2010. Source: <http://www.livemint.com/2009/07/10182535/India8217s-peak-power-defic.html>

Moreover, the ability to find these resources and companies' ability to absorb these funds in an effective manner is doubtful.

*"Enterprises have huge investment plans, but their managerial and organizational ability to manage that scale of resources is extremely constrained in India and adequate focus is required to set up good management (information) systems and accountability systems to manage those investments."*

- Survey participant -

### **Will the State be able to finance investments in the electricity sector over the next five years?**

Currently most of the power generated in India comes from its states and approximately 10–13 percent comes from private investors. However, respondents unanimously believe that private sector financing will be needed to finance future investments in the electricity sector as the states alone are not able to manage this alone. Public-private partnerships are considered distinct possibilities for future development.

*"The state does not need to finance the projects entirely; there is sufficient enthusiasm from the private sector to invest and earn substantial returns."*

- Major financial institution -

*"The state alone cannot finance such projects... So the Government will need to depend on new investments, mainly private ones."*

- Major technology supplier -

Apparently private sector players like Reliance Power, Tata Power, etc. are entering the market and setting up their plants in various states.

Nevertheless the government is expected to play an important role in supplementing the efforts of state utilities and maintain an ongoing Accelerated Power Development and Reform Program (APDRP) to provide investment assistance in the form of incentives.

### **Reorganization of the generation, transmission, distribution and trade sectors**

Current trends show more emphasis on private participation than government investments. Moreover government policies are formulated towards private participation, in turn reducing pressure on the state to generate large funds.

Private investments, which might be realized in various forms including privatization, are also required in the distribution sector. The scale of expansion is so great that a proper organizational capacity needs to be in place in order to manage it successfully.

On the generation side, the Government of India and state governments have taken numerous steps to attract private sector participation. Based on market screening, approximately 30 GW is currently being proposed in India by the private sector and another 30–40 GW is in the implementation stage. New initiatives in power sector development such as large scale power plants, merchant power plants, and captive power plants are expected to trigger capacity development in the private sector over the next few years. However, it will be difficult to sustain this trend in generation unless there is a corresponding increase in the transmission and distribution segments.

### **How is the privatization process expected to unfold in the Indian electricity sector?**

The power sector's privatization started in 1991–1992, but no significant degree of investments has actually been reached in the transmission and distribution segments.

The major cause of this is the high level of investment risk which makes private companies reluctant to enter.

*"Privatization has been in place since 1991. Today anyone can open a plant. But people do not want to invest as they are not sure when they will get returns."*

- Survey participant -

Currently the Aggregate Technical and Commercial<sup>36</sup> (AT&C) losses in India account for USD 6–8 billion annually, and are a major deterrent to private players entering the sector. If the Government was able to reduce the AT&C losses to 10 percent then privatization would be more feasible.

*"Transmission is open for private participation, but in 10 years it will accelerate, whereas distribution is one area which is still lagging behind."*

- Major financial institution -

The distribution sector must be opened up for participation with the introduction of different models in the private sector, of which privatization may play a role. The scale of expansion is so great that a proper organizational capacity needs to be in place in order to manage it successfully.

On the generation side the Government of India and state governments have taken many steps to attract private sector participation.

<sup>36</sup> Aggregate Technical and Commercial losses captures technical as well as commercial losses in the network and is a true indicator of total losses in the system.

In India approximately 30,000 megawatts is currently being proposed by the private sector and another 30–40,000 megawatts is in the implementation stage. New initiatives in power sector development such as UMPPs, merchant power plants, and captive power plants are expected to trigger capacity addition in the private sector over the next few years. However, it will be difficult to sustain this trend in generation unless there is a corresponding increase in the transmission and distribution segments.

Some respondents have suggested that the Government should consider limited privatization so that full control over hydro and nuclear could be maintained, while privatizing thermal power in a less restricted manner. Additionally, according to respondents, state electricity boards should make the whole process more commercial, by offering a suitable rate to attract private investors.

In conclusion, private sector investment will primarily flow into power generation, followed by transmission and distribution, while respondents foresee the Government as the major sector stakeholder in the coming years with a growing emphasis on public-private partnerships.

**What are the expectations on the level of public and private sector investments going into the electricity sector in the course of the next five years?**

The level of public and private participation will greatly depend on the financial viability of the sector in the coming years. Private capital will primarily focus on generation while the public sector will continue to have a high stake in transmission and distribution.

*“Transmission is open for private participation, but in 10 years it will accelerate. Distribution is one area which is still lagging behind.”*

*- Major financial institution -*

Currently the public sector retains the larger share of 75 percent, and unless issues are resolved, not many private players will be interested in investing. Respondents also claimed that unless there is clarity in government policies, guidelines and a single window clearance system, the sector is unlikely to see major participation from private players.

Distribution companies gravitate naturally to privatization, but they face huge challenges: AT&C losses of most of the State Power Utilities (SPUs) remain as high as 40 percent, making this business financially sick. For this reason, these utilities have only had limited success in attracting private investors to set up power plants.

The fact that private players cannot sell directly to consumers is also a drawback due to their vulnerability in the event that the state refuses to buy from a private player. A private player's only option would be to close down.

However, some domestic players like Reliance are keen on investing and are already setting up power plants with improved efficiency.

