

ENERGY

ELECTRICITY REGULATIONS NEED TO BE RECHARGED

Solange Monteiro, Rio de Janeiro

Brazil's growth over the next decade will depend on ensuring more electric energy at more competitive rates.

This decade holds great promise for Brazil: the Brazilian Institute of Economics of Getulio Vargas Foundation (IBRE-FGV) says that 5% growth in gross domestic product (GDP) will by 2020 increase national GDP to US$5.4 trillion and raise per capita income to US$15,000. But increased industrial activity and residential consumption will also push up electricity demand by 69%. By 2020 the government therefore wants to add 70 GW in generation capacity and install 36,800 km of transmission lines, which will require a US$120 billion investment.

Yet although projected economic growth would be almost double the growth Brazil recorded during the past decade — and higher than is estimated for most European, Asian, and American countries — it could be even greater if there was a decisive change in how the electricity sector operates. For instance, electricity rates could be more competitive than they are if taxes and fees charged as part of the electric bill were cut.

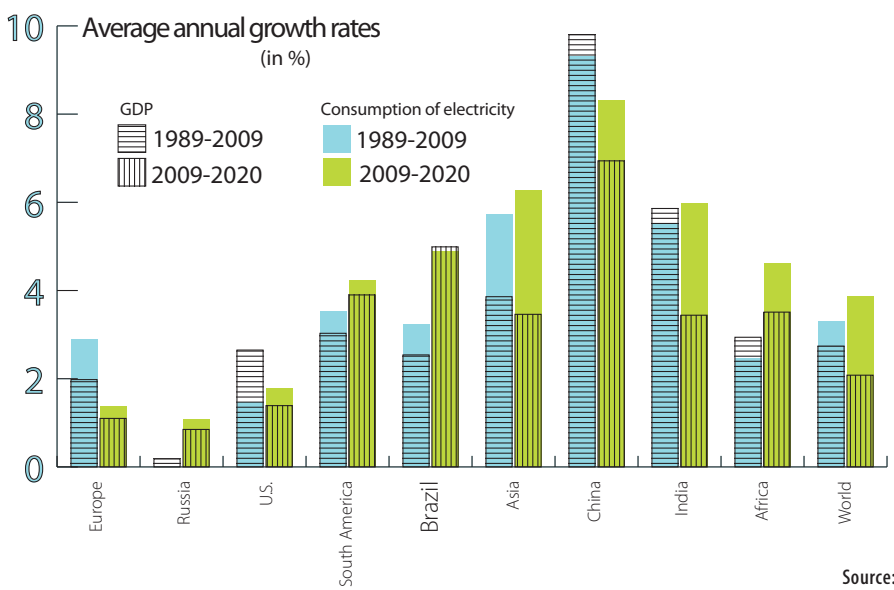
A study by FGV Projetos and the Brazilian Association of Major Power Consumers and Free Consumers (Abrace) found that reducing or eliminating such charges could add 0.92% to GDP through 2020 (US$318 billion). Also rising would be per capita income and exports, which could create four million jobs. For basic industries that depend on intensive use of electricity, such a revision means not just growth but survival itself, because today taxes and charges can represent up to half the costs of the energy they consume, undermining their competitiveness. "Failure to change current conditions could mean de-industrialization," says Fernando Garcia, a professor at the FGV School of Business Administration of Sao Paulo (EAESP) who was lead researcher on the project.

Thus, the planned new energy generation projects will not be enough to ensure a sustainable expansion if the Rousseff administration does not review the pricing of energy and consider modernizing the system.

