

ENERGY AND NATURAL RESOURCES

# Think BRIC!

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

COMPARATIVE STUDY

ADVISORY







# Contents

Contents	3
Foreword	4
Introduction & Methodology	5
Defining BRIC Markets	6
1. Countries in Figures	7
2. Population	8
3. Economy	10
4. Electricity Market	16
4.1. Electricity demand	16
4.2. Electricity supply	20
4.3. Ownership and investment potentials of the power industry	25
4.4. Main determining factors in the development of the electricity industry	28
5. Investment Opportunities	32
KPMG's ENR Practice Overview	33
KPMG's "Think BRIC! Key considerations for investors targeting the power sectors of the world's largest emerging economies" publication series	37
Other KPMG Thought Leadership	38

# Foreword



**Péter Kiss**  
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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 an overview of a series of country 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 BRICs' power sectors 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 investment, 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 comparative study will offer you deep insights into these unique, emerging energy industry markets.

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

# Introduction & Methodology

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

This comparative study sizes the overall investment needs of these high growth markets' electricity industries including historical analyses from 2000-2008 and also projected investment needs until 2020 by assessing socio-economical, technical, environmental and legal aspects.

To make this report KPMG's Global Power & Utilities Knowledge and Resource Center conducted comprehensive research both on- and off-site in Brazil, Russia, India and China. Based on research results, professional databases (e.g., Economist Intelligence Unit, International Energy Agency, Bloomberg, IMF, CIA – The World Factbook 2009 and various other sources) and KPMG's own market information and knowledge, forecasts in this publication were prepared based on the assumption that the economies of the BRIC countries are expected to start recovering from the global financial turmoil after 2010-2011 and progressively use predictable patterns and assume historical trends prior to the downturn.



# Defining BRIC Markets

Brazil, Russia, India and China, known in shorthand as the BRIC countries, are among the largest countries in the world and play an increasingly important role in the global economy. They have diverse political, social, macro-and microeconomic environments, and are on the right path to achieve global economic dominance in numerous areas, including the global energy – and especially the electricity – industries.

A chief economist, Jim O'Neill of Goldman Sachs was the first to group the four countries as BRIC, in order to describe the largest of the world's developing economies and predict their dominating role in the global economy and the implications this will have on globalization.

The BRIC countries account for more than a quarter of the global land area and about 40 percent of the global population. China alone uses half of the concrete and a third of steel consumption of the globe, while the Chinese GDP per capita amounts to only 60 percent of the global average and a mere 30 percent of the Western European level.

For the time being, per capita electricity consumption of the BRIC countries is slightly above the global average, however, they consume only 40 percent of the Western European and 21 percent of the North American levels.

The BRIC leaders organized their first ever summit in Yekaterinburg, Russia, on 16 June 2009 proclaiming their interest in becoming major players in

the global economy, including a larger role in global financial infrastructure.

The BRIC countries announced in a joint communiqué: *"The emerging and developing economies must have a greater voice and representation in international financial institutions"*.

The BRIC countries are poised to become the most important bloc in the global power industry during the course of the upcoming decades attracting investments of USD 4,632 billion up to 2030 for its large-scale infrastructure projects within its power sectors.



# 1. Countries in Figures

2008	Brazil	Russia	India	China	BRIC	World
<b>Population</b> (million)	191.9	141.8	1,148	1,328	2,809.7	6,680.4
<b>Nominal GDP</b> (billion USD at PPP)	1,981	2,260	3,357	8,148	15,746	68,237
<b>GDP per capita</b> (USD at PPP)	10,325	15,937	2,924	6,136	8,830.5	10,214
<b>Electricity production</b> (TWh)	455	1,036	692	3,433	5,616	20,202
<b>Electricity consumption</b> (TWh)	423	849	585	3,209	5,066	17,160
<b>Electricity consumption per capita</b> (kWh)	2,205	5,985	509	2,416	2,776.3	2,568
<b>Distribution losses</b> (% of the electricity production)	16.4%	10.6%	23.2%	6.7%	13.9%	8.5%

2020	Brazil	Russia	India	China	BRIC	World
<b>Population</b> (million)	220	135	1,403	1,424	3,182	7,518
<b>Nominal GDP</b> (billion USD at PPP)	3,342	4,173	9,340	26,872	43,727	146,344
<b>GDP per capita</b> (USD at PPP)	15,187	30,921	6,656	18,866	17,907.2	19,466
<b>Electricity production</b> (TWh)	785	1,332	1,108	6,857	10,082	27,708
<b>Electricity consumption</b> (TWh)	709	1,086	1,181	6,408	9,384	23,779
<b>Electricity consumption per capita</b> (kWh)	3,223	8,047	841	4,499	4,152.5	3,163
<b>Distribution losses</b> (% of the electricity production)	14.5%	9.2%	16%	6.7%	11.6%	8%

Sources: KPMG, Economist Intelligence Unit (EIU)

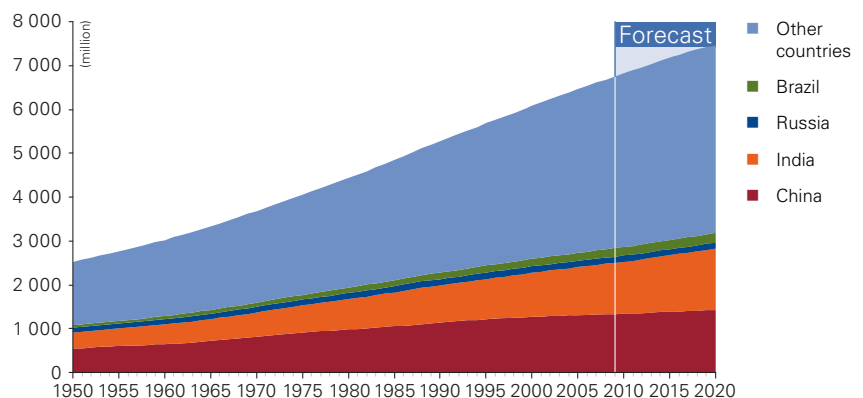
## 2. Population



At present the world's total population is approximately 6.7 billion<sup>1</sup>, a figure expected to grow to about 7.5 billion by the year 2020. The four BRIC countries currently account for more than a quarter of the world's land area and approximately 40 percent of its population. Based on historical tendencies, the populations of the four countries are expected to maintain this proportion of global population until 2020. At the same time, trends differ between the four: for example, Russia faces a decrease in population while the other three will continue to grow. Figure 1 shows the population growth of the world as compared to the BRIC countries from 1950 to 2020.

Population is one of the main determining factors of energy use in the BRIC countries. Although the share of the residential sector in electricity use varies between just 12 to 23 percent, population growth is fundamental to domestic demand for goods and products. In addition, it is crucial to both industrial output and domestic gross production as well. In the first section of the present study, the main demographic trends and trajectories are presented to highlight the future potential of these economies and their electricity industries.

**Figure 1:** Population of BRIC countries (1950-2020)



Source: KPMG, Economist Intelligence Unit

### Brazil

Brazil is the most populous country in Latin America with a total population of 191 million (in 2008)<sup>2</sup>. The population growth rate has been 1.43 percent<sup>3</sup> per annum in the last decade, which is the second highest of the BRIC countries after India. However, an examination of the demographic figures from 1950 shows that the rate of growth is decreasing due to lower fertility and birth rates. In line with this, the total population of Brazil is expected to grow to about 220 million by 2020.

Brazil's average population density is low and the majority of inhabitants live on or near the Atlantic coast. Since the 1970s, there has been an intensive migration from rural to urban areas resulting in 86 percent<sup>4</sup> of the population living in urban areas by 2008. Currently, the labor force of the country is approximately 100 million, which accounts for 52 percent of the total population.<sup>5</sup>

It can be stated that one of the main advantages of the Brazilian economy in the global context is the high availability of labor, which is expected to remain stable in the coming years.

1 Source: Economist Intelligence Unit

2 Source: Economist Intelligence Unit

3 Source: Economist Intelligence Unit

4 Source: CIA –The World Factbook 2009

5 Source: CIA –The World Factbook 2009





## Russia

The population of Russia was nearly 142 million in 2008<sup>6</sup>, which is the ninth largest in the world.

However, Russia, alone among the BRIC four, has a shrinking population, decreasing by about 0.4 percent annually.<sup>7</sup>

In 2005, the United Nations (UN) warned Russia that its population (about 143 million people in 2005) could fall by one-third by 2050 if trends were not reversed. Based on this forecast, the Russian population is expected to decrease to 135 million by 2020.

The total labor force of the country is currently 76 million, or 53 percent of the total population.<sup>8</sup>

## India

India is currently second after China in terms of population size, with about 1.1 billion<sup>9</sup> inhabitants, or 17 percent of the world's total population. India's population is growing significantly

compared to the other BRIC countries, with an annual growth rate of 1.7 percent in the last decade. This growth rate is expected to remain stable throughout the next decade, meaning India's population will match that of China soon after 2020.

In spite of significant migration from rural areas to cities, the majority of the Indian population (over 71 percent) continues to live in rural areas. However, while the growth of many major cities has slowed recently, forecasts show that the urban population is going to double by 2030.

Currently, India has an economically active population of some 523 million,<sup>10</sup> or around 45 percent of the total. If the demographic profile of India continues to expand at a similar pace, the country will add an additional 270 million to this pool by the end of 2025.<sup>11</sup> Based on this estimate there should be no shortage of low- or medium- skilled workforce.

Nevertheless, the growing population will pose fundamental social, economic, and environmental challenges for India in the coming decades.

## China

With approximately 1.3 billion people in 2008,<sup>12</sup> China is the most populous country of the world, representing approximately 20 percent of the global population.

China has a growth rate of approximately 0.6 percent annually, lower than the global average (1.07 percent), the previously high population growth having been curbed by the One Child Policy, in effect since 1979.<sup>13</sup> With this growth rate, expected to be stable in the next decade, the population is expected to reach approximately 1.4 billion in 2020. As a result of the current urbanization process, up to 0.4 billion rural people are expected to move to urban centers in the future. The labor force of the country is currently 808 million, about 61 percent of the total population.<sup>14</sup>

As a result of these demographic trends, China is now one of the most rapidly aging countries in the world.