*“If you look at the mega power projects, out of four, two have gone to Reliance. Reliance is building two plants, one at Sasan and Krishna patnam. The other plant that has also gone to Reliance is Tilaiya. Apart from these projects, more are pending.”*

*- Major regulatory agency -*

India is looking forward not only to high technology, but also to refurbishing its aging units. According to some respondents there will be quick capacity additions at optimal or minimum cost. Many underperforming (coal) power stations will be acquired – taken over by private enterprises to turn around and make a profit.

*“Refurbishment of underperforming units will become a priority in the coming decades.”*

*- Survey participant -*

#### 4.4. Main determining factors in the development of the electricity industry

As the global crisis affects India, a limited slowdown of investments can be expected in the electricity sector since country risks are increasing and the budgeting of private companies is becoming stricter. Even though the crisis is not expected to adversely affect all areas of the economy, the temporary slowdown is expected to last for some time.

In general, India is in good shape despite the fact that the global crisis is affecting the country. In India the pace of development is linked to increasing GDP growth and rising electricity demand. As India is currently facing a power deficit, its entire electricity production is utilized within the country.





As a result of this high demand, the economy is expected to return to its original growth path in a short period of time, if the necessary terms are provided.

One of the major concerns of both domestic and international investors is the country's fuel supply, which is a prerequisite for the continuous operation of large scale power plant investments. As previously mentioned, natural gas was a limited source in India until a discovery off the east coast by Reliance. This new source is expected to provide an uninterrupted gas supply for the next 10–15 years making room for new natural gas based power plants as well the existing plants which are underutilized or lying idle due to lack of gas.

**What are the expected effects of the global financial turmoil on India's electricity market in the next five years?**

According to most survey participants from the financial sector, the financial crisis has primarily affected private sector investments, both on the equity and debt sides.

- Some of the private players' revenue model of tapping the stock market to make money, either through IPOs, public issues or private equity, will not be viable for the next year given the global liquidity crisis. So raising equity for investment in the power sector by private sector players is not going to be easy.

- Similarly on the debt side, getting ECBs or other finance may not be easy for private sector players because in the risk averse environment of an economic slowdown lenders prefer public sector institutions as they are perceived as less risky.

*"There is a shortfall in equity. If we consider infrastructure or power, there is no surplus cash to invest. This is linked to the capital markets and their revival depends on global cash; it is a question of proper allocation."*

- Major financial institution -

*"Globally, stock markets have taken a beating. New deals and IPOs are not going to be very viable in the private sector."*

- Survey participant -

*This implies that India's attempt to shift the electricity sector into private hands will definitely need some adjustment and far more public sector spending will be required.*

*It is most likely that the financial turmoil will not have a major adverse effect on the big players of the power sector like NTPC and NPCL due to the assurance of repayment, but smaller players are likely to be affected as banks might be reluctant to fund them.*

*"The financial turmoil will affect smaller players. For bigger consumers like NPC and NTPC, there will be no problem in getting loans as they are sure to repay."*

- Major market participant -

*However, looking at the future, respondents are fairly optimistic and believe that India will quickly overcome the crisis and return to its previous growth levels.*

Evidence to support this includes:

- Indian stock markets boomed after the formation of the new government.
- India's economic growth is not dependent on a single sector and even if some sectors are negatively affected, the overall outlook for the economy's growth will counter balance it.

*"My personal opinion is that this global turmoil is a temporary phenomenon. Its impact is limited to countries like the USA."*

- Survey participant -

*"Global financial turmoil is hype in India. We do not have any problems as no Indian company has filed for bankruptcy nor have any declared huge losses."*

- Major technology supplier -

*“...too many subsidies should not be given or they should be minimized. There is no motivation to invest otherwise.”*

*- Major governmental authority -*

#### 4.4.1 Regulatory climate

The structure of the electricity industry was rather monopolistic before the reforms in 1991. Reforms were implemented to improve the regulatory regime, including abolition of the public sector monopoly delegating regulations to regulatory commissions, and privatizing of certain public enterprises.<sup>37</sup>

In the process of the electricity market's liberalization and development, free competition on a free market should be the desired goal, which requires precise legislative planning and careful organization. India has already shown willingness to bring in more experienced know-how through international market players, as demonstrated by increasing private ownership in the generation sector and the planned electricity market opening in 2010.

Another vital step has been taken by India, namely the opening up of power exchanges to stimulate the electricity market place. In this process legislation is being formed – carefully reviewing examples in more advanced markets like that of the United States or of European countries – with which it may best serve the needs of the market in the long term.

By continuing the implementation of such vital moves, and considering best practices, India should be able to successfully handle rising energy prices, the sale of newly added and planned generation capacities, the complexity of electricity distribution, the requirements for state subsidies, and issues regarding end-user prices.

The tariff question is closely linked to cross subsidization of households and farmers.

**How is the end-user electricity tariff structure expected to be during the course of the next five years? Will the regulator be able and committed to reduce subsidies and cross-subsidies in the existing end-user tariffs and gradually move towards a cost-reflective tariff regime in the next five years?**

*This politically tinged question involves protecting certain consumer groups and passing the costs over to other sectors, reducing their competitiveness.*

*“It will vary from state to state; regulators have their own political and social pressures.”*

*- Major market participant -*

*The present tariff system comprises many subsidies and cross subsidies coming from public and the private utilities. This is expected to be phased out gradually in moves towards a cost-reflective tariff mechanism.*

*“We feel that too many subsidies should not be given or that they should be minimized. The tariff structure should reflect costs – right now it does not. Otherwise, there will be no motivation to invest.”*

