



ENERGY AND NATURAL RESOURCES

Think BRIC!

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

BRAZIL

ADVISORY





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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 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 Brazilian power sector from political, socio-economical, technical, environmental and legal aspects. They offer the 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 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 Brazilian 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 Brazil 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 Brazilian 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 Brazilian 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 of 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 18 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 Brazil, the following listed companies and their representatives contributed to our survey:

Segment	Company
Major Market Participants	1. Eletrobrás
	2. Copel
	3. CEMIG
	4. Cesp
	5. Light
Regulatory Authorities	6. ANEEL
	7. Ministry of Mines and Energy
World Energy Council	8. WEC
Financial Institutions	9. Itausa
	10. Credit Suisse
	11. Bradesco
	12. ING Bank
	13. Unicredit Bank
Technology Suppliers	14. ABB Group
	15. Mitsubishi
	16. Siemens
	17. General Electric
	18. Schneider Electric SA

Executive Summary

The Brazilian electricity market, the largest in Latin America with a total annual demand of some 425,000 GWh, appears set for steady and sustainable expansion, supported by a combination of both economic and population growth along with government measures to increase the availability of electricity to the wider public.

And while the country's heavy reliance on hydroelectric power will continue, opportunities for other generating systems, from gas and nuclear to wind and solar energy, are already opening up and are likely to increase.

In addition, the country will require substantial investment in transmission and distribution, both for new facilities and refurbishment of existing equipment.

In total, the International Energy Agency has assessed the total investment needs of the sector to 2030 to be USD 252 billion (at 2005 prices), equivalent to USD 10 billion per year.

As a result, Brazil will offer a wide variety of financial, technical, consultative and training/educational opportunities to providers in the coming decade.

Since the country has introduced structural and legal reforms intended to support a mixed economy over the past ten years, along with specific measures to involve private capital in the electricity sector, Brazil would appear to be rich in potential for both domestic and foreign providers.

However, the state still plays a dominant role across the sector and this study has also revealed that a number of factors, including uncertainties in the tax system and the electricity regulation system, are causes for concern among all energy investors. In addition, Brazil suffers from a high rate of electricity theft, which, together with long transmission lines, push network losses to over 15 percent, roughly twice the global average.

In spite of these drawbacks, there is little doubt that overall the opportunities are immense. Brazil's population is expected to increase from 192 million in 2008 to 220 million by 2020, a jump of 10 percent. Economic growth, currently stagnant due to the global financial crisis, is forecast to pick up and expand by almost 5 percent annually after 2013. As a result, electricity demand is set to increase by between 4.00 and 4.5 percent annually, resulting in total consumption of between 710,000–785,000 GWh in 2020, that is a jump of 67–85 percent on 2008 figures.

Since domestic production already falls short of total demand (imports make up between 10–12 percent of consumption), it is clear Brazil will require substantial investment into generation facilities – this despite government programs to encourage energy saving and efforts to thwart electricity theft.

To meet needs, Brazil is forecast to need a total of 152GW installed capacity by 2020, compared to 93GW in 2006 – in other words an increase of 59GW, or 63 percent.

Brazil is blessed with a climate and topography which send hydroelectric engineers giddy with delight; it has the largest installed hydro-generation capacity in the world, which provided a staggering 85 percent of electricity produced last year. The remainder was sourced from biomass, oil, coal, gas and nuclear facilities.

In the short term, three large hydroelectric plants have been approved, all in the Amazon region, with a total capacity of 33GW. However the government, having experienced an energy crisis in 2001, brought on by an unexpected drought, is keen to diversify sources.

In addition, the environmental and social costs of large hydroelectric schemes (and the associated header reservoirs) are becoming contentious in Brazil. As a result, although hydroelectric capacity will increase substantially in absolute terms in the next decade, its share in electricity generated will fall to some 75 percent of the total.

Partly as a result of the environmental problems of large hydro-power schemes, a substantial proportion of the new hydro capacity should comprise smaller projects, including 'run of the river' schemes, i.e., without substantial header reservoirs.

Rapid expansion of such Small Hydro Plants (SHPs) is predicted, from the current 2,7 GW total capacity to some 7 GW within five years, and ANEEL, the electricity regulator, is conducting a study to assess the impact of installing up to 10 GW of SHP generating capacity.

However SHPs, lacking header lakes, will be more susceptible to interruptions in periods of extreme rainfall fluctuations.

In addition, growth in run-of-the-river schemes has been disappointing due to tariff limitations resulting in excessively long payback periods.

In terms of alternative prime energy sources, natural gas, which currently accounts for 3.6 percent of generated power, is expected to play a greater role, possibly comprising up to 11 percent of the total by 2020 depending on political will. New gas fields discovered by Petrobras in the southeast of the country are expected to contribute to this growth.

Brazil has two nuclear plants which currently provide about 2.6 percent of total production. A third plant, Angra III, is expected to be completed in the southeast of the country, helping to lift the proportion of nuclear-generated electricity to around 5 percent in 2020.

The perception of nuclear power has become more favourable in Brazil in recent years, and the Ministry of Mines and Energy projects an increasing role for nuclear power. However, there are no public plans to expand nuclear facilities at present, despite the country holding the sixth largest uranium deposits worldwide.

Coal-fired power plants are expected to double their share of the market (from 1.7 percent to 3.3 percent) by 2020, while oil-fired plants will slip in the rankings (from 3.1 to 2.7 percent).

Electricity sourced from biomass and waste currently accounts for about 4.1 percent of the total, much of this based on sugarcane bagasse, which is produced in tandem with ethanol. Some market participants believe there is a good future for growth in this segment, nonetheless biomass production will also struggle to hold onto its overall share of total production, with predictions that it will fall to 3.9 percent within the decade.

Energy experts also agree that Brazil offers huge potential for wind turbine generation, with 'abundant' winds in the northeast and south of the country, plus a long coastline. However, development depends on government policy, primarily the need for incentives to invest in wind power, and

respondents to the survey appear less than optimistic regarding progress. Predictions are that wind generated electricity will comprise only 0.6 percent of the total by 2020.

Even though Brazil is a signatory to (and potential benefactor from) the Kyoto Protocol of 2005, and there are a number of energy saving projects, progress on the ground towards a lower carbon economy appear limited. True, there have been initiatives, such as projects to replace electric boilers with solar water heaters, and some cities have modernized street lighting with more efficient sodium vapour lamps, however the desire to implement wide-ranging energy saving projects appears lukewarm.

As one market observer put it;
"It is cautious... I think that the state is being sensible, but it is not doing much, and it will not do much in the next few years."



But even with an all out embrace of energy saving technology, the electricity market is set to expand, and despite the expected relative decline in terms of market share of some forms of generation, it must be noted that in absolute terms every generation mode will see an overall increase in capacity.

And although market players do not expect any further moves to privatize the state-owned power sector – dominated in particular by Eletrobras with 40 percent of total installed capacity – much of the new investment will require private capital, with many projects comprising a 51 percent private stake and the state (using the financial clout of BNDES, the Brazilian Development Bank) the remaining 49 percent.

Some observers see this form of ownership as an ideal model for development, providing stability in times of uncertainty. *“The state has been fundamental [for progress]; without it, and considering the credit crisis, large projects would not have gotten off the ground in the past year,”* one respondent stated.

Hand in hand with the expansion of the generating segment, the transmission and distribution networks will also require modernization and new capacity. In both segments, earlier reforms have brought in private capital, with concessions for the construction of 10,000 km of transmission lines granted after the new regulatory framework was introduced in 2004.

As a result, system reliability has improved, and according to one market participant, this has been a very successful means of introducing investment and gaining efficiency.

“The transmission models have been the most successful ones in the country. They are similar to the generation model, in which one is paid to manage an asset. The tenders that have been conducted by ANEEL and the government have been very successful; we take part in them actively,” the participant said.

The reforms have also led to a majority of the distribution companies (EDCs) being transferred to private operators, who have worked hard to introduce efficiency into the networks, while cutting back on theft and other losses.

Much, however, remains to be done, certainly in the remaining state-owned EDCs where, as one observer put it, *“facilities are quite antiquated. It will be necessary to modernize the grid and implant new technologies for metering and control.”*

Even the privately run EDCs face further large investments to implement efficiency and reduce theft; projects include replacing more analogue meters with digital devices to identify more accurately any deviations in expected load demands (an indication of theft or network defects), new distribution lines located above main roads for better security, and replacing older cables with better armoured and lower impedance modern designs.

Overall, it is clear that the electricity sector needs substantial capital and human investment in the next decade. As many survey respondents noted, a proper, transparent regulatory regime is fundamental to enable these developments to proceed efficiently and effectively.

While the groundwork in terms of written legislation is in place, market participants have made

clear that this must be acted upon to attract private capital – even at the level of applying proper penalties for electricity theft.

The report notes that the regulator must include in its priorities an effort to maintain stable rules, enforce regulations, make impartial decisions and set clear guidelines. More efforts are required to further reduce cross-subsidies, and to increase tariff parity between the private and public sectors – while, in the generating segment – the regulator needs to differentiate between sources of energy in order to provide transparent and commercially viable returns on higher-cost power sources.

As the report puts it; *“Currently all types of energy are subject to the same auction, even if those energy sources have extremely differentiated costs, e.g., wind and hydro. ... This discourages most investors [from taking part in the higher cost alternatives].”*

There is also a need to draft a new strategic energy plan which resolves local differences and lays out an overall national scenario, the report notes.

With the right leadership the Brazilian electricity sector will see *“a period of substantial development”* with suppliers having to make investments in all three segments, i.e., generation, transmission and distribution.

With demand set to rise regardless of the various restrictions, as one major market participant put it; *“I think that you may conclude that there is optimism in the sector, with growing needs but also [with] an adequate model for its sustainability.”*

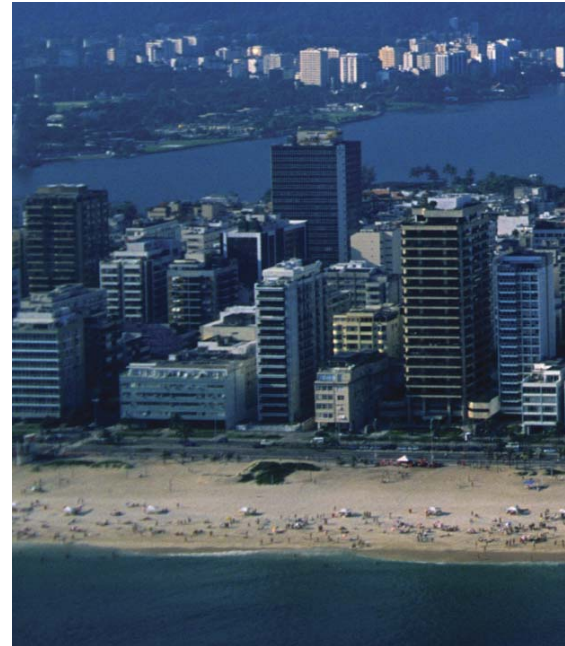
1. Brazil – Country in Figures



Area	8.5 million km ²
Government type	Federal Republic
Capital	Brasilia
Population (2009)	198.7 million (World rank: 6)
Population annual growth rate (2009 estimate)	1.19%

Source: KPMG, Economist Intelligence Unit

2. Population



Population growth is one of the main determining factors of energy demand in Brazil. Although the share of the residential sector in electricity consumption was only around 22¹ percent in 2008, population growth is decisive in respect to the domestic demand for goods and products; additionally, population growth is crucial to industrial output and domestic gross production. In the first section of this report, Brazil's major demographic trends and trajectories are presented to show the future opportunities in the country's economy and energy consumption.

Brazil is the most populous country in Latin America, as well as one of the most populous in the world, with a total population of nearly 192 million people in 2008.²

The growth rate of the population is considered to be high, amounting to 1.43 percent per annum³ (CAGR, Compound Annual Growth Rate between the years 2000–2008), the second highest growth among the BRIC countries after India. Accordingly, the total population of Brazil is expected to grow from the present 191 million⁴ to above 220 million by 2020.

Brazil's average population density is low due to the fact the majority of its inhabitants live on or near the Atlantic coast, and since the 1970's, there has been intensive migration from rural to urban areas, having currently reached an urban population ratio of 86 percent.⁵

According to historic tendencies, assumptions have been made for this forecast. Examining the country's

1 Source: International Energy Agency

2 Source: Economist Intelligence Unit

3 Source: Economist Intelligence Unit

4 Source: CIA – The World Factbook 2009

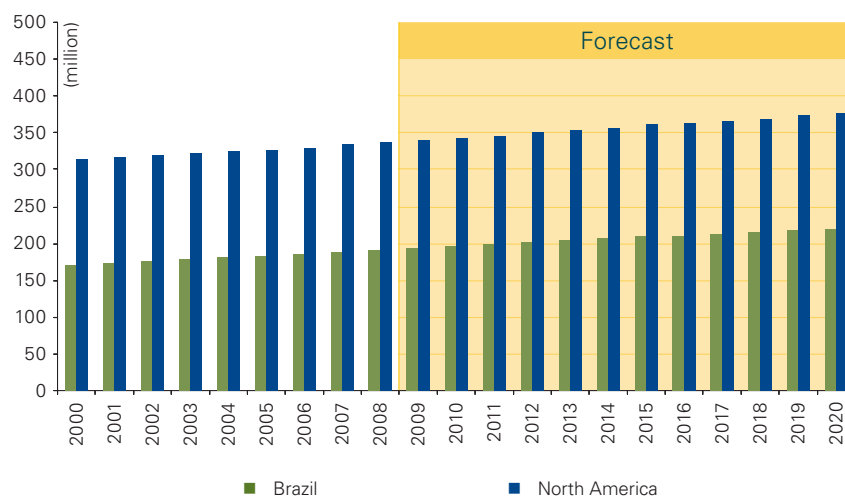
5 Source: CIA – The World Factbook 2009



demographic figures, since 1950 the population has grown from 50 million to the current 191 million with a continuously decreasing rate of growth due to both lower fertility and birth rates. Growth rate per annum was above 3 percent in the 60's while it is currently around 1.4 percent. Therefore a 1.4 percent increase in this rate was predicted until 2010, and 1.1 percent between 2010 and 2020.