6 Source: Economic Intelligence Unit

7 Source: Economic Intelligence Unit

8 Source: CIA – The World Factbook 2009

9 Source: Economic Intelligence Unit

10 Source: CIA – The World Factbook 2009

11 Source: CIA – The World Factbook 2009

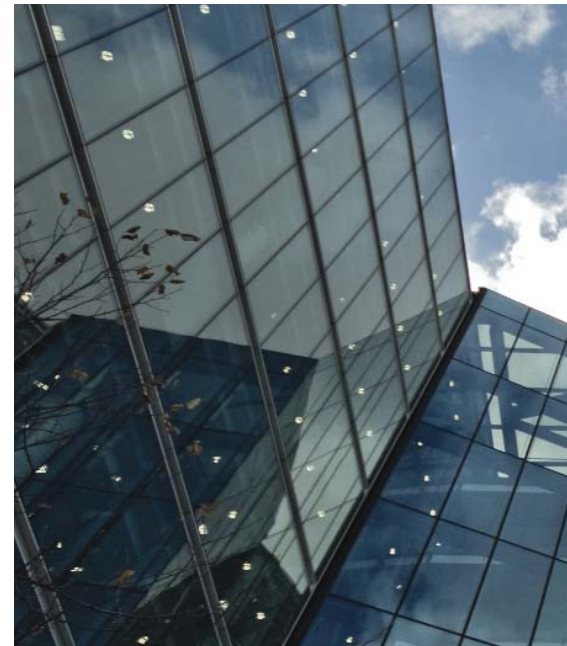
12 Source: Economist Intelligence Unit

13 <http://geography.about.com/od/population>

[geography/a/chinapopulation.htm](http://geography/a/chinapopulation.htm)

14 Source: CIA – The World Factbook 2009

# 3. Economy



Emerging economies are playing an increasingly important role in global economic development, and all four BRIC countries have shown spectacular economic growth in recent years, doubling their share of world output from 7.5 percent in 1998 to more than 15 percent in 2008.

Yet the structures of these four economies are very different, Brazil having specialized in agriculture, Russia in commodities, India in services and China in manufacturing.<sup>15</sup>

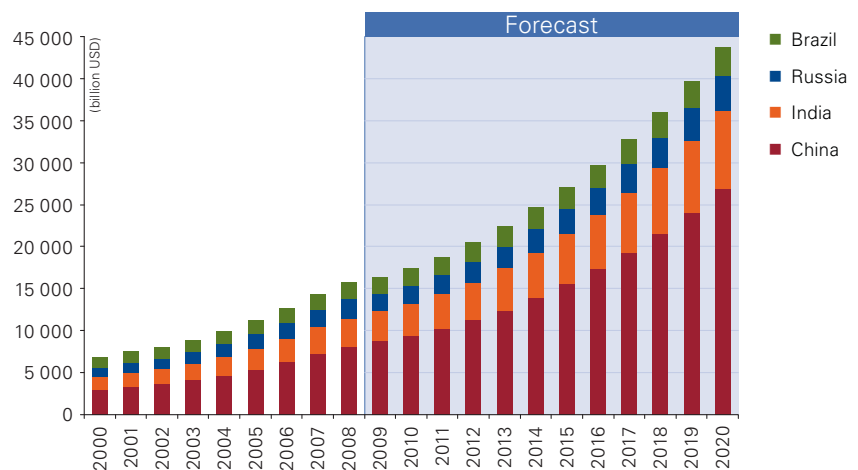
There is a relationship between economy, or more precisely the creation of wealth, and electricity usage. Electricity usage depends on technical and economic factors, while its increasing usage supports technological advancement and stimulates economic growth. Ferguson et al. (2000) finds a correlation between electricity use

and welfare<sup>16</sup> and most of his studies imply a relationship between the two. In this part of the present study, the main factors affecting economic growth are analyzed to describe their implications and the future prospects of the electricity industry in all the BRIC countries.

## Nominal GDP

The total nominal GDP of the BRIC countries was USD 15,746 billion in 2008<sup>17</sup> (see Figure 2) at purchasing power parity (PPP), which represented 23 percent of the total global GDP. The average growth of GDP of the four countries was nearly

**Figure 2: Nominal GDP (PPP)**



Source: KPMG, EIU

<sup>15</sup> Source: www.ft.com

<sup>16</sup> Ferguson, R., Wilkinson, W., Hill, R., 2000. Electricity use and economic development.

Energy Policy, 28, 923-934  
<sup>17</sup> Source: Economist Intelligence Unit



11 percent annually in the last decade, significantly higher than the world average of 6.4 percent.<sup>18</sup> The current annual GDP growth rate of the BRIC countries is predicted to be halved between 2008 and 2009 as a result of the global economic downturn. But after one year of slowdown, all BRIC economies are expected to start their recovery path with approximately 6 percent average GDP growth for the year 2010 and 8 percent for 2011. This tendency will continue and the annual growth rate of the nominal GDP is expected to return to close to the previous level of about 10 percent after 2012.

Of the four countries, China with an average 13.4 percent annual growth in the first decade of the millennia, leads the group, followed by India with 10.2 percent, Russia with 9.2 percent and Brazil with 5.8 percent.

The global financial crisis has affected all the BRIC economies to varying extents.

In particular, Brazilian and Russian nominal GDPs are expected to decrease between 2008 and 2009, while in the same period the Indian and Chinese indicators are predicted to increase 5–8 percent. All signs indicate that the BRIC countries will start recovering from the crisis after 2009, although in China and India the recovery period is predicted to be shorter than in Russia and Brazil.

### GDP per capita

As Figure 4 highlights the average GDP per capita of the BRIC countries was USD 8,830 in 2008, which was about 86.4 percent of the world average and approximately one-quarter of the Western European level.<sup>19</sup> The BRIC countries' average per capita GDP is predicted to be approximately USD 18,000, about 90 percent of the world average in 2020.

The Brazilian GDP per capita was USD 10,325 in 2008,<sup>20</sup> slightly above the world average.

**Figure 3:** Rate of households with more than USD 10,000 yearly income

<b>Brazil</b>	37.0%
<b>Russia</b>	58.7%
<b>India</b>	5.3%
<b>China</b>	5.5%

Source: EIU

The growth of GDP per capita in Brazil is predicted to be under 4 percent, somewhat lower than the global average until 2020. Brazil's GDP per capita is expected to be approximately USD 15,200 in 2020, roughly 25 percent below the world average.

Currently the GDP per capita of Russia is approximately USD 16,000, although mostly due to its declining population. This is expected to double by 2020 to about USD 31,000, or 158 percent of the global average.

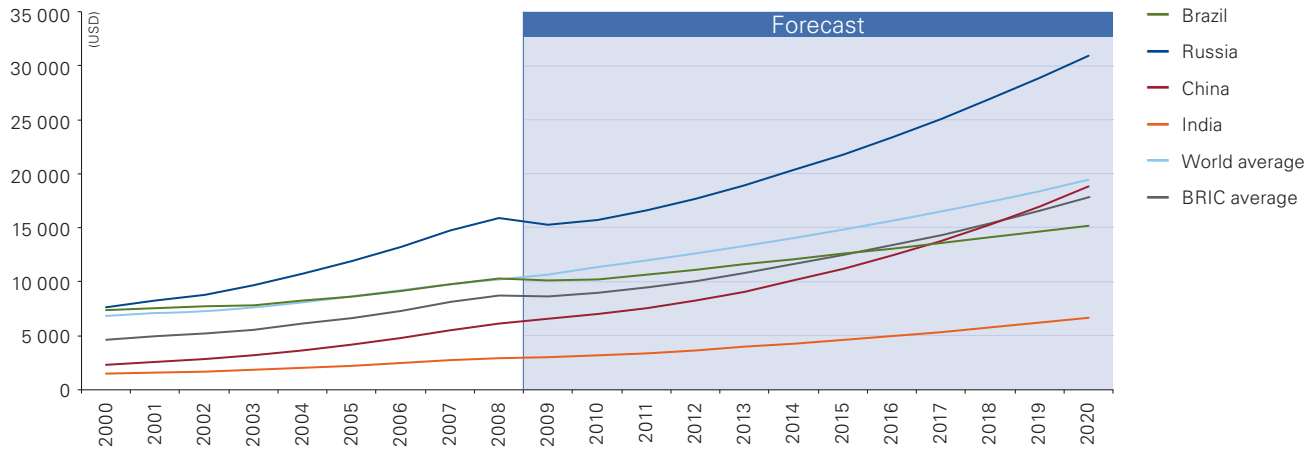
<sup>18</sup> Source: Economist Intelligence Unit

<sup>19</sup> Source: Economist Intelligence Unit

<sup>20</sup> Source: Economist Intelligence Unit



**Figure 4: GDP per capita**



Source: KPMG, EIU

GDP per capita in India was USD 2,900 in 2008, only 33 percent of the world average. In spite of its high population growth rate, India’s GDP per capita growth is still some 2.2 percentage points higher than the average growth rate of the other BRIC countries. Overall, it is expected that India’s GDP per capita will be USD 6,700 in 2020, around 35 percent of the global average.

The BRIC countries play an increasingly significant role in global trade, and moreover, their export performance and trade balance are of eminent importance in their economies (see Figure 5 and 6).

The export potentials of the Chinese and Russian economies have been strengthened by the devaluation of their domestic currencies against the US dollar.

Mainly due to fuel exports in the case of Russia, the accumulation of the export revenues of the BRIC countries has helped to build up considerable international reserves.

In particular, their increased financial clout enables BRIC companies (and state-owned funds) to appear on the global M&A markets, those operating in the energy sector.

**Figure 5: Foreign exchange reserves of the BRIC countries**

Rank	Country	billion USD
1.	<b>China</b>	2,132
3.	<b>Russia</b>	402
5.	<b>India</b>	265
7.	<b>Brazil</b>	207

Source: IMF, June/July 2009

**Figure 6: Trade balance of the BRIC countries (billion USD)**

	Import	Export
<b>Brazil</b>	223.2	225.8
<b>Russia</b>	368.5	522.8
<b>India</b>	371.7	294
<b>China</b>	1,232.9	1,580.2

Source: EIU

Decreasing foreign direct investment figures in Figure 7 are a consequence of increased investments made by BRICs abroad since 2005, which were supported by the incomes proceeding from the hiking energy prices.

In recognition of the increasing importance of enterprises within the emerging BRIC economies, six years ago, Dow Jones created the DJ BRIC 50 blue chip index comprising the top 50 BRIC companies (see Figure 8). This index now represents a total market capitalization close to USD 800 billion. Another index from Frankfurt, the DAX global BRIC, illustrates the relatively impressive performance of BRIC companies despite the global recession.

The BRIC countries have also exhibited a remarkable growth in domestic consumption, fuelled in part by population growth and in part by increasing wealth accumulation. In all countries an expanding middle class has been a significant factor in the increased demand for energy.

This is evident in numerous ways, for example the growing number of home electrical appliances requires more power, while new car sales increase demand for petroleum products, most notably in China where new auto sales began to surpass those of the US by the end of 2008.

**Figure 7:** Foreign direct investment, 2008 (billion USD)

	Brazil	Russia	India	China
<b>Direct investment</b>	45.1	70.3	41.2	138.4
<b>Net direct investment</b>	24.6	17.9	22.8	94.3

Source: Economist Intelligence Unit

**Figure 8:** DJ BRIC50 index

Source: KPMG, EIU

**Figure 9:** Global Competitiveness Index

Country	2009/10		2008/09
	Rank	Score	Rank
<b>Switzerland</b>	1	5,6	2
<b>United States</b>	2	5,59	1
<b>China</b>	29	4,74	30
<b>India</b>	49	4,3	50
<b>Brazil</b>	56	4,23	64
<b>Russia</b>	63	4,15	51

Source: World Economic Forum, Global Competitiveness Index 2009–2010

Figure 9 indicates the growing economies and trends in competitive rankings of the BRIC countries.

