Oil, Gas and Beyond

I was waiting for the ship to come in. In fact, so was everyone else in Nicaragua. Gas lines stretched around the block. The supermarket shelves were nearly bare. Lights went out again and again, plunging the country into frequent darkness. Telex machines couldn’t work, and we reporters had to depend on the few places with generators to file our stories (for younger readers, this was pre-computer and smart phones). U.S. President Ronald Reagan had imposed a trade blockade on Nicaragua in May 1985. The Soviets were sending oil, dodging the blockade.

We reporters did what we always do: we reported on the ship’s arrival. But we also breathed a collective sigh of relief. The arrival of the Soviet ship meant hot showers and light to read by.

Energy is intensely political. It shapes nations and trade and fuels wars and blockades.

Energy, I discovered then, is also intensely personal. It shapes our lives on a daily basis. It’s not only a matter of how we get around or whether we have enough food to eat; energy production affects the communities that receive it and those that produce it. It shapes attitudes toward gender and race and nationalism and identity. It pollutes the air and the rivers. It offers immense economic opportunities. Or it does both.

You might not think of Latin America and the Caribbean right away as a big energy producer or consumer. But Venezuela stands ninth in global oil production with gas reserves almost triple those of Canada. Three countries—Venezuela, Brazil, and Mexico—account for about 90 percent of the region’s oil production. And Latin America and the Caribbean also have the capability to provide abundant alternative and renewable energy sources: wind, solar, geothermal and biomass, among others.

Perhaps because of my experience in Nicaragua, I started to conceive this issue in terms of meta-politics. And there is certainly a lot of politics related to energy in the region: the political upheaval of Brazil as a result of corruption scandals in the national oil company; the turmoil in oil-rich Venezuela; the impact of the semi-privatization of Mexico’s oil industry; the targeting of Colombia’s energy installations by guerilla forces in a show of strength in the context of the ongoing peace process.

But then I thought back on how the arrival of oil had been experienced on a very local and personal level. I began to hear stories about the production of energy: what it felt like to grow up in an oil camp, how energy production affects indigenous women in one particular region, personal level. I began to hear stories about the production of energy: what it felt like to grow up in an oil camp, how energy production affects indigenous women in one particular region,

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The Power of the Brazilian Wind
How Wind Energy Became a Competitive Source

BY MAURICIO B.C. SAIRES

Almost a decade later, in 2001, a shortage of rain caused the water of the hydropower plant reservoirs to drop to very low levels. Brazil experienced an electricity crisis. As a result, the government recognized it needed to find a more flexible electricity generation model considering different primary sources of energy. Academic researchers had long recognized this fact, but it took a crisis to make the government see the importance of the possibilities they envisaged.

To cope with the problem, the use of other energy sources such as coal (3.4%), gas (3.2%), oil (4.9%), and nuclear (4.3%) increased, lowering the hydro-power sources to 82%. Between 2000 and 2001, electricity use dropped almost 8% because of energy rationing. Nevertheless, in 2002 the demand started to grow again, as in any other developing country. Brazil needed the current power capacity of the entire country and was waiting for the first governmental action towards developing wind energy.

In 2008, the federal government began to encourage the use of other renewable sources such as wind, biomass and small hydroelectric plants (SHP) through the Program of Incentives for Alternative Electricity Sources (PRO INFA). By coincidence, that was the year that I defended a Master’s Degree at the University of Campinas (UNICAMP) centered on Wind Power in Power Systems (and subsequently wrote one of the first theses on the subject in Brazil). Although PROINFA was not a very successful governmental program, it was certainly an important starting point to begin the new development of wind power in Brazil.

The first governmental auction that included wind power took place just after my Ph.D. thesis defense at the University of São Paulo (USP). During the two previous years I spent at a research institute at RWTH Aachen University in Germany, I learned how far behind Brazilian wind power was: the discussions in Germany were about mass developments of offshore wind farms located at the North and Baltic seas and many manufacturers competed to sell wind turbines in the market.

A few years later, a few governmental agencies (the Growth Acceleration Program - PAC) began to focus on the implementation of a wind industry in Brazil, offering incentives to launch new enterprises and produce domestic equipment. Due to high competition in bids for energy production, wind power prices have been gradually reduced, positively contributing to the diversification of energy sources. Almost 300 megawatts of wind power capacity were offered at the lowest ever price at a 2012 auction. The Brazilian federal government contracted all the capacity that will be produced by those wind farms for a 20 years period. The megawatt per hour (MWH) of wind energy was purchased for less than US$48 (converted from Brazilian currency on 12/14/2012).