In summary, one of the main advantages of the Brazilian economy is the high availability of labor resources (currently 52 percent of the population) which is predicted to remain stable in the coming decades as well.

Figure 1: Population of Brazil (2000–2020)



Source: KPMG, Economist Intelligence Unit

3. Economy

“BRIC represents the best regions for growth globally. I think they will continue to be a driving force for growth... and investment as well...”

- Major market participant -

An important relationship exists between the economy and electricity consumption. Interest in studying this relationship arises from the need to understand the complex links between the two. On the one hand, electricity use depends on technical and economic factors. On the other hand, electricity use 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 welfare⁶ and numerous studies imply a relationship between the two. Our survey looks at the main factors affecting economic growth to consider the implications and bring to light future prospects for the electricity industry until 2020.

Brazil's economy is among the 10 largest economies in the world and the largest in South America, with GDP (PPP) of USD 1 981 billion in 2008.⁷

Brazil's economy is considered to be free market and export-oriented with the services sector (66 percent) leading the way, followed by industry (28.5 percent) and agriculture (5.5 percent). Industrial production in Brazil ranges from automobiles, steel and petrochemicals to computers, aircraft, and consumer durables.

Brazil's economy is considered to be among the emerging markets and is one of the main recipient of foreign direct investment (FDI). Since structural reforms were first launched in the energy sector in the 1990s, the share of foreign capital in energy projects has increased rapidly. Nowadays FDI is still viewed favorably by a majority of the country's political class.

Nonetheless, the economy has experienced several periods of volatility in the past. By 2004, Brazil had accumulated USD 200 billion of external debt.⁸ Financing this debt and controlling inflation has pushed up domestic interest rates, which peaked just under 20 percent in 2005 – among

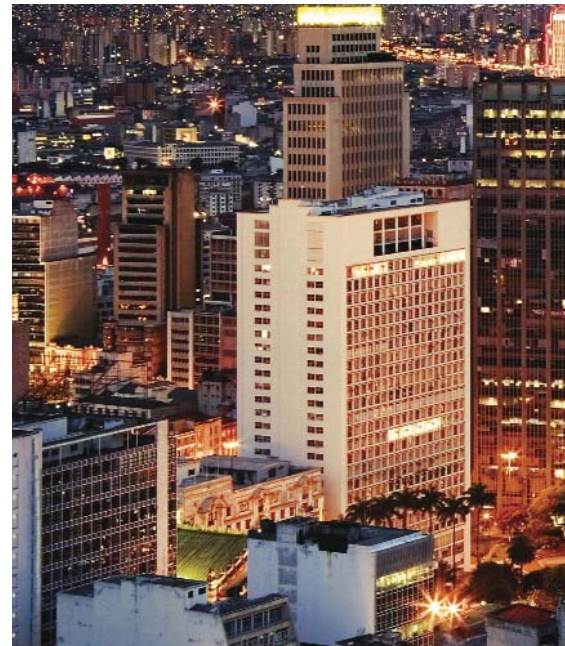


Figure 2: Main economic indicators

GDP (PPP)	USD 1 981.1 billion (2008)
GDP real growth rate	5.2% (2008 est.)
GDP/capita (PPP)	USD 10 325 (2008 est.)
GDP composition by sector	agriculture: 5.5% industry: 28.5% services: 66% (2008 est.)
Labor force	100.9 million (2008 est.)
Labor force by occupation	agriculture: 20% industry: 14% services: 66% (2003 est.)
Unemployment rate	8% (2008 est.)
Level of electricity provision to households:	Total 97% (2005)
Industrial production growth rate	4.4% (2008 est.)

Source: KPMG, Economist Intelligence Unit

6 Source: Ferguson, R., Wilkinson, W., Hill, R., 2000. Electricity use and economic development. Energy Policy. 28, 923-934

7 Source: CIA – The World Factbook 2009

8 Source: World Energy Outlook - 2006



the highest rates in the world. This has had negative effects on the economy, especially on public and private investments including long-term energy projects.

The financial crisis has affected the economy as well as the currency (the real, "BRL") and stock market (Bovespa). IBOVESPA, the stock market index, significantly lost 41 percent of its value in 2008.⁹

In 2006, the government announced a package of economic reforms to reduce taxes and increase investment in infrastructure. As a result, Brazil's economy is expected to be among the first to recover from the economic downturn.

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

As an overall opinion Brazil's attractiveness is considered to be high.

Besides being an enormous consumer market, Brazil has addressed the country's main problems over the past 10 years:

- *institutional credibility*
- *legally binding contracts*
- *stability of the regulatory framework.*

One drawback is that the transportation infrastructure needs improvement, especially ports and highways, both for domestic and export markets.

Regarding the electricity sector, Brazil is the country that has attracted the most foreign investments in the last 10 years.

On the other hand, non-motivating factors for investment there include:

- *the colossal tax burden, even on the labor force, negatively impacting investments*
- *a sluggish legal system*

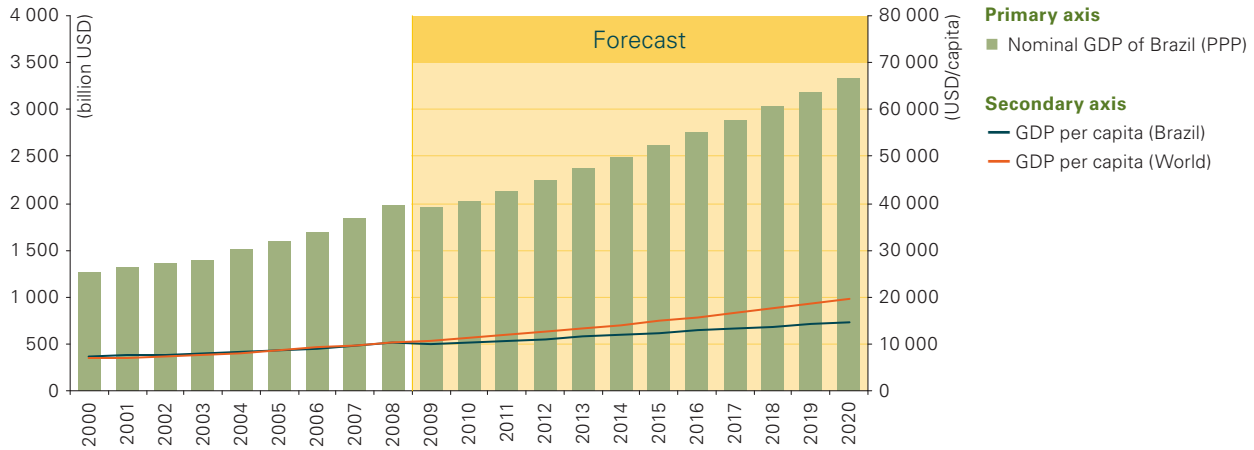
- *infrastructure issues, such as some sectors not keeping up with the country's growth, and the existence of major bottlenecks in railroads, highways, ports and airports that may seriously compromise logistics in distribution.*

"Brazil is the most stable of all the BRIC countries: we do not have the caste problems as in India, nor the problems Russia has – with a totally oil-based economy. Despite social inequality, domestic income is less concentrated and better distributed than in China."

- Major market participant -

9 Source: CIA – The World Factbook 2009

Figure 3: Brazil: Nominal GDP (PPP), GDP per capita



Source: KPMG, EIU

Nominal GDP

The nominal GDP of Brazil at purchasing power parity (PPP) was USD 1,981 billion in 2008.¹⁰ The stable growth of the Brazilian economy is expected to slow as a result of the financial crisis. Nominal GDP is predicted to decrease by approximately 1 percent between 2008 and 2009 after a 5.76 percent CAGR between 2000 and 2008. All signs indicate that the country will start recovering from the crisis after 2009. Between 2009 and 2013, the CAGR of the nominal GDP is expected to be roughly 5 percent (growing from 3 percent to 6.2 percent annually in the period). After 2013, Brazil's economy is forecasted to grow 4.9 percent annually following a trend which began in preceding years. As a result, the nominal GDP of Brazil is predicted to be USD 3,342 billion in 2020.

GDP per capita

GDP per capita was USD 10,325 in 2008 which was less than one-third of the Western European level (USD 34,420).¹¹ Considering the high population growth rate, the growth of GDP per capita is about 3.7 percent which is approximately 1.6 percentage points lower than the average global growth rate in the examined period (2000–2020). As a result, the GDP per capita of Brazil is forecasted to be USD 15,186 in 2020 which will be 25 percent lower than the world average (USD 19,466).

Energy economy

Brazil's economy 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 the last years. This production is mainly supported by the crude oil reserves, as well as by the robust sugar cane based bioethanol output, which had a growth rate of 27 percent in 2007 from the previous year.

On the other hand, the high rate of utilization of the vast water reserves by large hydropower plants contributes to the uniquely great share of renewables, which translates to more than 40 percent in the primary energy mix. This results a fairly limited carbon production of 330–350 million tons CO₂ vis-à-vis the global and BRIC emissions.

Figure 4: Main energy indicators of Brazil, 2006 (million TOE)

Production	206.72
Import-Export	20.35
Dependency (Net Import/TPES)	9%
Total Primary Energy Supply (TPES)	224.13
Total Final Consumption (TFC)	202.89
Conversion Rate (TFC/TPES)	91%
CO₂ emission (million tons)	332.42

Source: OECD/IEA Energy Balances of Non-OECD Countries, MEM Balanco Energético Nacional 2008

¹⁰ Source: Economist Intelligence Unit

¹¹ Source: Economist Intelligence Unit

Figure 5: Forbes Global 2000 ranking of Brazilian companies (2009)

World Rank	Company	Industry	Revenue (billion USD)	Profits (billion USD)	Assets (billion USD)	Market Value (billion USD)
25	Petrobras	Oil & Gas Operations	92.08	14.12	120.68	110.97
74	Vale	Mining	30.75	9.28	79.26	66.14
78	Banco Bradesco	Banking	39.97	3.26	194.51	26.75
106	Banco do Brasil	Banking	33.38	3.77	223.13	14.96
163	Itaúsa*	Banking	39.41	1.16	265.22	13.56
215	Unibanco Group	Banking	14.74	1.94	82.12	13.75
312	Eletrobrás	Electric utilities	12.61	0.87	66.86	12.30
498	Metalurgica Gerdau	Materials	22.82	1.65	25.99	2.79
535	CSN-Cia Siderurgica	Materials	6.42	1.64	14.94	10.16
606	Tele Norte Leste	Telecommunications	9.87	1.32	15.86	5.21

Source: Forbes

*Itaúsa and Unibanco merged in the first quarter of 2009

The demand for crude oil and petroleum products continuously exceeding the domestic production with a 2 million barrels per day refining capacity, despite of the increased resource base and production of Petrobras. Moreover the natural gas sector imports yearly 10 billion cubic meters of gas via pipeline from Bolivia. The electricity production consumed 12,4 percent of the natural gas supply in 2007, while representing nearly 23 percent of the coal

consumption, the supply for which is apparently rather limited in terms of steam coal.

The main user of the total final consumption of more than 200 million TOE is the industrial sector with more than 80 million TOE in 2007. Households were still slightly ahead of the energy sector in terms of final consumption in 2007, each having about 10 percent share, but given the latter's greater pace of increase, this will be changed soon.

Figure 6: Fossil resources of Brazil (2008)

	Proved Reserves	Production	Consumption
Oil	12.6 billion barrel	1.9 million barrels per day	2.4 million barrels per day
Natural gas	330 billion cubic meters	14 billion cubic meters	25.2 billion cubic meters
Coal	7 billion tons	6.4 million tons	44 million tons

Source: Forbes

4. Electricity Market



Brazil has the largest electricity market in South America. The country has one of the largest capacities for water storage in the world and is highly dependent on hydroelectricity generation. These factors make for a high level of investment but relatively low generation costs compared to countries with a more diverse supply mix. However, dependence on hydro power makes Brazil especially vulnerable to power supply shortages in drought years, as was demonstrated by the 2001–2002 energy crisis.

The power sector in Brazil was essentially in the government's hands until the early 1990's. By the late 1980's, the state-ownership model was on the verge of collapse. This situation was the result of heavily subsidized tariffs and a revenue shortfall in the sector, which led to a delay in the construction of several large hydro plants due to lack of funds for investment.

Consequently, reforms in the power sector were introduced in the 1990s. After the power crisis of 2001, the Brazilian government introduced a new regulatory framework for investment. Concessions for the construction of over 10,000 km of transmission lines¹² were subsequently awarded and the reliability of the integrated grid has improved. Electricity generation and distribution have also been opened up to private capital.