## Energy economy

As far as conventional energy resources are concerned, the BRIC countries together control almost 10 percent of global oil reserves, and more than 25 percent and 40 percent of natural gas and coal reserves, respectively. With regard to these fuels, Russia is the only net exporter among the BRICs.

Eurasian markets largely depend on Russian natural gas and oil output, and global markets highly depend on the fossil fuel demand of the emerging economies especially the Brazilian, Indian and Chinese.

The four countries represent one-quarter of the world's total primary energy production, and in turn they are also responsible for one-third of global CO<sub>2</sub> emission (see Figure 10).

### Brazil

The economy of Brazil is supported by a dynamically developing energy sector. The primary energy sources produced in the country covered 80-90 percent of the domestic demand in previous years. This production is mainly supported by crude oil reserves and by robust, sugar cane-based bio ethanol output. At the same time the high rate of utilization of vast hydro reserves by large hydropower plants contributes to a uniquely great share of renewables, which translates to more than 40 percent of the primary energy mix. This results in a fairly limited carbon production of 330–350 million tons of CO<sub>2</sub> emissions.

**Figure 10:** Main energy indicators, 2006 (Mtoe)

	Production	Import – Export	Total Primary Energy Supply (TPES)	Total Final Consumption (TFC)	CO <sub>2</sub> emission (million tons)
Brazil	206.72	20.35	224.13	202.89	332.42
Russia	1,219.98	-531.12	676.2	422.38	1,587.18
India	435.64	134.83	565.82	378.48	1,249.74
China	1,749.29	135.88	1,878.74	1,213.4	5,808.54
BRIC	<b>3,612</b>	<b>-240</b>	<b>3,345</b>	<b>2,217</b>	<b>8,978</b>
World	11,796	-	11,740	8,084	28,003
BRIC/World	<b>30.6%</b>	-	<b>28.5%</b>	<b>27.4%</b>	<b>32.1%</b>

Source: OECD IEA, UN-ECE

### Russia

Russia, having the world's greatest proved reserves by far, is the single largest exporter of natural gas, delivering 150 billion cubic meters to Western Europe yearly. Russia provides more than 12 percent of global oil production, while it is the fifth largest producer of coal, supported by the second largest coal reserves in the world. More than half of the total primary energy supply is based on natural gas. Hydrocarbons together make up almost 75 percent of the total primary energy supply (TPES). Nuclear and hydro power account for around 8 percent of the primary supply and coal still represents almost 20 percent of it.

The industrial and residential shares of total final consumption are about 30 percent and 25 percent respectively, while transportation makes up 20 percent.

### India

Though India is abundant in natural resources, the country's rapidly increasing appetite for energy exceeds its current production substantially.

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.

Oil represents one-third of India's primary supply mix, while natural gas adds a further 8 percent. Although India's oil refinery capacity of about 3 million barrels per day exceeds the needs of the domestic market, the country largely buys crude oil 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. At the same time, growing nuclear power and hydroelectricity contribute 8–9 percent to 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 constitutes nearly 30 percent, while transportation represents a bit more than 10 percent.





## China

The global economy has been deeply affected by the unprecedented growth rate of the Chinese energy sector as efforts to keep pace with the huge demands required for both industrial production and private consumption during the last decade. The primary energy production of China is dominated by coal, which represents nearly 70 percent of total primary energy supply. Though China possesses 14 percent of the world's proved

reserves, industrial needs are responsible for more than 55 percent of total consumption, which makes China the seventh biggest exporter and sixth biggest importer of coal. Parallel with this, China has become the largest emitter of CO<sub>2</sub> since 2006.

Twenty percent of the primary energy supply comes from oil while large hydro and nuclear power production add some 7 percent further to TPES.



# 4. Electricity Market



Electricity demand and supply are reliable indicators of the economic and technical progress of a country. The BRIC countries, except for Russia, lag behind the developed countries in terms of electricity use per capita. However, their predicted economic growth implies an exponential growth in their respective electricity markets. The following chapter describes the expected development of the BRIC countries' electricity sectors.

## 4.1. Electricity demand

While the four BRIC countries currently account for more than 40 percent of the global population and 23 percent of the global GDP, their combined average electricity consumption was only slightly above 29 percent of the global average in 2008<sup>21</sup>. On the other hand, their share has been rising at an especially fast pace since 2000, when it was only 20 percent.

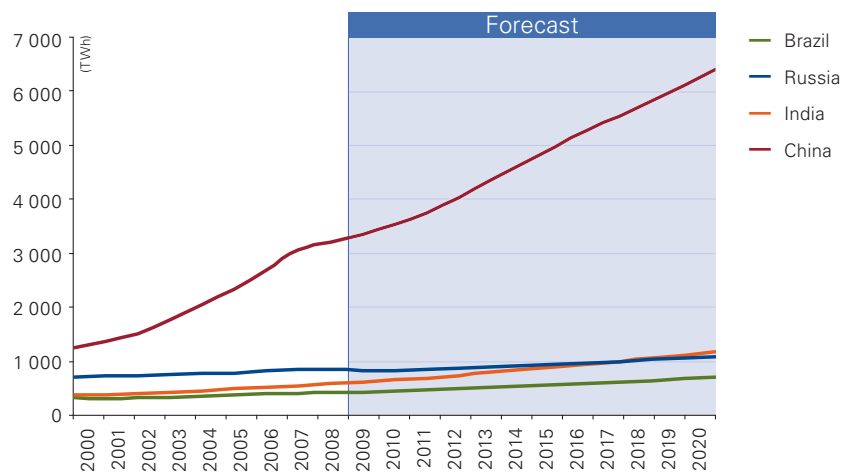
Based on current expectations, the total electricity consumption of the BRIC countries will account for 40 percent of total global electricity consumption by 2020, China being the principal driver of this growth. Figure 11 shows the electricity consumption of the BRIC group by country.

### Brazil

Brazil possesses the largest electricity market in South America, with a consumption of 423TWh in 2008 – 2.6 percent of the world total.<sup>22</sup>

The electricity consumption of Brazil has grown by 3 percent annually in the

Figure 11: Electricity consumption



Source: KPMG, EIU

21 Economist Intelligence Unit

22 Economist Intelligence Unit



last decade. Assuming this trend continues, consumption is going to be approximately 710TWh in 2020. Despite this growth, Brazil will remain the lowest electricity consumer out of the BRIC group.

### Russia

Russia currently possesses one of the largest electricity markets in the world, representing 5 percent of total global consumption.

In the 1990s Russian electricity production dropped significantly due to diverse factors, including the decommissioning of several nuclear reactors and decreasing demand following the financial crisis of 1998. However, due to a rapid economic recovery, consumption has increased continually in the last decade, on average 2.1 percent<sup>23</sup> annually, to reach approximately 850TWh<sup>24</sup> by 2008. Due to the global economic downturn, a

slight decline in consumption is anticipated in 2009, but the earlier growth trend is expected to resume soon after. Based on KPMG's analysis, the annual electricity consumption will be approximately 1,000TWh in 2020. As a result of a relatively low growth rate compared to other BRIC countries, Russia is expected to be overtaken by India and become the third largest electricity consumer out of the BRIC four by 2020.

### India

The Indian economy is among the fastest growing in the world, and there is therefore enormous potential for growth in the energy sector. Electricity demand in India, at 517TWh, was the eighth largest in the world in 2008 representing 3.2 percent of total world electricity consumption.<sup>25</sup>

Out of the BRIC countries, India had a 5.7 percent annual growth rate in

electricity consumption in the last decade, the second highest of the BRIC four.<sup>26</sup> Assuming the current trend is maintained to 2020, consumption in India will be 1,180TWh, slightly exceeding that of Russia.

### China

China has the most rapidly expanding economy in the world, and being the most populous country as well, electricity demand growth has been particularly high.

Electricity consumption in China has been grown by 12.5 percent annually in the last decade.<sup>27</sup> Similar high growth is expected to continue, total consumption reaching approximately 6,400TWh by 2020.

23 Source: KPMG analysis based on Russian government program "The General Scheme  
24 Source: European Intelligence Unit

25 Source: IEA  
26 Source: Economist Intelligence Unit  
27 Source: International Energy Agency



## Electricity consumption per capita

Figure 12 is a comparison of the four BRIC countries' and the North American, Western European and the average electricity consumption rates per capita of the world.

Figure 12 shows that of the BRIC countries, currently only Russian consumption levels are comparable to the Western European level, which is itself only about 53 percent of the North American rate. Consumption per capita of the other three BRIC countries is currently below the world average, which is less than 40 percent of the Western European level.

Based on European Union's policies to reduce energy consumption, Western European electricity consumption is expected to grow by only 0.6 percent in the period until 2020.

The electricity consumption per capita is a comparable indicator of electricity consumption of countries

### Brazil

Brazil has achieved an average growth of 1.5 percent in per capita electricity consumption in the last decade.<sup>28</sup> This has resulted in a per capita consumption figure of 2,200 kWh, roughly 14 percent below the global average. As the Brazilian economy is growing faster than the population, per capita electricity consumption is expected to be 3,200 kWh by 2020, slightly above the expected world average.

### Russia

Although Russian per capita electricity consumption is comparable with the Western European level, it is still far behind the North American indicator. Russian consumption was approximately 6,000 kWh per capita in 2008, after growing by 2.5 percent annually between 2000 and 2008.<sup>29</sup> Because the Russian population is decreasing, the growth in per capita electricity consumption is expected to continue, with a Compound Annual Growth Rate (CAGR) of approximately 2.5 percent level until 2020. As a result, Russian consumption is expected to be approximately 8,000 kWh/capita, or slightly more than the forecast Western European level, which is growing more slowly.

### India

India has the lowest per capita electricity consumption of the BRIC countries, amounting to 510 kWh in 2008,<sup>30</sup> despite a surge in electricity demand in the previous decade. Indeed, India had the second highest growth rate in per capita electricity consumption among the BRIC countries from 2000-2008, the increase averaging nearly 4 percent annually.