*- Survey participant -*

*As fuel prices rise, the Government will not be able to resist pressure and eventually tariffs will increase. There is an expected increase of 5–7 percent per year which the end consumer will have to bear.*

*“Regulation should be totally independent as open access is going to start very soon, by 2010.”*

*- Major governmental authority -*



<sup>37</sup> Infrastructure Regulation and Institutional Endowments in India, Devendra Kodwani

*Investors want to earn money and the survival of the sector depends on the profits it reaps for investors.*

*Respondents, however, pointed out that subsidies needed to be reduced or aligned to those sectors which genuinely need it.*

*“There is a lot of energy poverty. Out of the world’s 2 billion energy poor, 500 million are from India. We have to ensure a minimal amount of electricity is available to them. For this reason, subsidies cannot be totally phased out.”*

*- Survey participant -*

*“Government must protect small power generating units through subsidies or they will not be able to compete. Currently they play a vital role in supplying power to the state.”*

*- Major technology supplier -*

## 4.4.2 Environmental concerns

In order to reduce global warming, the industrialized countries (with the exception of the US) signed the U.N.’s Kyoto Protocol which sets targets for national greenhouse gas emissions.

India ratified the Kyoto Protocol in August 2002 and thus actively participates in the fight against climate change. Since India is a developing country, it belongs to the “Non Annex I” countries that do not have official targets for reducing their emission levels. India is one of the main beneficiaries of the project based emission reduction mechanism, namely the Clean Development Mechanism (CDM) of the Protocol. The majority of CDM projects are partly based on India having achieved almost 69 million tons of emission reductions to date.<sup>38</sup>

The per capita emissions rate of India represents a tiny fraction of those in the developed world. However, looking at the future, economic growth is likely to result in a parallel rise in emissions. India, along with China, will account for most emissions in the coming decades, owing to their rapid industrialization and economic growth.

### **What are the effects of health, climate change and environmental issues/concerns on the current and planned power-related projects?**

*Although India is a signatory of the Kyoto Protocol, it is exempted from the framework of the treaty, and expected to gain from the protocol in terms of the transfer of technology and related foreign investments.*

*“There is always a tradeoff between growth and environment. The growth is sustainable to a country but the environmental effects caused by that growth are not limited to geographical boundaries.”*

*- Major market participant -*

*The per capita emissions rate of India represents a tiny fraction of those in the developed world. Therefore, following the principle of common but differentiated responsibility, India maintains its position that the major responsibility of curbing emissions rests with the developed countries, which have produced emissions over a longer period of time.*

*“The government should conduct intensive programs at small and end user levels. This will help attaining maximum benefits.”*

*- Major technology supplier -*

*“We have a fraction of the environmental CO<sub>2</sub> emissions compared to the US and UK and with our commitment towards constant improvement we are not likely to be bigger contributors than they are.”*

*- Survey participant -*

*However, looking at the future, India along with China will account for most of the emissions in the coming decades, owing to their rapid industrialization and economic growth.*

*Respondents pointed out that there is always a trade off between growth and environment. Today, India’s top priority is generating enough power to fuel the country’s economic development at an optimum cost.*

*Respondents highlighted the “3A theory”:*

**Accessibility:** Everyone should have access to electricity

**Availability:** Appropriate capacity generation and distribution to meet demand

**Acceptability:** Environmentally friendly /acceptable in terms of the environment

*A balance must exist among these, according to participants:*

- *Some felt that environmental issues were taken into consideration in power generation as there is an increased emphasis on the quality of*

<sup>38</sup> United Nations Framework Convention on Climate Change



coal and a shift towards higher efficiency in terms of applied technology (supercritical technologies, clean coal).

*"We are employing new technology but it is not our top priority. On a commercial and viable basis, we have to see that we are able to meet the basic priority of energy access."*

- Survey participant -

- Furthermore, some felt that by setting up more nuclear power plants, the negative impacts on the environment would be reduced.
- Others highlighted the importance of keeping a renewable energy target in coming years, if not in absolute terms then at least in percentage terms.

Major support initiatives exist which are clearly defined in "Eight Missions", the government's priorities in addressing climate change. The Eight Missions identified in the National Action Plan on Climate Change are currently being elaborated and the exercise is drawing to a close.<sup>39</sup>

The Eight Missions in India comprise:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for a Green India
- National Mission for Sustainable Agriculture

- National Mission on strategic Knowledge for Climate Change.

### **How strong is India's commitment towards fostering carbon sensitive economy over the next five years?**

While keeping a low carbon economy in mind it is crucial to note the fact that in India half of the population does not have access to electricity. Hence, it becomes very difficult to balance growth in the electricity sector with concerns for the environment.

*"We have a verbal commitment, which is not feasible because it sounds like: Stop your growth. The discussion is about growth versus the environment."*

- Major financial institution -

*"The fact is that in India half of the population does not have an electricity connection... So creating more generation programs, and focusing on an adequate system to take care of transmission and distribution is key. If that is done sufficiently in a low carbon way, this will be the best strategy."*

- Survey participant -

### **What kinds of energy saving technologies are expected to be implemented during the next five years? What levels of support will the state provide in this respect? How will it influence the consumption?**

A majority of respondents consider energy conservation a very important issue as evidenced by the popular slogan "Energy saved is energy generated". The successful implementation of energy saving technologies, however, will most likely be purely based on cost. Although energy conservation is an important concept, an appropriate

pricing mechanism needs to be developed to drive consumer behavior towards saving energy.