In the framework of structural reforms in the energy sector the roles of the operator and regulator that had coexisted in Eletrobrás earlier have been successfully separated, and clear rules for all operators, including the government enterprise, were established.

The Ministry of Mines and Energy (MME) bears the overall responsibility for policy setting in the electricity sector, while ANEEL (Agência Nacional de Energia Elétrica), which is linked to the Ministry of Mines and Energy, is the Brazilian

Electricity Regulatory Agency which was created in 1996. ANEEL's function is to regulate and control the generation, transmission and distribution of power. The National Council for Energy Policies (CNPE) is an advisory unit to the MME in charge of approving supply criteria and structural projects while the Electricity Industry Monitoring Committee (CMSE) monitors supply continuity and security.

The Operator of the National Electricity System (ONS) is a non-profit private entity created in 1998 that is responsible for the coordination and control of the generation and transmission installations in the National Interconnected System (SIN). The ONS falls under ANEEL's authority and regulation.

While the liberalization of Brazil's electricity sector has already begun, further steps are necessary to achieve a stable and secure market, especially the participation of foreign and domestic private capital.

¹² Source: International Energy Agency: World Energy Outlook – 2006



4.1. Electricity demand

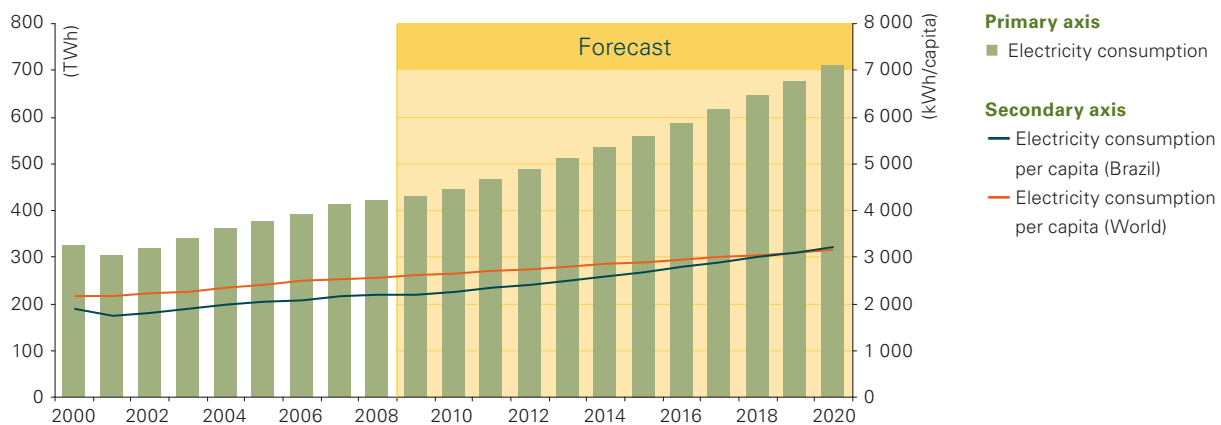
Brazil possesses the largest electricity market in South America, with power consumption of 423,086 GWh in 2008 which represents 2.65 percent of the total electricity consumption of the world.

Electricity consumption

Brazil's electricity consumption grew by 2.99 percent annually between 2000 and 2008.¹³ The tendency is not expected to change significantly until 2020 and based on predictions, the annual electricity consumption of the country should be

approximately 709,221 GWh in 2020. The compound annual growth rate of Brazilian electricity consumption is 3.99 percent for the entire 2000–2020 period, which is lower than the average of the other BRIC countries. As a result, Brazil is on a trajectory to become the smallest consumer of electricity among the BRIC countries by 2020.

Figure 7: Electricity consumption, electricity consumption per capita



Source: KPMG, EIU

¹³ Source: Economist Intelligence Unit

The per capita electricity consumption of Brazil has shown stable growth in the past eight years. The CAGR was 1.54 percent between 2000 and 2008¹⁴ which resulted in 2,194 kWh per capita electricity consumption in 2008 – roughly 14 percent lower than the global average. As the economy and the social welfare of the Brazilian population are growing faster than the population itself, the per capita electricity consumption is expected to be 3,222 kWh by 2020.

How would you characterize the dynamics of household electricity consumption during the course of the next five years?

Electricity consumption growth in the household sector has historically been 1.5–2 times that of the GDP.

Electricity consumption of the residential sector in Brazil accounts for approximately 21 percent of the total electrical energy consumption of the country. Per capita consumption in Brazil is around 2,330 kilowatts/hour, which is low. The growth rate is

forecasted to be 4–4.5 percent, which is lower than the 5–5.5 percent rate achieved in previous years. Per capita consumption is thus estimated to reach 2,800 to 3,000 kilowatts/hour in five years' time.

The sector offers good growth potential which has not suffered significantly from the financial crisis. Even in the case of some decrease, fast recovery is expected.

Overall, the residential sector in Brazil is not considered to be very sensitive to recessions. Even in moments of crisis, it is easier to cut expenses in other areas than with electricity, which tends to be the last thing on which people spend less.

"The impact is minor. People do not stop using home appliances, or watching TV; when they have an electric hot water boiler, they do not stop taking hot showers... They cut down on other things, like going out to dinner, travelling, and superfluous spending..."

- Major market participant -

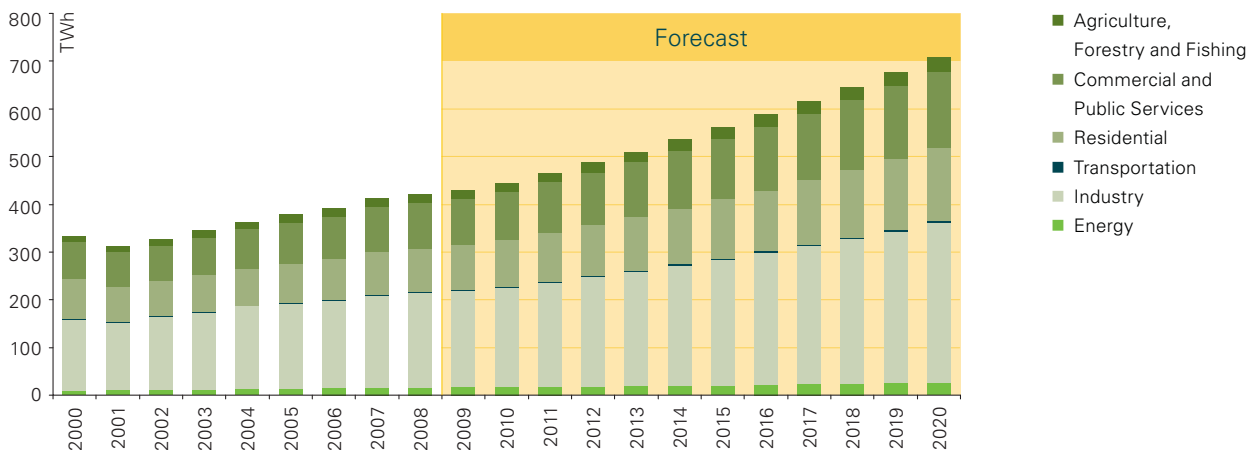
According to the big Brazilian energy companies a culture of a more conscious energy use has arisen, but it will not have any effect in the short term.

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

The Luz para Todos ("Light for All") federal government program,¹⁵ which is spreading electric power both to urban and rural areas to eradicate "electrical exclusion", has made great progress. Consumers in interconnected areas already have access to electric power. The initial completion deadline of 2010, when all program goals should be fully met and 100 percent of all Brazilians are set to have access to electricity, has been extended to 2012. By the end of the program, an estimated total of 1–1.5 million consumers are to have received access.

Participation in Luz para Todos is mandatory for electricity distributors

Figure 8: Electricity consumption by sector



Source: KPMG, EIU

14 Source: Economist Intelligence Unit

15 A demonstration project; energy will be free for low-income consumers, and for residential consumers with consumption less than 80 kWh/month tariffs will be reduced. The Program's calculated cost is USD 7 billion. This sum will be achieved through a partnership of the federal government, state agencies and energy distributors. The federal government will designate USD 5.3 billion. The project is also supported by USAID funding. Source: <http://projects.wri.org/sd-pams-database/brazil/luz-para-todos>

and involves all the states. The program is considered very ambitious, with numbers that do not reflect the technical difficulties faced by distributors.

Respondents are generally not aware of what percentage of the program has been implemented. Some estimate that 60 percent of the program has been achieved.

The total electricity consumption of the country can be divided into six major sectors. Figure 8 shows the share of each sector in total power consumption based on the International Energy Agency's database and KPMG's forecast.

In 2006, the energy sector accounted for 3.74 percent of the total electricity consumption of the country, which had increased from 3.17 percent in 2000. The industrial sector is the most significant consumer of electricity in Brazil with 183 440 GWh annual consumption, accounting for about 47 percent of total consumption in 2006. The transportation sector had a minor, 0.29–0.39 percent share between 2000 and 2006. Although the total consumption of the residential sector increased from 84,610 GWh to 85,820 GWh, the share of the sector decreased in the period in question, from 25.31 percent in 2000 to 22.01 percent in 2006. The commercial and public services sectors had almost the same share as the residential sector of total consumption: 22.64 percent in 2006. The consumption of the agriculture, forestry and fishing sector increased from a 3.77 percent share in 2000 to 4.21 percent in 2006.

It is assumed that the share of each sector of the economy will not change substantially. Thus, in 2020, industrial electricity consumption will have the biggest share, followed by the residential and service sectors.



Industrial sector

Besides the Brazilian commercial sector, industrial activities are providing an increasing share of GDP, reaching around half of the commercial sector's contribution while it employs only 14 percent of the total labor force. Trends show an increase in the industry sector due to the availability of natural resources.

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

In Brazil, power intensive industries include:

- *Raw-material processing (minerals, wood, petroleum), via steel mills, refineries, aluminum industries, pulp and paper companies, etc.*
- *Chemical product processing*

The sector has a strong relation with the external market as a good portion of its production is oriented towards export. For this reason, it was the sector most

affected by the economic crisis, thereby causing a decrease in its energy demand in the short-term.

The commodities sector is suffering a strong downturn, the prices of commodities have significantly decreased on the global market, export volumes are decreasing and a quick return to previous levels is not expected. Some big players in the commodities sector have already closed facilities while other substantial enterprises have halted some large projects that were scheduled to be carried out this year.

Regarding electricity consumption levels, an initial decrease is to be expected in 2009 in relation to 2008 (estimated at around 10–15 percent), which could continue from one year to 18 months, with a recovery likely after two years. If no additional crisis emerges, an acceleration of consumption growth is expected in 2011 and 2012, as a result of a potential return to previous consumption levels, in line with the expected increase of commodities prices on the international market.

One positive consequence of the crisis is that if demand were to continue as before the crisis, the country would have unlikely been able to meet energy demand. This halt will in some way allow Brazil to catch its breath and the supply side may expand without the pressure of the demand side.

Commercial sector

The commercial sector is the major contributor to the Brazilian economy. This sector provides 66 percent of production by employing the same share of the labor force.

What are the expectations for development of the SME (small and medium-sized enterprise) and the commercial sectors and its expected effect on electricity consumption in the next five years?

Growth rates tend to be very similar and follow the fluctuations of the GDP. If the economy maintains the current pace, the growth rate is expected to vary between 3.5 and 6 percent.

*The **commercial sector** is considered by most respondents as being responsible for the most meaningful part of this growth.*

The growth of electric energy consumption in the commercial and service sectors will probably grow in the next five years, after a sharp decrease in 2009 and part of 2010.

*The **trade & retail sector** impacts growth differently, depending on the specific region of the country. Shopping malls are the largest consumers in this respect. In the southeast part of the country demand for power is already strong, while in the north and northeast there is still great potential for expansion.*

Another relevant tendency is the fact that big retailers (for example, WalMart) are starting to create their own power generation projects with solar panels or diesel and gas engines for intermittent use.

*Especially among **small and medium-sized entrepreneurs (SMEs)**, the pressure for cost savings tends to be increasingly strong.*

A major cost optimization effort is expected to be undertaken, seeking greater energy efficiency – purchase and/or replacing of electronic consumer goods for energy saving models – and energy savings via changes in consumer behavior.

Agriculture

Brazilian agriculture is well diversified, and the country is largely self-sufficient in food production. Agriculture accounts for 5.5 percent of the country's GDP, and employs about one-fifth of the labor force in more than 6 million agricultural enterprises.

Agriculture in Brazil is expected to be modernized, as in other developing countries, which will result in increased energy consumption.

How do you see the development of Brazil's electricity consumption in agriculture over the next five years?



The use of electric power in agriculture has increased significantly. Consumption growth is forecasted to be similar to that of the industrial sector for the next five years, with higher rates in regions where agriculture and livestock activities are expanding and modernizing.

The midwest region of the country is growing at 8 percent or more, which is higher than the industrial consumption growth rate. The irrigation needs of new crops have led to increased electric power consumption.

The agro industry, however, is becoming a provider of electricity through biomass and, on a smaller scale, of eolic and solar energy.

In the liberalized system, electricity is traded between generating concessionaires, independent energy suppliers, auto-producers and eligible consumers. Consumers are eligible with contracted annual capacity above 3 MW.

As far as the price level is concerned, the average retail tariff rose from 7.45 centavo/kWh (7.45 cent/kWh) in 1996 by 40 percent to 10.85 centavo (6.01 cent, due to the devaluation of the national currency) by 2000.