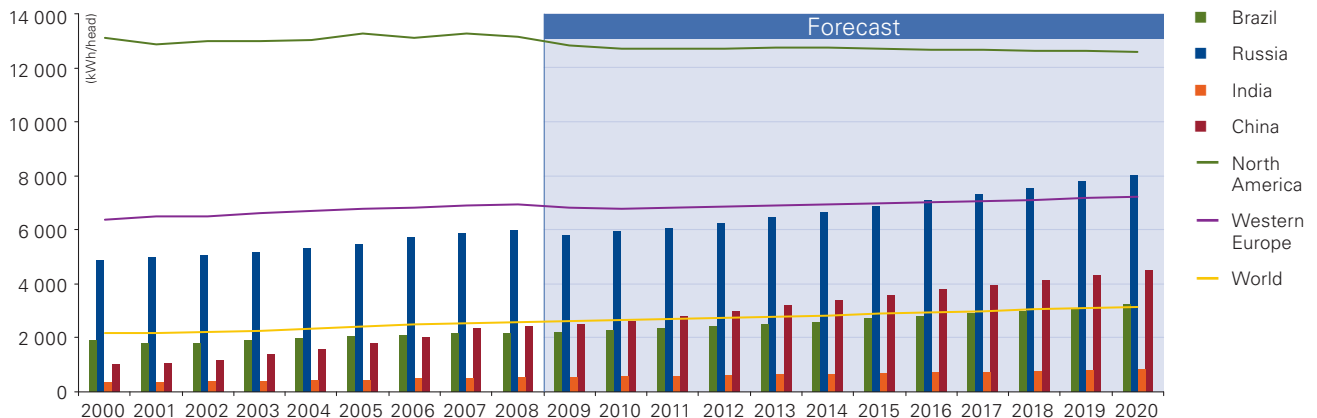
This increase in demand is expected to continue; however, (partly due to a large increase in population) per capita electricity consumption is expected to be about 840 kWh in 2020, only 26.6 percent of the global average.

### China

In the recent past China has had the highest growth rate of electricity consumption per capita of the BRIC countries, specific demand rising by approximately 12 percent annually between 2000 and 2008.<sup>31</sup>

Consumption in China was only 990 kWh per capita in 2000, just 46 percent of the world average, but had climbed to

Figure 12: Electricity consumption per capita



Source: KPMG, IEA

28 Source: EIU

29 Electricity consumption per capita was calculated based on EIU data, by dividing the total electricity consumption of the country with the total population.

30 Source: EIU

31 Source: International Energy Agency

2,416 kWh per capita by 2008, 94 percent of the world average. This remarkable growth was mainly triggered by state controlled infrastructure projects and by the continuous expansion of export-focused industries. China is expected to exhibit similar growth in the forecast period, resulting in electricity consumption of approximately 4,500 kWh per capita in 2020, 42 percent above the world average.

## Electricity consumption by sectors

As Figure 13 shows, the total electricity consumption of these countries can be divided into six major sectors – namely energy, industry, transportation, residential, commercial and public services, agriculture, forestry and fishing along with ‘other’ sectors. The main electricity consumers in the BRIC countries are the industrial, residential, commercial and services sectors; the share of agriculture and transportation in the total is relatively small.

### Brazil

Out of the six major sectors, the Brazilian industrial sector is the most significant consumer of electricity, with 183 TWh in 2006.<sup>32</sup>

Although the consumption of the residential sector increased in absolute terms, the share of the sector decreased from 25 percent to 22 percent<sup>33</sup> in the examined period.

Commercial and public services sectors had a share of 22.6 percent in 2006, similar to the residential sector.

The consumption of agriculture, forestry and fishing increased from 3.8 percent in 2000 to 4.2 percent in 2006.

It is assumed that the shares of these sectors of the economy will not change substantially. Therefore, in 2020, industrial electricity consumption will still have the biggest share, followed by the residential and service sectors.

### Russia

The energy sector accounted for nearly 22 percent (or 177 TWh) of the total

electricity consumption of Russia in 2006.<sup>34</sup> Industrial sector usage amounted to 333 TWh in 2006, or 41 percent of total consumption. However, due to the global financial downturn, electricity demand from the energy intensive enterprises has fallen significantly. Furthermore, the crisis is expected to stimulate energy-saving policies in the energy-intensive industries.

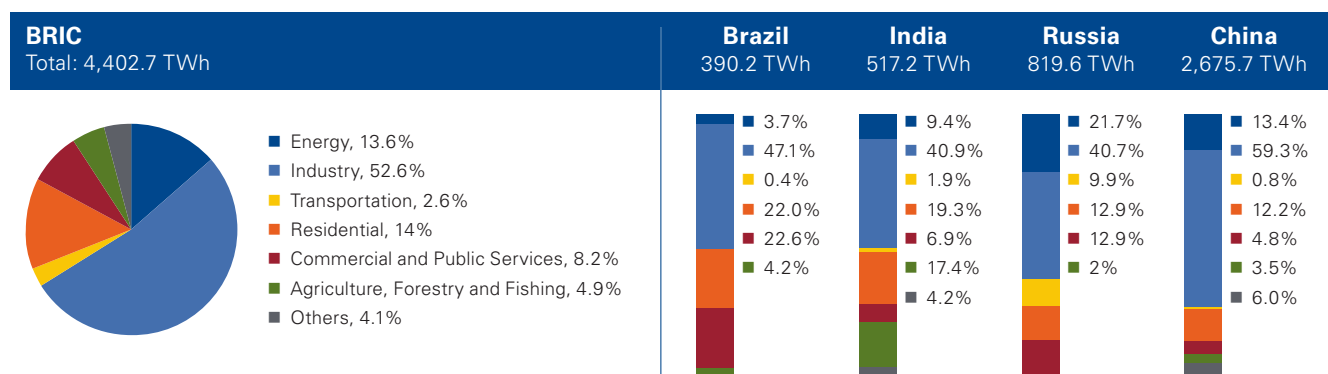
The cumulative share of the residential, commercial and services sectors decreased from 27 percent in 2000 to 26 percent in 2006.<sup>35</sup>

Based on prevailing tendencies, the industrial sector will likely bear the biggest share followed by the residential, commercial and energy sectors in 2020.

### India

The industrial, residential and agriculture sectors are the major drivers of consumption growth in India. The industrial sector was biggest consumer of electricity in 2006, taking 212 TWh, or nearly 41 percent of the total.

Figure 13: Electricity consumption by sectors (2006)



Source: KPMG, IEA

32 Source: IEA

33 Source: IEA

34 Source: IEA

35 Source: IEA

The total consumption of the residential sector increased from 69.5 TWh in 2000 to approximately 93 TWh in 2006.<sup>36</sup> This proportion is expected to increase as the rural electrification programs move forward, connecting about one-third of the Indian population to the grid. The share of the agriculture, forestry and fishing sector decreased from 20.7 percent in 2000 to 17.4 percent in 2006.<sup>37</sup> As the application of modern technology and automatization spreads in this sector, growth in the level of consumption is foreseeable.

Based on historical trends the industrial sector will be the primary user of electricity consumption, followed by the residential and agriculture sectors in 2020.

**China**

Electricity consumption of the industrial sector increased by 16 percent annually between 2000 and 2006, when it totalled nearly 1,600 TWh, or about 59 percent of total consumption.

The residential sector also saw rising demand, with consumption increasing from 167 TWh in 2000 to 325 TWh in 2006. However, the share of the sector slipped from 13 to 12 percent.

The energy sector accounted for 360 TWh in 2006, or just over 13 percent of total consumption, while the commercial and public services sectors constituted 129 TWh, or 8 percent of the total.

In China, based on prevailing trends, the industrial sector followed by the energy and residential sectors will continue to be the main electricity consumers by 2020.

**Electricity prices**

Average consumer electricity prices are often relatively low in the BRIC countries, primarily due to significant subsidies, including significant cross-subsidies between consumer groups. In India and China, the industrial and commercial sectors cross-subsidize household consumers.

However, as a result of rising fuel price, end-user electricity prices are generally increasing, a fact not always entirely reflected in available data because of the devaluation of the US dollar against BRIC currencies (see Figure 14). It is also gradually becoming apparent that subsidized electricity prices hamper capital investment in the sector and ultimately lead to power shortages.

As a result, capital investment needs are increasingly included in the cost of power in the BRIC countries in the course of ongoing regulatory reforms.

**4.2. Electricity supply**

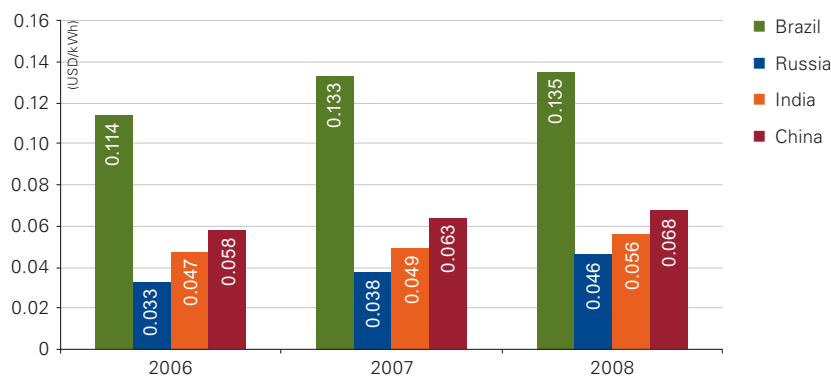
Electricity production in the BRIC countries has been increasing substantially in the last decade, with China the star performer, where annual growth averaged 12.3 percent per annum from 2000 to 2008. In the same period both Indian and Brazilian generators achieved approximately 3 percent growth on an annual basis, while Russia had an average 2.2 percent growth in production.

Despite having the lowest growth rate of the BRIC four, per capita consumption in Russia will reach the Western European level in 5–7 years.

In 2020, China is expected to lead the four countries in terms of production with about 6,800 TWh generated, with both India and Russia each at about 1,300 TWh. Brazil should generate about 785 TWh by that time.

Figure 15 shows the projected total electricity production of the four BRIC countries from 2000 to 2020.

**Figure 14: Total average end-user electricity prices**

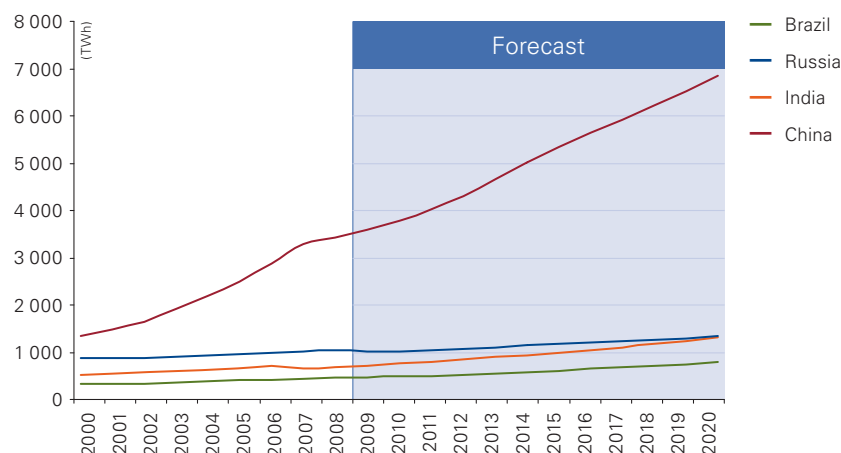


Source: ANEEL, RAO UES, CEA, NBS China, NDRC, DB Research, KPMG calculations and estimates

The BRIC countries collectively produced 5,600 TWh of electricity in 2008, representing roughly one-quarter of the world’s total generated power.<sup>38</sup> While this already illustrates the importance of BRIC in the global context clearly, the four countries are on course to generate more than 10,000 TWh in 2020, accounting for more than one-third of the global power output, which is expected to be around 27,700 TWh by that time.