THE GREAT EXPANSION

To reach production of 656,981 Twh by 2020, the government has signaled a willingness not just to unlock large hydroelectric projects but also to encourage energy diversification, taking full advantage of Brazil's potential for producing clean energy. Although there many questions about the means, analysts and industry players are unanimous in endorsing the goal: directing all efforts to meet the challenge of increased demand. "We have to double the supply that we

MORE GROWTH, MORE ELECTRIC POWER CONSUMPTION



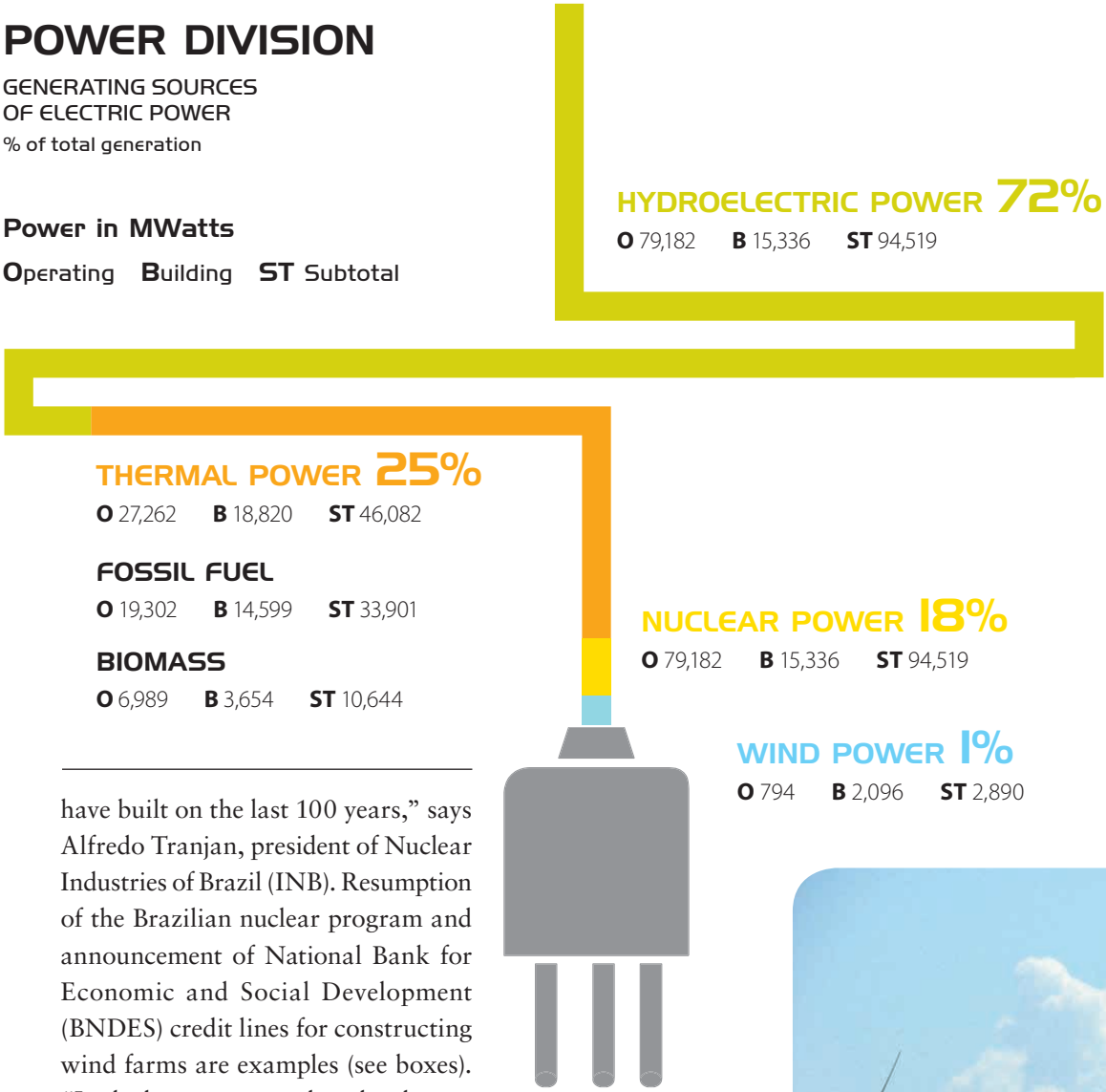
Source: FGV Projetos.