Further price developments, and differences due to the still existing cross-subsidization between the individual consumer groups are reflected in the below table.

It is worth noting, that the USD/BRL foreign exchange rate has a direct effect on the domestic prices, because of the USD accounting of the imported hydro electricity from Paraguay.

Power pricing

With the implementation of the reforms, the sector was divided into two different systems. Under the regulated system consumers purchase electricity at the tariffs defined by ANEEL from their local distributor who, in turn, purchases electricity through public tender regulated by ANEEL.

ANEEL tariff setting is based on the performance of the individual regional distribution companies, so the end-user prices show significant differences, ranging from 19.7 to 41.4 centavo/kWh for the residential users in 2009. Accordingly, the average prices differ in the various supply regions, with the north of Brazil being generally 15–20 percent more expensive than South.

Figure 9: Electricity prices in Brazil

ct/kWh	2006		2007		2008	
	BRL	USD	BRL	USD	BRL	USD
Residential	29.49	13.40	29.36	15.45	28.20	15.67
Industrial	20.77	9.44	21.66	11.40	19.94	11.08
Commercial	27.42	12.46	27.31	14.37	27.12	15.07
Rural	17.63	8.01	17.47	9.19	17.89	9.94
Total average	25.08	11.40	25.29	13.31	24.23	13.46

Source: MME/DGSE, ANEEL, Deutsche Bank Research, KPMG calculations

4.2. Electricity supply

Electricity production in Brazil has been growing substantially in the last eight years to cover the country's increasing electricity demands. The annual growth of consumption was nearly 3 percent between 2000 and 2008, while the growth rate of production was 3.6 percent annually in the same period.

Figure 10: Installed capacity (GW)

2000	68.2
2001	73.7
2002	76.2
2003	82.5
2004	86.5
2005	90.7
2006	93.2
2015	128.3
2020	151.8
CAGR (2000–2006)	5.34%
CAGR (2000–2020)	4.36%

Source: KPMG, IEA, EIU

Brazilian power generation is highly dependent upon hydroelectricity, which is not expected to change in the short term; however there is a need for diversification of the generation mix to avoid further energy crises.

Installed capacity

Brazil's installed capacity was 93.2 GW in 2006¹⁶, and according to the National Energy Strategy (Plano Nacional de Energia 2030), the level of domestic capacity will be expanded to 151.8 GW by 2020.

As already discussed, electricity demand is constantly growing and is driving generation investments; furthermore the security of electricity supply is required, therefore it is essential to reach the forecasted figure. Accordingly, electricity generation is expected to reach 785TWh in the year 2020.

Breakdown of electricity production

Brazil has the largest capacity for hydro power in the world and more than 85 percent of its electricity was generated in hydro power plants in 2008. The remainder was generated in plants fueled by coal, oil, natural gas and biomass or waste as well as in nuclear power plants.

As Brazil is highly dependent on hydroelectricity generation, the country is especially vulnerable to precipitation change and drought affecting hydroelectric generation, as was demonstrated by the energy crisis in 2001. At the same time, hydro based capacities reduce the country's generation costs relative to countries with more diverse supply mixes.

In order to meet a more diversified generation mix, the share of hydro power generation is predicted to decrease to around 75 percent by the year 2020.

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

Forecasts for Brazil's future energy outlook envisage a highly favorable situation for the country.

The country has great energy potential in terms of hydro, renewables (SHPs, wind, biomass and solar) as well as for fossil fuels like natural gas, oil and coal.

Brazil continues to pursue hydroelectric energy mainly generated by large hydro plants.

Excluding hydropower, other power sources are increasing their share in the Brazilian energy matrix.

Thermal energy (oil and coal) currently comprises about 5 percent of Brazil's generation mix. The development of coal power plants (with clean burning technology) may also increase their role in generating power for the country.

"The flexibility of the type of energy is a factor. You have highly significant hydro resources and you can supplement demand with an investment that is more flexible, which allows you to stop production, stop spending. Thermal plants are flexible..."

- Survey participant -

It is easy to control production and obtain environmental approval for thermal power. Thermal power plants play a complementary role in hydropower production, especially in the dry season. The initial deployment cost of such a plant is low, but fuel costs are high.

Natural gas currently accounts for 2 to 3 percent and could reach 5 percent or even 10 percent, depending on political will and on availability. Investments made by Petrobras are supposed to generate a quantity of natural gas that might allow for greater utilization of this source, substituting thermal energy.

¹⁶ Source: International Energy Agency

“By 2012, natural gas will gain market share from the natural gas that Petrobras is going to sell and from the thermal efficiency of combined cycles. These are the integrated cycles of gas turbines with steam turbines, with which one can reach 55 percent efficiency, recovering the heat from the gas turbines and generating steam.”

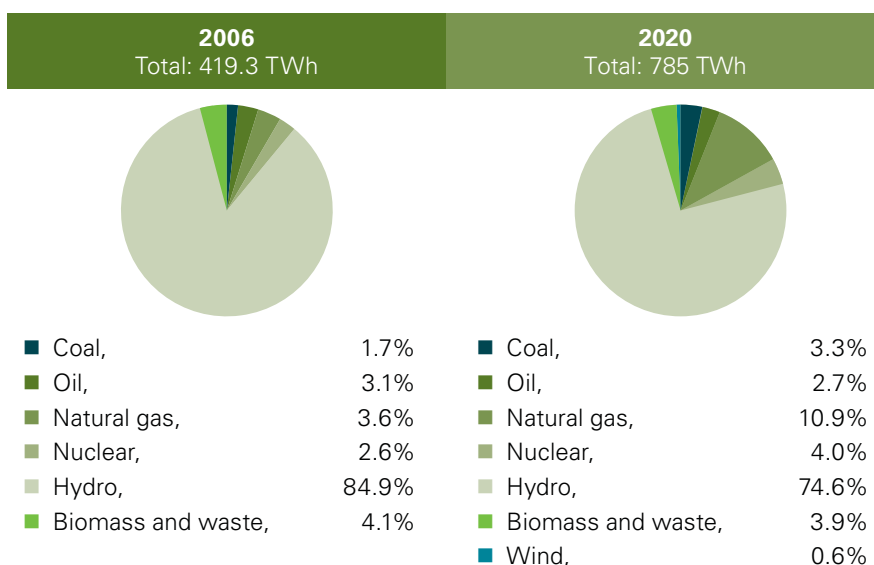
- Survey participant -

The new gas fields discovered by Petrobras in the Campos basin in the southeast region of Brazil should increase the share of combined cycle gas turbine (CCGT) power plants, as well as the more intensive use of Bolivian gas.

Renewable energy sources, like biomass (sugarcane bagasse), wind, and solar could comprise, in total, a volume of as much as 5–10 percent in the long term.



Figure 11: Breakdown of electricity production



Source: KPMG, EIU

What are the expectations for the development of large-hydro capacity for forthcoming decades?

There are still great prospects for hydropower development in Brazil. Due to social and environmental problems, however, the share of large hydroelectric plants in the Brazilian energy matrix should shrink in the mid-term, down to 75 percent by 2020.

The greatest promise for building hydropower plants is in the northern Amazon region. However, because of the need to flood rainforest areas and impact Indian reservations, and due to public opposition, it has been very difficult to obtain environmental approval to build them.

At present, in line with global trends, these environmental requirements are increasingly rigorous thus approval is becoming increasingly difficult to acquire only to build a station, but also to operate it making the entire process overallly complex. To illustrate this problem, the share of large hydroelectric power plants was 95 percent at the end of the 1980s and has declined to 85 percent due to environmental restrictions.

Despite limitations, which are likely to change the future outlook of the sector, "run-of-the-river" plants have been deployed in the Amazons. Although these hydroelectric plants are more expensive and generate less electricity because they do not have large reservoirs, they are environmentally acceptable.

*"What has been going on?
Due to environmental restrictions, Brazil's new large hydroelectric plants do not have reservoirs like Itaipu, Furnas, Três Marias, Porto Primavera... all of these new projects are hydroelectric power plants, where the water passes through rather than being kept in a reservoir, which does not exist. The generation of energy is proportional to the water that passes through. If no water goes through, no energy is generated. Therefore, in times of drought, energy generation drops. Twenty years ago, the reservoirs were enough for two or three years, but today it is only sufficient for nine months."*

- Survey participant -

In the short-term, there are three new approved hydro plants in Brazil's northern region, which will account for 60 percent of the growth in power generation capacity. Together, these can produce up to 33,000 MW.



In relation to mega hydroelectric projects, which involve thousands of megawatts, with the exception of those projects already underway – Santo Antonio, Jirau and Belo Monte – market players do not believe a significant number of new projects will emerge for a number of reasons:

- The largest hydro potential lies in the northern region, which gives rise to an enormous distance between the generated energy and consumption centers, increasing costs and generating transmission losses.
- Serious environmental issues, controversies and wearisome tasks are involved, politically as well as financially.
- Complexity and a high volume of resources is required, yet generation is still almost completely under state control.
- Other energy sources are quicker and less complex to develop, with emphasis on biomass energy, SHPs (Small Hydroelectric Plants) (which already have a developed regulatory, financial and technological infrastructure), and wind energy that, despite moving at a slow pace, at the

moment offers potential that is continuous, clean and bears much room for exploration.

"Take Rio Madeira, with two plants, to be developed by 2013. As of this date, you add Belo Monte and you have seven more years, up to 2020. Then, the tendency is for big projects like these to be ruled out. This should create more space for SHPs..."

- Survey participant -

What are expectations for the development of nuclear power generation over the course of the coming decades?

In Brazil, owing to its great dedication to hydroelectric, and to other feasible alternatives such as sugarcane bagasse or biogas, it is not yet possible to foresee if nuclear power will play an important role.

The share of nuclear power in the Brazilian energy matrix is currently around 2 percent, with two operating plants. From a 10-year perspective, it should reach 5 to 6 percent.

The Ministry of Mines and Energy is planning to generate 4–8,000 megawatts of nuclear-generated power by the year 2030.

The way nuclear plants are perceived in Brazil has changed greatly over recent years, and they bear several advantages:

- NPPs (Nuclear Power Plant) are more cost-effective than thermal stations.
- NPPs supply clean energy, which speeds up environmental approval.
- Safety is increased due to new technologies (third and fourth generation reactors).
- They are costly to deploy but production costs are cheap as NPPs are not sensitive to fuel costs.
- The sixth largest uranium reserve in the world is in Brazil and the country is equipped with uranium enriching technology.

What officially exists now is the intent to complete the Angra III plant and incorporate it into the supply network in the southeast region. Angra III is included in all forecasts of the major Brazilian energy organizations, such as Eletrobrás, ANS and ANEEL, regarding both power supply and consumption.

Besides Angra III, which has not been concluded yet, there are no public plans to expand the generation of nuclear power in Brazil.

“The nuclear program takes nearly nine years for the first megawatt to be delivered.”

- Major regulatory agency -

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?

Increasing concerns over the environment should increase the share of renewable power over the next five years. The 1.3 percent share in the energy matrix is likely to increase to 4 percent by 2017.

The main sources of renewable power in the country will be **small hydroelectric plants (SHPs)**, wind and biomass.

These are low generation plants in comparison to large hydroelectric power plants and nuclear facilities. However, there is potential for many alternative power stations, which will contribute to energy supply in a novel way. There is a major incentive program for the increasing use of small hydroelectric plants (SHPs) and this kind of hydropower generation with lower environmental impact has grown.

SHPs thus receive high priority and, despite generating less energy, individually, their numbers are growing in Brazil, for several reasons:

- They are in line with the country’s inclination to pursue hydroelectric.

- There is a reliable financing structure, essentially that from BNDES (National Economic and Social Development Bank, which finances as much as 70 percent of implantation), as well as for environmental licensing, construction, and selling of the energy that is generated.

- They have no significant environmental impact, do not require large civil work projects and do not call for personnel changes.

- They are a source of highly stable generation.

- There are tariff advantages in production.

“They set a turbine with a generator in the river, the water runs through it generating a small amount of production, but it is stable and continuous.”

- Survey participant -

However, growth has not reached government expectations, as tariff limitations result in a very long payback period, which makes capital expenditure unattractive for investors.

“This means that economic logic was lost in the process. Eletrobrás has an incentive program for alternative power sources. It has incentives for SHPs, and for wind power plants, which are included in the same program. However there has not been much progress due to cost issues. For the next five years, they will launch a new bid, which is scheduled for this year. They will probably have to better remunerate investors...”

- Major market participant -

“It took five years to get environmental approval for the hydroelectric power plants on the Madeira River. As far as I know, the Angra III was quickly approved.”

- Major market participant -

Over a five-year span, SHPs are likely to grow very fast. Their overall installed capacity is 2,700 megawatts and should reach 7,000 megawatts in five years' time – more than the capacity of the Madeira River power station. ANEEL is conducting a study to assess the generation of 10,000 megawatts via SHPs to be constructed in the future.

Brazil is the second largest alcohol producer in the world, using its own production technology. This sector is likely to continue growing in the coming years. **Biomass**, especially sugarcane bagasse, has also been developing especially, although prices float according to the prices of both sugar and alcohol.

"Biomass energy comes from sugar cane, and the country has a great inclination toward sugar cane cultivation and ethanol production. Ethanol is a big hit in terms of recent discoveries and is a very interesting process, where you produce sugar,

ethanol, energy, and then steam... It is something that closes the cycle. It is a highly intelligent and natural process..."