36 Source: IEA  
 37 Source: IEA  
 38 Source: Economist Intelligence Unit



**Figure 15:** Total electricity production of the BRIC countries (2000–2020)

Source: KPMG, EIU

Indeed, by then China alone is expected to produce almost one-quarter of total global power generation.

With the BRIC countries expected to generate such a large proportion of the world's electricity by 2020, the potential of these countries in terms of investment in industrial plants and know-how is huge.

However, while they are set to account for 36 percent of global electricity production in 2020, the combined share of the BRIC countries

in global GDP, currently at about 23 percent, will only just reach 30 percent by that time.

The variation in the performances of the BRIC countries in terms of their share of GDP compared to their electricity production implies there are substantial inefficiencies in production and transmission. This further implies that there is significant potential to enhance generation efficiency and introduce energy-saving measures and equipment across the spectrum.

## Installed capacity

The steady growth in demand for electricity and the need to replace aging power generation assets mean significant new generation capacity is required in all four BRIC countries.

As Figure 16 shows in 2006, the total installed capacity of the BRIC four was 1,085 GW, one-quarter of the world total.<sup>39</sup> By 2020 the BRIC countries will add a net total new capacity of almost 1,000 GW, bringing their total capacity to about 2,070 GW. This will equate to one-third of the forecast world total of almost 6,300 GW.<sup>40</sup>

Unsurprisingly China will see the biggest growth, followed by Brazil and India; Russia is expected to see an average growth in capacity a bit above 1 percent in the decade up to 2020.

Considering that the average time frame needed to plan, develop and build a power plant runs from three to six years (or more like 10 for a nuclear plant), these massive developments represent major challenges to investors, financial institutions, equipment suppliers and regulators in the coming decade.

**Figure 16:** Installed capacity (GW)

	2000	2001	2002	2003	2004	2005	2006	2015	2020	CAGR (2006–2020)
<b>Brazil</b>	68.2	73.7	76.2	82.5	86.5	90.7	93.2	128.3	151.8	3.54%
<b>Russia</b>	203.5	204.7	205.6	214.4	215.5	217.2	218.4	255	257	1.17%
<b>India</b>	108.2	111.8	122.1	126.2	131.3	137.4	151	204	241	3.39%
<b>China</b>	298.6	319.1	338.3	380	442	517	622	1,189	1,418	6.06%
<b>BRIC aggregated installed capacity</b>							1,084.6	1,776.3	2,067.8	4.72%
<b>World aggregated installed capacity</b>							4,344	5,697	6,264	2.65%

Source: KPMG, IEA, EIU, National Energy Plan of Brazil MME, e-m.ru

39 Source: IEA, World Energy Outlook, 2008

40 Source: IEA, World Energy Outlook, 2008

## Breakdown of electricity production

The power generation mix of the BRIC countries varies considerably as these countries' natural resources are inherently diverse.

Brazil has the largest installed hydro power capacity in the world, more than 84 percent of its electricity was generated in hydro plants in 2006, accounting for more than 10 percent of global hydroelectric generation. The remaining power was generated in plants fuelled by coal, oil, natural gas and biomass or waste, as well as in nuclear plants.

Russia has significant fossil fuel reserves including natural gas, coal and oil. Therefore thermal power generation is the most dominant, with a 67 percent share of the total. Hydropower (17 percent) and nuclear (16 percent) make up the remainder.<sup>41</sup>

India is rich in coal resources, and uses coal to generate 70 percent of its electricity.



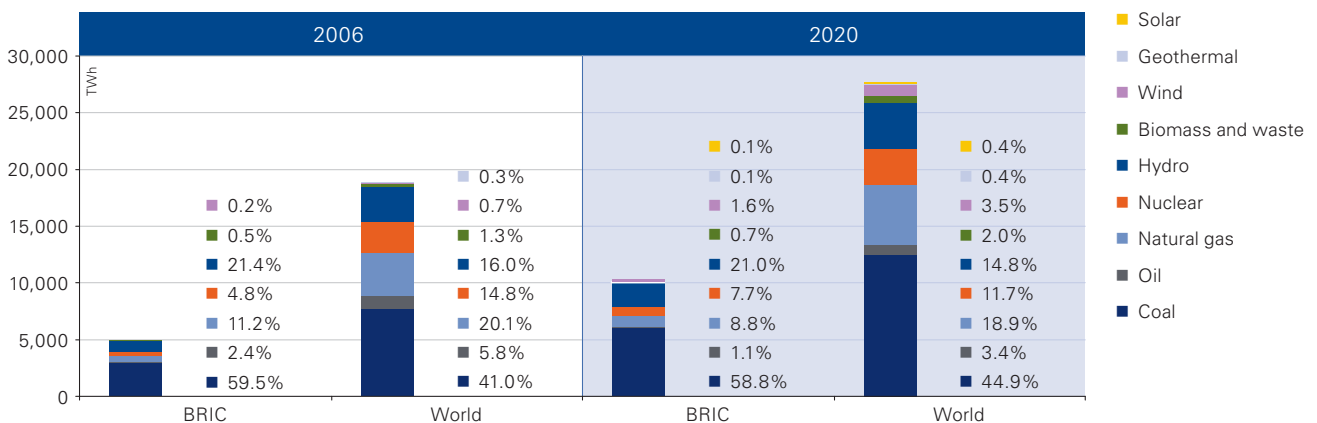
China has enormous coal reserves, while its oil and natural gas reserves are now limited. As a result, China relies on coal for 80 percent of its power generation. Hydro power plants generated 15 percent of the remaining electricity produced in 2006.<sup>42</sup>

As Figure 17 shows, coal is the single most important primary energy source for electricity generation in the BRIC countries. In total, coal is responsible for nearly 60 percent of the total electricity generated in the four nations, which equates to nearly 40 percent of global coal-based generation. Hydro is the

second most important source of electricity, with a 21.4 percent share in the total power supply of the BRIC four. The shares of natural gas and nuclear power are about 11 and 5 percent respectively.<sup>43</sup>

Based on predictions within the industry, the overall primary energy mix is not expected to change radically up to 2020. Coal will remain the most significant source of generation, with an almost 60 percent share, followed by hydro (21 percent), natural gas (8.8 percent) and nuclear (7.7 percent).

Figure 17: Breakdown of electricity production



Source: KPMG, IEA

41 Source: European Intelligence Unit  
 42 Source: IEA, World Energy Outlook 2008  
 43 Source: IEA, World Energy Outlook 2008

However, the aggregated share of wind, geothermal and solar power is set to be 1.8 percent, compared to the current level of below 0.5 percent.

In Brazil, the shares of natural gas and nuclear energy are expected to increase in total electricity generation, while the relative shares of coal, oil and hydro power are expected to decrease by 2020.

In Russia, the share of thermal power will not change significantly; only natural gas is predicted to lose share in the generation mix, while the importance of coal is expected to increase slightly by 2020. The share of nuclear within the country's overall electricity production looks to increase from the current level of 16 percent to about 20 percent in 2020.

In India, the share of thermal power should barely change in the next decade, and is expected to account for 79 percent of total generation in 2020, although natural gas will replace oil to some extent in that figure.

Most significantly, nuclear is expected to account for 5.3 percent of the total in 2020, three times more than it does currently, and wind power will also triple its share to about 3.7 percent.

In China, coal will likely retain its dominant role in electricity generation through to 2020, although due to environmental considerations and the spreading use of other energy sources its share in the generation mix could slip to 71 percent. In response to the country's energy saving and emission reduction targets, nuclear and hydro plants are expected to offer unprecedented opportunities.

All BRIC governments are aiming to increase the role of renewable sources, with wind power expected to reach a 1.6 percent share of the total in the four countries, up from the current level of 0.24 percent.

## Network losses

Network losses (both technical and commercial) occur in the process of supplying electricity to consumers. Technical losses arise during the transmission and transformation of power. Technical losses can be minimized, but are intrinsic to the physics of electricity. Commercial losses are mainly caused by pilferage and metering errors.

The four BRIC countries represent more than one-quarter of total electricity production and global consumption. As a result of the enormous distances often involved in transmission, along with ageing electricity systems and relatively high rates of pilferage, network losses in the BRIC countries are relatively high. As Figure 18 shows, the only exception is China, where losses are below the world average.

### Brazil

ONS, the Brazilian Transmission System Operator (TSO), operates more than 90,000 km of transmission lines at various voltages.

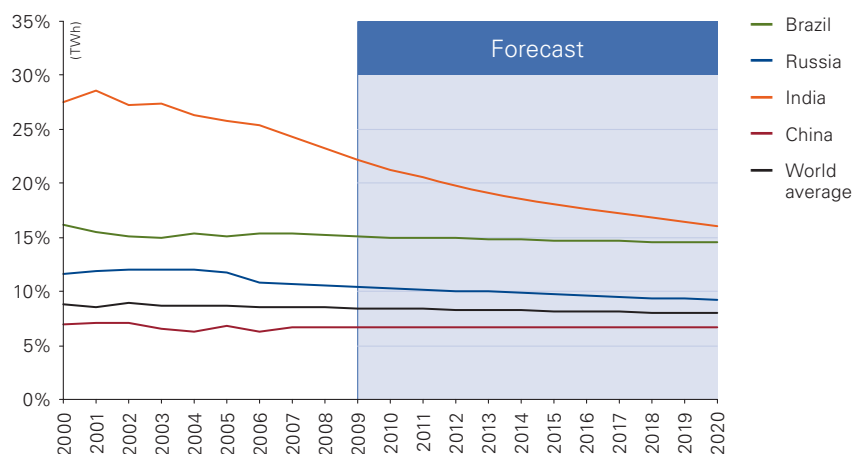
Network losses amount to about 15 percent, twice the world average, due to the long distances involved, old and poorly maintained equipment and a high rate of theft. The grids need large investments to reduce network losses, and combating theft is one of the country's priorities for the next five years. The Brazilian operators hope to reduce network losses to 14.5 percent by 2020.

### Russia

FSK UES, the Russian TSO, is responsible for the operation of the unified national transmission network (UNEG), as a federal grid company. The grid comprises 118,000 km of transmission lines and 757 substations.

As a result of steady improvements, distribution losses have been trimmed by 1.15 percent annually in the last decade, bringing the system close to the global average.

Figure 18: Network losses



Source: KPMG, EIU



However, much of the equipment is ageing, and a sustained refurbishment program is still required to meet the target of bringing network losses down to approximately 9.2 percent by 2020.

**India**

The Power Grid Corporation of India (PGCI), the country’s main transmission operator, runs a grid the total length of which is 71,500 km with 120 substations. PGCI invested approximately USD 1.84 billion in 2008, and intends to spend a further USD 2.76 billion in 2010 as part of an investment plan worth USD 12 billion up to 2012. The five regional grids of India comprise more than 297,000 km of transmission lines.

A combination of obsolete equipment, poor system management and theft mean technical and commercial network losses in India are among the highest in the world. Losses nationwide average 23 percent, but the worst performing state systems manage to lose some 50 percent of the electricity input.