*"If you are not paying for the electricity consumed... you will not switch off fans when you leave a room."*

- Survey participant -

In addition, emphasis has been placed on the states' and regulators' roles in supporting the development of energy saving technologies by creating more awareness and, if needed, giving subsidies to specific areas, such as CFL<sup>40</sup> usage. The Government is conducting campaigns to create awareness among the public, but at this point that awareness is not yet apparent among average citizens.

Respondents applauded the role of the Bureau of Energy Administration who as per the Energy Conservation Act 2001 is doing energy audits for companies to provide them with information showing differences between energy saving appliance use and conventional appliances.

However, some respondents were pessimistic about the subject and think that such topics are more suited to seminars and white papers. They believe that even though much has been said on the concept of energy conservation, no serious concrete steps have been taken, in contrast to countries like China which is growing in accordance with proper planning.

*"This is a topic of discussion among those in the seminar circuit. People like to discuss such issues, there will be various seminars held, but nothing concrete comes out of it, no action is taken. It is all only on paper."*

- Major market participant -

39 Government of India – National Action Plan on Climate Change

40 CFL is an abbreviation for compact fluorescent lamp

### 4.4.3 Key challenges

India faces challenges on many fronts, being in the process of a significant development boom in terms of population, economy, and as a result of electricity consumption. In the coming decades, it is of vital importance that India be well organized, as the smallest missing component could set back its development.

Based on the survey, the most important challenges determining the long term development of the country are connected to skills development, regulatory effectiveness, corporate governance, electrification, and the ensuring of investments.

**What are the issues/ matters of the highest importance, those that are the most influential regarding the future of the electricity sector? What will determine the next five years of the sector?**

*The main issues considered to be critical regarding the future development of the electricity sector mentioned by respondents were:*

- Reducing AT&C losses
- Distribution sector reforms to be accelerated
  - Collection efficiency to be improved
  - Introduction of stringent measures against power theft and pilferage
- Gradually setting up a cost-reflective tariff mechanism shifting the sector towards market based operation and increased competition
- Encouraging private players to further participate in thermal generation (via privatization)
- Increasing transparency and accountability of responsible regulatory and government bodies
- Creating a high level authority to resolve domestic issues and also federal versus state issues, to avoid delays between responsible ministries
- Increasing government flexibility to take private players' opinions into consideration when drafting policy
- Promoting renewable energy sources, with a special focus on solar energy as India has abundant sunlight
- Promoting energy efficiency and energy conservation technologies
- Approvals relating to environment and land acquisition should be granted within a stipulated amount of time, ensuring that projects can be finished on time.

**What can be the solutions for India to fulfill the increasing demand for equipment and technology services of the electricity sector over the next five years? How will suppliers be able to serve this demand?**

*Considering the fact that India's power generation sector is expected to grow by 40–60 percent, India is going to face challenges in meeting the demand for equipment and technological services. Respondents mentioned that although huge investments are being made in the sector, this part of the industry remains neglected.*

*India's dependence on technology imports has significantly increased over time, as local producers are not able to fulfill domestic demand for equipment and technological services.*



This takes a toll on most of the projects, delaying them unnecessarily.

*"We need to expand our manufacturing capacity and assimilate and upgrade technology from sub critical to super critical as the generation of power capacity has gone up to 16,000 megawatt and this demands upgraded technology. The kind of ramp up we have in mind means we need more players in this sector to set up the plant and equipment base."*

- Major financial institution -

At present BHEL is the country's major manufacturing unit. They have a monopolistic advantage and outside of them, there are few vendors, namely only Tata, Jindal, Larsen & Toubro are setting up production capacities.

Survey respondents suggested that the government and regulatory bodies should encourage new companies to venture into the sector, providing them with support, while maintaining quality standards. Respondents mainly pointed out the prerequisite standards restricting new vendors from entering the sector.

*"The rules and regulations should be the same and strengthened to ensure quality, but for first timers there should be no prerequisite standards."*

- Major technology supplier -

*"Facilitate the entrance of more global players."*

- Major technology supplier -

Some respondents also said that it was essential for the Government to refrain from strong-arm methods when someone does not want to buy Chinese products.

On the contrary they should encourage NRIs and other global investors to come and invest in plants.

On the generation side, India needs to work on clean coal technology as coal remains the primary source of power generation. The concern here is that these technologies are extremely specialized and advanced and, currently, scarce in India.

To overcome this, more vendors apart from BHEL should be given incentives to bring the technology into the country. Secondly, expansion of the vendor base all across the generation, transmission and distribution segments is needed. Thirdly, more focus on research and development would be necessary, according to respondents.

In order to also be able to meet the growing needs of equipment and technological services domestically, the availability of Indian skilled labor is crucial in addition to capacity investments.

**Does India have enough skilled and available labor to lead and execute the necessary investments into the electricity sector in the next five years?**

A majority of respondents maintain that there is a shortage of skilled labor in the energy sector.

This is one issue which has been left overlooked and requires immediate attention.

*"The paradox is this: We have unemployment but the unemployed have no skills."*

- Survey participant -

*"No, unfortunately India does not have much labor available. Even those graduating from college have to be retrained. The education system has still not evolved."*

- Survey participant -

*"We have a shortage because the demand is going to go up."*

- Survey participant -

The following limitations were brought to light:

- There is a lack of universities and training centers to develop skilled labor, emanating from the fact that focus on organizational structure and accountability is missing throughout the country.
- Organizations in the sector employ an aged workforce who are not motivated towards betterment or developing their skills.
- There is a need to re-set internal educational system and create incentives for training programs.