- Survey participant -

Sugarcane bagasse is already used internally by alcohol factories as a source of power. The Government's proposal is for these factories to produce and sell the energy. All plants that were previously alcohol mills have the capacity for the cogeneration of energy.

Good prospects exist for the development of **wind power** in the northeast and in the south, where wind is abundant, but at the present time wind generation is insignificant.

Currently, the State is continuing to study this alternative but still has not come up with a scheme to offer wind mill operators incentives that stimulate the construction and purchase of this energy, whose generation is much more expensive than the others.

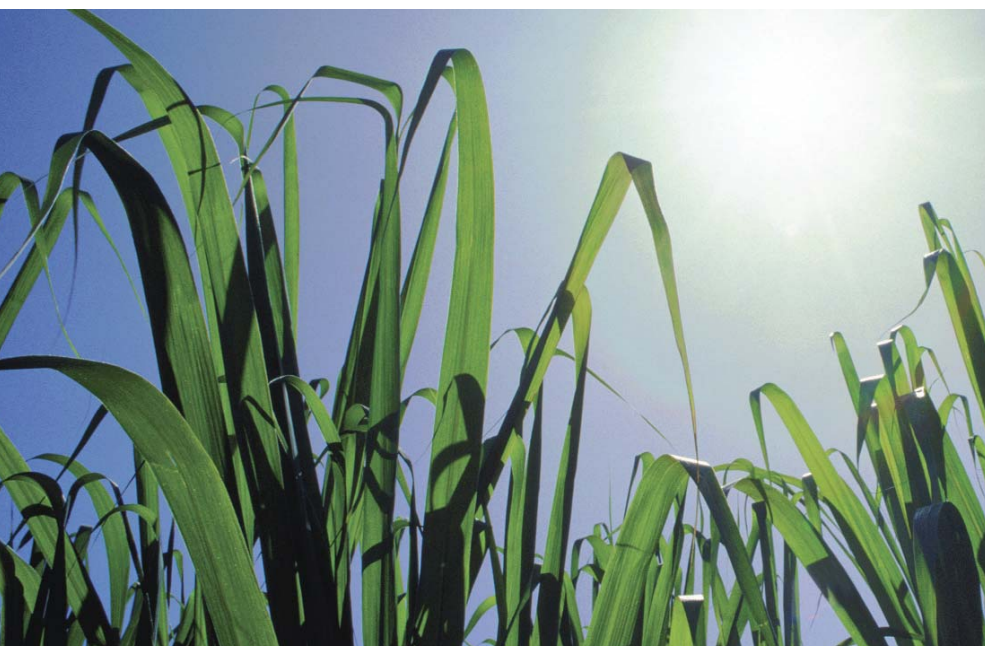
Tests have already been conducted in those wind facilities in operation, in the northeastern states and in the southern region of Brazil, which indicate that wind variability is above the mean average considered ideal for the continuance of these projects.

"All of these possibilities are linked to government policies, to the effective actions of the State and its execution in relation to these programs. Overall, all sources should exhibit growth, but, if we are talking about stake holding, that is highly linked to government policy. For example, wind power, which is the craze of the moment; there is enormous wind power potential in Brazil, mainly in the southern region, in Santa Catarina, in the northeast ... and we have an extensive coastline, but whether this gets off the ground will depend on the priority that the State gives to this issue."

- Survey participant -

Biodiesel is another program that is growing but not as quickly as expected. It will continue to be a priority because it does not impact climate change negatively, creates jobs and allows people to remain in rural areas.

In the next five years, there should be minute **solar energy** growth, perhaps including government subsidy for the installation of the first few units, along the same lines as for Proinfra. Still, the required technology makes it costly and consequently unattractive.





Network losses

Brazil has one of the highest rates of network losses in the world due to the long distances through which power is transmitted and distributed. Additionally, the country's old and poorly maintained distribution network is suffering from a high rate of theft.

Currently, network losses compared to the level of power production are above 15 percent which is nearly two times higher than the world average.

Large investments are expected in order to reduce network losses; private capital will be involved as well to meet the objectives. In accordance with this, by the year 2020, the rate of distribution losses is expected to be approximately 14.5 percent of the total electricity production of Brazil.

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

In Brazil, the main problem is not non-technical loss, but theft in distribution. Nearly 12 percent of all the power produced in Brazil is not paid for by consumers: that is, power theft accounts for 12,000 megawatts, a major challenge for ANEEL.

In this respect, Brazil still faces a series of structural problems that make a short-term solution to the problem of theft difficult and which require a great deal of investment on the part of distribution companies.

Reducing power theft is one of ANEEL's priorities for the forthcoming five year period.

The costs of power theft – greater in some states, such as Maranhão and Rio de Janeiro – have been passed on down to consumers. ANEEL is changing this situation, working to encourage companies to manage fraud by investing in loss-reduction technology and mechanisms. ANEEL is working hard with

distributors to implement the reference company model and reduction targets:

"... non-compliant companies will be penalized: that is, it is the stock holder that will pay the bill and not consumers."

- Survey participant -

*Energy Suppliers clearly see that the regulator is setting controls and stimulating them to achieve higher efficiency levels. Respondents believe that the **distribution sector** has to be improved, because losses in the transmission sector are minimal.*

The main actions recommended include:

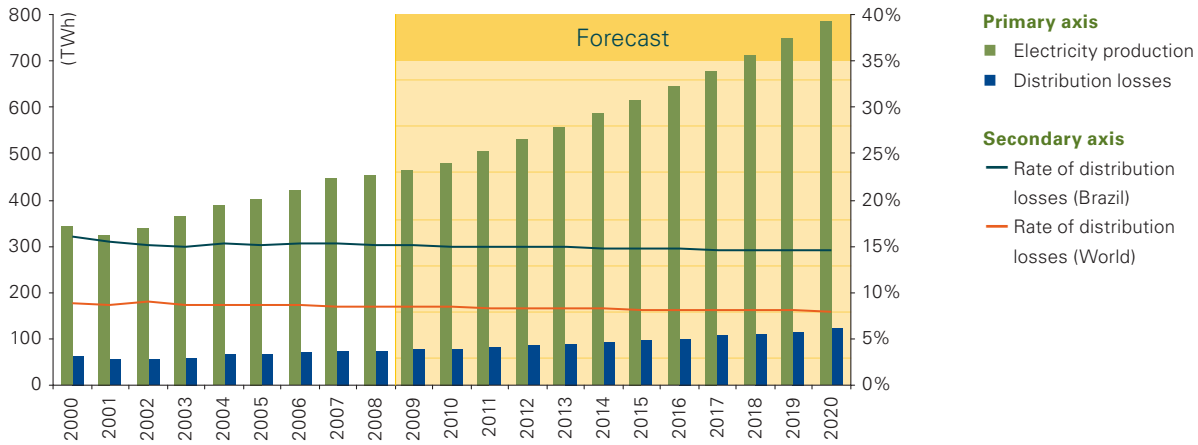
- *Replacing analogue meters with digital meters, which makes it possible to remotely control and identify deviations due to fraud and/or defects in the network.*
- *Changing the arrangement of wires as a solution to prevent power theft.*
- *Using more modern cables that are more resistant to the wear and tear caused by weather conditions.*
- *Applying penalties for power theft.*

All distribution companies have invested in these improvements that, despite their high cost, immediately result in increased earnings.

"These allow you to monitor consumption full-time. It is a strong trend. It began in the states where power theft was greater, such as Rio de Janeiro, Minas Gerais and São Paulo."

- Major market participant -

Figure 12: Electricity production and distribution losses



Source: KPMG, IEA

“In the states of Mato Gross and Tocantins, with a more efficient management process they were able to reduce power theft. However, in Rio de Janeiro things are complicated, because there are many illegal connections, not only in the slums but also in the city...”

- Survey participant -

As for companies, a few important initiatives have already been implemented, and should increase in the next few years:

- Installing much higher posts, with transmission lines above avenues to impede access
- Installing shielding on meter boxes
- District electronic monitoring equipment, in order to cross check with meters
- The installation of meters in shanty towns, with incentives for residents like identification and address, to facilitate social inclusion and the acquisition of other benefits.

In relation to technical losses, the scenario varies widely from one region to another and from one distributor to another.

- At privatized distributors, many important actions exist to avoid technical losses, like changing transformers, substation controls, and joint consumer programs to teach awareness of efficient energy use, which should continue or intensify within the next few years.
- At federal distributors, mainly in the northeast, theft and low efficiency is a major problem.
- Regarding transmission, good maintenance will be suitable, because the distances are very large and certain loss is inevitable, while technology is relatively limited in reducing losses and runs up the costs of investment.
- Furthermore, according to regulations public facilities, like hospitals, colleges, etc. do not pay for electricity.

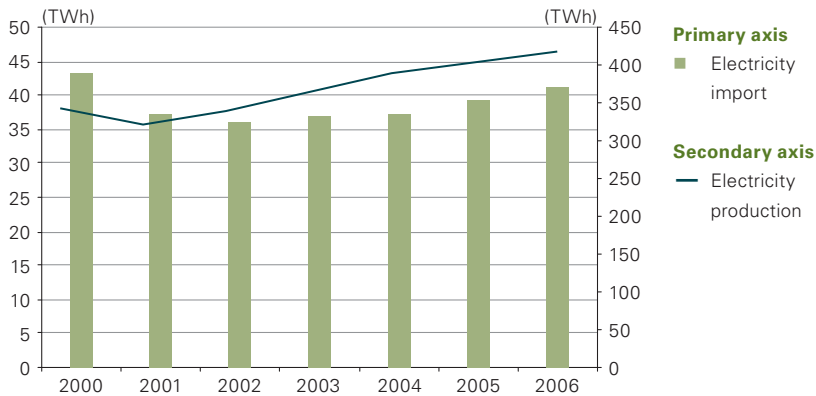
Electricity import, export

Because the total consumption of the country is currently higher than the total production reduced by the distribution losses, Brazil must import electricity, mainly from neighboring Paraguay. Figure 13 shows the country's import and export trends for electricity compared to total electricity production.

Based on the data, Brazil imported approximately 10–12 percent of the total supply between 2000 and 2006 which fluctuated between 35,987 GWh and 43,346 GWh year to year.¹⁷

It is expected that domestic electricity production will increase in a manner to nearly meet the demand and investments are planned to reduce network losses, therefore Brazil will rely on import sources less than it does currently. The forecasted level of electricity import in 2020 is around 5–6 percent of domestic production.

17 Source: International Energy Agency

Figure 13: Electricity import, export and total electricity production

Source: KPMG, IEA



4.3. Current ownership structure of the power industry of Brazil

Global know-how and best practices support the fact that decentralization and privatization lead to market liberalization and sustainable development. To allow these to happen, a supporting legislative background is required, which is one of the essential constraints of the development of a country's electricity system.

As governments are usually unable to maintain their power system in a satisfactory condition through investments, the involvement of private capital is necessary to keep the technology stream flowing into the country. This also requires regulatory support from the state.

Ownership of generation sector

State control still plays a major role in the electricity sector, although the privatization process was initiated

in the 1990s; however the process has slowed down since the electricity crisis in 2001.

Large government-controlled companies dominate the electricity sector: state-owned Eletrobrás holds about 40 percent of generation capacity, with state-companies CESP, Cemig and Copel controlling 8 percent, 7 percent and 5 percent of generation capacity respectively. The most notable exception is Gerasul, in the south of the country, which is now operated by France's GDF Suez.¹⁸

Investors were visibly reluctant due to the lack of a sound regulatory framework and due to the Government's decision in 2003. Based on this decision, the government increased regulatory control through the Ministry of Mines and Energy, rather than transferring control to the sector's semi-autonomous regulator, the Agência Nacional de Energia Elétrica, ANEEL. Investors are waiting for the clarification of some regulatory issues, especially a pricing mechanism in order to encourage private sector investments.

Organization of the transmission, distribution and trade sectors

The restructuring process took place through the privatization of distribution companies in the 1990's; with the exception of some smaller state-owned companies, transmission lines were also partly auctioned.

Private capital is likely to play a key role in the development of the transmission and distribution infrastructure due to the weak financial status of the state-owned companies.

What sort of time frame do you expect for the acceleration of the privatization process in the electricity sector?

Changes in privatization guidelines will depend on the political agenda chosen by the next Federal Administration to come into power in 2010. However, there is a consensus amongst respondents that, regardless of the outcome of the next elections, there is little prospect of any advance in privatizing as this has disappeared from the political agenda for some time now.

¹⁸ Source: Economist Intelligence Unit



"I think we will not see a privatization process, but rather an increase in private projects... It is very unlikely that a state-owned company will undergo a privatizing process in the next five years."

- Major market participant -

"I do not see any progress in this sense, and things are good enough the way they are. The auctions are going well, they're attracting foreign investments... And it cannot be said that all of the state companies are inefficient; on the contrary, there are companies like Cemig, which are very efficient."

- Survey participant -

Advancing the privatization of state-owned assets is not likely, as private capital already has stakes in transmission, in distribution and in new ventures for generation.

According to a new standard which has been practiced since 2007, all of the new ventures in the electricity sector are held by joint consortiums (private capital plus public capital).

"I would say that, in the context of the funding shortage, the best thing to do today is to use private resources to ensure expansion, rather than to privatize existing state-owned companies."

- Major market participant -

Distribution

Most of the sector has already been privatized. There is the possibility that CESP will be privatized, as previously announced by the state government of São Paulo.