These wind-power projects started during a period of major technological evolution of wind turbines, which improved performance through better aerodynamics of the blades, advanced mechanical transmission speed systems (gearbox) and new control and operation strategies for turbines. As a result, wind power has become a very competitive source, generating energy at the same price or lower than hydro-power plants. In the first semester of 2015, the use of wind power compared to hydropower was 4.2% and 62%, respectively. The production of wind power energy does not reach its maximum capacity on a constant basis because the wind does not blow all the time—it fluctuates according to the wind patterns. Nevertheless, these numbers show a considerable improvement.

Installed wind power grew from almost zero wind power around 6.2 gigawatts (GW) in the first half of 2015. The Global Wind Energy Council’s (GWEC) last reported ranking indicates that Brazil was in 10th place for worldwide installed capacity by December 2015. The expectation is that the country will move to 7th place by December 2015.

POTENTIAL OF INSTALLED CAPACITY

Brazil recently became one of the top five global investors in wind energy and renewable energy. The National Bank for Economic and Social Development (BNDES) ended the year 2014 with an equivalent of 2,358 MW of installed capacity investment approvals for new wind power projects. According to the Atlas of the Brazilian Wind, among the most important studies for turbine heights above 246 and 328 feet—73 and 100 meters, respectively, the Brazilian territory could have around 150 GW of installed capacity. The potential for offshore installations is not yet exactly known, but the National Institute for Space Research (INPE) concluded in a recent study that the offshore wind capacity potential for the Brazilian coast in water depth up to 328 feet (100 meters) is 600 GW. If you consider the current Brazilian energy system to be almost 137 GW, the wind potential is huge. Onshore and offshore together account for almost seven times the installed capacity of all sources and 154 times the already installed wind power capacity.

In this sense, the investments in the Northeast and southern regions are changing these areas of Brazil. More recently, new studies have pointed out a great wind potential also in the south-east in states such as São Paulo, Minas Gerais and Espirito Santo. With the current growth rate and a coastline of 5,600 miles, the country is among the world leaders in installed capacity. Because of the Northeast’s strong and constant winds, several companies have been especially attracted to the region for both energy production and installation of the transmission lines. Rio Grande do Norte, for example, is the first Brazilian state to have more than two gigawatts of installed capacity with 80 wind farms: it has become Brazil’s main producer of this type of electricity generation. However, the Northeast state of Bahia is constructing many wind power plants and will very soon reach first place.

WIND POWER GENERATION POTENTIAL

Wind power generation potential depends strongly on the wind speed and the efficiency of the turbines. Wind power installed capacity, however, is directly connected to job creation, as well as the selling and buying of equipment (we will get back to that). Brazil is said to have better geographic conditions than Europe and the United States, because the rate of change in wind speed and direction, as well as the turbulence levels, are lower. Wind farm revenue is strongly dependent on this issue and new R&D policies need to create incentives for the adaptation of the European and American designs to Brazilian wind characteristics.

Besides promoting sustainable energy development, the installation of wind farms brings several benefits to the population in areas around the power plants. As most of the farms are built in areas with a poor standard of living, as measured by the Human Development Index (HDI), the entry of large business groups has brought new investments to these small cities. Compensatory measures (included in the permit) and social responsibility policies have been carried out to a large degree. Current social projects include free community courses, construction of recycling plants, advice to farmers, maintenance of fish farming boats and construction of tanks for water storage, among other initiatives that vary according to local needs.