Compared to China, which provides training institutes in almost every province, India has only a few training centers like NPTI (National Power Training Institute) to support the increasing demand for manpower in the sector.

Key investment opportunities may lie in the development of training centers to improve and train skilled workforce, and expanding manufacturing capacities supporting state-of-the-art technologies.



## 5. Investment Opportunities

As described in this publication, India's electricity sector bears enormous potential for growth and business development, but exploitation of these opportunities requires tailor-made investment strategies and careful planning processes.

This study aims to help both domestic and international financial investors in identifying business opportunities in the Indian power sector throughout the asset lifecycle.

The main results of our assessment of the Indian power sector are outlined in the chart which follows.



### Macro-economic trends

- Population is forecasted to grow significantly and even bypass China's after 2020.
- Electricity consumption is predicted to grow continuously as a result of the electrification program and increasing living standards.
- The electricity sector is a top priority on the political agenda; the government's goal is the expansion of the sector through supporting programs.
- Electricity regulation is erratic, but electricity sector regulatory policies are undergoing improvements regarding compliance with rules, changing regulation, unregulated issues, cross-subsidies, liberalization and open access.
- A strong and growing domestic market mainly led by the commercial and industrial sectors.
- Improvements in operational and pricing efficiency to support further growth.

### Investment characteristics

- High investment opportunities for vendors and suppliers because of the increase in the demand for generation, distribution and transmission as:
  - Expanding and improving installed capacity is attractive for many private players entering the sector with huge investments.
  - Supplying new metering and control technologies and equipment.
  - Supplying components required to expand transmission lines.
- Overall, huge investments are expected in India:
  - Large capacity additions are planned
  - Privatization of SEBs
  - A large portion of the country's rural area has yet to receive access to electricity.
- There is a high level of support from the central government. Electricity is in focus as a basic component.
  - India is rich in coal reserves and natural gas has recently been discovered.
  - Privatization is on the way, limited private equity is already present in the country.
  - India has the potential for further development wind energy.
  - India has a large volume of unexploited hydro resources throughout the country.
  - India's power system is under revision.
- The issues of high subsidies to the rural sector and cross subsidization are not yet settled. There is a possibility that cross-subsidies will be maintained over the next five years.
- The lack of skilled labor in the electricity sector and manufacturing must be addressed. There is an increasing market for training centers to improve employee training.

### Market factors

- Growing pressure for expanding the use of renewable, non-polluting and environmentally friendly energy sources.
- High quality standards issued by the regulatory body present challenges to new investments.
- Increasing focus on capacity additions, utilizing the country's vast unexploited potentials, like hydro power sources.
- There is increasing demand for specialized know-how, which can hardly be satisfied. Unemployment exists, but few skills among those out of work. There is pressure to install training centers similarly to China.
- Politically sensitive issues like cross-subsidies are present in the electricity sector.
- An alarming level of T&D losses is dissuading private investments into the electricity sector.

# Acronyms

**APDRP** – Accelerated Power Development and Reform Program

**AT&C** – Aggregate Technical and Commercial

**BPO** – Business Process Outsourcing

**BRIC** – Brazil, Russia, India, and China

**CAGR** – Compound Annual Growth Rate

**CDM** – Clean Development Mechanism

**CFL** – Compact Fluorescent Lamp

**ECB** – External Commercial Borrowing

**EIU** – Economic Intelligence Unit

**GDP** – Gross Domestic Product

**GHG** – Greenhouse Gas

**IEA** – International Energy Agency

**IPO** – Initial Public Offering

**IPP** – Independent Power Producer

**MNE** – Multinational Enterprise

**NHPC** – National Hydroelectric Power Corporation

**NPCL** – National Power

**NPT** – Non-Proliferation Treaty

**NPTI** – National Power Training Institute

**NRI** – Non Resident Indian

**NTPC** – National Thermal Power Corporation

**PPP** – Purchasing Power Parity

**PSU** – Public Sector Undertaking

**SEB** – State Energy Board

**SEZ** – Special Economic Zones

**SME** – Small and Medium Enterprise

**SPU** – State Power Utilities

**T&D** – Transmission and Distribution

**UNFCCC** – United Nations Framework Convention on Climate Change

**WEC** – World Energy Council

# KPMG's ENR Practice Overview

KPMG's Global Energy and Natural Resources (ENR) practice is dedicated to helping our firms' clients tackle the issues affecting them in today's operating environment. From global super majors to next-generation leaders, KPMG member firms strive to tailor our service offerings to specific client needs and deliver the highest standards.

KPMG's Global ENR practice is organized through a global leadership team aligned with member firms' ENR practices. The global leadership team focuses on our strategic framework, reputation and performance, supported by an executive group dedicated to

driving their implementation, and measuring and communicating our performance. Our management team focuses on providing account management, proposals, marketing, knowledge management, and administrative support to KPMG client service teams operating in the ENR industries.

KPMG's ENR professionals help our member firms' clients address the complexities and challenges that affect their businesses by creating industry groups that tackle different areas of the global energy marketplace. The industry groupings facilitate outstanding

coverage of this vast industry, which are: Oil & Gas, Power & Utilities, Mining & Forestry.

KPMG firms have Centers of Excellence (CoE) throughout the globe, dedicated to the Oil & Gas, Power & Utilities, Mining, and Forestry sectors. These centers are strategically located near major hubs of activity within the industry. CoE teams of experienced KPMG energy professionals provide high quality advisory services to clients based in those specific areas.