India is now making efforts to monitor and reduce this network deficit, since such massive losses cripple investment plans.

**China**

The State Grid Company of China (SGCC) is the country’s largest system operator. Operating in the north, it owns about 600,000 km of linage for 110/220 kV and higher. Another transmission company, China Southern Power Grid, has 67,000 km lines accommodating above 220 kV. Since 2007, the two TSOs have invested between USD 17 to 36 billion each year on grid expansion.

Out of the BRIC four, only China can boast network losses below the world average.

In the last decade the Chinese authorities have made successful efforts

to reduce network losses, reaching the current level of under 7 percent, which compares favorably with the rate in North America of approximately 6 percent.

**Electricity import, export**

The BRIC countries are generally on the right track in meeting their domestic electricity demand though only Russia and China are able to achieve a relatively small positive export-import balance, while Brazil and India are net importers. Both Brazil and India target self sufficiency in electricity by 2020, but meeting this goal will only be possible through stringent and coordinated efforts throughout the coming decade.

Whatever the outcome of their plans, in some border areas it may prove more efficient to import electricity from a neighboring country than to build new power plants.

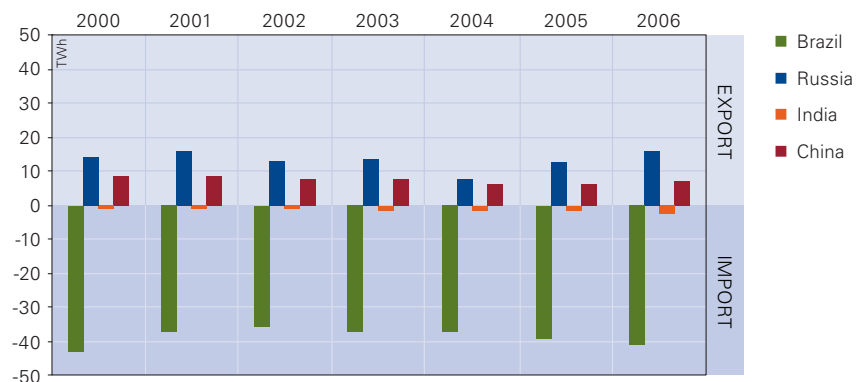
Figure 19 shows that Brazil imported between 36 TWh and 43 TWh annually, or approximately 10–12 percent of total production, between 2000 and 2006, mainly from Paraguay.<sup>44</sup> However, based on current plans for new generation capacity, Brazil hopes to trim imports to 5–6 percent of domestic production by 2020.

Russia trades electricity with a number of neighbors, including former Soviet states. In 2006 it exported a total of 20.8 TWh, or 2.1 percent of total production, to China, Finland, Norway, Georgia and Moldova. At the same time Russia imported a total of 5 TWh from Latvia, Lithuania, Belarus, Ukraine, Azerbaijan, Kazakhstan and Mongolia.<sup>45</sup> It is anticipated that Russia will be able to maintain and even significantly expand its positive export-import power balance in the coming decade.

India has increasingly turned to importing electricity to maintain supplies, with foreign generators accounting for 0.4 percent of total domestic production in 2006. It remains an open question if planned new investments are to be finalized in an accelerated manner, and whether the rate of high network losses can be considerably reduced to stop the trend of increasing imports in India.

China imported 5.4 TWh and exported 12.3 TWh of electricity in 2006, which represented only 0.18 percent and 0.4 percent of total domestic electricity production. This positive balance is not expected to change significantly in the forecast period.

**Figure 19: Electricity import-export balance of the BRIC countries**



Source: KPMG, IEA

44 International Energy Agency

45 Source: International Energy Agency

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

#### Privatization

A state is usually unable to maintain its power system in a satisfactory condition solely through its own investments, therefore the involvement of private capital and know-how is often necessary to develop the technology coming into the country. Additionally, states need a supporting regulatory framework.

The four BRIC countries are in different phases regarding the privatization process of their power sectors (see Figure 20).

#### Brazil

The Brazilian state still plays an important role in the electricity sector. Although privatization was initiated in the 1990s, it has slowed since the electricity crisis in 2001.

Large government-controlled companies dominate the generation sector, such as Eletrobrás, CESP, CEMIG and Copel. The most notable exception is Gerasul, to the south of the country, which is now operated by France's GDF Suez.<sup>46</sup> Foreign investors are cautious, partly to the lack of a sound regulatory framework and partly due to the government's strong political control of the industry through the Ministry of Mines.

Privatization of distribution companies started in the 1990s, and with the exception of some smaller state-owned companies, transmission lines have also been partly auctioned off. However, due to the precarious financial state of most state-owned electricity companies, private capital is likely to play a key role in the future development of the transmission and distribution infrastructure.

**Figure 20:** Privatization



Note: there are considerable differences between the progress of privatization of different segments of the power industry  
Source: KPMG, IEA

#### Russia

The Russian power sector is currently undergoing a restructuring process. As a result, the dominant holding company (RAO UES of Russia) that controlled the majority of generation units and transmission lines has been reorganized and partially privatized.

In addition, wholesale generation companies and territorial generation companies (TGKs) have been established and privatized. However, hydroelectric power companies and all nuclear plants remain in state ownership, the latter under control of RosEnergAtom, an arm of the Ministry of Atomic Energy.



<sup>46</sup> Source: [www.suezenergyna.com](http://www.suezenergyna.com)

## India

The privatization of the generation sector started in 1991–1992, although currently most units remain publicly owned, with privatized plants making up just 10–13 percent of total output. Private investors remain concerned about the regulatory framework, cross-subsidies and high levels of electricity theft, and this has prevented any significant private investment into the transmission and distribution segments. Observers believe that privatization would be smoother if the authorities were able to reduce network losses down to 10 percent.

The generation segment is expected to attract more private investment in coming years, while in the transmission and distribution segments, where state control is expected to dominate, most private investment will take the form of PPP projects.

## China

The energy sector in China is dominated by numerous fully integrated conglomerates that control the entire value chain. As the industry is considered to bear strategic importance, these companies will mostly remain centrally controlled and owned by the state. In order to increase the efficiency of this business model, some minority stakes of certain conglomerates have been sold, and these companies are more likely to operate as western, vertically-integrated companies.

In addition, some private investment is likely in the generation sector, for instance in renewable energy.

## Energy efficiency

The energy intensity indicator on Figure 21 shows the total energy required, in tons of oil equivalent (toe), for the production of USD 1 million of GDP output (this at purchasing power parity for the year 2000). Figure 22 shows the development of energy intensity of BRIC economies, North America and the globe, assuming that historical trends from 1980–2006 will not significantly change in 2006–2020.

Although the energy intensity indicator was devised to show these countries' total energy consumption, it provides a good basis for the assessment of energy efficiency potentials of their national economies. Based on KPMG estimates, all the BRIC countries are converging towards the global average energy intensity indicator, all are effectively working to rationalize energy consumption and steadily increasing the economic output per unit of energy consumed. However, Russia and China are using significantly more energy resources per unit of GDP than the world average, at 206 percent and

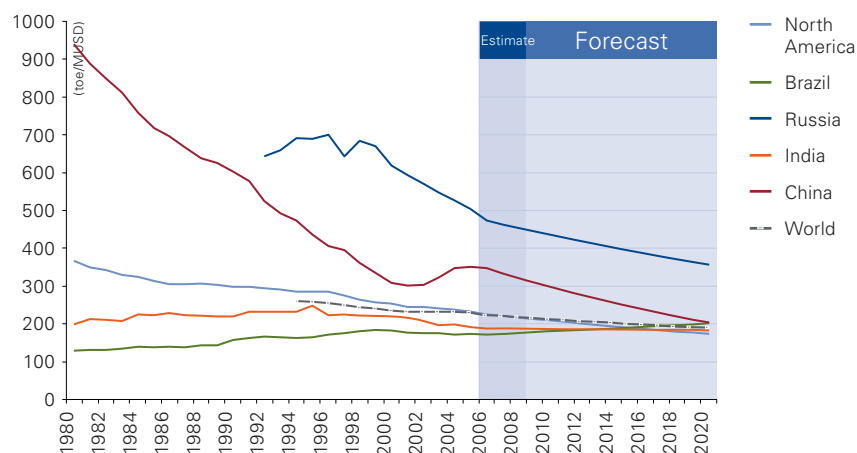
143 percent respectively in 2009. Since China is intent on addressing energy inefficiencies by 2020, only Russia is expected to lag behind on this issue, consuming 188 percent of the global average for the production of one unit of GDP.

In Brazil, the appearance of an opposite trend in energy intensity may be the result of a relatively high share of agriculture production in comparison with a smaller industrial sector.

Based on KPMG analyses, it is clear that India offers massive potential in terms of energy saving measures, given the high rate of network losses, and the expansion of power demand. China and Russia also provide good investment environments for energy efficiency investment in the next decade. China should achieve the global average energy intensity indicators by 2020. Russia on the other hand, will need further efforts to improve the efficiency of its national economy, resulting in a longer timeframe for potential investments.





**Figure 21:** Energy intensity

Source: KPMG, IEA

**Figure 22:** Investment indicators of the BRIC countries between 1990 and 2007

	Brazil	Russia	India	China
<b>Total Infrastructure (number)</b>	<b>329</b>	<b>311</b>	<b>308</b>	<b>813</b>
from which: Energy Projects (number)	145	89	97	334
Amount (billion USD)	70.21	19.12	33.9	35.55
<b>from which: Electricity Projects (number)</b>	<b>130</b>	<b>87</b>	<b>93</b>	<b>157</b>
<b>Amount (billion USD)</b>	<b>63.59</b>	<b>16.1</b>	<b>33.1</b>	<b>31.41</b>

Source: World Bank

**Figure 23:** Operating risk of BRIC countries

	Rating (E = most risky)		Score (100 = most risky)	
	Current	Previous	Current	Previous
Brazil	<b>C</b>	C	<b>49</b>	49
China	<b>C</b>	C	<b>46</b>	46
India	<b>C</b>	C	<b>51</b>	52
Russia	<b>D</b>	C	<b>61</b>	60

Source: EIU ViewsWire Risk Briefing

## Investment climate and needs

Notwithstanding the restrictions on foreign investment in what is regarded as a strategic sector by the countries involved, FDI is expected to play an increasing role in the BRIC four electricity industries.

Indeed, electricity investments dominate the private energy infrastructure investment record in the BRIC countries (see Figure 22). The Private Partnership in Infrastructure Database of the World Bank includes all projects between 1990 and 2007 which had financial closure. With regard to project categories, green-field investments were preferred in China and India, divestiture in Russia, while Brazil showed a somewhat balanced divestiture/green-field breakdown.

The overall perception of the BRIC investment climate has not changed significantly in the past decade, as illustrated by ViewsWire data on Figure 23.

According to International Energy Agency assessments, the investment needs of the BRIC four electricity sectors for the period until 2030 total approximately USD 4,632 billion. Approximately 47 percent of the total relates to power generation while the remaining USD 2,435 billion is needed for transmission and distribution networks (see Figure 24).