POWER DIVISION

GENERATING SOURCES
OF ELECTRIC POWER
% of total generation

Power in MWatts

Operating **B**uilding **ST** Subtotal



Sources: National Agency of Electric Energy (ANEEL) and Institute of Applied Economic Research (IPEA).

have built on the last 100 years," says Alfredo Tranjan, president of Nuclear Industries of Brazil (INB). Resumption of the Brazilian nuclear program and announcement of National Bank for Economic and Social Development (BNDES) credit lines for constructing wind farms are examples (see boxes). "In the last two years there has been a remarkable development of wind energy and cogeneration[1] with biogases — key initiatives [when] mega hydroelectric projects have become too costly," says José Goldemberg, a physicist at the Institute of Electrotechnics and Energy of the University of São Paulo (USP) and former São Paulo State Secretary of Environment. "We also need to make better use of natural gas, which we will have in abundance with the exploitation of deep sea oil; bring on line thermal power plants; and stimulate cogeneration with gas," says Adriano Pires, director of the Brazilian Center for Infrastructure (CBIE).



Even with the push for diversification, half the increase in power generation through 2020 is still concentrated in hydroelectric projects, mainly in Pará and Mato Grosso states. "I think the government is encouraging wind and nuclear energy to minimize resistance to the exploitation of the hydropower potential of the Amazon region; that's where you can keep electricity rates low," says Professor Edmar de Almeida of the Group for Energy Economics at the Federal University of Rio de Janeiro (UFRJ).

The most prominent, and controversial, project is Belo Monte on the Xingu River, which may become the last mega-hydroelectric project in the country; it will generate about 11 million MW. Although the environmental license was approved in February 2010, the government is still fighting legal injunctions that have prevented construction start-up. "Every big project ends up like this," José Antonio Muniz Lopes, then president of Eletrobrás, said last February. "What is overlooked is that, besides bringing benefits to Brazil as a whole, [Belo Monte] will benefit the region because it will pay US$2 billion in social and environmental compensation, which will ensure sustainable development there."

MULTIPLYING WIND

Increase in wind electric power

	GWatts	
2010	0,7	0,6 of total
2011	1,4	0,6 of total
2012	3,2	0,6 of total
2013	5,2	0,6 of total

Source: PSR Consultoria.

Favorable wind

Kalinka Iaquinta, Rio de Janeiro



Once considered expensive, today wind is already among the most competitive ways to generate electricity in Brazil: the average price in a recent auction was R$141 MWh, virtually the same as thermal plants (R$140 to R$150 MWh). "The price is behind only hydroelectric plants, which are still the cheapest source we have," says Mauricio Tolmasquim, president of the Empresa de Pesquisa Energetica (Company of Energy Research, EPE).

This has encouraged expansion. In 2003 Brazil had only 22 MW of wind power capacity. With the three auctions held in 2010, the number should rise to about 5,200 MW, according to Ricardo Simões, president of the Association of Wind Energy (ABEEólica). An EPE survey forecasts that by 2019 wind power production in Brazil will grow 320%.

Several factors have contributed to the increased attractiveness of wind energy. One is a change in the auction format, which since 2009 has adopted a contract for the band, leaving investors less vulnerable to wind uncertainty. "Before, when there was more wind, revenue increased, and when there was less, revenue declined, which could create a cash flow problem for investors paying down loans," Tolmasquim says. Now, instead of an annual volume requirement, a percentage is measured every four years. Tolmasquim points out, "When a wind park generates more, it's like inventorying wind — a credit to be used when it generates less."

Target — Changes in auctions, higher credit lines, an appreciated exchange rate, and the fall in U.S. and European demand for wind turbine equipment due to the economic crisis has made Brazil attractive to wind turbine investors and manufacturers. Richard Rose, director of the Department of Environment, Renewable Energy and Energy Efficiency of the Brazil-Germany Chamber of Commerce, believes that with more regular auctions Brazil's wind farms will increase considerably.