"Since the private sector has achieved good results in the distribution sector, I think the most adequate model is to pass this sector over to private companies. In this case, I would consider a five-year scope for privatizing the distribution sector."

- Major market participant -

Generation and transmission

The privatization model used for new power facilities is believed to be the ideal option – a partnership between the state, holding 49 percent, and private capital, with 51 percent of total investment.

For existing plants, the trend is that the Government will maintain its current share by not privatizing any of those.

What are the expectations for the levels of public and private sector investments going into the electricity sector in the course of the next five years?

A majority of the distribution sector is already privatized. Opinions regarding the future are divided into two extremes: one group believes the remaining distributors will be privatized, while the other group thinks the situation will remain the same.

Regarding the power generation sector, the privatization model used for the new power plants is believed to be the ideal option – a partnership between the state, with 49 percent, and private capital, with 51 percent of total investment.

Private capital in hydropower plants will primarily be national capital, because of the high initial investment required and the long payback period.

Foreign capital is likely to invest more in thermal power plants, which have lower initial costs, despite their high operating costs.

For the currently existing plants, the trend is that the government will maintain its current share by not privatizing any of them.

Further supporting up the view that no acceleration of privatization is likely to occur, it is worth highlighting the case of CESP, which works under the São Paulo State Government, and whose privatization process was interrupted. It could be taken up again, but, outside of CESP, no additional privatizations are on the horizon.

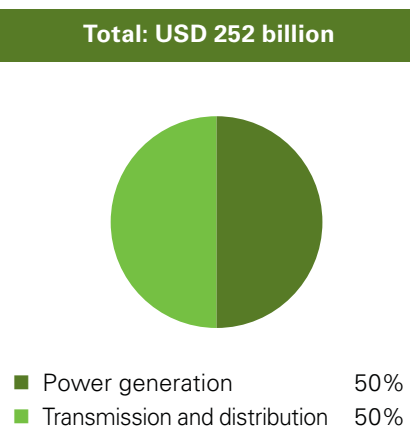
In the transmission sector, the split between private and public capital should be similar. However, the share of foreign capital should be higher in this sector because of its shorter payback period on investment.

Investment needs

The International Energy Agency has assessed the total investment needs of the sector to be USD 252 billion (2005 prices) which is divided 50/50 between the generation and transmission infrastructure of the power industry. Based on an IEA forecast, an estimated USD 10 billion per annum investment in the sector is necessary.

Programa de Aceleração do Crescimento (PAC, "Growth Acceleration Program"), launched in 2007, highlighted a massive need for investments, however it should be noted that in order to be able to attract the required level of private capital, some regulatory issues should be clarified, like for example licensing procedures.

Figure 14: Investment needs of the electricity sector up to 2030



Source: IEA

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

Power generation requires very high levels of investment, as it is a very capital-intensive sector and demand is growing. According to studies made by EPE (a power research company) of the Ministry of Mines and Energy, Brazil will require 5 GWh per year, and to fulfill that need it will be necessary to invest. The current focus is on expanding capacity at competitive cost.

The global credit crisis has created a challenge for financing generation projects.

In transmission, it is necessary to reinforce the system, to provide a more robust, reliable system, and obtain transmission flexibility, meaning solving the challenges of taking energy generated in faraway locations to where consumers reside.

"In the transmission sector, the government has already implemented a large interconnection program, because the system was not sufficiently interconnected in the past... Now, expansion has become the purpose of system development..."

- Major market participant -

The existing investment scheme in the transmission sector has been very efficient in meeting expansion needs and should also be able to meet the future needs associated with new hydroelectric power plants in the north of the country. Since 2004, there have been one or two auctions annually for transmission lines.

"Transmission models have been the most successful ones in the country. They are similar to the generation model, in which one is paid to manage an asset. The tenders that have been conducted by ANEEL and the Government have been very successful; we take part in them actively."

- Major market participant -

Specific BNDES lines with well coordinated returns exist **in distribution**, but companies still need to establish more efficient models in terms of tariffs. At a majority of the state owned distribution companies, base facilities are quite antiquated, and it will be necessary to modernize the grid and establish new technologies for measuring and control. Private distributors (who make up the great majority) are in a better position, and have been investing in new equipment and technologies.



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

The government will continue to finance the expansion of the electricity sector through BNDES which has gained greater importance in the face of the crisis.

“BNDES continues to play an essential financing role in the sector, and once the guarantee fund is approved, which will be a substantial source of support, we will be on the right track for the coming years.”

- Major market participant -

Currently, the Government provides funding for distribution and transmission areas, participating as a minority investor in all major projects. Its participation is very important as its role is to promote development and define public policies.

“The State has been fundamental; without it, and considering the credit crisis, these large projects would not have gotten off the ground in the past year. It was the State, through BNDES and state companies, which managed to maintain the scheduled investments. Nowadays private capital is no longer able to raise capital alone and, if you do not have a state company on board, you will not be able to operate.”

- Survey participant -

However, the Government is likely to participate less in the next five years, as large power plants will have a smaller share of total supply.

A public and private partnership system should be maintained in much the same way. As of 2007 the standard has been concessions, offered in auctions through mixed consortiums, with the presence of state and private capital.

This standard has contributed to maintaining the level of investments and to the efficiency of the system.

In the next five years, the role of the State will continue to be fundamental. BNDES has sufficient credit lines available (for long-term projects, long lines of credit are necessary), which are not available at banks.

“For example, BNDES has made an extraordinary line available to the Madeira region, with 25 years of financing.”

- Survey participant -

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

The financial crisis has affected Brazil. Nevertheless, a slowing of the economy and in the growth of the electricity sector could be an advantage from a security of supply point of view. As electricity demand has been growing at a faster pace, with which supply could not keep up, for decades, the crisis has given time to Brazil to prepare its regulatory, financial and general structural conditions for anticipated growth of both the economy and electricity demand.

In general, Brazil is in a good position despite the fact that the global crisis has affected the country. Its course of growth is expected to reach the same level as before the crisis within a short period of time.

What are the expected effects of the global financial turmoil on Brazil’s electricity market in the next five years?

The country was in very good shape when the crisis broke out. The amount of its debt is low because times have been good. Therefore, growth rates are not expected to drop significantly in any sector, except for a slight contraction in industry.

"The crisis hit us when we were in a very favorable position, enabling us to weather it without major problems. The only challenge is achieving growth. If the economy begins to grow again, we will have to build new power plants which will require financing."

- Survey participant -

In the electricity sector specifically, the crisis has had the positive effect of delaying an emerging electricity shortage. The slight drop in demand should mean more time to build and/or expand power plants.

Unless there is a major credit crunch, which has not occurred until now, not allowing BNDES to continue financing projects, investments are being extended over the next five years at lower financing costs, a trend which should also attract foreign investors already present in the country or who are committed to investing in Brazil.

The greatest difficulty brought about by the crisis is maintaining the sector's growth. The credit crunch has hindered the expansion of the network and the construction of new power plants.

BNDES has been a major player in financing the sector's expansion, but lack of foreign investment and private capital will delay the development of the sector.

"... In today's economic environment, we will see companies that are not going to be able to make it through this period. It is a matter of liquidity... So for the next five years, I believe that whoever survives this crisis will be in a good position."

- Survey participant -

If Petrobras invests in a natural gas program, it is likely to generate a boom of new investments, due to the country's abundant natural gas.

If Petrobras for some reason postpones investments, 2009 and 2010 will show slow, creeping progress and growth in 2011 and 2012 will be affected.

"Until now, what we have seen is more along the lines of the first scenario. The crisis has had a strong impact, but Petrobras is signaling that it has money for this year, and the State is providing firm backing to their program."

- Survey participant -

Regulatory climate

The regulatory framework of the electricity sector in Brazil is considered to be the most developed among the BRIC countries. In order to achieve an efficient market, competition should be open among the market participants and Brazil is far ahead in regard to privatization in the developing world. The remaining challenges of the energy strategy stabilizing the regulatory rules, hastening licensing issues and creating a more reasonable pricing mechanism in order to attract more investments into the electricity infrastructure.

What are the top priorities of the Regulatory Agency for the next five years?

After many years, the role of regulatory agencies has been clarified: they regulate, mediate and supervise the sector. It is now fundamental not to create new regulation but to make what already exists useful, facilitating the correction and the application of those rules, to create secure conditions for those who want to invest.

"Rules have changed drastically in the last few years, creating uncertainty for investors. This uncertainty increases risks and increased risks lead to higher tariffs..."

- Major market participant -

The regulator's main priorities for the next five years include:

- Maintaining stable rules, as they have been the object of many changes in recent years, increasing investment risks
- Enforcing current rules and regulations and supervise the observance of contracts
- Making impartial and transparent decisions and set clear guidelines, to ensure reasonable and attractive yields for investors and stimulate participation from the private sector
- Increasing tariff parity between the private and public sector
- Supervising distributors, readjust tariffs and put pressure on distributors to benefit consumers, even to reach those who do not have access to electricity

- Stimulating efficient energy programs, giving incentives for the generation of clean energy
- Making licensing processes easier for generation projects
- Researching the new Brazilian power grid, drafting a strategic energy plan in advance, resolving local differences towards an overall national scenario
- Regularly organizing and stimulating acquisitions in regulated auctions.

In relation to auctions, the regulator should characterize them according to the source of energy; currently all types of energy are subject to the same auction, even if those sources have extremely differentiated costs like, for example, hydro and wind do, something which discourages most investors.

Respondents indicated as another top issue concerning regulation the pricing and tariff structure setting of electricity. Policies should increase tariff parity between the private and public sectors and should create mechanisms to reduce electric power costs and end-user prices.

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

The tariff system is very complex in Brazil because of the high level of social inequality, which the electric power tariff structure takes into account.

“The subsidy should continue. We are in a political phase of increasing social inclusion. And inclusion is brought about through various things, one of which is access to basic infrastructure, where one of the priorities is energy. So households having electric lighting is something the State supports... Lower tariffs can also contribute to social inclusion.”

- Survey participant -

In Brazil, the regulatory agency does not create subsidies or taxes, it only applies the law. According to ANEEL, there is a commitment to modernizing the tariff structure, which is scheduled to undergo the reform process by the end of 2010.

Most respondents of the survey agreed with the intentions of the regulatory agency, which has gradually eliminated cross-subsidies and is shifting towards cost-based tariffs:

- Subsidies for low-income and rural populations should continue, but for other consumers, subsidies are continuously being removed.
- Some consider that this change will take time to be completed because of the need to update technology – especially to replace analogue meters with digital meters, making it possible to automate and differentiate tariffs for different parts of the day.
- Tariffs tend to increase slightly because of taxes. Several resolutions of the federal government have yet to pass. One possibility mentioned is the introduction of a subsidy to foster sector development lines, for example, in the area of renewable energy (solar).

- According to a respondent, ANEEL’s main objective in this area is to eliminate subsidized thermal power generation (the cost of which is shared by all the distributors) and to find a balance with a tariff that will not discourage investment.

- There is an intent to channel the funds assigned to burning fuel oil, collected by the CCC account (funds used to cover the costs of using fossil fuels), towards investments in other forms of power generation to reduce tariffs in the future.

“A large number of cross-subsidies have already been eliminated... even as a result of legal provisions that have been in place since 2002 and that had deadlines set in 2007/2008... There are still some subsidies left for the low-income consumer, for rural electrification. Those are still in place. But most of them have been eliminated.”

- Major market participant -

“Things are being changed so that in five years’ time the tariff will actually reflect power costs overall. We have even noticed that pricing in tenders, which is defined by EPE and ANEEL, increasingly reflects this....”

- Major market participant -



Environmental concerns

Concerns over climate change, sustainable development and atmospheric pollutants have focused the international community's attention on possible measures to address these threats. One of the most important international treaties was the Kyoto Protocol¹⁹ which came into force in 2005.

Brazil has ratified the treaty as a "non-Annex I" country, meaning that it has agreed on efforts for the reduction of green house gas emissions (GHG) but has not set emissions reduction targets. Brazil is one of the main beneficiaries of the project based emission reduction mechanism, namely 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 emissions reductions in a more cost effective way.

Examining the environmental situation in Brazil, GHG emissions are not an urgent issue yet since the generation mix is highly dependent on hydropower. However, considering the situation in the long term due to the increasing share of fossil fuel reliant power plants, Brazil can not avoid facing the problem of emissions.

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

There are many projects being developed and implemented to increase efficiency and savings in the use of electricity, but the impact of such projects is still small.

High profile initiatives include:

Companies operating in the energy sector must invest 1 percent of their revenues in research and development projects, many of which are targeted at increasing efficiency in electric power consumption.