## KPMG's Global Power & Utilities Knowledge and Resource Center – Budapest, Hungary

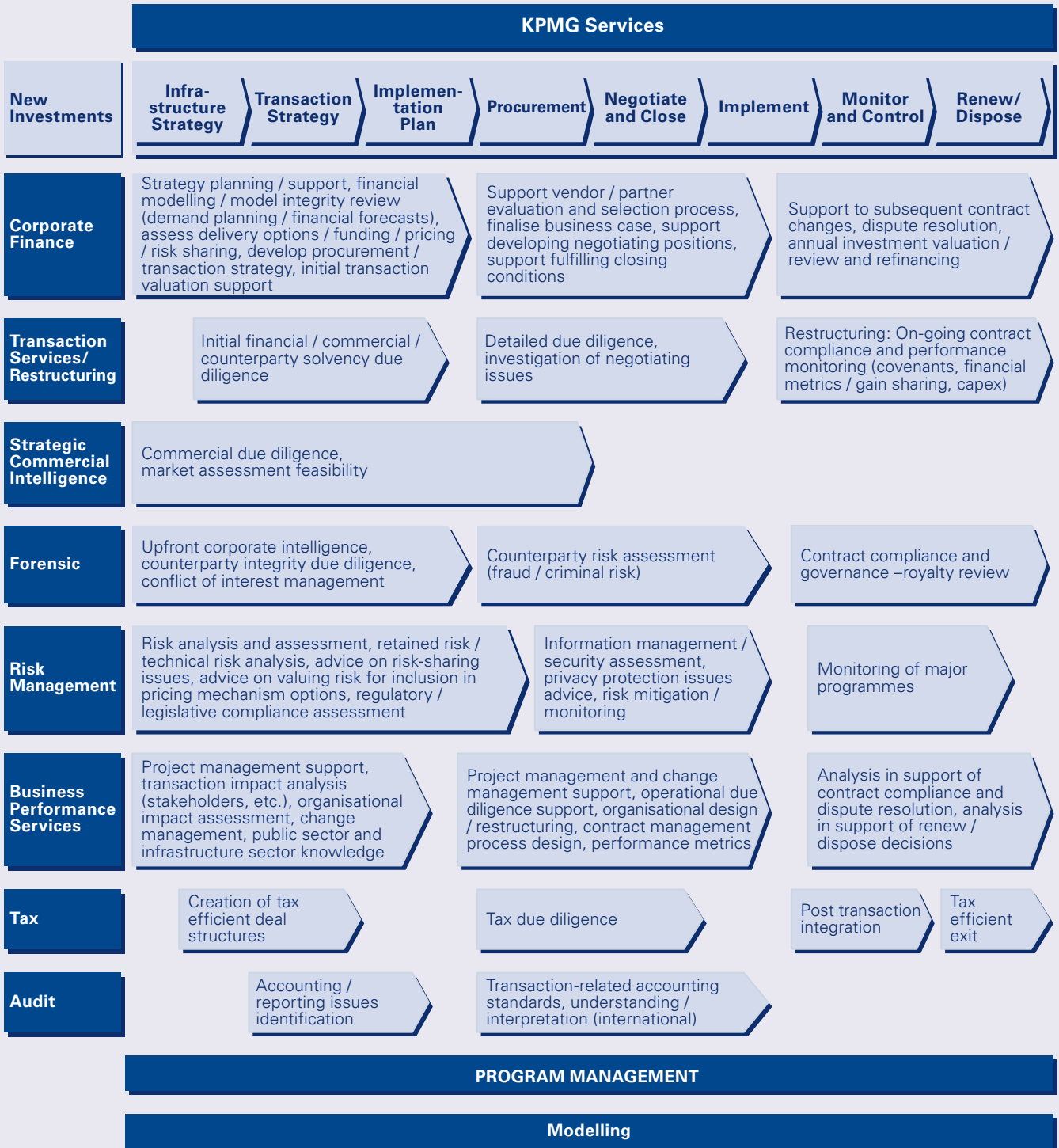
The Power & Utilities market has been developing at an extremely rapid pace globally in recent years. This fast development is characterized by large scale infrastructure projects that require a global base of experience and a high level of specialized industry knowledge.

As a focal point of Power & Utilities, KPMG's Global Power & Utilities Knowledge & Resource Center based in Budapest, Hungary (Central and Eastern Europe) consolidates global know-how and knowledge in a single location and takes a hands-on approach to match client needs with KPMG's