"Unlike Europe and the United States, where wind power was heavily subsidized, wind energy in Brazil is not a burden on the consumer or the Treasury," Tolmasquim says. Moreover, winds here are stronger than those that blow in the north. In Europe, the capacity factor — the ratio of power generation to installed capacity — is 25%–30%. In Brazil it is above 40%, since the winds here are not only stronger but also more consistent. "This means that with less capacity much more energy can be generated," says Simões, resulting in a lower cost per kilowatt-hour.

The potential is such that ABEEólica wants to create a Center for Research and Technology in Wind Energy and a field test for wind generators. "We want to discuss with the Ministry of Science and Technology where would be the best place for these facilities. The idea is that, as we already dominate in ethanol, we can dominate in wind power," Simões says.

Not only does expansion offer new job opportunities, Simões notes, he also recommends that wind farms be installed mainly in poor areas, as in the Northeast: "Since the royalties are paid directly to the owners of the land and wind farming does not interfere with other activities like livestock and agriculture, they help increase income and property values."

According to Professor Almeida, cases like Belo Monte are the result of two problems that Brazil must resolve: failure to define how much environmental impact we are prepared to accept, and a lack of political leadership and legal framework that leaves projects to the mercy of the courts.

THE TASK OF REDUCING TAXES

Moreover, "the electricity sector is old," says the CBIE's Pires. "In marketing, we still sell electric energy as being generated by large hydroelectric power plants. We need to change the rules to include new sources without increasing electricity rates." How to do this? Pires answers, "We have to stop thinking of the electric energy sector as a tax revenue resource and see it as fundamental for the country's development."

Today, according to the International Energy Agency (IEA), Brazil's electricity rate, US$180 per MWh, is the world's third most expensive, behind only Italy and Slovakia. Garcia, who has monitored electricity rates since 2002, confirms that rates are escalating, especially for industry: "To face the energy crisis in 2002, the government implemented rationing by price, which increased the cost for industry and decreased it

The future of natural gas

Kalinka Iaquinta, Rio de Janeiro

The discovery of deep sea oil, which contains natural gas, should stimulate Brazil to clearly define what role gas can play in electricity generation. Until now, natural gas was used only for reserve electric power to meet temporary demand peaks. "That model does not make it viable to produce gas to generate electricity," said Edmar de Almeida, member of the Economics of Energy Economics Institute, Federal University of Rio de Janeiro.

With the 2009 completion by Petrobras of liquefied natural gas (LNG) terminals the natural gas industry gained some flexibility. "Now," de Almeida says, "with the large volumes that will come from deep sea oil, the government will have to decide whether to export the gas or use it here, and the electric power sector is an interesting market."

Natural gas consumption in Brazil is very low. Ministry of Mines and Energy data show that in 2010 natural gas accounted for just 9% of the Brazilian energy matrix. Total gas demand was 79 million cubic meters per day, with sales for electricity generation accounting for 16 million cubic meters. The consultancy Gas Energy estimates that by 2020 the gas byproduct of deep sea oil will be 40 to 45 million cubic meters a day. (Gas from deep sea oil is considered "associated," i.e., it is merged in the oil.)

Currently, analysts say, the policy for pricing gas creates uncertainty for new investors. "What is needed is more auctions of gas that use 'take or pay' clauses. It is just a matter of pricing [gas] appropriately." says Xisto Vieira Filho, president of the Association of Thermoelectric Generators (Abraget). 'Take or pay clauses' state that the buyer must buy minimum amounts of gas for a previously agreed price.

Another concern is the lack of significant investment in infrastructure. The industry hopes that with the new Gas Law (Law 11909/2009, regulated by Decree no. 7.382/2010) this will be resolved. "Where, how, and when infrastructure will be built are not just decisions of Petrobras but also political decisions that involve the Ministries of Planning and Mines and Energy," says Sylvie D'Apote, partner and director of Gas Energy.