The federal government, together with municipalities, Electrobrás and ANEEL, has several projects in place to increase the efficiency of the population's use of electricity:

- *The federal government is sponsoring the purchase of more economical light bulbs to replace old ones.*
- *CEMIG has a project offering incentives to replace electric boilers with solar water heaters.*
- *Cities have replaced mercury lamps with sodium vapor models for municipal lighting.*
- *Fiscal incentives for the production of energy saving refrigerators, as well as financing for consumers to purchase such items are also available.*

According to the regulator the solution to increasing efficiency is to reduce consumption. To achieve this, energy efficiency programs are being planned:

- *Electricity price structure to encourage consumers to reduce usage, especially for the industrial and power-intensive sectors, with prices varying according to level of consumption*

¹⁹ The Kyoto Protocol is a set of rules to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), an international environmental treaty which was produced with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" The Kyoto Protocol establishes legally binding commitments for the reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride), and two groups of gases (hydrofluorocarbons and perfluorocarbons) produced by "Annex I" (industrialized) nations, as well as general commitments for all member countries. As of January 2009, 183 parties have ratified the protocol, which was initially to have been adopted for use on 11 December 1997 in Kyoto, Japan and which entered into force on 16 February 2005. Under Kyoto, industrialized countries agreed to reduce their collective GHG emissions by 5.2 percent compared to the year 1990. National limitations range from 8 percent reductions for the European Union and some others to 7 percent for the United States, 6 percent for Japan, and 0 percent for Russia. In the non-binding "Washington Declaration" agreed on 16 February 2007, Heads of governments from Canada, France, Germany, Italy, Japan, Russia, United Kingdom, the United States, Brazil, China, India, Mexico and South Africa agreed in principle on the outline of a successor to the Kyoto Protocol. They envisage a global cap-and-trade system that would apply to both industrialized nations and developing countries, and hoped that this would be in place by 2009.

- Replacing 1 million old refrigerators per year over the next 10 years, (including those of the middle class) with new energy-saving models (up to 45 percent energy savings)

continue at enterprises, mainly those that do not require large investments, like the use of waste to generate energy for internal utilization, the quest to achieve greater energy efficiency within businesses, or the reduction of losses.

thermal power plant that runs on diesel oil or other oil fuels and produces greenhouse gas emissions, than to build a hydroelectric power plant.

- Major market participant -
 - Educational campaigns on the conscious use of energy, emphasizing energy savings during the months when energy costs are higher

“Perhaps in 2013 or 2014 we will begin to see investments in this direction, for energy efficiency, as we call it. Perhaps within a 10 year scope, this will represent savings, but not in the short term.”

- Survey participant -

This situation is changing, as society is reflecting on how to prevent the Brazilian energy matrix from becoming fossil fuel dependent. Concessions for the Jirau and Santo Antonio hydropower plants in the Amazonia is a sign that the country is beginning to give priority to the construction of less polluting, although less productive, power plants.
 - Incentives for the production of energy saving technologies and equipment

What are the effects of health, climate change and environmental issues/concerns on the current and planned power generation portfolio?

- Major market participant -
 - Research and development of less polluting and more efficient energy, such as projects to install solar panels for heating water.

The Brazilian energy matrix is 43.8 percent clean, compared with an average of 13.6 percent in developed countries and 8 percent in the United States. About 90 percent of electric power is produced from renewable sources, which is noteworthy.

“Nowadays, the trend is to build hydroelectric power plants with smaller reservoirs: a “smaller lake area”. This is a trend that should continue...”

- Major market participant -
 - PROCEL (National Program of Electric Power Conservation)²⁰ – federal energy saving program, coordinated by the Ministry of Mines and Energy and executed by Eletrobrás, which has become a popular brand in Brazil, visible on seals used to indicate energy saving consumer goods.

Since 2005, the major challenge for the Brazilian electricity sector has been the deployment of power generation plants that comply with national environmental standards. The requirements for receiving environmental permits are extremely rigorous, generating distortions in the Brazilian system which favors the construction of polluting power plants, creating the risk of a dramatic increase in CO₂ emissions.

Currently, the institutions financing projects are banks that have signed the “Equator Principles”, a series of environmental rules that, if not fulfilled, impede financiers from taking part in a project.

How strong is Brazil’s commitment to fostering a carbon-sensitive economy over the next five years?

Brazil is one of the countries which has signed the Kyoto Protocol, demonstrating the growing political commitment to environmental protection by reducing greenhouse gas emissions. This commitment is changing the profile of the supply side rendering it compliant with environmental requirements.
- “We want consumers to be able to reduce their demand every time prices go up – and they only go up when thermal power is used. If you reduce demand, you do not use thermal, so you have low prices for everybody. This is the price structure that we intend to implement for the industry...”*
- Survey participant -
- As for the next five years, respondents believe in the continuance and growth of existing initiatives. Initiatives presently underway should also
- “Today we have a strange situation in the country. It is much easier to get environmental approval to build a*

20 National Electrical Energy Conservation Programme (PROCEL) Administrative Directive no. 1877. Policy to combat waste in the production and use of electrical energy. Measures include: Consumption labelling to inform consumers, influence purchasing decisions and induce manufacturers to make efficient products; energy diagnostics/audits to assess energy use and efficiency; supporting R&D of efficient technologies/products; marketing to strengthen the PROCEL trademark; replacing incandescent lamps in public lighting with mercury vapour and high pressure sodium vapour lamps that consume 75 percent less energy; promoting efficient lighting and appliances in government and residential buildings; measures to reduce losses in electrical system; actions to reduce electricity demand during peak hours; offering training courses, seminars, and conferences to industrial and commercial consumers, concession-holder staff and public organisations to combat energy waste. PROCEL also helps utilities obtain low-interest financing for major energy efficiency projects from a revolving loan fund. Source: <http://projects.wri.org/sd-pams-database/brazil/national-electrical-energy-conservation-program-procel>

However, most respondents believe that concrete actions to develop a low carbon economy would require a long period of implementation in Brazil and they do not foresee significant steps being taken in the next five years.

"It is still cautious... I think that the State is being sensible but it is not doing much, and it will not do much in the next few years..."

- Survey participant -

This may be because the Brazilian power grid is fundamentally clean and renewable and, therefore, no official compromise on a low carbon emissions economy has been reached.

However some significant initiatives have been achieved:

- *Biomass power plants already sell power and are eligible for carbon credits, attracting investments*
- *The transportation sector has replaced half of its fleet with bio fuel vehicles*
- *Investors in the electricity sector are trying to certify their projects to be able to sell carbon credits.*

In relation to regulating carbon, according to respondents there is a lack of clear regulation that encourages such practices, not just in Brazil but globally, and the movement that already exists in the country, in this sense, has been spearheaded by foreign companies.

"The entire gas generation arising from the São João garbage landfill was bought by a Dutch company, which is trading those credits in Europe!"

- Survey participant -



Key challenges

It can be stated that Brazil is in a stable position in regard to its economy and electricity market, though it is vital to maintain its regulatory stability and to further improve its energy policy in order to be able to keep up with the expected demand growth. Based on the analysis conducted, the most important challenges determining the long term development of the country are connected to skills development, regulatory effectiveness, and the ensuring of further investments.

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

Respondents do believe that Brazil is in a comfortable position regarding its labor force for the electricity sector, as there is enough availability and expertise to meet demand in the coming years.

However, if the country had continued to grow as it did before the crisis, specialized labor might have been lacking.

Skills and competencies are especially high in the hydroelectric sector. The country has developed the technology, which does not change much, and higher educational courses are developing adequate labor resources. To back up this belief, respondents pointed out that all the country's major projects have been conducted by Brazilian constructors like Camargo Corrêa and Odebrecht, not only in Brazil but abroad as well, with substantial help from Brazilian labor, in terms of construction as well as in operations.

Considering that the experienced labor force is getting older, companies have started training younger employees in-house, which is a process that takes a few years. Investment in specialized education, and importation of labor from other countries, however, are needed, especially for areas like nuclear energy, where domestic expertise is lacking, and therefore still relies on foreign labor and technology.

What are some possible approaches for Brazil 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?

The next five years will be a period of substantial development. Suppliers will have to make investments to meet the demand in all three areas – generation, transmission and distribution – paying particular attention to the following:

- In the power generation sector, installed capacity should be expanded and improved. Foreign suppliers will play an important role in expanding the installed capacity of the industry, especially in supplying components for non-hydropower facilities.
- Distribution will demand new technologies as well as measuring and control equipment, which will be supplied by national and foreign companies.
- The expansion of transmission lines will also require components which are currently supplied by multinational companies established in Brazil, a situation that will continue.

“Demand growth in itself is a very good incentive to fuel investments in this area. The electricity sector is growing steadily, providing equipment and material manufacturers a trend that is easy to foresee. Therefore, the decision-making process is somewhat easier.”

- Major market participant -

Brazil supplies equipment to the entire **hydropower generation** sector. There are numerous suppliers established in Brazil.

“Itaipu has the largest turbines and generators in the world: 700 megawatts each, assembled in São Paulo. The turbine is manufactured by Voith and the generator by Siemens. The Siemens generator factory in Brazil is much larger than the one in Germany, and Voith’s

facility in Brazil is much larger than in Switzerland.”

- Survey participant -

With respect to equipment for **wind power generation**, the country does not yet have the required technology and depends on foreign suppliers.

Some technology transfer has also occurred for **nuclear power**, as there are factories in Brazil supplying equipment. However Brazil, still relies on imported nuclear technology.

What are the highest profile issues that will bear the most influence upon the future of the electricity sector? What factors will determine the next five years of the sector?

During the course of the next five years, major developments in the power sector will be driven by the following issues:

- Evolution of economic growth, rebounding to the former level of investments in the sector
- Meeting growing domestic energy demand (investments in generation and transmission)
- Availability of funds to carry out the required expansion projects
- Development of sustainable ways of expanding the sector, driven by environmental and social issues
- Seeking regulatory stability via standardization of concessions, increasing their attractiveness for private investors; auctions specific to the type of energy
- Redefining tax loads and tariff policies.

“What will be important in the next five years is growth in demand. This will determine major energy sector decisions for the future.”

- Major market participant -

For Brazil’s regulatory agencies, the determining factor in the next five years will be the ability to expand supply in a timely manner. This will entail:

- Developing the sector in compliance with environmental requirements and ensuring a place for renewable power in the energy matrix
- Encouraging a more rational use of power, by acting on the demand side
- Offering power at lower costs.

This requires action in the three segments of the supply chain:

- Production, with cheaper power plants
- Transportation, with increased efficiency
- Distribution, implementing legal and tax changes to reduce labor charges and taxes currently paid by consumers.

Respondents believe that the global credit crunch has provided Brazil with a necessary breather, to better adjust and organize its sector.

“I think that one can conclude that there is optimism in the sector, which has growing needs but also bears an adequate model for its sustainability.”

- Major market participant -

5. Investment Opportunities

As previously described, 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 main results of our assessment of the Brazilian power sector are outlined in the following chart.



Macro-economic trends

- Electricity consumption is predicted to grow continuously over the next five years despite the global crisis.
- The electricity sector is a top priority in the political agenda and in government programs targeted at expanding the sector and eradicating exclusion from access to electricity in the next 2–3 years.
- Regulatory instability exists in the electricity sector: compliance with rules is not absolute, they change frequently and some issues have not been addressed through.
- A strong and growing domestic market, in all regions of the country.
- Inflation is under control and prices are stable.

Investment characteristics

- Available credit from the National Economic and Social Development Bank (BNDES) to finance the electric power sector.
- Taxing mechanisms (resulting in reduced tariffs for the end-user) which should undergo changes soon and may negatively impact return on investment.
- Possibility of cross-subsidies being maintained over the next five years.
- Good investment opportunities for private ventures in all the links of the supply chain – power generation, transmission and distribution.
- Opportunities in power generation, because of the deployment of SHPs, which should increase more than the two times their installed capacity over the next five years, besides the planned changes in regulation to favor return on investment.
- Prospects for distribution, because of investments in technology and mechanisms to reduce losses, such as remote metering and control systems to identify power outages and defects in the network.
- Possibilities in transmission, because of new large hydro plants already approved and scheduled to begin operating within the next five years.

Market factors

- Obstacles and costs of the environmental approval process for electricity sector projects.
- A large volume of unexploited water resources in the country.
- Specialized know-how and technology in the electricity sector, especially regarding hydropower. However the alternative power sources sector (wind, nuclear power), which is still in a stage of infancy in Brazil, lacks specialized labor.
- Environmental legislation and resistance from civil society against certain electricity projects.
- Intent to reduce cross-subsidies in the electricity sector.

Acronyms

ANEEL²¹ – Brazilian Electricity Regulatory Agency

ANEEL was founded in 1996. It is a special regime agency linked to the Ministry of Mines and Energy and its mission is to provide favorable conditions for the electricity market to develop in a balanced environment amongst varying interests, for the benefit of society.

BRIC – Brazil, Russia, India and China

BNDES²² – National Economic and Social Development Bank

The Brazilian Development Bank (BNDES) is a federal public company linked to the Ministry of Development, Industry and Foreign Trade (MDIC). Its goal is to provide long-term financing aimed at enhancing Brazil's development, and, therefore, improving the competitiveness of the Brazilian economy and the standard of living of the Brazilian population.

CAGR – Compound Annual Growth Rate

CEMIG – Companhia Energética de Minas Gerais

Companhia Energética de Minas Gerais – CEMIG is one of the largest and most important electric energy utilities in Brazil due to its strategic location, its technical expertise and its market. CEMIG's concession area extends throughout nearly 96.7 percent of the State of Minas Gerais, whose territory is situated in the southeastern region of Brazil

CESP – Companhia Energética de Sao Paolo

CESP is the largest power generation company in São Paulo state in terms of output volume, according to State Energy, Water Resources and Sanitation Department figures for 2006, and the third largest in Brazil, according to ANEEL, the Brazilian Electricity Regulatory Agency. CESP has six hydroelectric plants, 57 generating units, an installed capacity of 7,456 MW and assured power of 3,916 MW (on average), representing 8 percent and 10 percent of the national total, respectively.