### Brazil

The IEA estimates the total investment needs of the Brazilian electricity sector to be USD 252 billion (2005 prices), divided equally between generation and transmission infrastructure. Based on this forecast, an estimated USD 25 billion investment per annum is necessary for the sector.

**Russia**

The Russian government’s investment program<sup>47</sup> puts the total investment needs in the power sector up to the year 2020 at USD 655 billion.<sup>48</sup>

The IEA, on the other hand, estimates total investment to 2030 at only USD 440 billion (in 2007 prices), significantly less than the government’s figure.<sup>49</sup> Given the current financial and economic situation, the level of actual investment implemented by 2020 could be in the range of USD 500–550 billion.

**India**

The IEA estimates the Indian energy sector needs USD 960 billion in investment by 2030. The generation sector requires some USD 435 billion, the distribution networks USD 360 billion and the transmission grid USD 165 billion.<sup>50</sup>

**China**

The IEA estimates China needs a total investment of USD 2,765 billion for its electricity sector up to 2030. This alone represents more than half the investment needs of all four BRIC countries, and 25 percent of the investment needs of the global energy sector up to 2030.

In contrast to Brazil and Russia, more investment is needed in the development of the transmission and distribution sectors than in power generation. Although the level of network losses is particularly low in China, the development of high voltage grids and distribution systems still requires significant investments, particularly to allow further industrial development in the central regions, away from the Pacific coast.

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

The development of the electricity industry is determined by the regulatory and economic climate of a country and various environmental concerns in addition to the factors detailed in this report. These factors differ significantly among these countries as their histories, current situations and even the future intentions of their governments vary.

**Regulatory climate**

Worldwide know-how and best practice support the view that decentralization and market liberalization lead to privatization and sustainable development. To successfully complete this process, a supportive legislative environment is essential.

**Brazil**

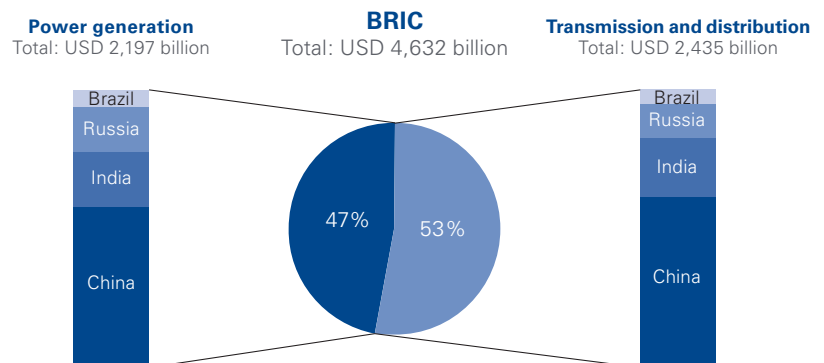
The regulatory framework of the electricity sector in Brazil is considered to be the most developed among the BRIC countries, and Brazil is as a result a leader in privatization in the developing world.

However challenges remain, including clarification of regulatory rules, speeding up licensing procedures, and creating better pricing mechanisms in order to attract more investment into the electricity infrastructure.

The main priorities for the regulator in the future are to:

- Maintain stable rules to reduce investment risks
- Enforce current rules and regulations and supervise the observance of contracts
- Increase the transparency of decision making to attract investors and stimulate participation from the private sector
- Make licensing processes easier for generation projects
- Encourage energy efficiency programs and provide incentives for the generation of clean energy
- Create tariff parity between the private and public sector
- Continue subsidizing low-income and rural populations, but remove other subsidies.

**Figure 24: Investment needs until 2030\***



Source: KPMG, IEA  
\*note: in case of Russia the investment need is until 2020

47 The General scheme of power industry objects placement in 2015-2020  
48 Calculate based on 32.59 RUB/USD (Bank of Russia)  
49 Source: International Energy Agency

50 Source: IEA

## Russia

Russia needs the involvement of private capital to both properly maintain and modernize the country's electricity system, and as a pre-condition for this it needs a sound regulatory system, with clear rules to govern both state- and privately-owned assets.

The desired goal should be free, efficient competition on the market with equal access to competing companies.

With proper restructuring and effective liberalization of its electricity market, Russia should be able to successfully handle rising energy prices, the sale of newly-added and planned generation capacities, complex issues of electricity distribution, requirements for state subsidies and end-user tariff issues.

In future the regulator's main priorities are to:

- Liberalize the wholesale and retail electricity market
- Create clear market rules, providing private investors with predictable business conditions
- Assure reliability and continuity of electricity supply at an optimum price
- Implement a fully competitive generation market to attract private investors
- Abolish cross-subsidies and strengthen competition rules
- Define a future development strategy, and its priorities, as energy consumption has changed due to the crisis
- Reduce subsidies so that the tariff structure reflects the real market prices for electricity



- Continue to support energy saving investments to reduce current high power intensity and increase the efficiency of industry.

## India

The restructuring and privatization process of the electricity sector in India began with reforms initiated in 1991. India has already shown a willingness to open its markets to international market players. There is increasing private ownership in the generation sector and a planned electricity market opening in 2010 is designed to allow consumer choice between electricity supply companies.

In another vital step, India is creating power exchanges to stimulate the electricity market. Legislation is currently being drafted to support this, and experts are carefully reviewing examples in the more advanced North American and European countries to find the best examples to follow.

By fully implementing these vital moves, India should be able to successfully handle problems associated with rising energy prices, the sale of newly-built and planned generation units, complex issues of electricity distribution, the requirements of state subsidies, and end-user price issues.

The main priorities for the regulator in the future are to:

- Create stable policies and a competitive market environment in order to make the sector attractive to investors
- Focus on the development of distribution and transmission networks in order to cut losses and reduce the need for excess additional generation capacity
- Continue to reduce the high level of electricity theft by strict regulation and control

- Set up a transparent, clear and stable tariff setting mechanism
- Reduce cross-subsidies to diminish mismanagement and pilferage
- Support energy saving investments to reduce the growth of demand
- Focus on energy efficiency of the residential sector.

**China**

As a result of the efforts made by the government over decades, China has a unique and relatively efficient regulatory and institutional framework in place. The approach of the government in the electricity sector is conservative, as energy is considered to be a strategic national commodity. Therefore the current strong state control over the power sector is expected to remain in place leaving only limited room for private investors to enter the market.

A huge proportion of China’s population has not yet achieved high living standards, and tariffs are therefore a sensitive issue; subsidies remain large in some cases.

The main priorities for the regulator in the future are to:

- Support the implementation of energy saving technologies which directly influence the prices of energy and electricity
- Continue to boost the application of energy-saving technologies in the residential and commercial sectors
- Support the construction of new power plants using highly efficient supercritical and ultra-supercritical technologies to replace obsolete, small scale generation facilities

- Transformation of the grid to provide more space for the development of the power generation sector
- Set standard rules for market players that better serve their interests to substantially ease the difficulties of foreign enterprises seeking to enter the Chinese market
- Draw up policies and continue the macro-control of the electricity industry
- Focus on electricity pricing, as this influences the decision-making of all electrical enterprises and their investment priorities
- Reduce subsidies to international standards in order to make prices more cost reflective.



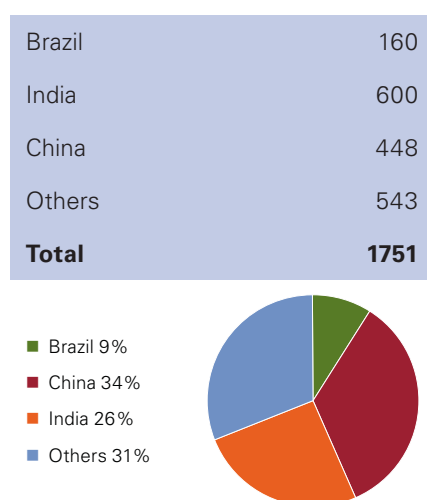


## Environmental concerns

Concerns over climate change, sustainable development and atmospheric pollution have prompted the international community to take measures to overcome these threats. The Kyoto Protocol, which came into force in 2005, is one of the most important international treaties resulting from this process. According to the Protocol, industrial nations (Annex I countries of the Protocol) have set limits on greenhouse gas (GHG), emissions meanwhile developing countries have agreed on efforts for the reduction of GHGs but have not yet set any emission reduction targets.

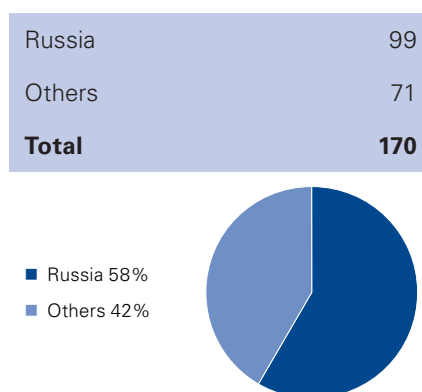
All the BRIC countries have ratified the Kyoto Protocol and thus actively participate in the fight against climate change. Brazil, India and China are non-Annex I countries of the Protocol, as they are considered to be developing nations.

**Figure 25: CDM project pipeline**



Source: UNFCCC as of 09 Aug. 2009

**Figure 26: JI project pipeline**



Source: Thomson Reuters

As Figure 25 shows Brazil, India and China are the main beneficiaries of the project based emission reduction mechanism, called the Clean Development Mechanism (CDM) of the Protocol. CDM projects are investments, executed in developing countries, partly or entirely financed by developed countries which are parties to the Protocol. The overall logic behind this type of investment is that developed countries are able to achieve GHG emission reductions in a more cost-effective way.

From the total 322.1 million tons of emission reductions achieved up to date based on the Protocol, 33.5 million tons originate from Brazil, 69 million tons from India and 149.6 million tons from China.<sup>51</sup>

Nearly 60 percent of these projects are aimed at the energy industries (through the usage of renewable and non-renewable sources in an efficient way). Based on KPMG estimates, up to 2012 about 600 registered projects are planned to achieve approximately 241.2 million tons of GHG emission reductions per year in the energy sectors of Brazil, India and China.

Russia, as an Annex I country of the Protocol, has set the overall greenhouse gas emission limit in Annex B of the Protocol. This aims to maintain emissions at 1990 levels. Having an emission limit, Russia qualifies for another project-based investment mechanism, the so-called Joint Implementation (JI). JI allows cooperation of Annex I countries for emission reduction projects.

The total planned emission reductions through JI projects total some 200.1 million tons in Russia, with about half focusing on the energy sector.<sup>52</sup> Based on KPMG estimates, about 50 projects in the energy sector are expected to generate 100 million tons of emission reductions up to 2012. However, it should be noted that these projects are all in the validation/determination phases of the JI procedure, and that none have been finally registered.