The Ten-Year Plan for Energy Expansion 2019 (PDE 2019) projects spending about R$15 billion for gas pipelines, LNG gasification terminals, and gas processing units.



for residential and rural consumers. But this policy has not meant financial gain for the producer — just more taxes."

Garcia points out that this has been a heavy constraint on many capital- and energy-intensive industries. Thus, the steel and heavy construction sectors could lose significant market share related to events like the World Cup, the Olympics, and deep sea oil.

Aluminum is a clear example. Brazil has the third largest reserves of bauxite in the world, the third largest production of alumina (aluminum hydroxide), and the sixth of aluminum metal. Brazil's producers should be unbeatable, but "since 1985, not a single new factory has been built in the country, and for years annual production has stagnated at 1.5 million tons," says Edward Spalding, energy coordinator of the Brazilian Aluminum Association (Abal). Why? Electricity accounts for 35% of the total cost of production. Spalding says that between 2001 and 2009, electricity costs for Abal members rose 189%, though inflation was only 87%.

To ensure a secure and reliable supply, about 40% of aluminum producers have invested in cogeneration. Albrás and Alumar, which together represent 58% of national production, in 2004 won at a public auction a 20-year cogeneration contract for energy at U$60 per MWh. "Still, worldwide," Spalding says, "the average for the sector is US$25–US$30 per MWh." He notes that for factories that must buy electricity from the network the situation has become impossible. In the past two years, two factories closed,

BRAZIL'S ELECTRICITY IS AMONG MOST EXPENSIVE.

Electricity rates
(US$/MWh)