CDM – Clean Development Mechanism

CNPE – The National Council for Energy Policies

CMSE – Electricity Industry Monitoring Committee

COPEL²³ – Companhia Paranaense de Energia

Companhia Paranaense de Energia, the largest company of the State of Paraná, was founded in 1954 with ownership control held by the State of Paraná. The Company went public in April 1994 (Bovespa) and, in 1997, it was the first company within the Brazilian electricity sector to be listed on the New York Stock Exchange.

FDI – Foreign Direct Investment

GDP – Gross Domestic Product

GHG – Greenhouse Gas

IEA – International Energy Agency

ONS – Operador Nacional do Sistema Elétrico /Operator of the National Electricity System

PPP – Purchasing Power Parity

SME – Small and Medium-sized Enterprise

TOE – Ton of Oil Equivalent

UNFCCC – United Nations Framework Convention on Climate Change

WEC – World Energy Council

21 Source: <http://www.aneel.gov.br/areaPerfil.cfm?idPerfil=9>

22 Source: <http://inter.bnides.gov.br/english/thecompany.asp>

23 Source: <http://www.copel.com/hpcopel/english/nivel2.jsp?endereco=%2Fhpcopel%2Fenglish%2Fpagcopel2.nsf%2Fdocs%2F87A2F4B44EE7EC82032574AD00596C10>

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.

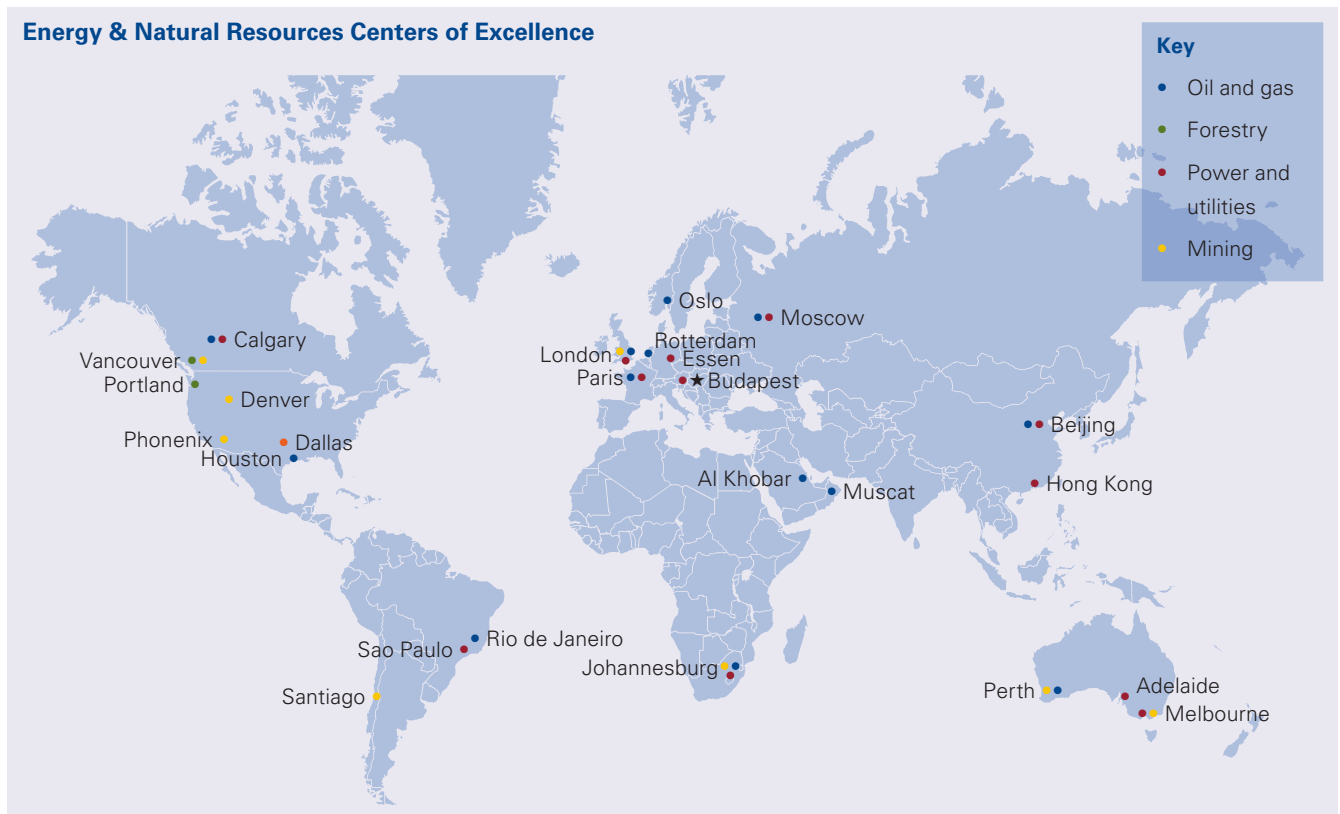
KPMG's Global ENR practice is organized through a global leadership team aligned with member firms' ENR practices. The global leadership team focuses on our strategic framework, reputation and performance, supported

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

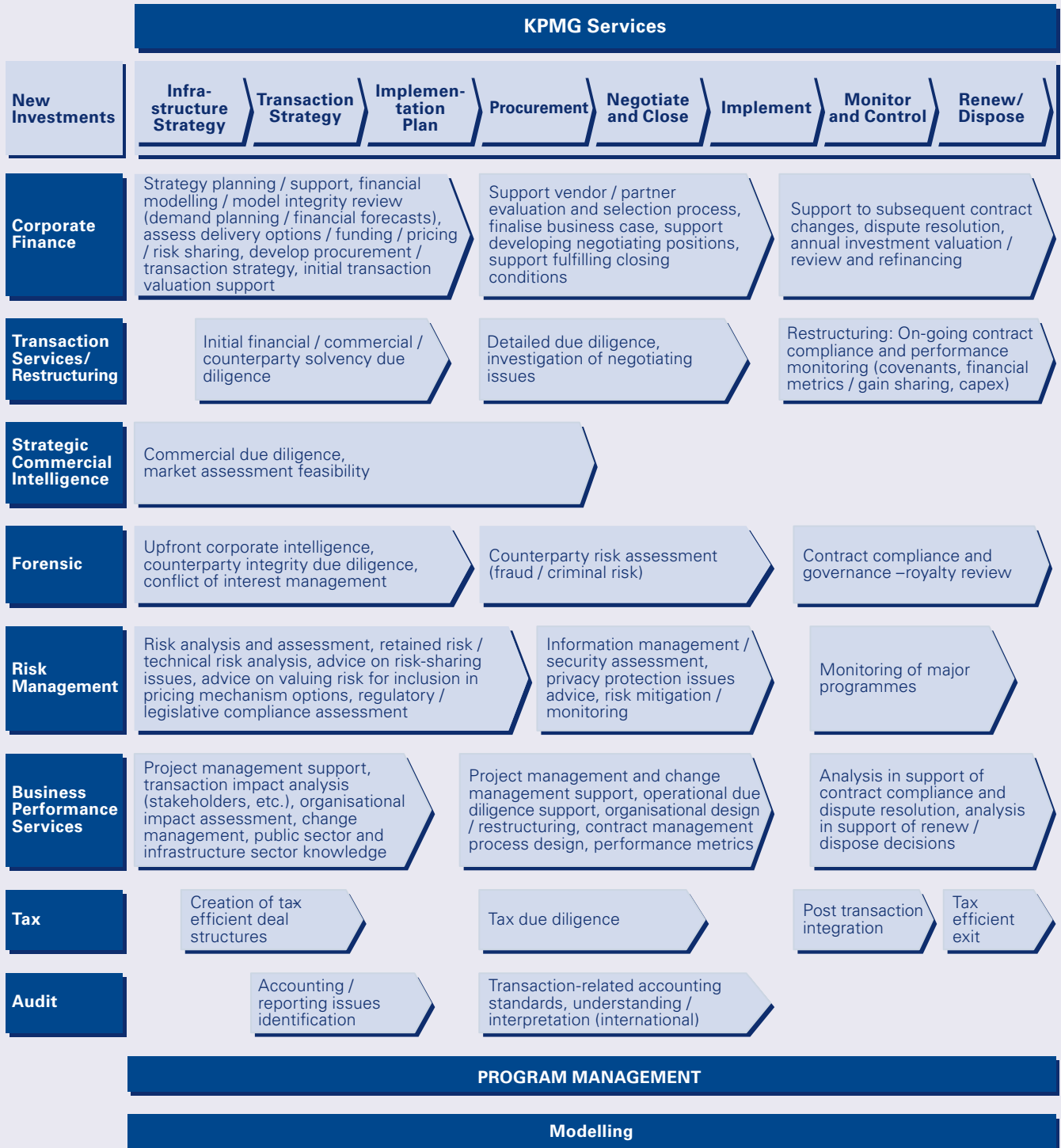
The Power & Utilities market has been developing at an extremely rapid pace globally in recent years. This fast development is characterized by large scale infrastructure projects that require a global base of experience and a high level of specialized industry knowledge.

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

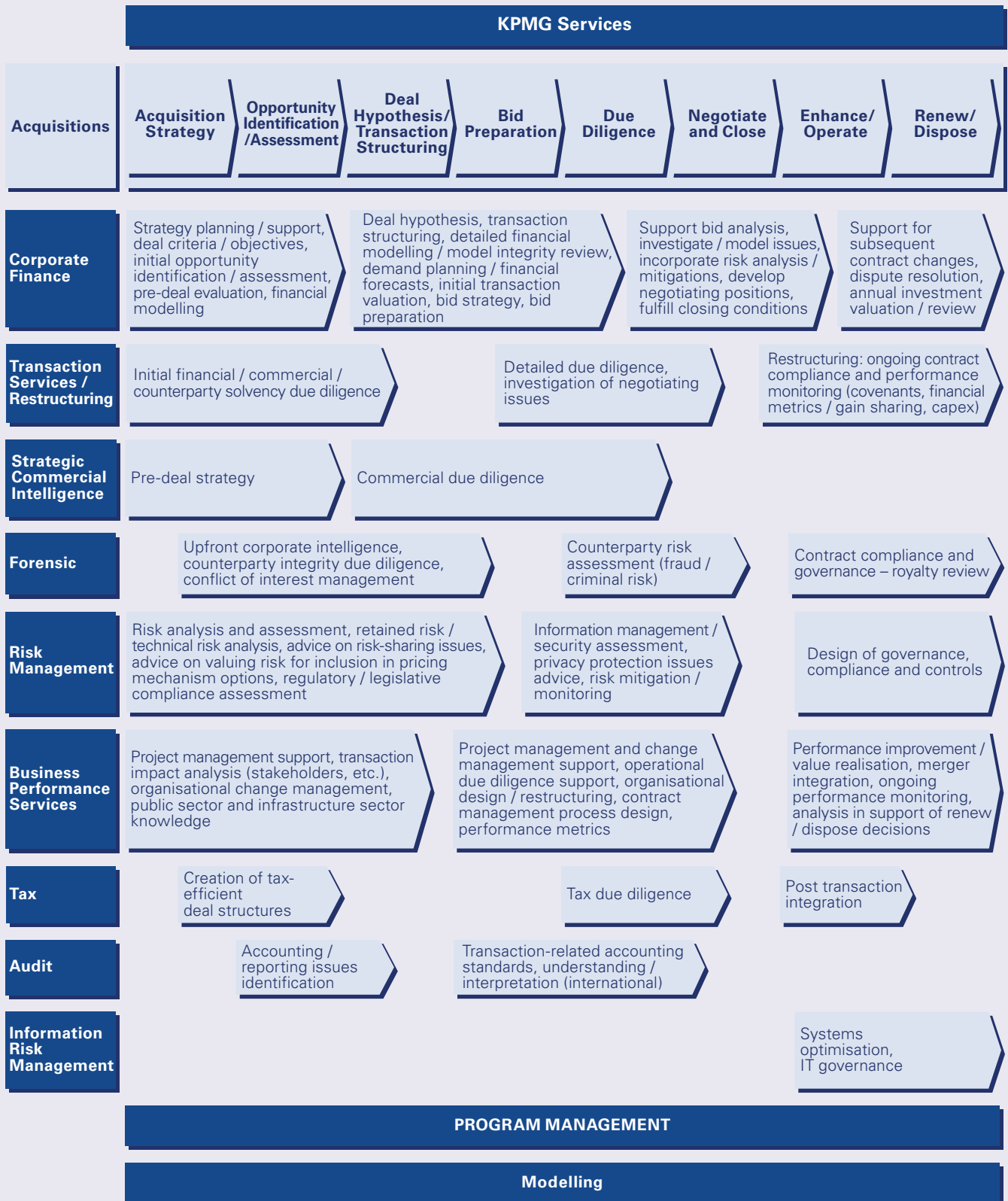
Centers of Excellence (CoE) across the globe that are best suited to providing professional advice and support that addresses clients' strategic and transactional activities.



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:

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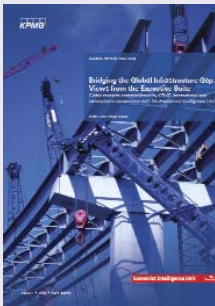
China's Energy Sector – A Clearer View

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



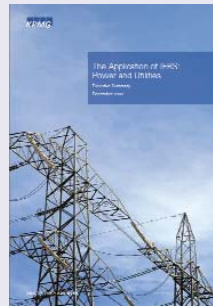
Central and Eastern European Nuclear Energy Outlook

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.

For more information about the GEI, please e-mail us at 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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