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ReVista

HARVARD REVIEW OF LATIN AMERICA

ENERGY

OIL, GAS AND BEYOND

EDITOR'S LETTER BY JUNE CAROLYN ERLICK

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.

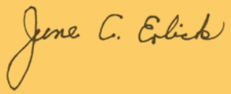
You might not think of Latin America and the Caribbean right away as a big energy producer or consumer. But Venezuela stands ninth in global oil production with gas reserves almost triple those of Canada. Three countries—Venezuela, Brazil, and Mexico—account for about 90 percent of the region's oil production. 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 guerrilla 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, how local communities involve themselves in deciding what is done with oil.

And just recently Alvaro Jiménez, Nieman Affiliate at Harvard '09, happened to mention to me that he was starting a website "Crudo Transparente," a site that monitors the Colombian oil industry. Out of curiosity—and as a quick break from proofreading this issue—I took a peek. The site focuses on five areas: local economy, contracts and royalties, environment, security and human rights and ethnic conflicts. I was pleased to see how much overlap there was with the themes I had chosen for this issue of ReVista.

Although the website deals with only one country—Colombia—it felt like an affirmation of the focus I had chosen for this wide-ranging topic. Energy is political. Energy is personal. Energy matters.



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ON THE COVER

Petrobras Oil Platform

Photo By Ricardo Stuckert/PR

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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 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 complementarity (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 combination 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).

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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 SHAHRIYAR 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 shortages. In just a few years, the gas supply to 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 the government promoted the construction of liquefied natural gas (LNG) terminals to compensate for these changes and have another alternative to Argentine gas.

The successive energy crises have taught us a valuable lesson. The country is now more concerned with energy diversification, understanding its important role for the security of the system. The country has learned that short-term gains come at a high long-term cost. In addition, the economy's dynamism over the last decades, including the significant improvement in the welfare of the population (poverty, for example, has decreased from 40% to 13% in two decades), has doubled electricity demand. Chile is now the country with the highest energy consumption per capita in Latin America, well ahead of larger countries like Argentina, Brazil and Colombia.

Chile is also considered one of the most attractive countries for the development and deployment of renewable energy technologies (RET), mostly because its geographic location and diversity provide abundant renewable energy resources (RES). Significant potential exists in the use of biomass, hydropower, geothermal, solar, wave and wind energy. In particular, Chile has one of the largest solar potentials in the world. 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. Therefore, adding solar energy to the energy mix can be an important opportunity to contribute to the country's energy diversification strategy.

To attract renewable energy investment, several new regulatory incentives have 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 2014 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 incompliance occurs again.

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.

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.

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 20/25 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 matrix 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.

Investors in renewable energies in Chile also face significant challenges. Although the Chilean government has shown interest in promoting the development of RES, a number of obstacles remain, resulting in a moratorium on several projects. Most of these projects are wind and solar technologies, with only around 10% in terms of capacity realized thus far, despite having environmental approval.

The most important barriers that renewable energy projects face in Chile are the high cost of the initial investment, limited access to financing, opposition from local communities, the practical and regulatory difficulties to connect to the grid, and lack of interest from large consumers to sign long-term contracts with intermittent sources (solar energy is produced only during the day and wind energy is produced only when there is enough wind blowing; solar and wind have plant factors of 30% or 40% at most). Removing or at least mitigating these barriers and creating further incentives remains a key challenge for the development of the Chilean renewable energy sector.

The evidence increasingly supports that solar energy has great potential to become a major source of clean and secure energy in Chile. In addition to overcoming the hurdles facing many renewable energy projects, both misconceptions about solar energy and some of its unexpected benefits must be explained.

Even as the costs of solar power continue to decline, the public and many policymakers perceive solar energy as "too expensive"—thinking that solar energy would lead to increased energy prices. However, solar panel prices per watt generated have decreased 86% between 1996 and 2013 because of sig-

PHOTO: COURTESY OF SERC/CLAUDIO AGOSTINI

Although solar power's most obvious benefit is the environmental advantage from producing less CO2 emissions than fossil-fuel-burning technologies, the use of solar energy has a potentially large social value that is missed by traditional cost-benefit analysis.

nificant technological advances. The costs, therefore, are becoming increasingly competitive with respect to other technologies. If pollution caused by the use of fossil fuels such as coal and diesel were figured into the costs through the implementation of corrective taxes, solar energy cost would become even more competitive.

Although solar power's most obvious benefit is the environmental advantage from producing less CO2 emissions than fossil-fuel-burning technologies, the use of solar energy has a potentially large social value that is missed by traditional cost-benefit analysis. Solar energy can strengthen the economy in rural areas because network extension of traditional energy systems is typically not a viable economic option for these communities. In isolated rural areas with lack of access to electricity, grid extensions are often not cost effective. Therefore, isolated, or off-grid, small solar energy systems can provide a sustainable and cost-effective alternative to the diesel based solutions that are typically deployed in such areas. Chile has more than 3,500 isolated rural communities with no access to energy networks, many of them lacking access to roads and infrastructure to maintain the flow of fossil fuels.

Solar energy has now started to play a greater role in the energy matrix of the country. There are still some problems that need to be overcome to allow the full deployment of its large potential, but a future with cleaner energy and sustainable development is becoming increasingly feasible.

Achieving the ambitious renewable energy goals and overcoming existing barriers require strong, consistent and balanced policy support by the government. Unless the Chilean government takes a leadership role establishing prioritized areas of policy interventions to address challenges rapidly and properly, it could miss a chance to materialize large-scale solar development and to recoup the benefits of solar energy investments for the development of its communities and regions' economic growth. Establishing a policy framework to accelerate market competitiveness, supporting the needed confidence for investments in local technology advancement and manufacturing capacity, facilitating large-scale solar grid integration, implementing new financing and business models, expanding international collaboration to provide accelerated learning and knowledge transfer to Chile, and improving training, education and awareness for solar energy technologies are among the priority policy actions to be taken shortly.

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Geothermal Energy in Central America

Under the Volcano

BY JACQUES E. C. HYMANS

WHEN WE THINK ABOUT GLOBAL TECHNOLOGY leaders, Central America does not typically come to mind. But Central American countries have indeed been in the vanguard in their use of geothermal energy: an abundant, constant, efficient, renewable and low-carbon source of electric power.

Twenty-four percent of El Salvador's electricity comes from geothermal. That figure places it second out of all countries in the world in its level of reliance on this power source. (Iceland is tops.) Meanwhile, fifteen percent of Costa Rica's electricity comes from geothermal, as does ten percent of Nicaragua's and five percent of Guatemala's. Compare those numbers with the worldwide figure of 0.3 percent. The basic reason for Central America's geothermal energy riches can be summed up in one word: volcanoes.

Even more impressive is the amount of geothermal energy that Central Americans have under foot, but so far failed to exploit. World Bank reports indicate that the countries of the region may have up to 25 times more geothermal energy than they are currently using, and that geothermal power alone could cost-effectively satisfy their entire electricity demand.

Yet the Central Americans have added only a relatively small amount of additional geothermal plant capacity since returning to peace and democratic governance after the end of the Cold War. The region's geothermal production did increase approximately fivefold between 1990 and 2012—from 747 to 3,542 giga-

NICARAGUA: MASAYA VOLCANO IN NICARAGUA. PHOTO BY JOSÉ GABRIEL MARTÍNEZ FONSECA/SVALDWARD INK 2012 (FLIKR)