Industrial **R**esidential

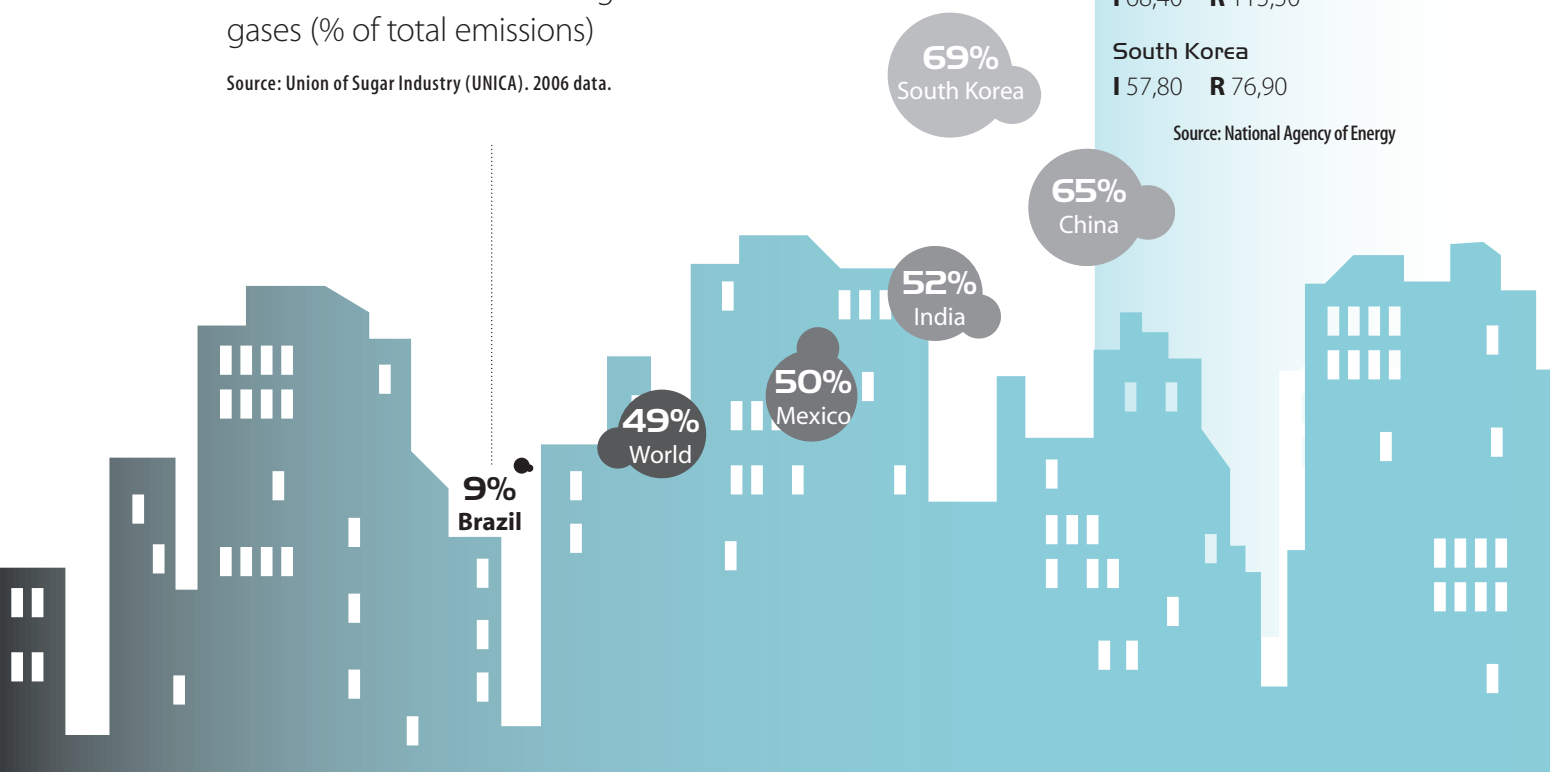
	I	R
Italy	276,10	284,20
Slovakia	194,80	230,90
Brazil	179,60	227,60
Japan	157,80	227,60
United Kingdom	135,00	206,00
Portugal	127,40	215,20
France	106,70	159,20
Mexico	84,60	78,60
China	74,50	88,00
United States	68,40	115,50
South Korea	57,80	76,90

Source: National Agency of Energy

BRAZIL: CLEAN ENERGY

Electric sector emissions of green house gases (% of total emissions)

Source: Union of Sugar Industry (UNICA). 2006 data.



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reducing industry capacity by 10%, and imports of aluminum products in 2010 increased by 82% over 2009. Meanwhile, the government collects R$17 billion (US$10 billion) in annual taxes on industry energy bills.

Garcia points out the risk of de-industrialization if the current situation continues. "If that happens, we will not have a class of industrial workers with high enough wages to maintain growth," he says, citing the case of Detroit, symbol of the American auto industry, where unemployment and poverty surged as production declined.

"The temptation to collect more taxes will always be present, but it destroys more wealth than it generates," says Paulo Pedrosa, Abrace president. Based on the study with IBRE / FGV, Abrace argues that industry will become competitive only with a basic electricity rate of R$50 per MWh (US$29) compared with the current R$85 (US$50) from existing power plants, which are already paid for, and R$100 per MWh (US$59) from new plants. A substantial cut in electricity fees and taxes, the organization says, could reduce electricity rates by 22% to 27% for industry and up to 24% for residences.

Almeida believes that the debate on electricity rates is just beginning, and "I cannot see this government leaning toward a radical revision. Half of these taxes are sales taxes, which are an important source of government financing and therefore practically impossible to cut." The rest are subsidies to public programs to give the poor access to electric energy and reduce rates for consumers in isolated regions, which otherwise would pay three or four times more.