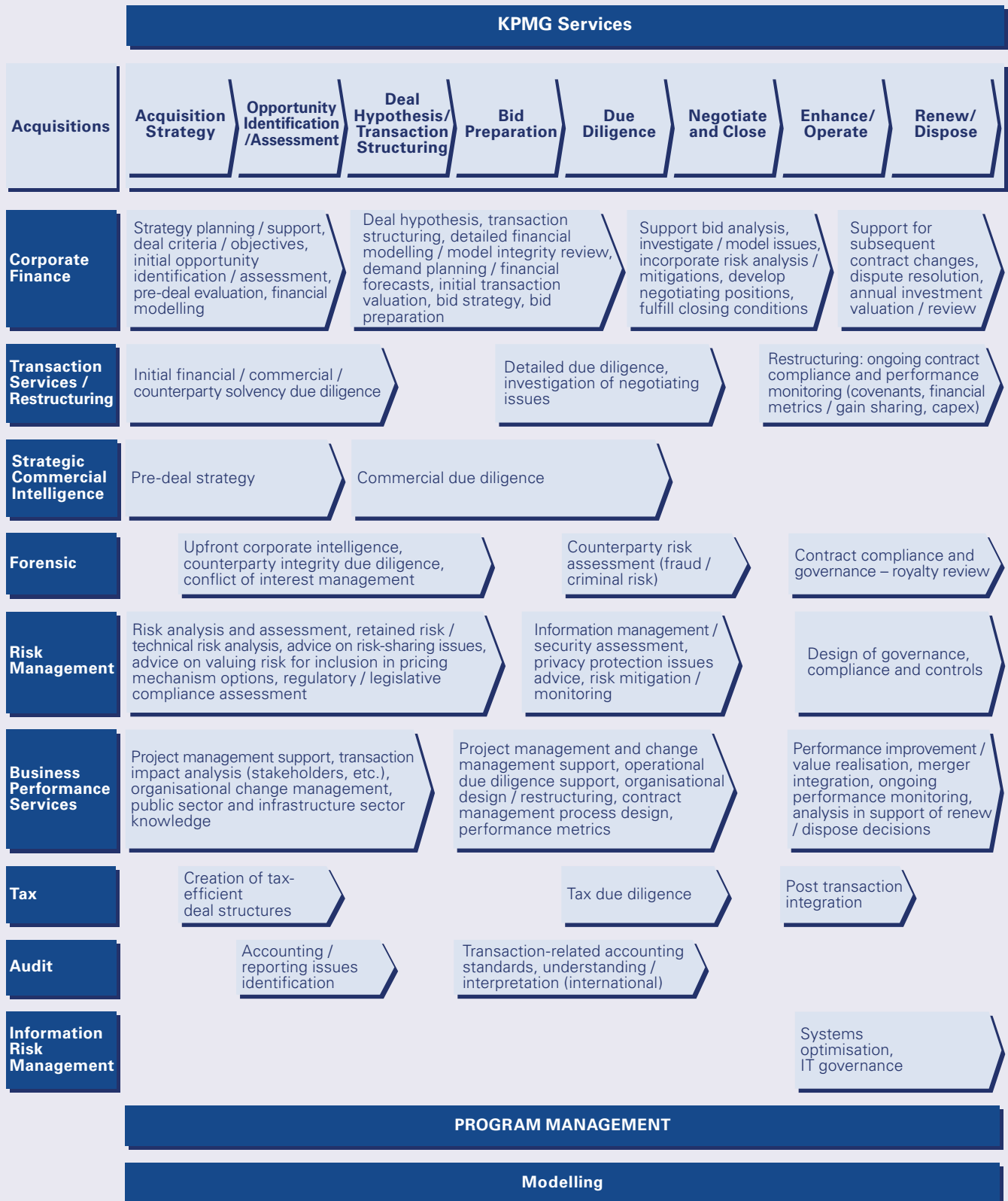
Centers of Excellence (CoE) across the globe that are best suited to providing professional advice and support that addresses clients' strategic and transactional activities.



Throughout the globe, KPMG member firms provide clients with offerings in relation to the following services:



Throughout the globe, KPMG member firms provide clients with offerings in relation to the following services:





## KPMG's "Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies" publication series

"Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies" publication series aim to highlight major trends and challenges shaping the evolution of the BRICs countries' power sectors over the course of the next decade in light of the global economic crisis. Perspectives of top-level executives and stakeholders of the BRICs power sector are included in these country reports which are based on a qualitative research and KPMG analyses.



*Think BRIC! – Key considerations for investors targeting the power sectors of the world's largest emerging economies –*  
**Comparative study**

This KPMG report sizes the investment needs of the power sectors in Brazil, Russia, India and China; including historical analyses from 2000–2008 and also projected investment needs until 2020 by assessing socio-economical, technical, environmental and legal aspects.



**Brazil's** electricity sector bears enormous potential for growth and business development, but accessing the opportunities

requires tailor-made investment strategies and careful planning processes. This study aims to help both domestic and international investors in identifying business opportunities in the Brazilian power sector throughout the asset lifecycle.



The **Russian** market is one of the largest on the planet. Scores of power plants feed almost 1 million gigawatt hours of electricity into a vast grid that

comprises some 3.2 million kilometers of cables that stretches across 11 time zones. More recently, the global financial crisis, along with the fall in the price of oil, has hit Russia hard but the Russian electricity sector is still a target for foreign investments.



**India's** population around 1.1 billion in 2009, is growing fast, and is expected to surpass that of China soon after 2020 – making it the largest in the

world. To fuel its economic growth, which is expected to be over 9 percent for most of the next decade, with electricity, total generating capacity should jump by 90 GW, to 241GW, with an increased emphasis on nuclear, clean coal and renewables, including solar and small-hydro.



**China** invested some USD 83 billion in the electricity sector in 2008. Longer term estimates predict that China will need to invest USD 2,765 billion

into the industry by 2030 to cope with its power demand – an estimated one quarter of the total global energy sector investment within that period. How will such a gigantic sum be spent, and what opportunities will it offer investors and suppliers?