## Future investment potentials in the emission reduction market

The future of the Kyoto Protocol is still undecided, although the international mood strongly supports the continuation of shared efforts in the fight against climate change. The main milestone in setting up the new framework post-2012 is to be in Copenhagen, in December 2009. However, it is assumed that China, India and Brazil will not agree to any emission limits but will support the maintenance of the project-based investment mechanisms of the Protocol. In this way they will potentially be the main beneficiaries of foreign financed emission reduction projects. The majority of these projects is aimed at emission reductions in the energy sector, which is inherently one of the main GHG emitter sectors globally.

<sup>51</sup> United Nations Framework Convention on Climate Change

<sup>52</sup> Thomson Reuters, Carbon Community

# 5. Investment Opportunities

As previously described, power sectors within BRIC countries bear enormous potential for growth and business development, but accessing the opportunities requires tailor-made investment strategies and very careful planning.

This study aims to help both international and domestic financial and professional investors in identifying business opportunities and market risks throughout the asset lifecycle.

The main results of KPMG's assessment of the BRIC countries' power sectors are outlined in the following table.



## Macro-economic trends

- Electricity consumption is predicted to grow continuously up to 2020 as a result of various government programs and increasing living standards.
- Populations are forecast to grow significantly in Brazil, India and China in the coming decade.
- The electricity sector is one of the top priorities on the political agenda in all BRIC countries. Their governments aim to develop the sector through various support programs.
- There is a strong and growing domestic market in every country, mainly led by the commercial, residential and industrial sectors.
- Electricity regulation and policy have to improve to support private participation and investment in the sector

## Investment characteristics

- Numerous investment opportunities will open up for vendors and suppliers because of the expansion of capacity in the generation, distribution and transmission segments, considering the following:
  - Expanding and improving existing but outdated capacity is attractive for many private players entering the sector;
  - Supplying new metering and control technologies and equipment;
  - Supplying components required to expand transmission lines;
  - Large rural areas remain without electrification.
- The electricity sector is one of the top priorities of each of these governments.
- BRIC countries are rich in natural resources.
- Privatization is immature, with limited private equity present in these countries.
- The lack of skilled and available labor in the electricity sector, and at associated manufacturing companies, has to be solved. There is an increasing market for training centers to improve employee skills and the overall quality of employees.

## Market factors

- Growing pressure for the use of renewable, non-pollutant and environmentally friendly energy sources
- An increasing focus on capacity expansion, utilizing the large unexploited energy reserves in each country
- The reduction of network losses is one of the most important technical and regulatory issues
- Outdated equipment in the distribution and power generation sectors
- Politically sensitive social issues like cross-subsidies are present in the electricity sectors of all four countries

# 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.

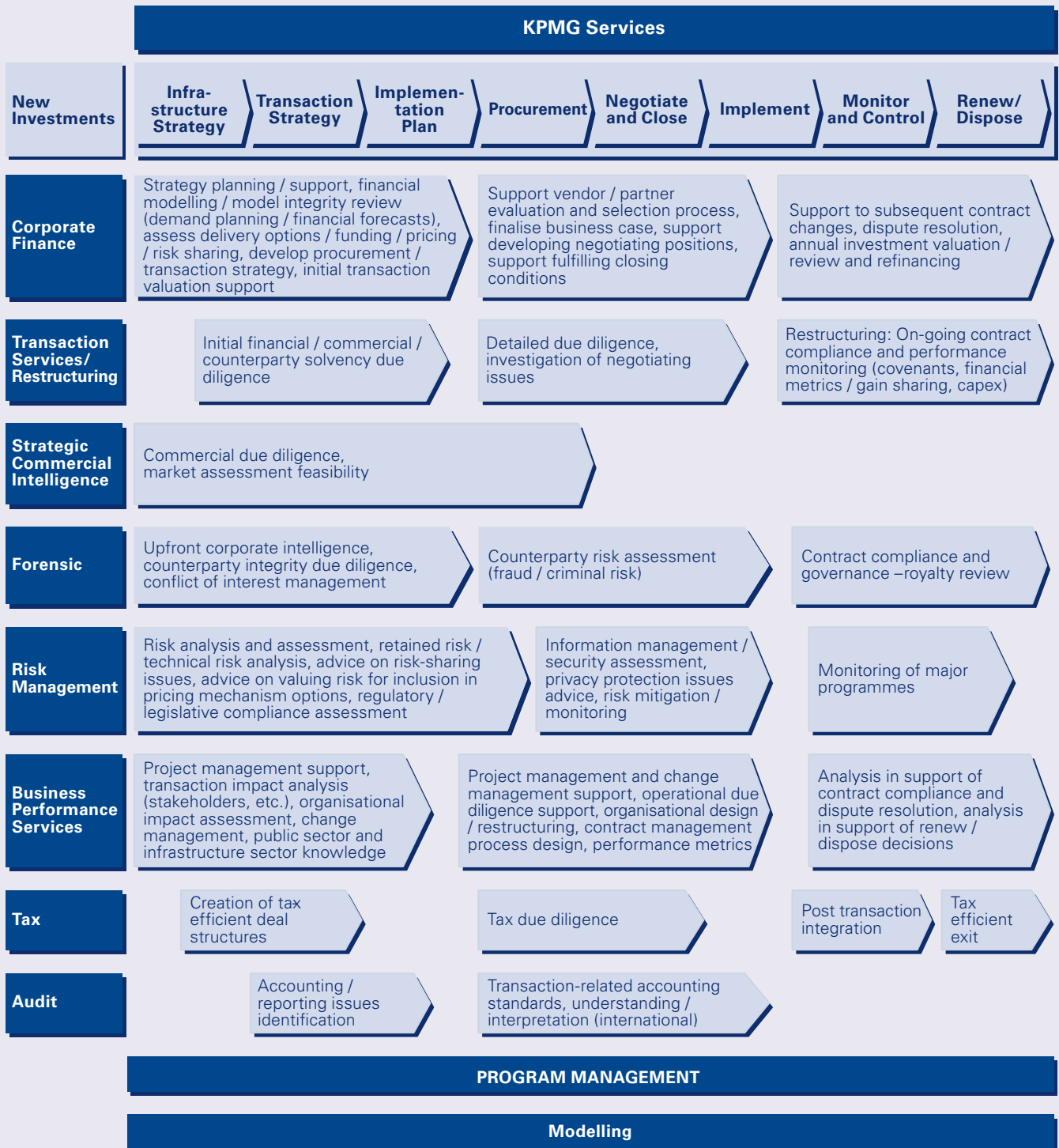
As a focal point of Power & Utilities, KPMG's Global Power & Utilities Knowledge & Resource Center based in Budapest, Hungary (Central and Eastern Europe) consolidates global know-how and knowledge in a single location and takes a hands-on approach to match client needs with KPMG's

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

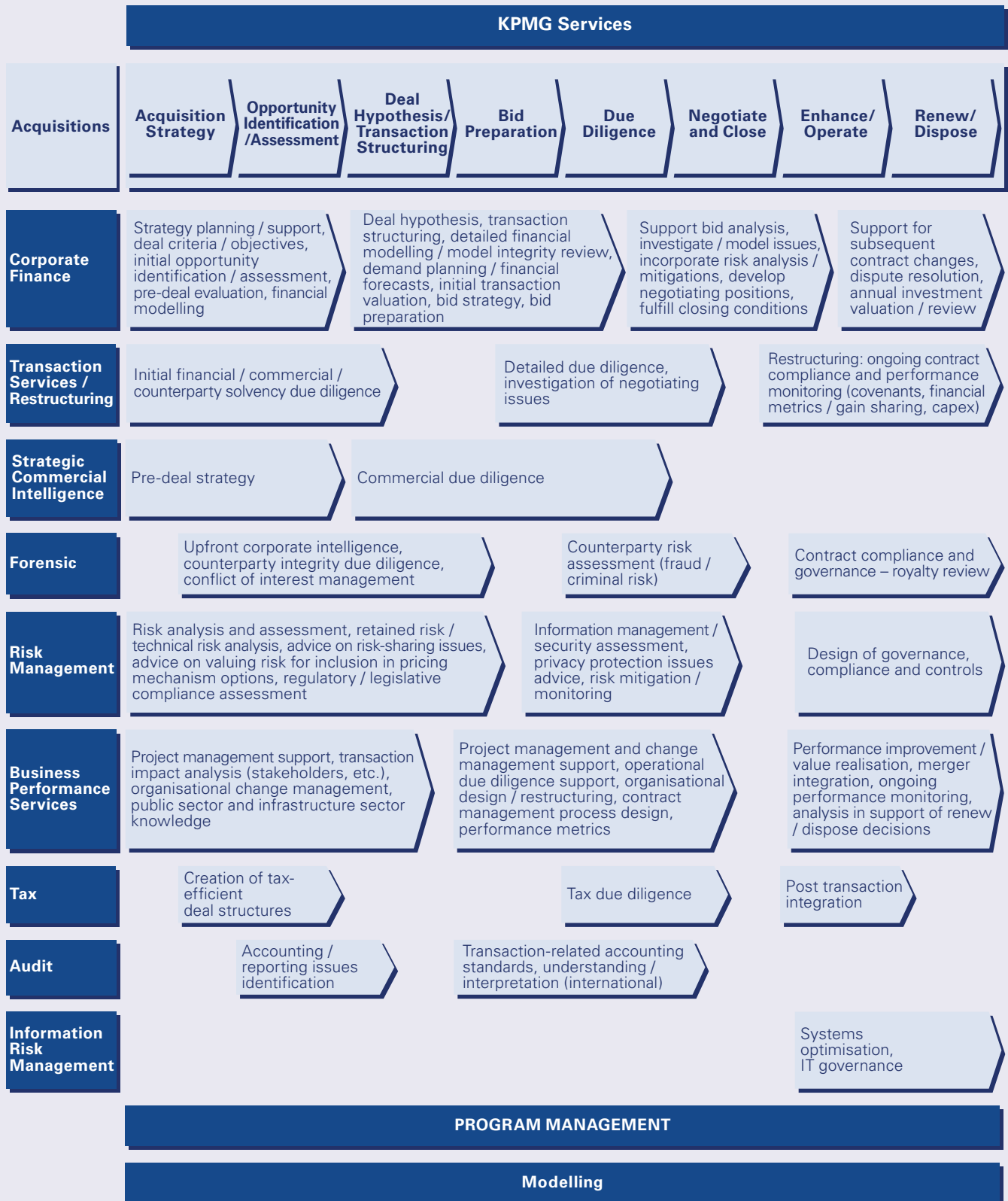




Throughout the globe, KPMG member firms provide clients with offerings in relation to the following services:



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## 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>



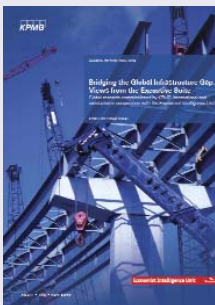
### China's Energy Sector – A Clearer View

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



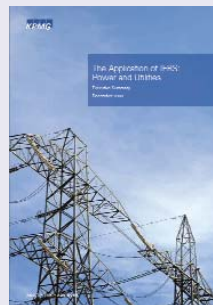
### Central and Eastern European Nuclear Energy Outlook

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:

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