Power field

Solange Monteiro, Rio de Janeiro

Recent major changes in the sugar cane sector — the latest was the joint venture formed by state-owned Cosan S.A and Anglo–Dutch Shell that became Raizen — not only hold promise for ethanol to become a significant agricultural commodity but may also help diversify the Brazilian energy matrix. The sugar cane industry has the capacity to generate electricity equivalent to three hydroelectric power plants like Belo Monte. It also has two other advantages: Cane can be harvested in the dry season, supplementing hydroelectric generation, and its production is concentrated in the Southeast, where Brazilian consumption of electricity is highest, which suggests the possibility of reducing transmission costs.

According to Union of Sugarcane Industry (UNICA) estimates, by the 2020-2021 crop sugarcane biomass could fuel generation of 13,158 MW. If this potential is to be fully realized, however, industry representatives seek regular auctions of biomass energy to avoid the risk of derailing investments in both new plants and improvement of old plants to produce more efficiently. "Today, the sector can offer 500 MW a year, but we need a policy that guarantees annual contracting for alternative sources," says Zilmar Jose de Souza, UNICA bioelectricity advisor, who suggests that even in 2012, auctions are still uncertain.

A major challenge with biomass generation is the price. In the two auctions in 2010, the average price of biomass energy was R$134 per KWh; wind energy was R$123. The industry complains that the criteria adopted are a factor in this lack of competitiveness, and that government support for biomass and for wind is not balanced. "There were initiatives for wind energy in 2009 that produced good results, and lines of credit from Banco do Nordeste with low interest rates that we have never had for sugarcane and that would really help the industry. We also need this support," de Souza says.

To achieve a more competitive price, industry representatives advocate dividing the costs of connecting its energy to the network; today that is the total responsibility of the generator. "Currently, the cost of connecting is absorbed by the project; in remote rural areas, that may exceed 30% of the total investment," de Souza explains. "Ideally, it should be divided between the cogenerator and the system." The industry also seeks higher credit lines and a review of taxes.



Abrace argues that such subsidies should be included in the federal government budget. "Today, half those fees are used to secure the government's fiscal balance. It makes no sense," Pedrosa says. "It's time for this issue to be viewed in the light of economic logic."

SECTOR GIANTS

There is also a question of how industry can attract investments so that it can expand. "There is no lack of interest from private enterprise in entering the electricity generation business here," Almeida says. Rafael Andreatta, analyst for Planner Consultoria, agrees: "In recent auctions, interest was low because of government pressure for deadlines and low rates of return. ... But the generation sector in Brazil is highly recommended and there are hopes for new auctions."

This year, Eletrobras, the largest Brazilian utility company, is expected to accelerate its internationalization, mainly in South and Central America. By 2020 it intends to raise 10% of its revenue from abroad. Analysts point out that this strategy may represent a necessary diversification to make up for possible loss in profitability when some of its concessions expire in 2015.

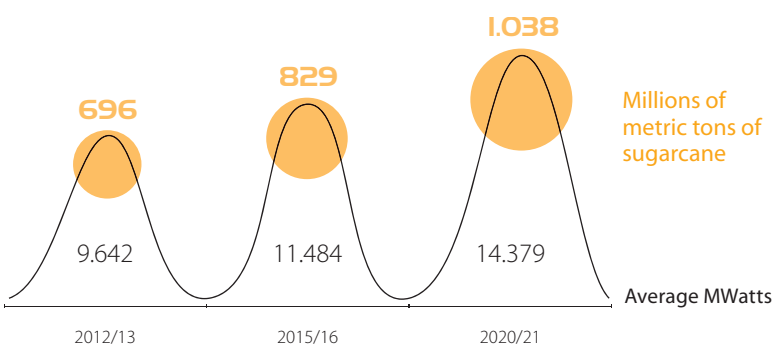
The possibility of profiting from economies of scale is also behind the drive for mergers and the emergence of new electrical giants. The merger of São Paulo Power Company (CPFL) and Neoenergia, pending approval by Spain's Iberdrola, will create a giant with revenues of R$26 billion. The Minas Gerais Energy Company (CEMIG) is said to be negotiating to buy Bandeirantes and ESCELSA. "As demand speeds up and [companies] have more cash than projects, such mergers will be normal," Almeida says. "Given the difficulty of getting new projects going, it can also be an easier way for companies to expand," he adds, noting that relative to economies

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SUGARCANE ENERGY

Biomass electric generation



Source: Gesel/IE/UFRJ.

of similar size, concentration of industry in Brazil is still low.