Authors and co-authors of the "Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies" publication series:

Péter Kiss, Global Head of Power & Utilities, Attila Szepesi, Judit Pintér, Balázs Zambó and KPMG's Global Power & Utilities Knowledge & Resource Center, Budapest, Hungary; IPSOS

## Other KPMG Thought Leadership

To receive electronic copies or additional information about any of the documents below please contact your local KPMG firm. Alternatively, please visit the following web sites:

### KPMG.com:

<http://www.kpmg.com/Global/WhatWeDo/Industries/Energy/Pages/default.aspx>



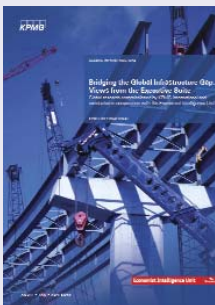
### China's Energy Sector – A Clearer View

The following KPMG report shares our observations on key trends in each area of the energy sector, from upstream oil and gas to power generation



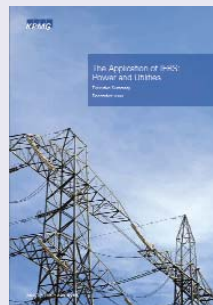
### Central and Eastern European Nuclear Energy Outlook

A discussion of the nuclear energy industry in Central and Eastern Europe, this document discusses both the region as a whole and individual nations.



### Bridging the Global Infrastructure Gap: Views from the Executive Suite

Global research commissioned by KPMG International and conducted in cooperation with the Economist Intelligence Unit



### The Application of IFRS – Power and Utilities

The publication examines trends and challenges in implementing true IFRS across the Power and Utilities industry and is based on the reports of various companies across a variety of countries.



### The Winds of Change

The Winds of Change is the 2009 version of an annual publication which discusses trends in M&A in the Renewable Energy Industry. Over 200 executives were surveyed, and supplementary interviews were carried out by the Economist Intelligence Unit.



### Indian Power Sector – Rising up the Curve

The Indian power sector is going through an exciting growth phase-high GDP growth lead to increased demand, generation capacity, transmission and distribution.

## About the KPMG Global Energy Institute (GEI)

The KPMG Global Energy Institute has been established to provide an open forum where industry financial executives can share knowledge, gain insights, and access thought leadership about key industry issues and emerging trends.

Power and utilities financial, tax, risk, and legal executives will find the GEI—and its Web-based portal—to be a valuable resource for insight on emerging trends.

To register for your complimentary membership in the KPMG Global Energy Institute, please visit [www.kpmgglobalenergyinstitute.com](http://www.kpmgglobalenergyinstitute.com).

For more information about the GEI, please e-mail us at [globalenergyinst@kpmg.com](mailto:globalenergyinst@kpmg.com).





Comments and questions in relation to the *Think BRIC!* publications series and their content are welcome and should be addressed to:

E-mail: [ThinkBRIC@kpmg.com](mailto:ThinkBRIC@kpmg.com)

**Péter Kiss**

Global Head of Power & Utilities  
KPMG's Global Power & Utilities  
Knowledge and Resource Center

KPMG in Hungary  
Tel: +36 70 333 1400  
E-mail: [pkiss@kpmg.com](mailto:pkiss@kpmg.com)

Media relations:

**Judit Pintér**

Business Development Coordinator  
KPMG's Global Power & Utilities  
Knowledge and Resource Center

KPMG in Hungary  
Tel: +36 1 887 7118  
E-mail: [jpinter@kpmg.com](mailto:jpinter@kpmg.com)

Global ENR Contacts

**Michiel Soeting**

Global Chair  
Energy & Natural Resources

KPMG in the UK  
Tel: +44 20 7694 3052  
E-mail: [michiel.soeting@kpmg.co.uk](mailto:michiel.soeting@kpmg.co.uk)

**Pamela O'Leary**

Global Executive  
Energy & Natural Resources

KPMG in the UK  
Tel: +44 20 7311 8438  
E-mail: [pamela.o'leary@kpmg.co.uk](mailto:pamela.o'leary@kpmg.co.uk)

ENR and Power & Utilities  
Contacts in India

**Arvind Mahajan**

Executive Director

KPMG in India  
Tel: +91 (22) 3983 6206  
E-mail: [arvindmahajan@kpmg.com](mailto:arvindmahajan@kpmg.com)

**Manish Agarwal**

Executive Director

KPMG in India  
Tel: +91 22 3090 1770  
E-mail: [manishagarwal@kpmg.com](mailto:manishagarwal@kpmg.com)

Global Infrastructure Projects  
Group Key Contacts

**Dr. Timothy Stone**

Chairman  
Global Infrastructure Projects Group

KPMG in the UK  
Tel: +44 20 7311 8244  
E-mail: [timothy.stone@kpmg.co.uk](mailto:timothy.stone@kpmg.co.uk)

**Nick J. Chism**

Global Head of Infrastructure  
Global Infrastructure Projects Group

KPMG in the UK  
Tel: +44 20 73118603  
E-mail: [nick.chism@kpmg.co.uk](mailto:nick.chism@kpmg.co.uk)

**Jai Mavani**

Executive Director  
Head of Infrastructure

KPMG in India  
Tel: +91 22 39896000  
E-mail: [jmavani@kpmg.com](mailto:jmavani@kpmg.com)

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

KPMG and the KPMG logo are registered trademarks of KPMG International, a Swiss cooperative.

© 2009 KPMG International. KPMG International is a Swiss cooperative. Member firms of the KPMG network of independent firms are affiliated with KPMG International. KPMG International provides no client services. No member firm has any authority to obligate or bind KPMG International or any other member firm vis-à-vis third parties, nor does KPMG International have any such authority to obligate or bind any member firm. KPMG and the KPMG logo are registered trademarks of KPMG International, a Swiss cooperative. All rights reserved.