The wind power sector creates many jobs (temporarily or permanently); how many depends directly on the installed capacity. Rural residents have been trained to work in the sector, and local demand for services and products has grown. According to the Brazilian Association of Wind Energy (ABEEólica), 120,060 directly related jobs had been created in Brazil by 2013. In 2014, 37,000 jobs were created and investments were expected to reach more than US$60 billion by 2018. Recently, Presidents Barack Obama and Dilma Rousseff announced a joint agreement to generate 20% of electricity power through renewable resources by 2030 (excluding hydro-power plants). These jobs are mainly temporary during the construction of the wind farms, although some permanent jobs remain, mainly in the areas of management and maintenance. The projects also serve as a source of income for smallholders because a portion of their land is leased to house the wind farm, usually with 20-year contracts. In these areas, agricultural and livestock activities still can be carried out at the same time.
Beyond Brazil, the integration of renewable energy into the electric grid is facing many challenges. Germany sets a good example of high penetration of renewable energy. In order to cope with the pre-defined levels of reliability, other sources of energy must be connected to the grid, ready to begin generating electricity in case of a sudden lack of wind. In the case of Germany, the backup source of energy is gas or coal. One of the best alternatives to increase the penetration of renewable energy is probably energy storage systems, but those are still very expensive and the most promising technologies are only in the infancy stage of development for large amounts of energy. My research as a visiting scholar at Harvard University is about advanced energy storage systems that might allow more renewable energies in power systems. What is going to be unique in Brazil and will be even more interesting than the seasonal complementality (between hydro and wind) is the fact that we could use the flexibility of existing hydropower plants to back up the fast changes in wind speeds (because sometimes the wind can stop blowing in an entire region). The large hydropower plants reservoirs in Brazil can be considered great storage systems. This would enable high levels of wind energy penetration and would turn the Brazilian electric power generation into one of the most successful sustainable electricity matrices in the world. That will happen if the wind does not stop blowing, the rain keeps falling on the right places and the rivers continue to flow (not considering the negative impact of big reservoirs, which is another long and interesting discussion).

Mauro de Sousa is a Visiting Scholar at Harvard and Assistant Professor of the Department of Electric Energy and Automation Engineering (FEEA) at the Polytechnic School of the University of São Paulo.

Ana Maria Peres, a Brazilian journalist and former resident of Cambridge (MA), collaborated with this article.

Solar Energy in Chile

Development and Challenges

By Claudio A. Agostini, Carlos Silva and Shahriray Nasirov

FOR SEVERAL DECADES, CHILE HAS STRUGGLED to have a stable and reliable mix of energy sources to satisfy its growing needs. In the 1980s, the country relied heavily on hydroelectricity, considered almost the sole solution to its growing energy requirements. As a result, every time the country faced a drought, there were even periods of blackouts and rationing because not enough energy was being produced. In the mid-1990s, a combination of continued rapid growth in energy demand, increasing environmental concerns regarding large hydro projects, and the unreliability of hydropower prompted the Chilean government to diversify energy sources by encouraging the use of low-price natural gas from Argentina. The low-cost energy from the imported natural gas made it more attractive to build combined-cycle power plants instead of relying on large hydro plants and coal. Thus the energy sector invested heavily in this source, building four pipelines from Argentina, setting up new gas distribution networks and constructing a half a dozen new combined-cycle power plants. In 2004, natural gas accounted for 26% of Chile’s total energy consumption, of which 80-90% came from gas supplied from Argentina. As a result, in 2004 the Argentine government restricted the volume of gas exports to Chile in order to relieve its own domestic gas shortfall. In just a few years, the gas supply in Chile stopped. This brought about another energy crisis in which generators were forced to replace gas-fired electricity with expensive and more polluting diesel generation, and some regulatory incentives had been introduced. In 2008, the Chilean government took a significant first step forward by requiring energy-generating companies to include at least 5% of their electricity from non-conventional renewable energy sources by 2010, without including large hydro (only up to 20 MW). This quota of renewable energy set a 5% target from 2010 until 2018 as the transition period, with 0.5% increments from 2015 through 2024, when generators are expected to produce 10% of power generated through renewable sources. If companies do not comply with the quota, they have to pay a fine, which doubles if the incompatibility occurs again.

Although the fines are in some cases cheaper than the cost of compliance, the policy has been quite successful, and energy generation from RES has met or even surpassed the defined quota of 5%. Renewable energy generation reached 7% of the country’s total energy generation in 2012. Until early 2012, small hydro and biomass were the leading renewable technologies used for the compliance of the legal quota, accounting for almost 90% of total renewable generation. However, during the last couple of years, other renewable technologies, including solar and wind, have started to play a more significant role.

In 2013, the Chilean government increased the quota by doubling its renewable-energy target from the previous goal of 10% by 2024 to 20% by 2025. Even though this new target provides attractive incentives to invest in the development of renewable energy projects, the amount of investment in new capacity required to reach the 20% target is quite significant. In fact, the new renewable energy capacity that should be added to the current energy matrix in the next 10 years to reach the target is much higher than the average annual renewable capacity that entered the market during the last five years. Additionally, to reach the renewable energy target of 20% by 2025, electricity grids will have to be upgraded and expanded.

With almost 356 days of clear skies, high solar radiation and low humidity, the Atacama Desert in northern Chile offers excellent conditions for generating solar energy.

The Chilean group met with NREL researchers in Denver, Sandia in Albuquerque and the University of Arizona in Tucson and explored the latest technological developments.