Many stress that the country can no longer wait to clarify the rules. Andreatta says that licensing delays caused by environmental issues mean investors have to go shopping in the energy market to meet supply contracts.

And the third revision of electricity rates by the National Agency of Electrical Energy (Aneel) generated controversy because the rate of return on investments Aneel proposed was below market expectations. Almeida points out that in the U.S., "from which we imported the regulatory model," utilities regulators have been in operation more than 100 years. In Europe, the European Commission is above national agencies, creating policies to guide the process. In Brazil, the process for establishing rates is confused. "With each revision comes a new idea, and the methods change, creating uncertainty," Almeida says. "And uncertainty for the market could mean a blackout for private investment, just when Brazil needs a lot of power."

[1] Cogeneration (also known as combined heat and power, CHP) is the use of a heat engine or power station to generate simultaneously both electricity and useful heat.

The advantages of nuclear energy

Thais Thimoteo and **Solange Monteiro,** Rio de Janeiro

Reappointed Minister of Mines and Energy Edison Lobão is still interested in reviving the nuclear program of the Lula administration, in line with the worldwide trend for using this source of energy to produce clean electricity. He has announced plans to approve later this year construction of three or four plants besides Angra (which has a generation capacity of 1.4 GW and is scheduled for completion in 2015) and creation of a regulator for the sector. The National Energy Program envisions eight new nuclear plants by 2030.

Brazil should exploit an advantage that for years has been overlooked: with the United States and Russia, it is one of only three countries in the world that have both nuclear technology and uranium ore. According to Eletronuclear (the Eletrobrás nuclear power company), Brazil is sixth in uranium ore reserves. "We wouldn't need to prospect more, because we already have 310,000 tons — enough to meet the demand of Angra 1, 2, 3 and nine more nuclear plants throughout their useful life of 60 years," says Alfredo Tranjan Filho, president of Nuclear Industries of Brazil. "However, given geological similarities between Brazil, Canada, and Australia, Brazil may have reserves of 1.1 million tons of uranium, which would put us at the second or third largest reserves in the world," he says, suggesting resumption of prospecting, which would require investing an estimated R$130 million by 2016.

However, nuclear will not be a major source of electrical power any time soon. "Today, nuclear power is 2.5% of the total, and the goal is to double it by 2030," says Odair Gonçalves, president of the National Council of Nuclear Energy (CNEN). For critics of nuclear plants, "The risks and costs are very high, and funded with public money," says Dawid Barlet, director of the Heinrich Böll Stiftung; "Angra 3 is being built with technology that is outdated by international standards." He adds that "In addition, the CNEN was not clear where the atomic waste would be stored. The plan for a deposit must be completed in 2016. We then have another 14 years before this issue is perhaps resolved."

For Tranjan Filho, rather than think about the number of nuclear plants coming on stream in future, Brazil must focus on achieving control of the two phases of the fuel cycle that are still lacking — conversion and enrichment — so that it can eventually export nuclear fuel. "We are negotiating with companies that can sell us a conversion unit. If we buy that unit, we would spend R$460 million in 2018 to build two modules, enough to feed Angra 1, 2 and 3," he says.

Self-sufficiency in enrichment, he estimates, would require an investment of about R$1.9 billion. "A nuclear plant can cost R$3 billion, with just over R$2 billion full circle, so instead of building 11 plants, we could build ten plants and guarantee self-sufficiency, with capacity to export value-added enriched uranium," Tranjan Filho argues. But such a decision will be difficult for the government due to the high demand for electricity expected in coming years.

